AMUNDSEN SCIENCE

2024

2024 EXPEDITION REPORT

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Table of content

List of Figures

Part I

Part II

List of Tables

Part I

Part II

2024 Expedition Report

The 2024 expedition report is a collection of all the participating research teams' cruise reports assembled by the Chief Scientists at the end of each Leg of the 2024 CCGS *Amundsen* Expedition. The 2024 expedition report is divided into two parts:

Part I gives an overview of the expedition and resulting data availability, presents the cruise track and the stations visited, and provides a synopsis of operations conducted during each of the legs.

Part II contains the reports submitted by participating science teams or researchers, with details on the specific objectives of their project, the field operations conducted, the methodology used, and in some cases, preliminary results. When results are presented, they show the data as they were submitted at the end of the legs in 2024. The data presented in this report are illustrative only and have not been quality checked or reviewed, thus parties interested in the results should contact the project leader, the researchers who collected the data or Amundsen Science's Data Coordinator (amundsen.data@as.ulaval.ca).

The sections in Part II provide a detailed description of each research program and the sampling teams on board. Specifically, Sections 1 and 2 discuss multidisciplinary programs that involve various types of sampling techniques. Sections 2 to 37 provide comprehensive information on seabirds, atmospheric conditions, surface ocean properties, water column characteristics, CTD-Rosette operations, physical properties, as well as a range of chemical and biological parameters. Sections 38 to 48 focus on seabed mapping, sediment and benthos, while sections 49 to 51 delve into mooring operations. Finally, as short conclusion is presented in Part III.

The four appendices provide information about the location, date, time and type of sampling performed at each station visited by the ship, as well as a list of science participants onboard during each Leg.

Part I – Overview and Synopsis of Operations

1 Overview of the 2024 *Amundsen* Expedition

1.1 Introduction

The Canadian Arctic Ocean is a vast area covering about 4 million km^2, and including over 70% of Canada's coastline. This area hosts unique and sensitive ecosystems, yet researchers still lack global, robust and reliable baseline data to fully understand the impact of global warming already affecting the region. Indeed, the Arctic is warming twice as fast as the rest of the world, and according to Environment and Climate Change Canada, the summer sea ice extent decreased by 7.5 % per decade over 1968–2020 in the Canadian Arctic, coinciding with increasing air temperatures. In 2024, a minimum sea ice extent of 4.28 million square kilometers was reached on September 11th, the seventh-lowest in satellite record. The national average temperature for summer 2024 (June–August) was 1.7°C above the average for the 1961–1990 period, with the some of the highest departure from mean in Nunatsiavut. The northern portion of the Canadian Arctic Archipelago presented near zero temperature departures from average in summer 2024.

Extreme seasonality in light regime and sea ice cover dictates the energy transfer through the food web in the Arctic Ocean, from micro-algae to large marine mammals. Changes in timing of biological events, northern shift of species along with increased marine traffic and pollution are all known consequences of the climate change and ice retreat in the Canadian Arctic. Satellites and meteorological stations have been providing reliable and rigorous datasets of sea ice and air temperature since the industrialization period. Ice camp, research vessels and moorings are tools that have been used to acquire data and to fill gaps in our understanding of the Canadian Arctic Ocean.

Since 2003, the CCGS icebreaker *Amundsen* equipped with its leading-edge scientific instrumentation has been monitoring the Canadian Arctic by supporting dozens of large-scale national and international research initiatives from academia, local communities, and the public and private sectors. Amundsen Science manages the scientific mandate of the icebreaker since 2017. Through its integrated operational approach, Amundsen Science is dedicated to optimizing the use of the vessel and increase data usage by the Canadian and international research community. In its 22 years of operations, the ship enabled over 50 large-scale national and international research initiatives that mustered over a hundred teams of scientists from academia, the North and the public and private sectors. During two decades, the *Amundsen* propelled Canada in the leading pack of nations studying the changing Arctic Ocean.

On 16 June 2024, the Canadian research icebreaker *Amundsen* left Quebec City for its 21th annual mission to the Arctic Ocean. The scientific programs boarded for Legs 2 to 5, and the multidisciplinary expedition ran until 29 October, allowing 188 scientists from national and international research teams to study the marine and coastal environments of the Canadian and Greenlandic Arctic. The research programs supported in 2024 studied the Arctic and subarctic marine ecosystems through multidisciplinary research activities and integrated studies targeting the physical, chemical and biological environments and the geology of the seabed of Labrador Sea, Baffin Bay, Nares Strait, Lancaster Sound, Ungava Bay and numerous fjords along the cruise track. From aquatic microorganisms to seabirds to melting glaciers and seabed mapping, all aspects of the northern environment were studied during this 136-day expedition.

1.2 Regional settings

1.2.1 *Labrador Sea*

Between Labrador and Greenland lies the Labrador Sea, a key region where critical exchange processes take place. The Baffin Current flowing from the Baffin Bay brings cold water as well as drifting icebergs and ice islands into the Labrador Sea. Cold waters from Hudson Bay's current circulates through Hudson Strait to the Labrador Sea where it joins warm sub-arctic water from the North Atlantic Current and feeds the source of water mass formation in the Labrador Sea. The water circulation in Labrador Sea is known to affect the global oceanographic circulation. Exchanges processes of carbon dioxide, oxygen and heat with the atmosphere and between water masses are also important in the area. From this perspective, gathering scientific knowledge about the area is of particular importance to inform decision makers, federal departments and the private sector about climate change, its impact on vulnerable ecosystems, and the risks associated with the exploitation of resources offshore.

1.2.2 *Baffin Bay*

Baffin Bay is located between Baffin Island and Greenland and connects the Arctic Ocean to the Northwest Atlantic. It is an important pathway for exchange of heat, salt and ice between these two oceans. Baffin Bay's connection to the Arctic Ocean consists of three relatively narrow passages through the Canadian Arctic Archipelago (CAA): Nares Strait, Jones Sound and Parry Channel.

The world's largest polynya, a year-round expanse of open waters surrounded by ice, is locates in the northern part of Baffin Bay. The North Water Polynya (NOW), also referred to as Pikialasorsuaq or Sarvarjuaq (respectively in Greenlandic and Canadian Inuit dialect, is the most productive polynya in the Canadian Arctic and it is of significance to many species of marine mammals, in addition to the tremendous marine bird resources in this area. The NOW polynya has been the subject of intense ecosystem studies, including the Canadian-led study of the NOW Polynya in 1998.

Over the last years, the CCGS *Amundsen* frequently visited Baffin Bay and Northern Baffin Bay for scientific sampling activities, in particular to monitor seawater physics, chemistry nutrients, contaminants, and the biodiversity present along precise transects.

1.2.3 *Canadian Arctic Archipelago*

The Canadian Arctic Archipelago (CAA) is a vast array of islands and channels that lies between Banks Island in the west and Baffin and Ellesmere Islands in the east. While transiting through the Northwest Passage, the science teams aboard the *Amundsen* extended their time series of atmosphere, ice and ocean data. This work aims at better understanding how the climate, ice conditions as well as ocean currents and biogeochemistry are changing under the effects of climate change and industrialization. With ice extent and volume shrinking in the Arctic, the Northwest Passage may become partly ice-free and open to navigation during summer in the near future. Bathymetry data and sub-bottom information were collected while transiting through the Northwest Passage to map the seafloor and identify potential geohazards and obstacles to the safe navigation of this seaway.

1.2.4 *Nares Strait and Lincoln Sea*

Baffin Bay connects with the Arctic Ocean through Nares Strait and Lincoln Sea, a body of water covered in sea ice yearlong. The thickest and oldest sea ice in the Arctic end up in

Lincoln Sea. This makes Lincoln Sea a refuge for ice-dependent marine species affected by climate change and sea ice loss. Although the significance of this region is established, data to study the environmental changes and support the development of protection initiatives is critically lacking. Access to the area via navigation is challenging and very specific ice conditions are required. Furthermore, changes have been observed in the stability of ice arches which are formed during winter in Nares Strait, preventing ice export from Lincoln Sea to the south, in the NOW polynya and in Baffin Bay, where it would melt during summer.

1.2.5 *Ungava Bay*

Ungava Bay is large bay separating Nunavik from the Hudson Strait and from Baffin Island. It is influenced by relatively fresh waters from Foxe Basin and Hudson Bay, by riverine freshwater runoff, and by saltier waters from Labrador Sea. Ungava Bay is characterized by a counterclockwise surface current circulation and by some of the highest tides in the world, especially at the mouth of Leaf River. Ungava Bay is home to marine wildlife supporting traditional hunting activities for the five Inuit villages along its shores.

1.3 2024 Expedition General Schedule

The 2024 *Amundsen* expedition plan was developed based on the scientific objectives and regions of interest of each research program. The expedition took place from 16 June to 29 October, after a two-week mobilization period in Quebec City in early June. Since the first Arctic Leg was dedicated to regular Coast Guard operations, the scientific portion of the expedition ran from July 11 to October 29, divided into 4 Legs spaced at 28-day intervals, for a total of 111 days at sea. Eight research programs are allocated ship time during the 2024 *Amundsen* expedition. They studied the arctic and subarctic marine ecosystems through multidisciplinary research activities and integrated studies targeting the physical, chemical and biological environments and the geology of the seabed of the Labrador Sea, Baffin Bay, Nares Strait, Lancaster Sound, Foxe Basin and Hudson Strait.

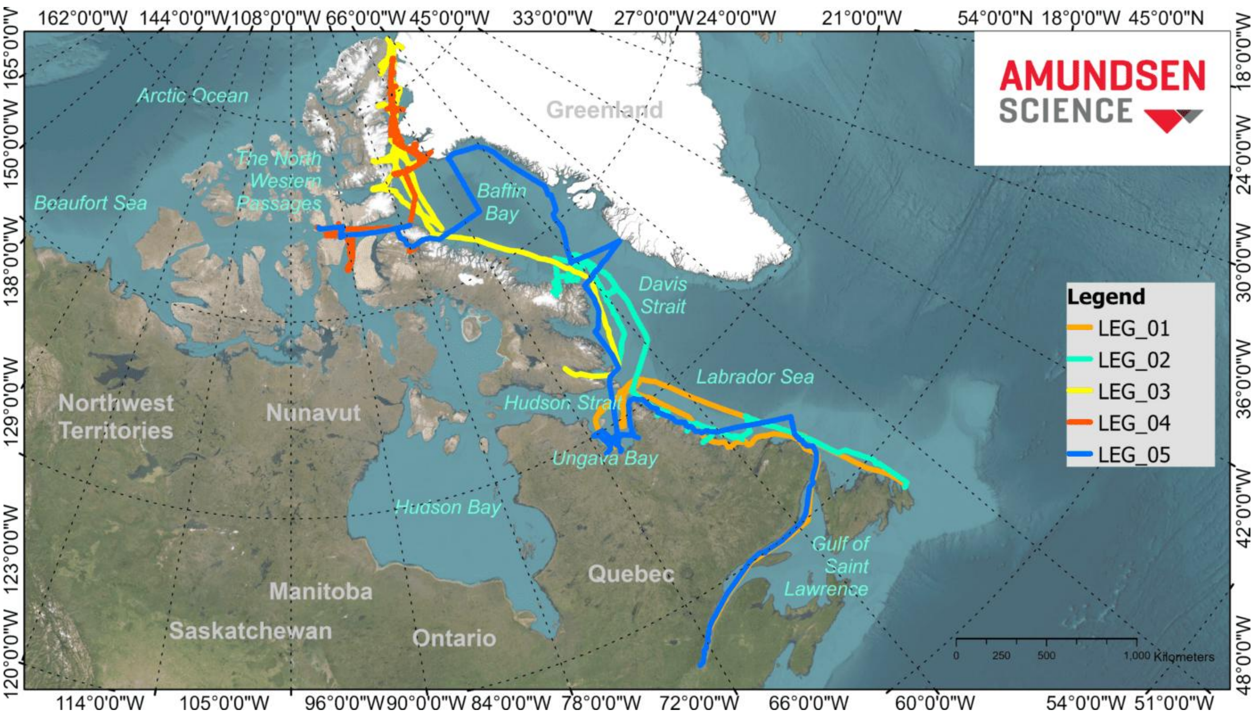

Figure 1-1: General map of the 2024 *Amundsen* Expedition

1.3.1 *Leg 2a – Imappivut – 11 to 29 July – Labrador Sea*

Leg 2a begun with a short mobilization in St. John's, swiftly followed by transit towards Labrador Sea for the realization of the Imappivut program. This research program led by the Nunatsiavut Government builds upon previous multi-disciplinary missions that surveyed benthic biodiversity in Canada's northern oceans, identified habitats from coastal to deep ocean waters, and characterized fish communities. Imappivut seeks to identify new vulnerable marine ecosystems along the Labrador Coast, with the valuable guidance of local Nunatsiavut knowledge and aims at enhancing the understanding of pelagic fish and primary producers' communities in data-poor areas. During this Leg, the remotely operated vehicle (ROV) ASTRID was used to explore the marine ecosystems in designated locations along the Nunatsiavut Coast, Labrador Sea, and Baffin Bay. Finally, the Imappivut project aims to promote the co-production of knowledge with participants onboard, fostering interdisciplinary learning and creating space for collaborative exchanges.

1.3.2 *Leg 2b – KEBABB/S & TCA – 29 July to 8 August – Baffin Bay*

After a science rotation in Qikiqtarjuaq on July 29, the CCGS *Amundsen* entered three fjords of the Auyuittuq National Park to study the seafloor sediments and the pelagic environment for the program Transforming Climate Action (TCA). This large research programs aims at constraining the role of the ocean in the global carbon cycle to reduce uncertainties in its role in climate change. The KEBABB/S (Knowledge and ecosystem-based approach in Baffin Bay/Barrow Strait) program was also part of Leg 2b and is a priority for the development and implementation of an ecosystem-based approach to fisheries management in Baffin Bay since 2019. During the cruise, they hoped to better understand key drivers for the productive capacity, diversity, and ecosystem in the region. To do so, three transects across Baffin Bay and a mooring turnover were planned for this Leg.

1.3.3 *Leg 3 – Refuge-Arctic & ArcticCORE – 8 August to 5 September – Nares Strait*

During Leg 3 of the expedition, the *Amundsen* studied the ecosystems of five fjords and glacier terminuses of Ellesmere Island and Greenland, and conducted various operations in Nares Strait and at the entrance of Lincoln Sea. The main project onboard was Refuge-Arctic, an international program studying the last ice area to understand past, present and future changes in the Arctic, assess impacts, and inform Arctic and global communities by providing comprehensive information and a benchmark to protect the Arctic environment and its ecosystems. The program involves more than 60 researchers from 21 institutions divided into five teams with a focus on physics, geochemistry, marine productivity, paleoceanography and modeling. The *Amundsen*'s helicopter was also used on six occasions to collect glacial, riverine and lacustrine samples.

Fisheries and Oceans Canada's ArcticCORE research program shared similar objectives and was able to join Refuge-Arctic aboard to study the Tuvaijuittuq marine area and understand how the ongoing changes impact marine ecosystems. These findings will contribute to sustainable management, engagement and conservation efforts in the area.

1.3.4 *Leg 4 – Refuge-Arctic & ArcticCORE – 5 September to 3 October – Nares Strait*

The fourth Leg of the expedition begun after a crew change at the Pituffik Space Base (Greenland) when the icebreaker headed north into Nares Strait. While the plan was to reach Lincoln Sea to study the oceanographic circulation and to sample floes of old ice for the Refuge-Arctic program, these operations were finally undertaken in Nares Strait. Science teams sampled along transects across Kennedy Channel, Kane Basin and Smith Sound, and on five ice floes. The *Amundsen* continued its journey towards Resolute Bay for the next crew change, while sampling the NOW polynya transect and recovering three moorings for the CEOS mooring program.

1.3.5 *Leg 5a – TCA & KEBABB/S – 3 to 20 October – Baffin Bay*

The TCA program returned on the CCGS *Amundsen* to continue their research program on carbon cycling in the Arctic, this time with a focus on closing the gateways of the Arctic Ocean. They sampled the deepest areas of Baffin Bay along a "L" shape transect from Canada to Greenland, and Davis Strait. The KEBABB/S program was also present to study the ecosystems in Davis Strait and in Lancaster Sound. Leg 5a ended on October 20th in Kuujjuaq, Nunavik.

1.3.6 *Leg 5b – Sentinel North – 20 to 29 October – Ungava Bay*

The participants of the International Graduate School on the Emergence of Innovative Blue Economies in the Arctic (joint initiative of the WAGE Circumpolar Partnership and the Sentinel North program) boarded the *Amundsen* in Kuujjuaq on October 20th. The participants had already been in the community for a week before they joined the vessel, exchanging and learning about the challenges and the opportunities Northern communities are facing in a changing North. They spent a few days in Ungava Bay as part of this unique training experience, sampling the marine ecosystem and visiting communities. The CCGS *Amundsen* traced her way back for her return to Quebec City on October 29th with some opportunistic sampling stations along the way, ending a 110-day long scientific journey in the Arctic.

1.4 Data availability

Guided by the principles of open science, Amundsen Science is committed to maximize data usage by delivering publicly available quality-assured and quality-controlled data to support research. Data collected from the *Amundsen* during the annual expedition can provide useful insights on the state of the Arctic climate, on oceanographic and meteorological conditions and on the biodiversity of the ecosystem.

Detailed datasets of CTD-Rosettes, ship-mounted current meter (ADCP), EM-304 multibeam echo sounder, EK80 echo sounder, sub-bottom profiler and underway atmospheric data and seawater surface properties with a thermosalinograph (TSG) were collected during this expedition. A rigorous quality assurance and quality control process is applied to all data collected with our instruments. Once the QAQC process is complete, the datasets will be made available on the Polar Data Catalogue (PDC) at www.polardata.ca or can be accessed on demand by contacting amundsen.data@as.ulaval.ca.

Following Amundsen Science's data policy, research teams must publish their metadata and ensure that their data are archived on the long-term. It is not mandatory to use the PDC to archive on the long-term, as long as a link to the data is provided in the metadata (see AS Data Policy for more details on data policy).

Proper acknowledgement and citation allow the tracking of data usage and is essential to demonstrate outcomes of the Amundsen Science program to funding agencies and stakeholders. Please, make sure to appropriately cite and acknowledge the data in your publications in agreement with our data citation guide (see AS Data Access).

1.4.1 *Overview of the data*

During the 2024 scientific expedition abord the CCGS *Amundsen*, the icebreaker travelled a total distance of 18 405 NM during which sounding and underway measurement were continuously collected. This data will inform the scientific community on seafloor bathymetry and composition, contribute to fish stock surveys, and provide an in-depth overview of the atmospheric and ocean surface conditions along the cruise track.

A total of 298 CTD-Rosette casts were conducted during the expedition, out of which 233 were conducted with the classic CTD-Rosettte, and 65 were conducted with the novel trace metal Rosette. The classic CTD-Rosette is equipped with sensors measuring temperature, conductivity, pressure, dissolved oxygen, nitrate, transmittance, colored dissolved organic matter, fluorescence and photosynthetically active radiation (PAR). An independent LADCP (lowered acoustic Doppler current profiler) is also mounted to the frame in order to measure the horizontal current velocities throughout the water column. Water collected by the 24 Niskin bottles (12 L each) is used for analysis by the research teams, as described in their cruise reports presented in Part II. The trace metal rosette is deployed through the moonpool and allows for the collection of clean water with 12 bottles of 10L each. Subsequent analyses on these sampled allow for the measurement of trace elements and trace metal. Conductivity, temperature, pressure and transmittance are also measured by the instrument throughout the water column.

1.5 Research permits and authorizations

Table 1-1: permits and authorization for the 2024 scientific expedition on the CCGS *Amundsen*

Saint-Lawrence River and Saguenay Fjord	
Department of Fisheries and Oceans Experimental License for Waters of the Region of Quebec	**# QUE-SCIENTIFIQUE-075-2024**
Parks Canada, Parc marin du Saguenay-Saint-Laurent, multiyear permit	**# SAGMP-2023-45498**
Newfoundland and Labrador	
Department of Fisheries and Oceans Experimental License for Waters of the Region of Newfoundland and Labrador	**# NL-8416-24**
Nunatsiavut Government Approval Letter	**# NGRAC-31061792**
Nunavik	
Screening from the Nunavik Marine Region Planning Commission (NMRPC) and from the Nunavik Marine Region Impact Review Board (NMRIRB)	**# 125678**
Nunavut	
Nunavut Research Institute Scientific Research License	**# 05 017 24R-M**
Nunavut Planning Commission & NIRB screening	**NPC ship-based: 150481** **NPC land-based: 150484** **NIRB file # 06YN071**
Department of Fisheries and Oceans License to Fish for Scientific Purposes in Arctic waters	**# S-24/25-1040-NU**
Canadian Wildlife Service – Access to Migratory Birds Sanctuary on Bylot Island and Prince Leopold Island	**# MM-NR-2024-NU-005**
Canadian Wildlife Service – Access to National Wildlife Areas Qaqulluit, Akpait, Nirjutiqarvik, Ninginganiq	**# NF-NR-2024-NU-003**
Park Canada Agency Quttinirpaaq, Auyuittuq and Sirmilik National Parks	**# QUTNP-2024-45974**
Nunavut Water Board (helicopter-sampling in Nunavut)	**# 8WLC-NWP2425**
QIA permit to access Inuit-Owned Land (helicopter sampling in Nunavut)	**# QL1-2441 /QL2-2441**
Foreign Waters	
Vessel Clearance to conduct scientific work in Greenland waters - Danish Ministry of Foreign Affairs	**# 2024/034776**
Note verbale	**# 24/26269**
Naviair	**# 24/00612**
Government of Greenland Survey License	**# G24-041**
Expedition Office Permit (access to Northeast Greenland National Park)	**# C-24-19**

1.6 Northern Community Tour (fall 2024)

Amundsen Science has created a new role within its organization to better engage and solidify collaborations with Northern communities. Myrah Graham was hired as the Northern Research Liaison and organized visits to meet and consult various communities.

The communities of Kinngait, Iqaluit, Pangnirtung, Kuujjuaq and Kangiqsualujjuaq were visited over a six-week period. The visits to Kuujjuaq and Kangiqsualujjuaq were conducted through the activities of the Sentinel North/WAGE graduate school (see part II).

During the fall 2024 Northern community tour, seven schools were visited in three communities, reaching over 85 students. In addition, Myrah participated in three radio interviews across Nunavik and organized two open-house events in Nunavut. Potential Inuit trainees were met, and new municipal and institutional connections were established in each community visited.

The Northern Research Liaison came back with ideas for projects Amundsen Science could develop, such as:

- Tangible documents that better communicate science onboard the *Amundsen* for northern communities;
- In-person or livestream activities to help solidify engagement and collaborations between scientists working on the CCGS *Amundsen* and northern community members;
- New working opportunities for northern community members to participate on the CCGS *Amundsen* as trainees or as artists;
- Art projects with Inuit and scientific visual artists to better share the results and experiences onboard the CCGS *Amundsen*

We look forward to continue these initiatives with more Northern community tours (one is planned for spring 2025) and ongoing collaborations.

2 Leg 2a – 11 to 29 July – St. John's to Qikiqtarjuaq

Chief Scientists: Rodd Laing[1] (rodd.laing@nunatsiavut.com) & David Cote[2] (david.cote@dfo-mpo.gc.ca)

[1] Nunatsiavut Government

[2] Fisheries and Oceans Canada

2.1 Introduction and Objectives

Leg 2a of the CCGS *Amundsen*'s 2024 mission was designed principally to support the Nunatsiavut Government's Imappivut marine spatial planning, as well as DFO's marine conservation initiatives in the Labrador Sea and Baffin Bay. The mission extended previous multi-disciplinary missions (Integrated Studies and Ecosystem Characterization of the Labrador Sea Deep Ocean - ISECOLD, Integrated Studies in the Coastal Labrador Ecosystem – ISICLE, both DFO-led, and Hidden Biodiversity – HiBio projects) that surveyed benthic biodiversity in Canada's northern oceans, identified habitats from coastal to deep ocean waters, and characterized demersal and pelagic faunal communities. This mission also contributed to additional research programs such as Aavaaforfish, the Northern Contaminants Program, DFO NL's Integrated Marine Response Planning Program, ArcticFish, ArcticKelp, Oceans Frontier Institute Sustainable Nunatsiavut Futures, and NRCan's marine mapping programs.

The primary scientific objectives were to 1) further study previously identified biodiversity hotspots (e.g. vulnerable marine ecosystems) and investigate new potential biological hotspots in Baffin Bay (DFO) and along the Labrador Coast (e.g. the Sentinel) with the guidance of local Nunatsiavut knowledge (Imappivut, ISICLE, DFO), 2) improve our knowledge of pelagic fish and plankton community data along data-poor areas of the Labrador Shelf and southern Baffin Bay (ArcticFish, Imappivut, Memorial, DFO), 3) map and sample potential sites of submarine landslides along the Labrador Coast (Imappivut, NRCan), 4) extend ISECOLD, multi-year oceanographic and pelagic data time series by recovering and redeploying moorings in the Labrador Sea (DFO, MUNL, Nunatsiavut Government, Scripps Institute of Oceanography, U of New Brunswick – UNB, Dalhousie), and 5) understand sediment biogeochemistry, carbon storage, remineralization and microbiomes within biodiversity hotspots and in the Arctic gateway (Dalhousie, DFO, U of Calgary).

Figure 2-1: Deployment of the ROV from the CCGS *Amundsen* during the cruise.

In addition to the scientific objectives, this mission emphasized the promotion of Inuit-focused research, knowledge co-production, and Inuit community participation. The 2024 program followed the principles of the National Inuit Strategy for Research for Inuit Self-Determination in Research and featured a co-chief scientist from Nunatsiavut on the scientific team. Through formal on-vessel presentations, and informal interactions, Leg 2a scientists and Coast Guard crew engaged with Nunatsiavut representatives, learned of the critical relationship between language (Labrador Inuttitut), culture and environment, and were informed about Inuit perspectives.

2.2 Synopsis of operations

The 2024 Leg 2a mission had challenging sea states, sea ice and strong currents preventing access or limiting operations at some stations. Nevertheless, the mission was able to address most planned objectives, with additional time used to expand operations at existing sites or explore new sites. In total, the vessel traveled in Labrador Sea and Baffin Bay, sampled 29 stations, and conducted 111 operations. Many of the scientific results of this mission will require further study but mission highlights already include newly discovered dense hanging coral gardens at the Sentinel, significant verified range extensions for some taxa (e.g. Novodinia, Paragorgia arborea), and the successful completion of complex ROV operations that including installing instrumentation on vertical coral habitats.

Part II of the mission report compiles multidisciplinary contributions from the teams that participated in Leg 2a. Each contribution identifies team-specific objectives, methods employed, and samples collected, and in some cases preliminary results, and recommendations for future missions. These data will be the basis of many collaborative scientific papers, help shape management of these study areas, and form the foundation on which future *Amundsen* missions are constructed in the Labrador Sea and Baffin Bay.

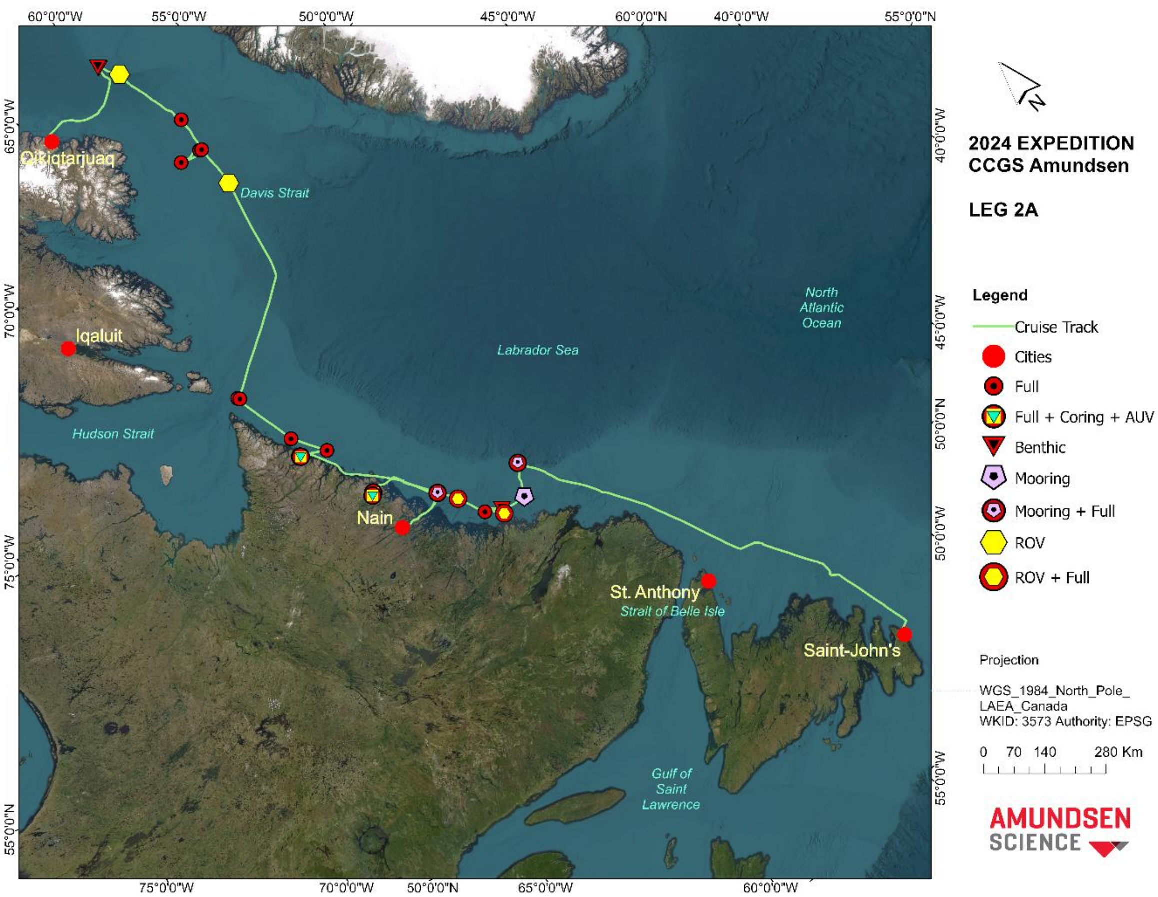

Figure 2-2: Cruise track and stations visited during Leg 2a of the 2024 *Amundsen* scientific expedition.

3 Leg 2b – 29 July to 8 August – Qikiqtarjuaq to Iqaluit

Chief Scientists: Amélie Desmarais [1] (amelie.desmarais@as.ulaval.ca)

[1] *Amundsen Science, Université Laval*

3.1 Introduction and Objectives

Leg 2b of the CCGS *Amundsen*'s 2024 mission was designed to support oceanographic sampling for the following programs:

1) The Transforming Climate Action (TCA) program, aiming at understanding the ocean's role in climate change and reducing uncertainty about ocean carbon sequestration in the Arctic. For Leg 2b, TCA focused on the Maktak, Coronation and North Pangnirtung Fiords of Auyuittuq National Park, with a strong geology component.

2) The KEBABB / KEBABS programs (Knowledge and Ecosystem-Based Approach in Baffin Bay / Barrow Strait), which is a Fisheries and Oceans Canada program aiming to better understand key drivers for the productive capacity, diversity, and ecosystem structure in conservation and management areas of Baffin Bay and Barrow Strait, and their connectivity. This program contributes to the development and implementation of an ecosystem-based approach to fisheries management in Baffin Bay since 2019, and in Barrow Strait since 2022. For Leg 2b, KEBABB's objectives were to sample along three of five well-established transects across Baffin Bay and to recover and redeploy a mooring at station C4-23.

In addition, wildlife observers from Environment and Climate Change Canada were onboard for the Eastern bird survey program. The teams were very committed in working together to achieve the objectives of the mission with efficiency and professionalism.

3.2 Synopsys of operations

The first three days of Leg 2b were dedicated to the TCA program. The teams used the CCGS *Amundsen*'s scientific instruments to sample seawater, sediments, fish and zooplankton in the Auyuittuq National Park. Between one and two gravity cores and box cores were collected in each of the fjords. Dedicated mapping was conducted during the night. Sampling along transects B, C and D of the KEBABB program then took place for almost four days. Sea ice was present on the transects and, although it was melting, it considerably slowed the operations and led to the cancellation of station D5 and prevented us from recovering the mooring. A mooring deployment still took place at an alternate location. Towed nets had to be cancelled on a few occasions as well. Cruise track and stations sampled are shown in Figure 3-1. Overall, the teams were able to accomplish 107 operations at 31 stations during Leg 2b of the 2024 expedition on the CCGS *Amundsen* (Table 3-1).

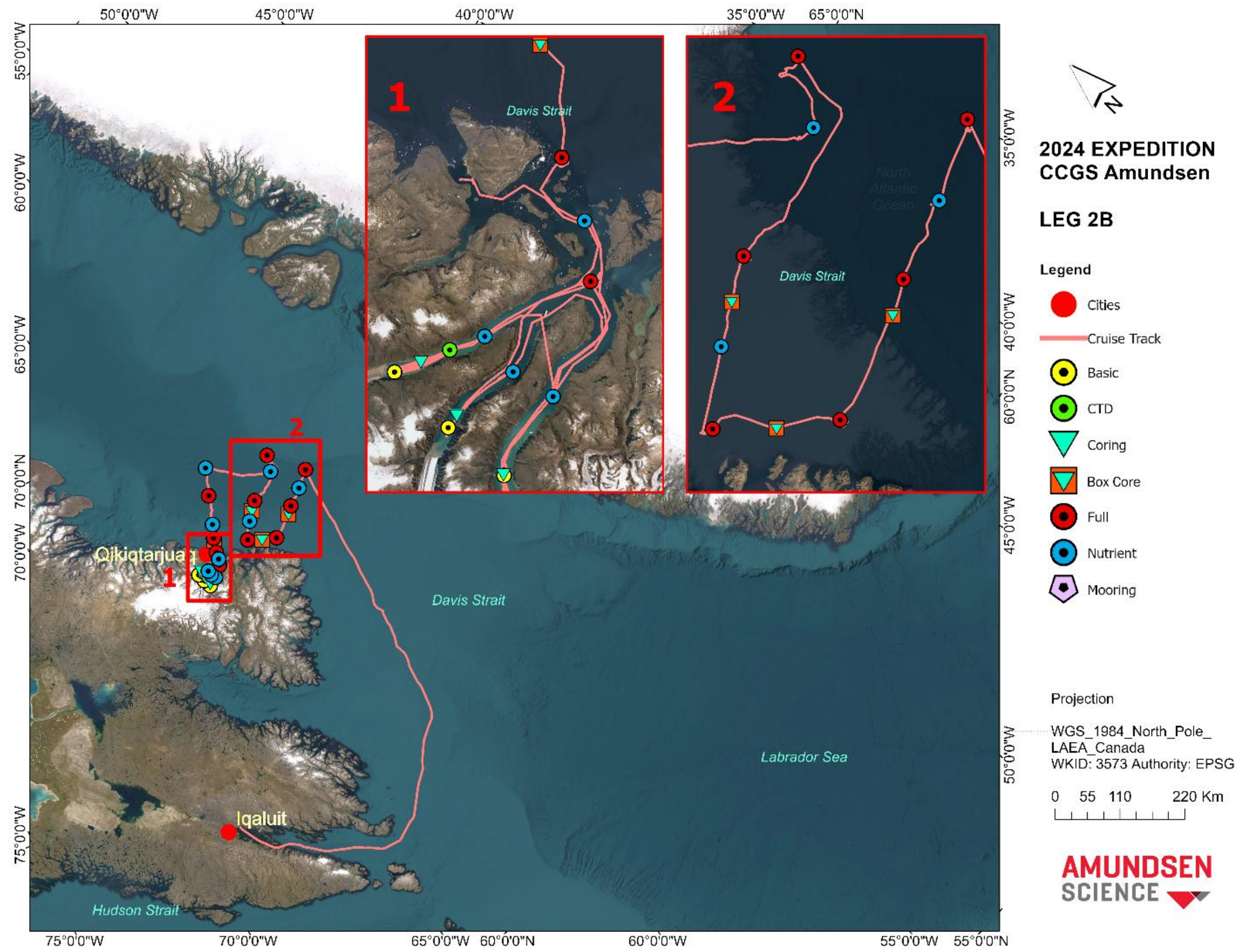

Figure 3-1: Cruise track and stations visited during Leg 2b of the 2024 *Amundsen* scientific expedition.

Table 3-1: Planned and completed operations during Leg 2b of the 2024 *Amundsen* scientific expedition.

Operations	Planned	Conducted	%
Tucker Nets	14	12	86%
IKMT	8	4	50%
Plankton Nets	15	19	127%
Monster Nets	3	3	100%
Beam Trawls	6	5	83%
Hydrobios	11	10	91%
CTD Rosettes	25	26	104%
Nights dedicated to mapping	3	3	100%
Mooring recovery	1	0	0%
Mooring deployment	1	1	100%
Giant gravity core	3	7 (5 successful)	233%
Box cores	17	17 (14 successful)	100%
AUV dives	3	0	0%

3.2.1 *Daily synopsis*

29 July: The crew change went smoothly, with an overnight stop in Iqaluit for embarking personnel. A first meeting with the captain, the ship's officers and the scientist was held at 19h to introduce participants, present the cruise plan and give the Life On Board presentation. Familiarization tours were also conducted. We entered Auyuittuq National Park and are mapping Maktak Fjord overnight.

A last-minute request was made to collect two box cores in front of Qik, but those deployment were unsuccessful. More sub-bottom data is needed in the area to guide future sediment sampling.

30 July: Station TCA-QFC1 completed in the morning. We changed the location of the station to move deeper in the fjord and to access shallower waters (about 100m). Suitable coring location found for TCA 5.2, although we had to do three deployments to recover only one core (sand layer preventing penetration). We completed TCA-QFC2 right before a safety drill, and started mapping until midnight (North Pang and Coronation).

Figure 3-2: Deployment of a Monster net (left) and a box core (right) in Maktak Fjord.

31 July: Station TCA-QFA1 and TCA-QFA2 was completed during the night, with an interesting secondary chlorophyll maxima at the latest station. Operations went well. Coring at station TCA-5.3 (initial position) was unsuccessful (overflown box core). We moved to a second coring location, and the teams were able to recover 2 gravity cores and two box cores that were a little better. Station TCA-QF3 was completed in the evening. Mapping in North Pang Fjord during the night.

1 August: Station TCA-QFB2 and TCA-QFB1 were completed during the night and early morning respectively. The location of TCA-QFB1 was moved to the exact same location as the coring site identified for TCA-5.1 due to the presence of ice. Coring was a real success (2BC, 2GC)! We left the fjord while finishing the mapping and moved to TCA-QF4 and D1.

2 August: Due to unexpected ice conditions, we moved station D2.5 (BC) to another suitable location (D1.5), sampled during the night. We had one rosette at station (TCA-D1B) and at station D2. Transit towards station D3 went smoothly, with less ice concentration than expected.

Just before we could start the operations, the medical officer and the captain decided to evacuate a scientist who had been sick for a few days without amelioration. Medical care was administrated yesterday, but the lack of improvement (and a new strong cough) justified their evacuation. Evacuation to Qik went smoothly (flight around 8:30 in the morning). The scientists went to the clinic in Qik and their transport south was organized by the Coast Guard Operational Centre.

In the meantime, we were able to continue the scientific operations onboard, loosing a few hours in the process.

3 August: We completed station D4 overnight. Due to ice conditions and the delays that we had already accumulated, we did not go to D5, the last and deepest station of the D transect. We had planned a net at D4 to compensate, but a small part of the Hydrobios broke (so it was canceled). The hydrobios was quickly fixed after that.

A 13h slow transit finishing around mid-day took us to our mooring deployment site. As C4-23 was still under the ice, we were not able to retrieve it, but took the decision of deploying C4-24 at an alternate location anyways (nearby C4, just outside of the ice edge). Deployment went extremely well considering the length of the mooring (over 1km), with calm seas and good visibility. The method used by our technicians (attaching pre-measured ropes to equipment during deployment) worked well and prevented entanglement. We were able to see the mooring on multibeam imagery. We collected water and deployed nets at the C4-24 location.

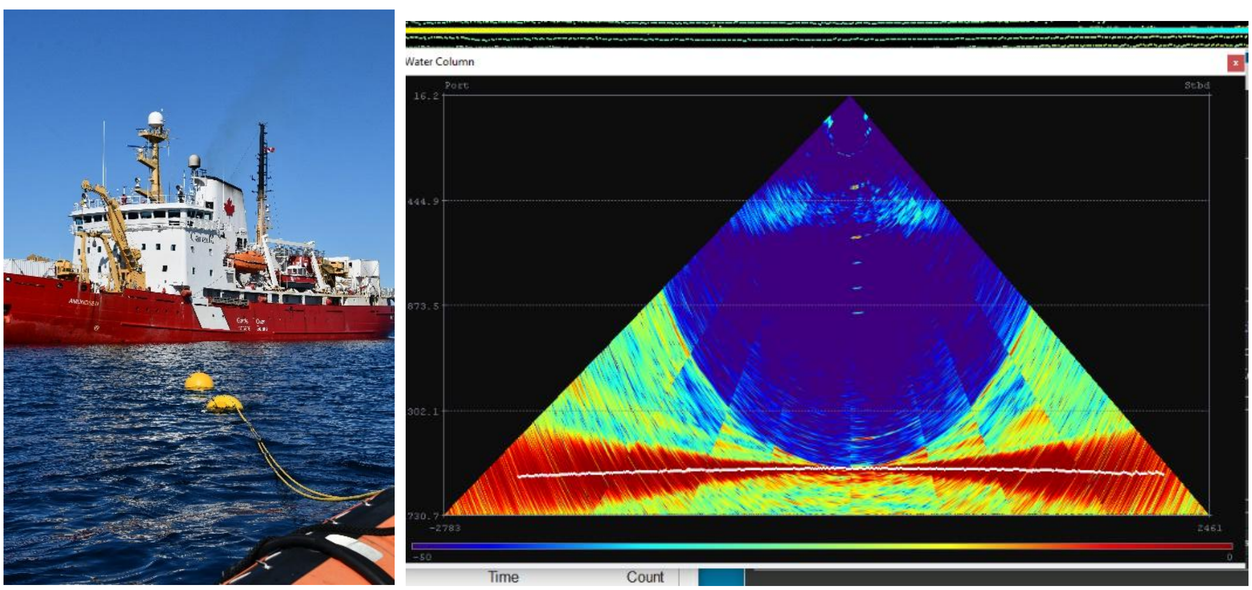

Figure 3-3: Deployment of the mooring (left) and multibeam imagery of the mooring (right).

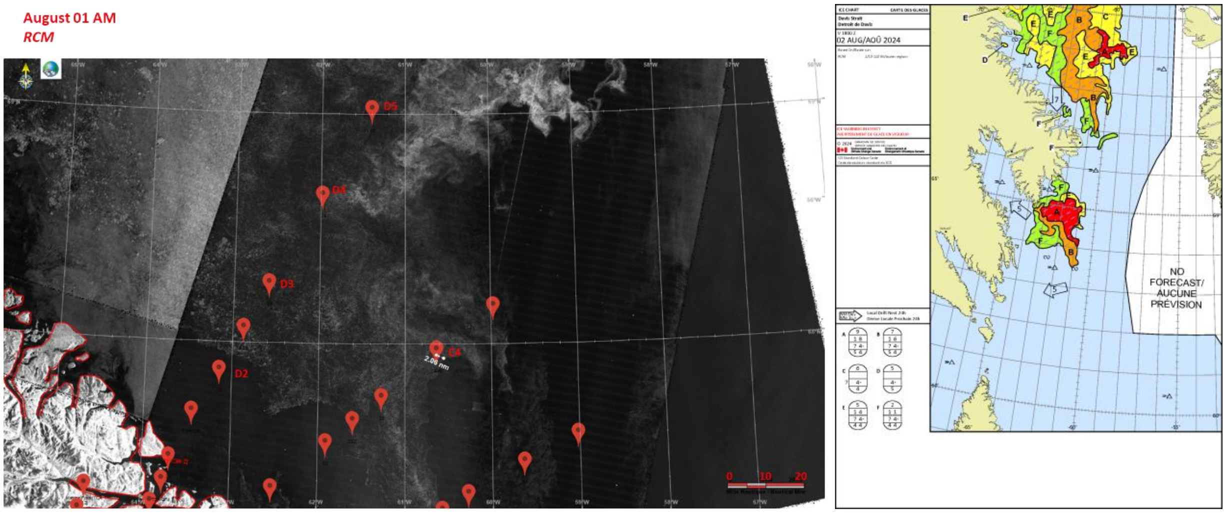

Figure 3-4: Satellite imagery from August 1st (left) and CIS ice chart from August 2nd (right).

August 4: Sampling of C5 overnight, transit to C3 until mid-day. No towing nets at C3 due to ice concentration. Box core at station C2.5 was not very successful, with a lot of rocks. Stations C2 and C1 went smoothly overnight, we even made up some time during operations and transit. Box core at station B1-C1 was ok (quite sandy).

August 5: Last 24h of operations. No issues at station B1. B2 was canceled to make sure that we had time to do B3 and B5, with ice expected around B2.5. In the end, the ice had moved and was around B3, preventing us from doing the horizontal nets. This freed up some time, so we were able to do B4 (with an additional tucker net).

August 6: B5 was completed around 8AM on August 6 (with a shortened IKMT). Transit to Iqaluit begun directly afterwards.

August 7: We were hoping to launch the helicopter for river sampling just before lunch, but visibility decreased since this morning. We delayed the flight and reassessed in the afternoon, but we had to cancel the operations due to poor visibility. The teams were cleaning the labs, dealing with their chemical waste and putting away equipment.

August 8: Crew change in Iqaluit with the ship docked at dwarf. Our flight was 3h late, but everything went smoothly otherwise. While we were docked, we had the visit of the Arctic

Region Assistant Commissioner Youssef Mani with other representatives of the CCG and of the US Coast Guard

Figure 3-5: Scientists and crew during Leg 2b of the 2024 *Amundsen* Expedition.

4 Leg 3 – 8 August to 5 September – Iqaluit to Pituffik

Chief Scientists: Audrey Limoges[1] (Audrey.Limoges@unb.ca) & Mathieu Ardyna[2] (Mathieu.Ardyna@takuvik.ulaval.ca)

[1] University of New Brunswick

[2] Takuvik, Université Laval

4.1 Introduction and objectives

Forty scientists took part in Leg 3 of the CCGS *Amundsen* Expedition 2024, between August 8 and September 5. The expedition began in Iqaluit and ended in Pittufik. It was dedicated to the multidisciplinary REFUGE-ARCTIC program, led by Takuvik and involving partners from twenty international institutions, as well as DFO's ArcticCORE program. The REFUGE-ARCTIC program focuses on the Last Ice Area (LIA), and in particular on fjords and the continuum between glaciers/rivers and the ocean. More specifically, it included station transects in four fjords along northeastern Ellesmere Island (Makinson Fjord, Dobbin Fjord, Archer Fjord, Conybeare Fjord), one fjord in northwestern Greenland (Newman Fjord), as well as stations in Nares Strait and eastern Jones Sound.

The LIA, located at the northern end of the American continent and Greenland, is one of the least explored and least known regions of the world ocean. First, this region is unique because it is home to the oldest sea ice, which is in danger of disappearing over the next few decades. Despite being one of the coldest oceanic regions, this unique marine environment may be an oasis harboring endemic Arctic fauna. Second, the LIA is perhaps the most spectacular convergence zone in the world ocean. Indeed, the general circulation in the AO, made up of giant vortices with opposite gyration, converges in the central basin to generate the transpolar drift whose destination is the LS in the heart of the LIA. This system creates an assemblage of water from the Pacific and the Atlantic, modified during its transit through the central basin of the AO, and collects the freshwater brought by the Arctic rivers from a gigantic watershed. Once in the LS, these masses of water continue their journey through Baffin Bay (BB), collecting meltwater from large glaciers and Greenlandic and Canadian ice caps, before flowing into the Labrador Sea. This convergence makes the LIA one of the best sentinels of processes affecting the ocean today, in a context of global change: changing water cycle, melting permafrost, acidification, pollution, and changing biodiversity.

The LIA is a crucial *in situ* "laboratory" for studying the evolution of the most endemic Arctic biome in a rapidly changing Arctic environment. The general processes of change are now well known separately, but their synergistic and coupled impacts on biogeochemical cycles and marine and adjacent terrestrial ecosystems are not yet understood. The primary scientific questions of REFUGE-ARCTIC addressed during Leg 3 were:

- *How do sea ice dynamics and ocean transport shape elemental composition, contaminant pathways, and biodiversity?*
- *How do changes in sea ice regimes affect sympagic, pelagic, benthic and adjacent terrestrial ecosystems?*
- *How freshwater inputs change hydrology, elemental composition and ecosystems?*
- *What are the key processes and increasing stressors influencing future Arctic ecosystems?*

Key achievements of the expedition included reaching the entrance to the Lincoln Sea (latitude of 82.41°N), successfully recovering six oceanographic moorings that recorded data and collected samples during a full annual cycle and mapping 8200 km^2. Additionally, the full spectrum of sampling conducted in the water column, air, ice and rivers will allow for a comprehensive understanding of environmental gradients and bio-physico-chemical processes at the interface between the oceans and glaciers, and in the LIA.

Part II of this report summarizes the contributions from the different teams that participated in Leg 3. Each team provided a detailed account of their objectives, methods, samples collected, preliminary results when applicable and recommendations for future expeditions.

Figure 4-1: Cruise track (brown) and full sampling stations (red circles).

4.2 Synopsys of operations

During Leg 3 of the 2024 expedition, the multidisciplinary teams onboard the vessel sampled an extensive range of included parameters of the water column, air, ice and rivers at station transects in:

- four fjords along northeastern Ellesmere Island (Makinson Fjord, Dobbin Fjord, Archer Fjord, Conybeare Fjord),
- one fjord in northwestern Greenland (Newman Fjord),
- stations in Nares Strait and eastern Jones Sound.

In total, the vessel traveled 3954 nautical miles and the team completed 185 operations at 25 stations.

Table 4-1: Operations conducted during Leg 3 of the 2024 *Amundsen* scientific expedition.

Operation	Number of operations
Mooring Recovery	6
Barge (optics and mapping)	5
Beam Trawl	3
Box Core	30
CTD Rosette	41
Drop Camera	15
Gravity Core	15
Hydrobios	11
IKMT	4
Monster Net	6
Phytoplankton Net	5
Rosette TM	30
Tucker Net	14

5 Leg 4 – 5 to 26 October – Pituffik to Resolute Bay

Chief Scientist: Marcel Babin[1] (marcel.babin@takuvik.ulaval.ca)

[1] Takuvik, Université Laval

5.1 Introduction and objectives

The second part of the Refuge-Arctic campaign (leg 4 of the Amundsen 2024 expedition) took place from September 5 to October 3. Embarkation took place in Pituffik, Greenland, and disembarkation in Resolute Bay. The overall objective of the Refuge-Arctic campaign was to document the hydrology, biogeochemistry and biodiversity of the system stretching from the Lincoln Sea to northern Baffin Bay. We were interested in the water masses coming from the central basin of the Arctic Ocean, as well as the freshwater inputs from the numerous fjords on either side of this axis.

The second part of the Refuge-Arctic campaign (leg 4) comprised three main program elements specific to this leg. Whereas the first leg (leg 3) had focused heavily on the study of fjords, the second was to:

1) Go to the Lincoln Sea at the start of the leg to document the hydrological properties of this largely unexplored region. This was the most fundamental element of the Refuge-Arctic project, the term "refuge" referring to this last refuge of multi-year sea ice in the Arctic. The sampling program included between 5 and 10 ice-free water sampling stations. The preferred tools were an array of physical sensors (CTD and various ADCP, autonomous platforms) and geochemical water mass tracers. We also wanted to measure several elements and compounds of biogeochemical importance (e.g., nutrients), as well as associated fluxes (e.g., primary production), and document the biodiversity of microbes (archaea, bacteria and microalgae), zooplankton and fish.

2) Intensively sample at least three multi-year ice floes for: i) physical and mechanical properties, ii) optical properties, iii) trace elements and contaminants, iv) nutrients, v) microbial diversity, and vi) carbon fluxes (bacterial activity and primary production).

3) Describe the hydrological, biogeochemical and biological properties along several zonal (east-west) transects distributed at different latitudes along the Lincoln Sea-North Polynya axis.

The Leg 4 program also included extensive sampling of sediment cores (box, piston and gravity cores) for studies of paleoceanography, and of benthic faunal activity and diversity. In addition, we recovered three CEOS moorings and sampled nutrient stations along a meridional transect near Resolute Bay for the Transforming Climate Action program.

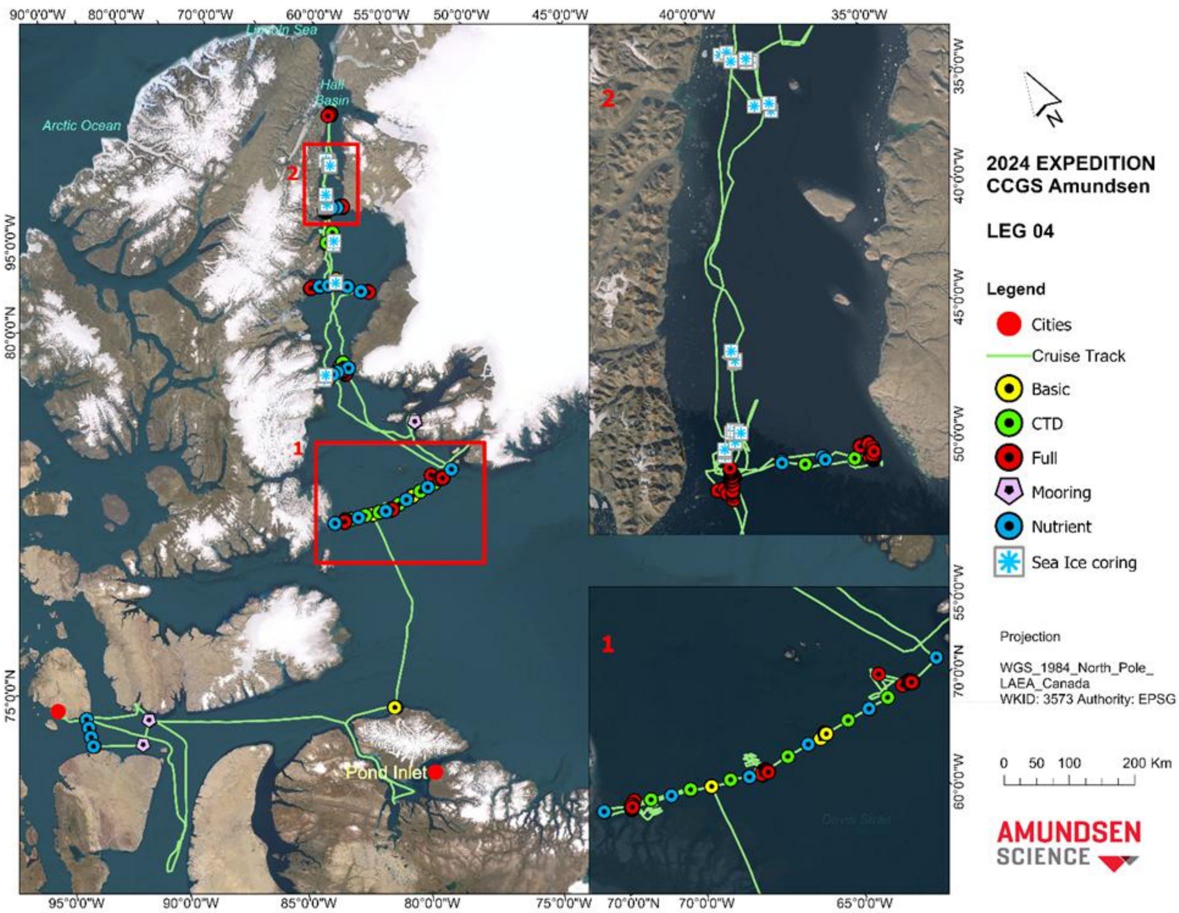

Figure 5-1: Cruise track and stations sampled during Leg 4 of the 2024 *Amundsen* scientific expedition.

5.2 Synopsys of operations

Immediately after boarding, we headed for the Lincoln Sea from Pituffik as planned. Unfavorable ice conditions put us about a day behind schedule. Once we reached Archer Fjord, the commanding officer decided to halt our northward progress for 24 hours to assess the navigability situation. Indeed, the area was occupied by a significant quantity of multi-year ice floes. After 24 hours in the area, the commanding officer decided to cancel the Lincoln Sea portion of leg 4, citing a high level of risk. We then embarked on our first zonal transect in this sector. Only the first station at the west end was completed, however, as the commanding officer wished to leave the area and move further south. In the weeks that followed, our activities were divided between work on multi-year ice floes (5 in all), and a mix of Full, Basic, Nutrient and CTD stations distributed along 4 zonal transects (Kennedy Channel, Kane Basin, Smith Sound, NOW), and one meridional transect (Resolute Bay).

Working on the multi-year ice floes was a first. Very busy, but very well organized, a routine was established from the second floe onwards. An entire day was devoted to each ice floe. Mooring the ice floes was complex. But the light winds made it easy. Teams followed one another to carry out the sampling, supervised by ice experts and crew members, some of whom were responsible for monitoring the polar bears. It took 6 to 8 hours to complete the sampling program. Poor visibility conditions forced us to cut short operations on 2 of the 5 floes sampled.

Work on the transects went very well. Using two rosettes (one deployed on the port side, and the other, dedicated to trace elements, deployed through the moonpool), several corers and numerous nets, operations were very well run thanks to the routine developed during leg 3 (first part of Refuge-Arctic).

The moorings were raised without a hitch. Apart from the abandonment of the Lincoln Sea section, which was a major disappointment for the scientific team, the only significant disruption to leg 4 was the refueling issue. The latter, which was finally carried out during leg 5, meant that we lost around 2 days of sampling to missed appointments with the tanker that was supposed to serve us. The most positive aspect of the leg was our work on multi-year ice floes. We were able to sample 5 of them, which was the best-case scenario. Leg 4 proved to be very productive also in terms of sampling at open-water stations, as demonstrated by the number of CTD launches, stations and coring sites.

The abandonment of the Lincoln Sea section was one of the scenarios envisaged during the preparation of the campaign. This region is known to be very icy, even in September, although conditions vary greatly from one year to the next. We thought that conditions were favorable during Leg 4, especially as the *Amundsen* had been able to visit the area a week earlier, as well as a year earlier in apparently complicated ice conditions. We understand that the assessment of the commanding officer takes precedence over any other assessment. Nevertheless, we would like to see a transparent review of the experience, so that the scientists know what they are dealing with, objectively, in terms of the possibility of navigating the Amundsen in the Canadian Archipelago.

Table 5-1: Operations conducted during Leg 4 of the 2024 *Amundsen* scientific expedition.

Operations	**Number of operations**
CTD-Rosette	84
Plankton net	7
Tucker net	11
Monster net	13
Hydrobios	5
IKMT	7
Beam Trawl	2
Agassiz	3
Box core and Van Veen	28
Gravity core	9
Mooring recovery	3
Barge for optics	8
AUV/catamaran	8
Buoys deployments	9

6 Leg 5a – 5 to 20 October – Resolute Bay to Kuujjuaq

Chief Scientist: Jean-Éric Tremblay[1] (jean-eric.tremblay@bio.ulaval.ca)

Co-Chief Scientist: Marie-Hélène Forget[1] (marie-helene.forget@takuvik.ulaval.ca)

[1] Université Laval

6.1 Introduction and objectives

Transforming Climate Action (TCA):

Despite the importance of Baffin Bay (BB) as a conveyor or sink of Arctic 'constituents', the physical pathways and biogeochemical processes involved are not well understood and their variability and climate-driven change remain to be characterized. Major knowledge gaps include the nature, origin and concentrations of constituents that enter the bay from multiple sources, the extent to which BB simply 'passes on' constituents into the Labrador Sea (LS) via the Baffin Island Current (BIC) or central Davis Strait, incorporates nutrients, inorganic carbon and contaminants into the local pelagic and benthic food webs that support indigenous harvest, and stores constituents in sediments and the deep central basin, where extremely large pools of nutrients and carbon have accumulated over time.

Our main objectives are to reduce uncertainty by (1) better resolving the structure, composition and provenance of waters and constituents entering/exiting Baffin Bay (BB) and the Labrador Sea (LS) (including Hudson Strait), determining (2) how the waters entering BB impact and are impacted by ecosystem processes within the bay, and better understand (3) how the above processes collectively affect the transfer of constituents 'downstream' (with emphasis on the western and central LS, but keeping in mind the connection with the St. Lawrence), and the impact of those constituents on Labrador Sea processes.

KEBABB/BS:

The Knowledge and Ecosystem-Based Approach in Baffin Bay (KEBABB) program was developed by Fisheries and Oceans Canada in 2019 to provide fundamental oceanographic, biological, and chemical data for the development and application of the ecosystem-based approach to fisheries management. The program also contributes to the overall understanding of the productive capacity of the marine ecosystem of Baffin Bay, and how it is impacted by climate and ocean changes. In 2021, DFO expanded the KEBABB program to Barrow Strait, a key productive area of the Tallurutiup Imanga National Marine Conservation Area (TINMCA).

The KEBABS (Knowledge and Ecosystem-Based Approach in Barrow Strait) program complements DFO's long-term moorings for ocean currents and sea ice conditions by adding the ecosystem component to evaluate changes in the productive capacity of this ecosystem and to support the ecosystem-based management of TINMCA and the exploration of fisheries potential as part of the IIBA (Inuit Impact Benefit Agreement) (Pucko et al. 2022).

The five main components of the KEBABB/BS sampling program include: 1) physical and chemical oceanographic conditions; 2) spatial distribution and diversity of primary producers and microbial communities; 3) spatial and vertical distribution, abundance and composition of zooplankton communities; 4) benthic communities and sediment biogeochemistry; and 5) ecosystem health and interactions, including biomarkers. More information about the programs can be found in Pućko et al. (2019, 2022).

Figure 6-1: Scientists and crew during Leg 5a of the 2024 *Amundsen* Expedition.

6.2 Synopsis of operations

Leg 5a took place from Resolute Bay to Kuujjuaq. The initial sampling plan was quite ambitious and had to be adapted due to some delays and weather constraints, leading to the cancellations of activities for both the KEBABB and TCA programs. Nonetheless, 136 operations were conducted at 38 stations across Baffin Bay and Lancaster Sound.

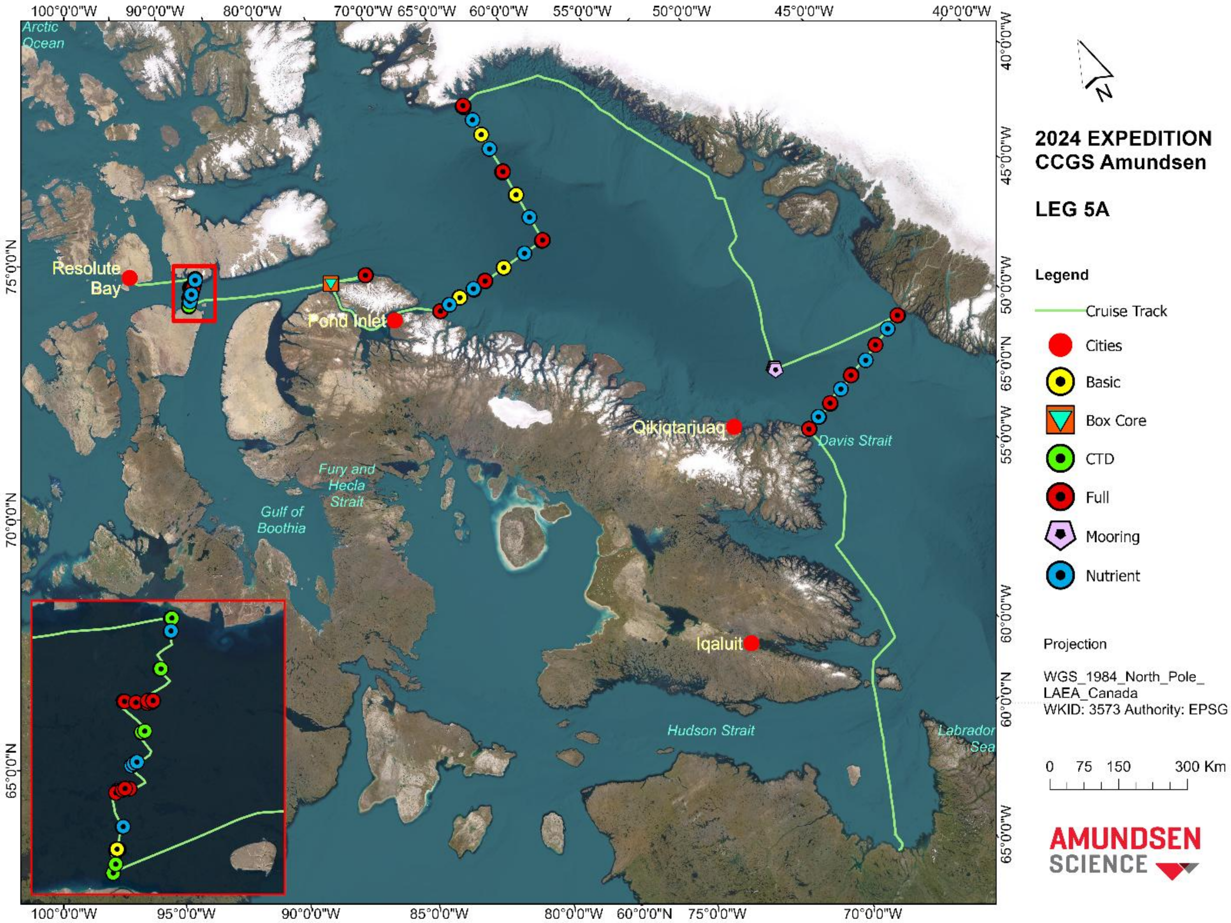

Figure 6-2: Cruise track and stations sampled during Leg 5a of the 2024 *Amundsen* scientific expedition.

Table 6-1: Operations conducted during Leg 5a of the 2024 *Amundsen* scientific expedition

Operations	Number of operations
Beam Trawl	3
Box Core	10
CTD Rosette	60
Hydrobios	11
IKMT	6
Monster Net	8
Rosette TM	19
Tucker net	17

Zodiac	2

6.2.1 *Daily synopsis*

3rd to 5th October: Flight from Quebec to Resolute Bay. Transfer by helicopter of all CG, cargo and scientific personnel. Transfer completed by 18:30 EST followed by a departure for line S at 20h30. The general science meeting was held at 20h30 with welcoming remarks by the captain and senior officers, followed by a round of introductions by the participants, a discussion of logistical and sampling plans, and the Life on Board presentation. A sequence of safety meetings with lead scientists, officers and crew (both the day and night shift) was initiated early on October 4th prior to each new operation. Line S started with station S11 at 8:00 and proceeded South to S1. The Tucker, Monster and Hydrobios were canceled at station KEBABB-S5 due to wind gusts exceeding 40 knots. Line S completed at 10:00 on October 5th, followed by a transit toward station TCA-S3. It took somewhat longer than anticipated to complete the line but this was to be expected given that it was the first run of all operations and some participants had never sampled before. After evaluation of the remaining time available for transect T3, the following stations were removed from the operation list: TCAT3_02, TCAT3_04, TCAT3_06, TCAT3_18, TCAT3_14, TCAT3_12. Moreover, the net strategy was re-evaluated with the team onboard as well as Maxime Geoffroy and the remaining operations can be found in Table 6-2.

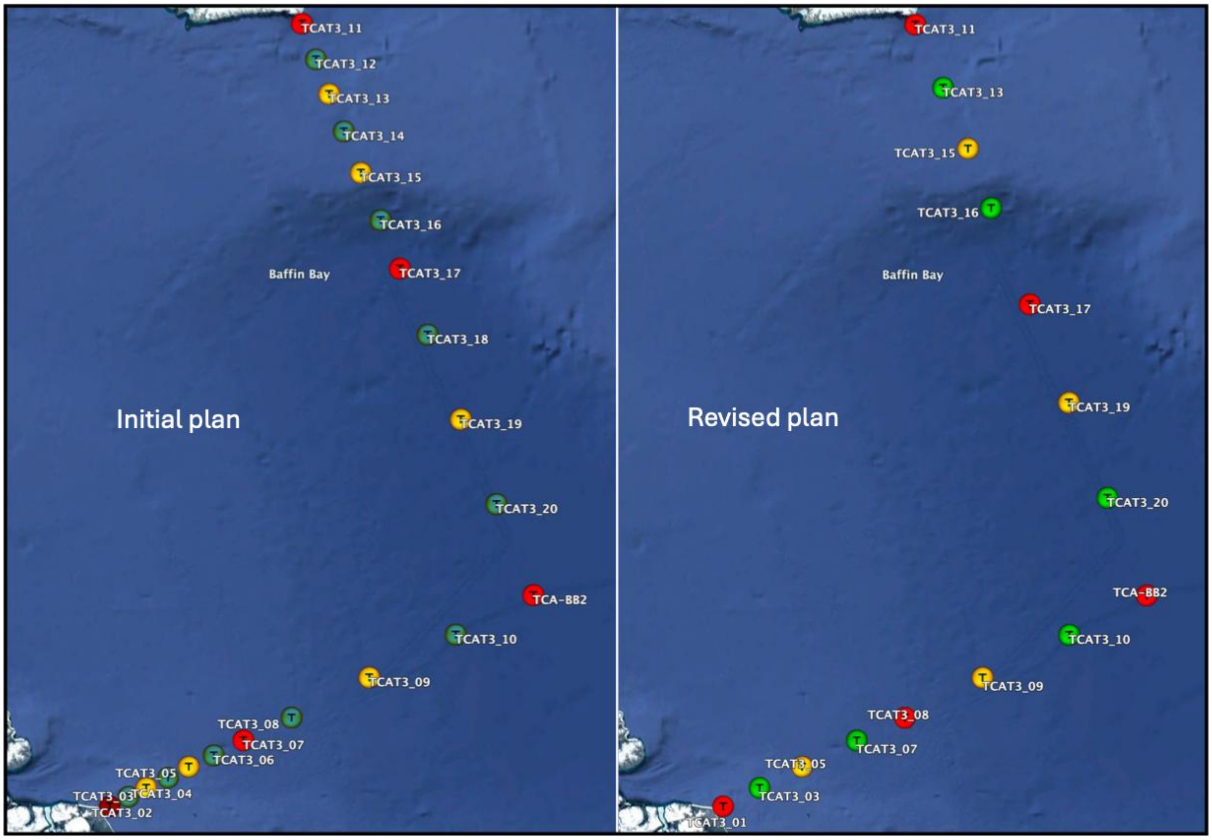

Figure 6-3: Comparison of the initial and revised sampling plans for TCA line T3.

6th October: Sampling at S3 started at 3:00 EST on 6th October. Trace Metal (TM) operations were slightly delayed due to a closed valve that prevented the floor drain from evacuating water. The rosette cable was damaged (most probably by the 'wire guide'' in combination with a strong current that put lateral strain on the assembly) which scraped the jacket of the cable and exposed the kevlar component in some places. Prior to the completion of the IKMT and the box core, station S3 was interrupted to initiate transit to the Wollaston Islands to meet the Kittiqmeot in time to begin the refueling operation before sunset. In any case the sediment at S3 was unsuitable for a box core and we managed to squeeze a little time to do one near station TCA-326 on our way to the Wollaston Island. Previous mapping there had shown promising sediment conditions but the box core unfortunately hit a large rock and was unsuccessful. After discussion with the net team, we did not push to do an IKMT there since they had prior data for the area.

The refueling proceeded efficiently and we sailed to the beginning of the TCA line T3. Due to time constraints, both inherent to the initial mission plan (which could not accommodate all needs at the onset) and the time consumed for the refueling, we proactively removed important operations before the start of the line (See Fig. 2 and Table 1). Six nutrient stations (TCAT3-02, TCAT3-04, TCAT3-06, TCAT3-18, TCAT3-14, TCAT3-12) were canceled. Basic stations TCAT3-03 and TCAT3-13 were converted to nutrient stations and the fish/zooplankton team agreed to reduce their requirements at basic stations. This plan corresponded to the maximum possible cuts short of comprising the entire scientific value of the TCA work, making it possible to properly achieve objectives for central Baffin Bay but sacrificing the ability to resolve physical structures and water-mass organization in shef/shelf-break areas. Plans were also made for the KEBBAB group to achieve a fairly comprehensive sampling on the TCAT3 line, including Full, Basics and even Nutrient stations in some cases.

Upon passing near Pond Inlet, the ship's assistance was requested for a search-and-rescue near the community. This SAR only implied launch/recovery of the helicopter between science activities and had no adverse impact on operations.

Table 6-2: List of operations completed (x) or canceled (c) on transect TCAT3.

Station	**Type**	**Depth**	**CR1**	**CR2**	**CR3**	**CR4**	**TM1**	**TM2**	**Zodiac**	**Tucker**	**Hydrobios**	**Monster**	**Beam Trawl**	**IKMT**	**BC**
TCAT3_01	**Full**	102	x	x			x		x	x		x	x		x
TCAT3_03	**Nut**	199	x												
TCAT3_05	**Basic**	717	x	x			x		c	x		x			
TCAT3_07	**Nut**	887	x												
TCAT3_08	**Full**	1149	x	x	x		x			x	x	x		x	x
TCAT3_09	**Basic**	1744	x	x			x	x		x					
TCAT3_10	**Nut**	2207	x												
TCA-BB2	**Full**	2381	x	x	x	x	x	x	x	x	x	x		x	x
TCAT3_20	**Nut**	2384	x												
TCAT3_19	**Basic**	2303	x	x			x	x		x					
TCAT3_17	**Full**	2209	x	x	x		x	x		x	x	x		x	x
TCAT3_16	**Nut**	1387	x												
TCAT3_15	**Basic**	460	x	x			x			x		c			
TCAT3_13	**Nut**	359	x												

TCAT3_11	**Full**	511	x	x	x		x		x	x	x			x	x

Note: an additional rosette was added at TCA-BB2 for large-volume incubations

7th October: Start of the line TCAT3 in good weather and sea-state conditions. During the night a deck-hand became sick, but operations were able to continue thanks to the contribution of Amundsen Science personnel. The deck-hand was out of action until October 11th and Amundsen Science personnel took the slack by taking night-shifts. Stations completed are TCAT3_01-full, TCAT3_05-nutrient, TCAT3_07-basic (night). All operations were successful, including a box core that had to be redeployed since it did not trigger the first time (easy to do in 100 m of water). The milli-Q water system located in the chemistry lab (aft) broke and could not be fixed onboard. To ensure enough milli-Q water is available, we have installed a container to collect and store water regularly when the tank is full. Also, we recommended to scientists who don't have stringent needs for high-purity water to rinse their bottles with the water of the ship, which is already clean, and if required only use the milli-Q for final rinsing. The MVP operations were canceled because the small winch to deploy the instrument was not operational.

8th October: good sea-state conditions, light wind (<10 knot), clear sky. Completed stations TCAT3_07-nutrient (night), TCAT3_08-full, TCAT3_09-basic (night). All operations were successful, including the IKMT that was deployed for the first time. Due to one deck-hand missing for the night shift, operations were shuffled so that more delicate operations, such as the IKMT, were completed during the day shift. The zodiac was canceled, the strategy was defined to aim at zodiac deployments at the stations TCAT3_01, BB2 and TCT3_11 to focus resources on the 2 TM-Rosette required at deep stations.

9th October: good sea-state conditions, with light wind (~10 knots), clear sky in the morning and foggy in the afternoon. Completed station TCAT3_10-nutrient and started BB2-full (day and night shifts). Overall, all operations are fully optimized with no delay

Station BB2 9-10 October

foggy and cloudy, good sea-state conditions, light wind (< 10 knots). The deepest station of the transect TCAT3. A large subsurface chlorophyll maximum was observed with blooming diatoms (mostly *Chaetoceros*). An additional shallow cast (50m) was deployed to collect water for nutrient experiments (Laurence's project) from the subsurface chlorophyll maximum, as planned for the leg 5A (location needed to be identified). A deep rosette was dedicated to tracers, including krypton (Casacuberta). Trace metal profiles required to be deployed on 2 separate casts. A deep cast of the hydrobios provided an interesting variability in species collected in the very deep water. IKMT was highly successful with a high variety and abundance of species.

10th October: cloudy, good sea-state conditions, light wind. After finishing BB2 station, the *Amundsen* initiated the second component of the TCAT3 transect, sailing north towards the Greenland coast. This section of the transect should be characterised by a larger representation of Atlantic waters, which have a higher salinity and nutrient concentration. In addition to completing BB2, stations TCAT3_20-nutrient was completed and TCAT3_19-basic was initiated (night). All operations were successful.

The weather forecasts (Environment Canada and models) indicated that strong southerly winds and waves in excess of 3-4 meters were to be expected across in central Baffin Bay and across its entire latitudinal swath of Baffin Bay, starting on Sunday and continuing through Monday (Fig. 3). The return of conditions permitting station work in southern Baffin Bay (mooring and lines E and A) was expected for late Monday/early Tuesday. These predictions were maintained on 11 and 12 October and it was decided not to plan for additional cuts on the TCA-T3 line even though it would finish past the initial cut-off time of 4h00 on October 12th. Leaving at that time would imply that the ship would reach southern Baffin Bay earlier but would be unable to resume scientific operations for at least a day.

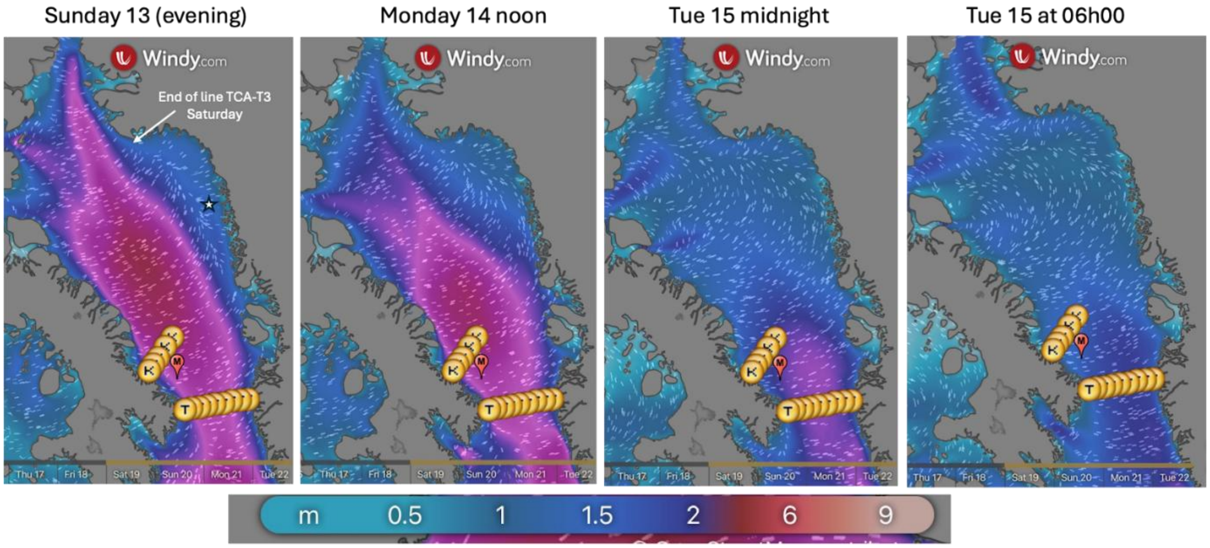

Figure 6-4: Wave heights in Baffin Bay from Sunday 13 October to Tuesday 15 October.

Friday 11th October: Groundhog Day! Good sea state, light wind and cloudy conditions. Stations completed are TCAT3_19-basic and TCT2_17-full. All operations were successful.

During station TCAT3_19, the TM rosette 'cable guide' winch showed limited capacity to lift the 'cable guide'. A maintenance of the winch took place by the CG mechanical engineer, and the system was operational for the TCAT3_17 TM cast. We believe that the winch should be operational for the remaining stations on the leg 5A.

Box core operations at deep stations are difficult to evaluate if the box core touched the sediment and was activated. At station TCAT3_17, there was a confusion in the expected depth as different values were provided by different sensors. Fortunately, the box core was successful and provided good quality sediments.

We experienced problems with the AS schedule platform two nights in a row, with frozen pages and problems in synchronization of the timing of the operations from one line to another. This issue resulted in confusion from the scientists in the timing of their operations, which is especially problematic when it occurs over night. Marcia was very helpful in resolving those situations repeatedly, but that's not a particularly efficient use of her time. The stability/reliability of the system did not improve before the termination of line A.

Saturday 12th October: Last sampling day of TCAT3 on the Greenland shelf with good sea state conditions (light winds and clear skies with few clouds). Stations TCAT3_16-nutrient (night), TCAT3_15-basic, TCAT3_13-nutrient and TCAT3_11-full were complete. All operations were successful. A Monster cast at station TCAT3_15 was canceled due to limited time resources for sorting given the accumulation of samples originating from TCAT3_17 and TCAT3_11. In the evening, a science meeting was held during which the captain described the expected weather and course that might be taken by the ship to keep time loss at a minimum. The chief scientist presented an overview of time constraints for operations in southern Baffin Bay, including the absolute cut-off time to depart for Kuujjuaq. It was agreed that a steering committee comprising the leadership of KEBBAB and TCA on board would be convened on Sunday to confirm priorities and cuts to be made.

Sunday 13th October: Upon completing work at TCAT3-11, the ship started heading South with a course hugging the Greenland shelf in order to avoid strong winds and waves off shore (Fig. 3). A meeting with the PIs of KEBABB and TCA took place at 13:00 to evaluate the priorities. The plan for the remaining days of the leg 5A is to focus on the recovery of the mooring at C4, where a full/basic station would take place followed by the line A. The line E would not be sampled this year. The Amundsen Science team cut 250m of the damaged cable from the TM rosette, which is now estimated at 2300m long.

Monday 14th October: The transit toward station C4-23 continued. The waves in the middle of Baffin Bay are expected to slowly die down throughout the day. Thus, after reaching about 71° North, the ship, which was up to now near the Greenland coast to be protected from the wind and waves, changed its course to a more direct itinerary. ETA to C4-23 is estimated at 7:00 on 15 October. All in all, this detour imposed by the weather conditions resulted in a loss of operational time representing ca. 16 hours, when compared to a course that would have taken the ship directly from station TCAT3-11 to C4-23, for example.

During the science meeting (7pm), following a brief daily update of upcoming operations, we initiated a series of short presentations from the students, and CG crew were invited to attend and participated in large numbers. Tonight there was a presentation from Lena Bodiguel (microscopy and taxonomy of phytoplankton) and Zoé Garminan (taxonomy of zooplankton).

Table 6-3: List of operations completed (x) or canceled (c) on mooring station C4-23 and transect TCAT6 (KEBBAB line A).

Station	Type	Depth	CR 1	CR 2	CR 3	CR 4	TM 1	TM2	Zodiac	Tuck	Hydrob	Monster	Beam	IKMT	Box

C4-23	Mooring	1613	x	x						x	x				
A9	Full	102	x	x			x		x	x	x	x	x		x
A8	Rosette	525	x												
A7	Full	874	x	x			x			x	x	x (shallow)			
A6	Rosette	910	x												
A5	Full	817	x	x			x	x		x	x			x	x
A4	Rosette	658	x												
A3	Full	131	x	x			x	x	x	x	x			x	x
A2	Rosette	70	x												
A1	Full	74	x	x			c			c	x		c		

Tuesday 15th October : Good sea state, light wind, cloudy. The C4-23 mooring station started at 7:00 with a successful location of the mooring with the multi-beam/sub-bottom profiler at a position that perfectly matched the deployment location in 2023. After conducting a rosette, the AS team initiated communication attempts with the mooring. The operation was unsuccessful and the operations were terminated at 15:00. A detailed narrative of the steps taken was written by Paco from Amundsen Science and is included as appendix to this report. Overall, it looks as though the problem was caused by the acoustic releases that anchor the mooring but a malfunction of the deck unit cannot be fully discounted.

After completing all operations at the station (a second rosette, a tucker and a hydrobios), the ship sailed over the mooring to validate its presence, which was confirmed by the sub-bottom sonar. Sailing to line A started at 18:30. During the science meeting (7pm), following a brief daily update of upcoming operations, we continued the series of short presentations from the students. The CG crew participated in large numbers. Tonight there was a presentation from Alice Pradel (nano-particles) and Emmy Hieronimus (water mass tracers - Argon and Krypton), Eugenie Jacobsen and Andeol Bourguoin (zooplankton and fish - net deployments and results).

Wednesday 16th October: Line A operations started at station A9 (on the Greenland coast). Good sea state, and light winds. The day started under clear sky with some clouds, and progressed to snowy conditions at night. Completed stations are A9-full, A8-nutrient/basic, A7-full, A6-nutrient/basic. At A9, the box core had sandy sediments that were not favorable for the incubation of Thibaut Combaz. A second cast was initially considered, but then was canceled because it required to scan the regions to find the proper sediment. Operations during the rest of the day and station were all successful.

During the science meeting (7:30pm), following a brief daily update of upcoming operations, we continued the series of short presentations from the scientist. Tonight there was a presentation by Marie-Hélène Forget about the Research Center that is constructed in Qikiqtarjuaq.

Thursday 17th October: Line A operations continued sailing East. Good sea state, light wind and cloudy and foggy conditions. Completed stations are A5-full, A4-nutrient/basic, A3-full, A2-nutrient/basic. All operations were successful.

Friday 18th October: Heavy winds started overnight, with 30-40 knots at station A1. Strong surface (10m) currents were created by the wind conditions and directed perpendicular to the deeper currents. The TM Rosette, as well as the Tucker net and the beam trawl were all canceled due to these conditions. A cut-off time was established by the commanding officer to leave the station by 8:00am. Transit to Kuujjuaq was initiated as planned.

During the science meeting, we had a presentation from the commanding officer, Pascal Pellerin, about the coast guard duties and operations, as well as a presentation from Chris Morrissey about ROV-ASTRID.

Saturday 19th October: The transit to Kuujjuaq continued with relatively calm sea conditions. Cleaning laboratories and storage of samples and boxes took most of the day.

Sunday 20th October: The helicopter transfer of luggages and personnel started at 7:20, with three rounds of luggages transfer followed by 6 rounds of personnel transfer. The Kuujjuaq airport was closed for embarking participants to enter the building and bring the luggages to the helicopter (opening expected at 9:00) but the helicopter pilot and the chief officer were able to contact the air traffic controller to resolve the situation. The chartered flight to Quebec City and Montreal left Kuujjuaq at 14:30 as planned.

7 Leg 5b – 20 to 29 October – Kuujjuaq to Quebec City

Chief Scientist: Philippe Archambault[1] (philippe.archambault@bio.ulaval.ca)
Co-Project Leaders: Gérard Duhaime[1] (Gerard.Duhaime@soc.ulaval.ca), Sophie Gallais[1] (sophie.gallais@sn.ulaval.ca)

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7.1 Introduction and objectives

Introduction

Climate change has many impacts in the Arctic, especially for coastal communities who have a close connection to the marine environment and depend on it for their food security, access, and abundance of culturally important resources, etc. This changing environment creates an uncertain future but could also allow new relevant economic development opportunities for Northern communities.

The *International Graduate School on the Emergence of Innovative Blue Economies in the Arctic* is looking at how indigenous communities are adapting to these changes and innovating using their knowledge and culture. These adaptive strategies are essential to maintaining their way of life, improving their well-being and proactively shaping the economy of tomorrow.

The school focuses on equity and local self-determination in innovation and adaptation, which could include taking advantage of migrating fish stocks, shellfish, and seaweed cultivation, emerging small-scale tourism, and promoting novel species that could be harvested to support local economies and also benefit the subsistence way of life.

Through an interdisciplinary approach, students integrate biological, chemical, and physical oceanographic data with social science research to better understand the emerging blue economy in Arctic communities.

By the end of the program, students gain a comprehensive experience that equips them with theoretical knowledge and allows them to apply that knowledge in the field or in real-world contexts, fostering deeper understanding and better preparation for future challenges.

Description

This School focused on observed changes occurring in the Ungava Bay marine region and how community members and organizations adapt to these changes while innovating blue Arctic economies. During the first days of the School in Kuujjuaq, students learned from Northerners about their observations of change and their consequences on food security and way of life. Students have also heard about innovation in Nunavik with climate change adaptation strategy, renewable energy initiatives, etc. Indigenous autonomy and self-determination over water and marine resources were also subjects of interest for the students. Students had the opportunity to understand potential science questions related to the blue economy thanks to all the knowledge shared during these first days. Some key messages from these meetings were that Inuit organizations need sound data to monitor and support their decision and that collaborative research is needed. Students learn also about the interdisciplinary approach and how to include local knowledge in their research activities.

On the CCGS *Amundsen*, participants explored otherwise challenging-to-access regions where little environmental data exists, acquired valuable data and perspectives related to ecosystem dynamics, and advanced our knowledge of climate change and Arctic sustainability. Moreover, participants from diverse disciplines have collaborated doing teamwork, facilitating a more comprehensive understanding of intricate Arctic systems, both natural and social, and their interconnectedness. Fieldwork on the CCGS *Amundsen* was a pivotal hub for this interdisciplinary graduate school on blue economy.

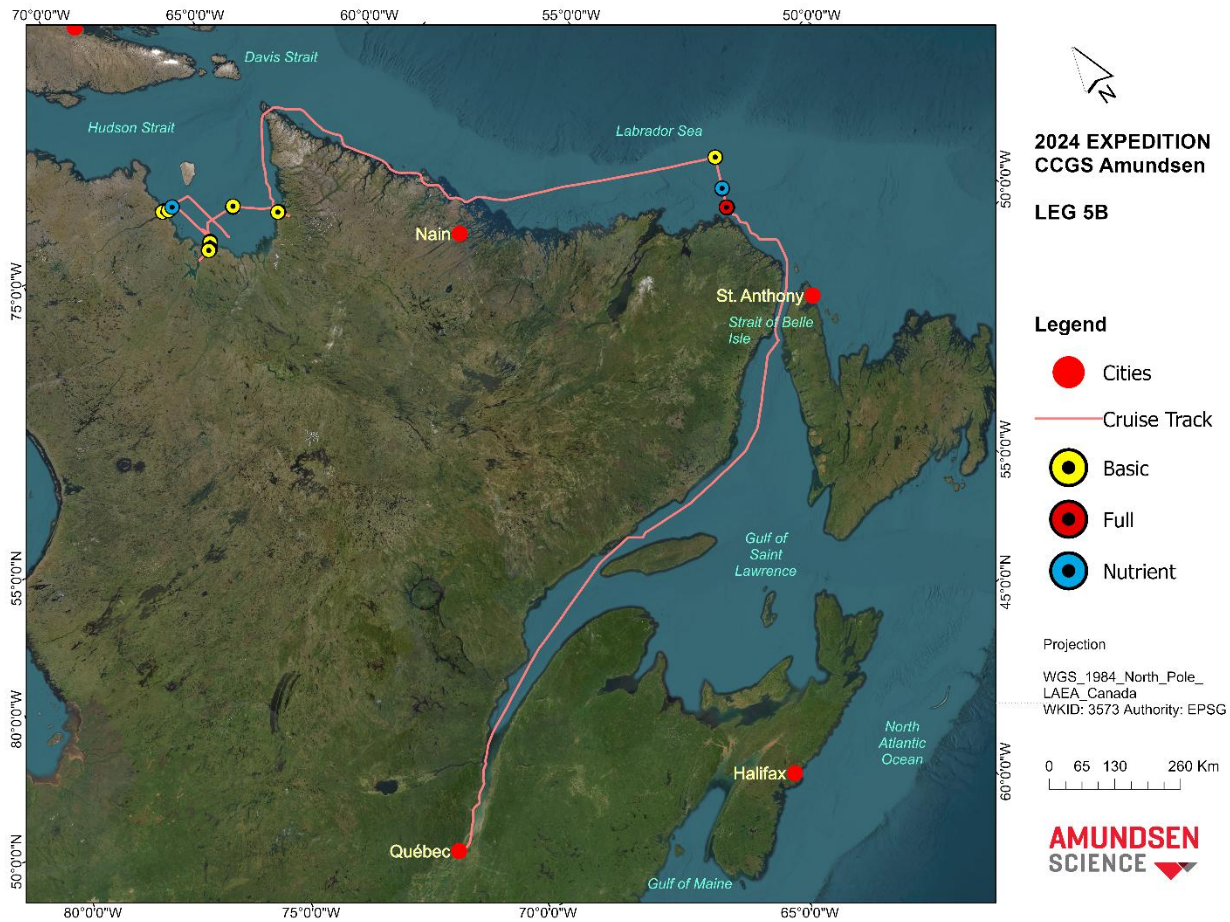

Figure 7-1: Cruise track and stations sampled during Leg 5b of the 2024 *Amundsen* scientific expedition.

7.2 Synopsis of operations

In our efforts to address some of the questions related to a better understanding of the marine ecosystems of the Ungava Bay complex, we designed a sampling plan to establish baseline ecological data for some of the largest tributaries of Ungava Bay. To achieve this, sampling operations were planned within the Bay (5 stations) and in the plume of three key rivers: Arnaud River (20 stations), Leaf River (20 stations), and George River (20 stations). This ambitious sampling program was mostly aligned to have the maximum flexibility to answer priorities for our Inuit consultations during the week in Kuujjuaq. Many stations had been set up to be flexible and adaptable, considering the sampling challenges (e.g.: bad weather conditions and strong tidal currents) in this region. In the end, operations were carried out at seven stations:

Table 7-1: Stations sampled for the School and activities per station (based on Eventlog_2024_LEG_05b)

Study area	**Station**	**Boxcore**	**CTD Rosette**	**Grab**	**Grab/Boxcore**	**Tucker**	**Total**
Arnaud River	AR24-17		1			1	2
Arnaud River	AR24-19		1	1		1	3
Arnaud River	AR24-20	1	1				2
George River	GR24-17	1	1			1	3
Leaf River	LR24-04		1		1		2
Leaf River	LR24-05		1		1	1	3
Ungava Bay	UNG24-3	2	1			1	4
Total	7	4	7	1	2	5	19

While we had planned to carry out sampling stations using the barge, we were ultimately unable to do so due to the following constraints:

- Arnaud River – October 21: Due to wind, tide and weather conditions, we were unable to launch either the barge or the zodiac. Therefore, we concentrated our efforts on sampling three stations from the *Amundsen*.
- Leaf River – October 22: We launched the barge to enter the Leaf River and sample stations. However, the Canadian Coast Guard had to turn back due to the river's current and tides. A breakdown rendered the barge unusable for the remainder of the leg.

Additional information on the samples collected and the operations are provided in the other cruise reports from leg5b and attached data files:

- Bioturbation and ecosystem functioning in Ungava Bay – Jasmin Godbold: Samples collected using the Boxcore or Van Veen grabs are also presented (microplastics, POMP project, bioturbation, BlueArc project).
- Marine productivity: Carbon and nutrients fluxes – Jonathan Gagnon: Samples for inorganic nutrients (ammonium, nitrite, nitrate, orthophosphate and orthosilicic acid) were taken at all the 7 stations to establish detailed vertical profiles.
- Assessing the linkages between marine food webs and Arctic Char quality in the context of climate change in Nunavik – Marianne Falardeau: Six samples collected using the Tucker net.

- Fish and Zooplankton – Maxime Geoffroy / Eugénie Jacobsen: Five samples collected using the Tucker net.

While we were working on Arnaud River, Leaf River and George River, we also planned to welcome on board people respectively from nearby communities (Kangirsuk, Tasiujaq, and Kangiqsualujjuaq) to discuss scientific operations, interact with participants, and share observations. Communications and contacts had been established with communities prior to the School, even in Kuujjuaq, where Myrah Graham of Amundsen Science spoke on local radio (10-minute interview). However, this part of the school could not be fully completed:

- Arnaud River – October 21: Due to wind, tide and weather conditions, we were unable to launch either the barge or the zodiac. We, therefore, concentrated our efforts on sampling three stations from the *Amundsen* in Ungava Bay and the entrance of the river. With Myrah Graham from Amundsen Science, we contacted the Kangirsuq local radio station for an interview to inform them of *Amundsen*'s presence and the operation near the community (10min).
- Leaf River – October 22: Given the distance between the *Amundsen* and the village of Tasiujaq (35 nautical miles), the time required to bring people on board with the zodiac and return them to the village was too long for the operation to be carried out.
- Kangiqsualujjuaq – October 23/24: It was initially planned to enter the George River and anchor for the night on October 23rd to bring people aboard the *Amundsen* on October 24th. However, the cargo from the sealift company changed its route and anchored that same day in front of the community. The ship's position was at a longer distance from the village than expected. However, a very brief window of time allowed a small delegation from the School to travel to the village by zodiac to discuss during the Parnasimautik meeting at the Town hall and engage with the community. This presence was broadcast on the radio and translated live into Inuktitut for all Nunavik radios (30 minutes).

Figure 7-2: Gérard Duhaime, Philippe Archambault, Marianne Falardeau, Isabelle Cooper, Mirkka Ollila and Myrah Graham in Kangiqsualujjuaq (Photos: Myrah Graham).

The return trip aboard the *Amundsen* allowed the mentors to share academic content and for the students to complete team projects combining natural and social sciences to answer complex questions about the blue economy. Four teams worked to produce two pagers' documents. The themes were the following:

- "*We have to be innovative in sustaining a traditional way of life*" Hilda Snowball Developing a Blue Economy to Support Socio-Ecological System Resilience
- How can the contemporary Inuit way of life successfully constitute a driving force of blue economy initiatives in Nunavik?
- How can economic development incorporate multiple knowledge systems to achieve Inuit self-determination?
- How can multiple knowledge contribute to an equitable and sustainable future in Arctic marine research?

Once past Ungava Bay, seven other stations were sampled for other research programs during leg5b on our way back to Quebec City.

Additional information on the samples collected by the other programs and the operations are provided in Part II of this reports:

- Marine productivity: Carbon and nutrients fluxes – Jonathan Gagnon
- Fish and Zooplankton – Maxime Geoffroy / Eugénie Jacobsen: Five samples collected using the Tucker net.

- Phytoplankton and absorption of Colored Dissolved Organic Matter – Zoé Garmirian

Table 7-2: Stations sampled for other programs during leg5b and activities per station (based on Eventlog_2024_LEG_05b)

Study area	**Station**	**Beam Trawl**	**CTD Rosette**	**Monster net**	**Rosette/UVP**	**Total**
Labrador Sea	TCAT1_05		1	1		2
Labrador Sea	TCAT1_03		1			1
Labrador Sea	TCAT1_01	1	1			2
Jacques-Cartier Strait	JACS-02				1	1
Jacques-Cartier Strait	JACS-01				1	1
Belle-Isle Strait	BIS-02				1	1
Belle-Isle Strait	BIS-01				1	1
Total	**7**	**1**	**3**	**1**	**4**	**9**

7.3 Notes and recommendations

As mentioned above, we had several constraints when sampling the rivers. Given the impressive tidal range in Ungava Bay and the fact that this region is little known to the Coast Guard, the icebreaker did not enter the Arnaud or Leaf rivers. For future investigation, we recommend involving Inuit members of the local community in advance to determine the best navigation and sampling options. Their local knowledge is invaluable in improving the efficiency of river sampling. We could also consider sampling rivers from the villages.

To increase the number of stations we could do, we could also consider working 24/24, as we were on a 12-hour schedule, limiting operations and synchronization with tides. We would also suggest adding stations in St. Lawrence, as the extra stations will permit us to perform general operations in case the ship arrives more than 24h earlier than expected in Quebec City. Furthermore, many of our transit times were at a speed close to 18knts. We suggest planning accordingly in the future so the scientific operations can be performed for a more extended period of time in the Arctic or at least in St. Lawrence instead of being at the dock 24h earlier.

Another important part of our training was the interdisciplinary teamwork the students must do during the return trip to Quebec City. Space to facilitate teamwork remains limited on the icebreaker and it would have been desirable to be able to access the officers' dining room (outside mealtimes) to have sufficient space to allow all students to work.

Finally, we recommend continuing Amundsen Science's efforts to forge links with local communities. Myrah Graham's presence and collaboration were greatly appreciated.

The technical and scientific staff of Amundsen Science and the Canadian Coast Guard were also very helpful, sharing their expertise and enabling students from all disciplines to take part in scientific activities on the boat.

7.4 Cruise participants and affiliation

Cruise participants – Leg 5b School WAGE/SN:

Kristin Bartenstein[1], Karen Everett[1], Marianne Falardeau[2], Jasmin Godbold[3], Davin Holen[4], Anna Karlsdóttir[5], Jonathan Gagnon[1], Britton Dempsey[6], Samantha Farquhar[7], Karima Hadria Gondry[8], Malou Platou Johansen[9], Ayse Akyildiz[10], Manuel Charette[11], Alexandra Gellé[12], Zoé Garmirian[1], Véronique Dubos[1], Nadine Boucher[1], Natalia Serrano-Burbano[1], Judith Gagnon[1], Vicky Gélinas[1], Sonagnon Olivier Tokpanou[1], Geneviève Vachon[1], Jacob Cohen[4], Mirkka Ollila[13], Isabelle Cooper[3].

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[13] University of Helsinki, Aleksanteri Institute, Metsätalo, Unioninkatu 40, P.O. Box 24, FI-00014 Helsinki, Finland

Media – Leg 5b - **School WAGE/SN**:
Tobie Lebel (Radio-Canada); François Genest (Radio-Canada); Meral Jamal (Independent Journalist)

Other cruise participants onboard – Leg 5b - TCA
Laurence Bisson[1], Andéol Bourgoin[1], Eugénie Jacobsen[14]
[14] Memorial University of Newfoundland, Marine Institute, Centre for Fisheries Ecosystems Research (CFER) 155 Ridge Road, St. John's NL, A1C 5R3, Canada

Other cruise participants onboard – Leg 5b - Amundsen Science
Antonin Drouet, Myrah Graham, Pascal Guillot, Christopher Morrissey, Marcia Pearson

Part II – Project reports

1 Nunatsiavut Community Engagement, Inclusion and Participation

Principal Leads: Rodd Laing (rodd.laing@nunatsiavut.com),
Cruise Participants (Leg 2a): Full science team.
Nunatsiavut Government, Nain, NL.

1.1 Overview

Nunatsiavut is the homeland of Labrador Inuit and is comprised of 72,520 km2 of land in a marine zone area of 48,690 km2 and was established through the signing of the Labrador Inuit Land Claims Agreement in 2005, establishing the Nunatsiavut Government, the first Inuit region in Canada to achieve self-government.

Inuit depend on the land, sea ice, and marine areas for their way of life. From food security to health to cultural preservation, the ability to access and use land and waters is paramount. In 2017, the Nunatsiavut Government (NG) initiated a marine planning project, Imappivut (Our Oceans) through the signing of a Statement of Intent with Canada in September 2017. This signing established their joint commitment to work together to implement Imappivut and pursue priorities shared by both levels of government.

The goal of Imappivut is community-driven marine planning in the coastal and marine zone of Nunatsiavut. Imappivut's primary objective is to establish a marine plan which prioritizes conservation objectives and social-cultural priorities to support community well-being, health and coastal stewardship programs within the marine Zone and adjacent waters. Imappivut will increase the Nunatsiavut Government's capacity in decision-making in Nunatsiavut waters and ensure that Inuit interests are represented in decision-making and contribute to the protection of important marine resources, with associated ecological and social-cultural benefits. Imappivut will also foster increased capacity within Nunatsiavut by consulting with Labrador Inuit to represent their interests, informing communities of activities, collecting knowledge, and mapping important Indigenous marine locations, uses, and resources for ongoing protection and stewardship. Imappivut ensures that Labrador Inuit have self-determination in research and decisions that affect their environment and way of life. By utilizing Inuit and scientific knowledge, Imappivut guides research activities within and adjacent to Nunatsiavut waters to address community priorities and ensure that Inuit can continue to access, use and enjoy a healthy marine environment.

The Nunatsiavut Government and Nunatsiavut Research Centre contributed to the development of the National Inuit Strategy on Research (NISR, 2018). The NISR describes 5 priorities for ensuring effective, impactful and meaningful research for Inuit: 1) Advance Inuit governance in research, 2) Enhance the ethical conduct in research, 3) Align funding with Inuit research priorities, 4) Ensure Inuit access, ownership and control over data and information and 5) Build capacity for Inuit Nunangat research.

With the guiding priorities of Imappivut and the NISR, the Nunatsiavut Government partnered with federal government and academic partners to co-lead the Amundsen Leg 2a - Imappivut to help further understand the marine environment of Nunatsiavut and adjacent waters, including Baffin Bay. The goal of the research was to be multi-disciplinary in nature and to encompass Inuit values and ways-of-knowing while using a holistic approach to research and science including natural science, social science, and Inuit Knowledge. The program respected individual areas of expertise while encouraging everyone to consider their research and work in the broader ecosystem and in the realities of the Imappivut Marine Plan of the Nunatsiavut Government.

The mission was co-led with two Chief Scientists, David Cote from DFO and Rodd Laing from the Nunatsiavut Government. The purpose of this was to highlight the existing partnerships that have been developed in the region, but also to have representation from the both the scientific community and the Indigenous government directly in decision making processes. This was very effective in managing scheduling and decisions that needed to be made through the mission.

Additionally, almost all of the scientific projects that were conducted on Leg 2a of the mission have either been co-developed or directly involve the Nunatsiavut Government, which allowed for true collaborative development of scientific objectives for the mission. This also ensured that appropriate and ethical research was taking place, while allowing for adaptations to projects and helped to build further relationships with the Nunatsiavut region.

Additionally, there were the following specific activities that took place on the mission related to community engagement and outreach:

1.1.1 *Okak Bay*

Okak Bay has, and continues to be, incredibly important to Labrador Inuit. Okak Bay is home to two former Labrador Inuit communities, Okak and Nutak. Nutak was forcibly relocated in 1956 and in 1918, Okak was decimated by the Spanish Flu. Labrador Inuit continue to use Okak Bay.

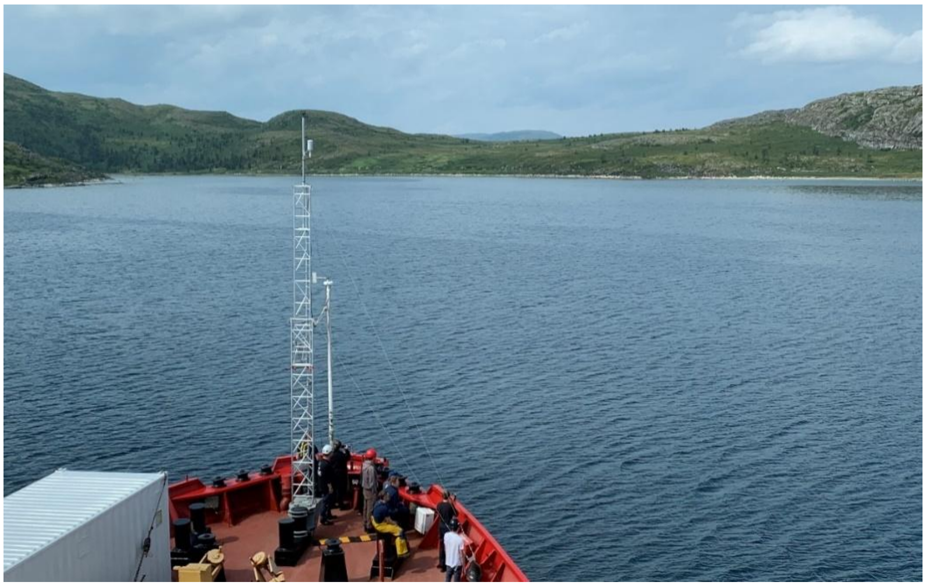

Figure 1-1: Scientists and crew viewing the Okak town site in Okak Bay

After sampling in Okak Bay, we watched the National Film Board documentary The Last Days of Okak. The video gives historical background and context for the importance of the area for Labrador Inuit.

1.1.2 *katimaks and Presentations*

Almost every evening there were presentations that followed the science meetings. These were a mixture of science presentations and katimaks (Inuttitut for meeting). The science presentations gave an overview of researchers work or other unique or relevant topics of interest, many in the context of the Imappivut marine plan. The katimaks (first half of leg 2a) were overviews of the Nunatsiavut Government research process or knowing the region you ’ re working in. These presentations were held to educate the Amundsen scientists about Nunatsiavut and the importance of ongoing work in the Labrador Sea and coastal Nunatsiavut. There were fewer katimaks than anticipated due to some last minute scheduling changes of Nunatsiavut Government staff.

1.2 Recommendations

- Ensure all participants on Amundsen missions are provided with a copy of the National Inuit Strategy on Research.
- Continue the collaboration and co-development of research projects and Amundsen scientific missions with Inuit, government and academic institutions
- Continue to look for capacity building and training opportunities for Inuit, scientific and CCGS personal.
- Ensure that Amundsen missions continue to provide space to learn and understand the area and the context in which the ship is operating in. This has led to significantly more valuable scientific information being collected, because it is grounded in the context of the region.
- Continue to promote multidisciplinary mission teams, that include Inuit and scientists, to fully implement the Inuit holistic approach to research.

2 Knowledge and Ecosystem-Based Approach in Baffin Bay (KEBABB)

Principal Investigators: Lisa Matthes[1] (Lisa.Matthes@dfo-mpo.gc.ca)

Program Co-lead and Scientific Coordinator: Monika Pućko[1] (Monika.Pucko@dfo-mpo.gc.ca)

Principal Investigators: Kevin Hedges[1], Zou Zou Kuzyk[2], Virginie Roy[3], Jean-Éric Tremblay[4], Brent Else[5], David Capelle[1], Maxime Geoffroy[6], Clark Richards[7]

Field participants (Leg 2b): Monika Pućko[1], Elizabeth Kitching[1], Megan Lee[1], Sarah Glowa[1], Tonya Burgers[1], Rachel Mandryk[1], Charlie Nakashuk[1], Stephen Friesen[2], Stephen Ciastek[2]

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2.1 Introduction

Stock assessment surveys are conducted by Fisheries and Oceans Canada (DFO) in the Eastern Canadian Arctic for major commercial fisheries - Greenland Halibut (*Reinhardtius hippoglossoides*) and Northern and Striped Shrimp (*Pandalus borealis* and *P. montagui*, respectively). However, an ecosystem-based approach to fisheries management requires additional collection of oceanographic data in the region to contribute to the interpretation of changes in major stocks' abundance, dynamics, and distribution. The Knowledge and Ecosystem-Based Approach in Baffin Bay (KEBABB) program, developed by DFO in 2019 in collaboration with university partners, will provide crucial oceanographic data for the development and application of the ecosystem-based approach to fisheries management, as well as for an overall Arctic marine ecosystem monitoring program of Baffin Bay.

2.2 Objectives

The general objective of KEBABB is to characterize the variability and trends in physical, chemical, and biological oceanographic conditions in order to evaluate their influence on fisheries resources of western Baffin Bay. Five main components of KEBABB are:

1) physical and chemical oceanographic conditions;

2) abundance and composition of phytoplankton and microbial communities;

3) abundance and composition of zooplankton;

4) benthic communities and biogeochemistry

5) ecosystem health and interactions.

2.3 Methodology

2.3.1 *KEBABB sampling operations*

The KEBABB program in 2024 was carried out during Leg 2B and Leg 5a of the CCGS A*mundsen* 2024 expedition by four teams:

1. Water biogeochemistry team – Monika, Elizabeth, Sarah and Megan
2. Zooplankton team – Megan, Sarah and Charlie, working in close collaboration with Maxime Geoffroy's team
3. Sediments team – Stephen
4. Carbon chemistry team – Tonya and Rachel

The KEBABB program consists of 5 transects (A, B, C, D, and E) located east of Qikiqtarjuaq, each composed of 5 stations. plus one additional transect in Barrow Strait (S-line). Line A consists of 9 stations which extend across Davis Strait to Greenland coast. KEBABB sites are designed to cover a coastal – offshore gradient. During leg 2B, three out of five KEBABB transects (B, C and D) were completed, as well as a mooring was deployed between stations C4 and C5. Recovery of a mooring at station C4 was attempted but canceled due to presence of sea in the area. KEBABB team was also able to sample at additional stations located in Maqtaq, Coronation and North Pangnirtung Fiords as part of collaboration with the TCA (Transforming Climate Action) program. A complete list of sampling operations conducted by KEBABB team during leg 2B is shown in Table 2-1. During leg 5A, we intended to collect samples at the Barrow Strait transect (S-line), two out of five KEBABB transects (A and E). On leg 5a, we attempted the C4 mooring recovery, but were unable to successfully communicate with the Edgetech Port LF releases (tandem configuration). A complete list of sampling operations conducted by KEBABB team during Leg 5A is shown in Table 2-1.

2.3.2 *Water biogeochemistry*

Water from the CTD-Rosette was collected at multiple depths depending on the station depth. Sampled depths and the analyses performed at each of them are listed in Table 2-2 for TCA Full stations, in Table 2-3 for TCA Basic stations, in

Table 2-4 for KEBABB Full stations, and in

Table 2-5 for KEBABB Basic stations. Fractionated chlorophyll a (total and > 5 µm) concentrations were measured onboard the ship, using a Turner Design fluorometer (model 10-AU), following Parsons et al (1984). All other water samples will be analyzed later, at the Freshwater Institute (DFO, Winnipeg), or will be sent to collaborators/contractors for analysis. Genomics (DNA), Particulate Organic Carbon/Particulate Nitrogen POC/PN, Fatty Acid (FA), HPLC and AP samples were filtered and kept frozen at -80 C until further analysis. For the other analyses, water was subsampled and kept at 4°C (DIC/TA, Salinity, delO18) or frozen (-80°C, flow cytometry).

Table 2-1: Sampling activities conducted by the KEBABB team during Leg 2b and Leg 5a of the 2024 CCGS Amundsen expedition

Leg	Station name	Station ID	Latitude (N)	Longitude (W)	Rosette Cast	Date	Water biogeoche	Carbon chemistry	Zooplankton stratified	Zooplankton fatty	Sediment biogeochemistry
2b	**TCA-QFC1**	Station #1	67.3534393	64.7550455	26	2024/07/30	B	X		X	
	TCA-QFA1	Station #2	67.2210518	64.7220822	30	2024/07/31	B	X	X*	X	
	TCA-QF3	Station #3	67.2711108	63.8797668	31	2024/07/31	F	X	X*	X	X
	TCA-QFB1	Station #4	67.0959945	64.6578475	34	2024/08/01	B	X		X	
	D1	Station #5	67.4730348	63.6910248	36	2024/08/01	F	X	X	X	X
	D1.5		67.64045	63.49163		2024/08/01					X
	D2	Station #6	67.8567902	63.1519578	38	2024/08/01	B	X			
	D2.5		Cancelled due to ice conditions								
	D3	Station #7	68.2405532	62.6123643	40	2024/08/02	F	X	X	X	X
	D4	Station #8	68.6234267	61.9849973	41	2024/08/02	B	X[1]			
	D5		Cancelled due to ice conditions/lack of time								
	C4-24		67.9483673	60.2007278							
	C4-24	Station #9	67.9392957	60.1521287	42	2024/08/03	F	X[1]	X	X	
	C5	Station #10	68.1541227	59.9792132	43	2024/08/03	F	X[1]	X	X	
	C3	Station #11	67.7348207	61.2537820	44	2024/08/04	F	X	X		
	C2.5		67.64668	61.60406		2024/08/04					X
	C2	Station #12	67.5498343	61.9212030	46	2024/08/04	B	X			
	C1	Station #13	67.3471677	62.5177987	47	2024/08/05	F	X	X	X	
	B1-C1		67.19975	61.98244		2024/08/05					X

	B1	Station #14	67.0599940	61.5084983	48	2024/08/05	F	X		X	
	B2		Cancelled due to ice conditions/lack of time								
	B2.5		67.25654	60.57405		2024/08/05					X
	B3	Station #15	67.3219992	60.2704313	49	2024/08/05	F	X	X		
	B4	Station #16	67.4682162	59.6665238	50	2024/08/05	B	X[1]		X	
	B5	Station #17	67.5819037	59.0214628	51	2024/08/06	F	X[1]	X	X	
5a	**S11**	N/A	74.5703510	90.3891163	1	2024/10/04	CTD cast				
	S10	Station #56	74.5433678	90.4098085	2	2024/10/04	F	X			
	S9	N/A	74.4665598	90.5426497	3	2024/10/04	CTD cast				
	S8	Station #57	74.3985030	90.6561388	4	2024/10/04	F	X	X	X	
	S7	N/A	74.3385503	90.7655347	5	2024/10/05	CTD cast				
	S6	N/A	74.2740027	90.8668327	6	2024/10/05	CTD cast				
	S5	Station #58	74.2221115	90.9864033	7	2024/10/05	F	X	Nets cancelled due to wind		
	S4	N/A	74.1435198	91.0291532	8	2024/10/05	CTD cast				
	S3	Station #59	74.0960197	91.0877555	11	2024/10/05	F	X			
	S2	N/A	74.0658960	91.1287517	12	2024/10/05	CTD cast				
	S1	N/A	74.0480748	91.1582388	13	2024/10/05	CTD cast				
	TCA-S3	Station #60	73.7362990	78.6598827	16	2024/10/06	F	X	X*	X	
	TCAT3-01	Station #61	72.4974233	75.0144367	18	2024/10/07	F	X	X*	X	
	TCAT3-03	Station #62	72.5414045	74.3254800	21	2024/10/07		X			
	TCAT3-05	Station #63	72.5785623	73.5187357	22	2024/10/07	B	X		X	
	TCAT3-07	Station #64	72.6051272	72.4770677	25	2024/10/08		X			
	TCAT3-08	Station #65	72.6393585	71.5754707	26	2024/10/08	F	X	X*	X	
	TCAT3-09	Station #66	72.6853675	70.0923838	30	2024/10/09	B	X		X	
	BB2	Station #67	72.7475850	67.0062620	35&37	2024/10/09	F	X	X*	X	

	TCAT3-19	Station #68	73.7907970	66.8323072	43	2024/10/10	B	X		X	
	TCAT3-17	Station #69	74.3141048	66.7234618	47&49	2024/10/11	F	X	X*	X	
	TCAT3-16	Station #70	74.8355887	66.6328012	52	2024/10/12		X			
	TCAT3-15	Station #71	75.1574723	66.5517332	53	2024/10/12	B	X		X	
	C4-23	Station #74	67.9261583	60.6481980	60	2024/10/15	F	X	X	X	
	C4-23	Mooring recovery attempt: UNSUCCESSFUL, Details in mooring recovery report by Amundsen Science									
	A9	Station #75	67.0955515	54.2741983	62	2024/10/16	F	X	X	X	
	A8	Station #76	67.0438257	55.0789047	65	2024/10/16	B	X			
	A7	Station #77	66.9830313	56.0627027	67	2024/10/16	F	X	X	X	
	A6	Station #78	66.8965787	56.9234342	68	2024/10/16	B	X			
	A5	Station #79	66.8707770	57.9370447	70	2024/10/16	F	X	X	X	
	A4	Station #80	66.8038758	58.7646205	72	2024/10/17	B	X			
	A3	Station #81	66.7300385	59.6114770	74	2024/10/17	F	X	X	X	
	A2	Station #82	66.6685062	60.4540250	77	2024/10/18	B	X			
	A1	Station #83	66.5977453	61.1933960	78	2024/10/18	F	X	X		

F – Full station

B – Basic station

* sample with TCA program

[1]only DIC/TA collected by the carbon chemistry team

Table 2-2: Sampling details for water column biochemistry sampled by the KEBABB team during Leg 2b and Leg 5a of the 2024 CCGS *Amundsen* at TCA Full stations.

Leg	**Depth (m)**	**DIC/TA**	**CH_4/N_2O**	**DOC**	**Salinity**	**^{18}O**	**Flow cytometry**		**DAPI**	**Chlorophyll *a***		**Phyto taxonomy**	**DNA**	**Phyto fatty acid**	**POC/PN**	**FRRF**	**AP**	**HPLC**
							Bacteria	**Protist**		**Total**	**> 5µm**							
2b	**5**	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	1x	2x	2x	1x	1x	1x

	10	1x	1x	1x	1x	1x				2x	2x							
	20	1x	1x	1x	1x	1x	2x	2x		2x	2x							1x
	30	1x	1x	1x	1x	1x				2x	2x							
	SCM	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	1x	2x	2x	1x	1x	1x
	40	1x		1x	1x	1x	2x	2x		2x	2x							1x
	50	1x	1x	1x	1x	1x				2x	2x							
	60	1x		1x	1x	1x	2x	2x		2x	2x							1x
	80	1x	1x	1x	1x	1x	2x	2x		2x	2x							1x
	100	1x	1x	1x	1x	1x	2x	2x		2x	2x							
	150	1x	1x	1x	1x	1x												
	200	1x			1x	1x							1x					
	250	1x	1x		1x	1x												
	300	1x			1x	1x												
	500	1x	1x		1x	1x												
	750	1x	1x		1x	1x												
	1000	1x	1x	1x	1x	1x												
	Bot.	1x	1x	1x	1x	1x	2x	2x					1x					
5a	**5**	1x	1x		1x	1x	2x	2x	2x	2x	2x	2x*	1x	2x	2x	1x	1x	1x
	10	1x	1x		1x	1x				2x	2x							
	20	1x	1x		1x	1x	2x	2x		2x	2x							1x
	30	1x	1x		1x	1x				2x	2x							
	SCM	1x	1x		1x	1x	2x	2x	2x	2x	2x	2x*	1x	2x	2x	1x	1x	1x
	40	1x			1x	1x	2x	2x		2x	2x							1x
	50	1x	1x		1x	1x				2x	2x							
	60	1x			1x	1x	2x	2x		2x	2x							1x
	80	1x	1x		1x	1x	2x	2x		2x	2x							1x
	100	1x	1x		1x	1x	2x	2x		2x	2x							
	150	1x	1x		1x	1x												
	200	1x			1x	1x												

	250	1x	1x		1x	1x												
	300	1x			1x	1x												
	500	1x	1x		1x	1x												
	750	1x	1x		1x	1x												
	1000	1x	1x		1x	1x												
	Bot.	1x	1x		1x	1x	2x	2x					1x					

* one sample preserved with formalin, and one with Lugol's acidic solution

Table 2-3: Sampling details for water column biochemistry sampled by the KEBABB team during Leg 2b and Leg 5a of the 2024 CCGS *Amundsen* at TCA Basic stations.

Leg	**Depth (m)**	**DIC/TA**	**CH_4/N_2O**	**DOC**	**Salinity**	**^{18}O**	**Flow cytometry**		**DAPI**	**Chlorophyll *a***		**Phyto taxonomy**	**Phyto fatty acid**	**POC/PN**	**FRRF**	**HPLC**
							Bacteria	**Protist**		**Total**	**> 5µm**					
2b	**5**	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	2x	2x	1x	1x
	10	1x	1x	1x	1x	1x				2x	2x					
	20	1x	1x	1x	1x	1x	2x	2x		2x	2x					1x
	30	1x	1x	1x	1x	1x				2x	2x					
	SCM	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	2x	2x	1x	1x
	40	1x		1x	1x	1x	2x	2x		2x	2x					1x
	50	1x	1x	1x	1x	1x				2x	2x					
	60	1x		1x	1x	1x	2x	2x		2x	2x					1x
	80	1x	1x	1x	1x	1x	2x	2x		2x	2x					1x
	100	1x	1x	1x	1x	1x	2x	2x		2x	2x					
	150	1x	1x	1x	1x	1x										
	200	1x			1x	1x										

	250	1x	1x		1x	1x										
	300	1x			1x	1x										
	500	1x	1x		1x	1x										
	750	1x	1x		1x	1x										
	1000	1x	1x	1x	1x	1x										
	Bot.	1x	1x	1x	1x	1x										
5a	**5**	1x	1x		1x	1x	2x	2x	2x	2x	2x	2x*	2x	2x	1x	1x
	10	1x	1x		1x	1x				2x	2x					
	20	1x	1x		1x	1x	2x	2x		2x	2x					1x
	30	1x	1x		1x	1x				2x	2x					
	SCM	1x	1x		1x	1x	2x	2x	2x	2x	2x	2x*	2x	2x	1x	1x
	40	1x			1x	1x	2x	2x		2x	2x					1x
	50	1x	1x		1x	1x				2x	2x					
	60	1x			1x	1x	2x	2x		2x	2x					1x
	80	1x	1x		1x	1x	2x	2x		2x	2x					1x
	100	1x	1x		1x	1x	2x	2x		2x	2x					
	150	1x	1x		1x	1x										
	200	1x			1x	1x										
	250	1x	1x		1x	1x										
	300	1x			1x	1x										
	500	1x	1x		1x	1x										
	750	1x	1x		1x	1x										
	1000	1x	1x		1x	1x										
	Bot.	1x	1x		1x	1x										

* one sample preserved with formalin, and one with Lugol’s acidic solution

Table 2-4: Sampling details for water column biochemistry sampled by the KEBABB team during leg 2b and Leg 5a of the 2024 CCGS Amundsen at KEBABB Full stations.

Leg	**Depth (m)**	**DIC/TA**	**CH_4/N_2O**	**DOC**	**Salinity**	**^{18}O**	**Flow cytometry**		**DAPI**	**Chlorophyll *a***		**Phyto taxonomy**	**DNA**	**Phyto fatty acid**	**POC/PN**	**FRRF**	**AP**	**HPLC**
							Bacteria	**Protist**		**Total**	**> 5µm**							
2b	**5**	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	1x	2x	2x	1x	1x	1x
	10	1x	1x	1x	1x	1x				2x	2x							
	20	1x	1x	1x	1x	1x	2x	2x		2x	2x							
	30	1x	1x	1x	1x	1x				2x	2x							
	SCM	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	1x	2x	2x	1x	1x	1x
	40	1x		1x	1x	1x	2x	2x		2x	2x							
	50	1x	1x	1x	1x	1x				2x	2x							
	60	1x		1x	1x	1x	2x	2x		2x	2x							
	80	1x	1x	1x	1x	1x	2x	2x		2x	2x							
	100	1x	1x	1x	1x	1x	2x	2x		2x	2x							
	150	1x	1x	1x	1x	1x												
	200	1x			1x	1x							1x					
	250	1x	1x		1x	1x												
	300	1x			1x	1x												
	500	1x	1x		1x	1x												
	750	1x	1x		1x	1x												
	1000	1x	1x	1x	1x	1x												
	Bot.	1x	1x	1x	1x	1x	2x	2x					1x					
5a	**5**	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	1x	2x	2x	1x	1x	1x
	10	1x	1x	1x	1x	1x				2x	2x							
	20	1x	1x	1x	1x	1x	2x	2x		2x	2x							
	30	1x	1x	1x	1x	1x				2x	2x							
	SCM	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	1x	2x	2x	1x	1x	1x

	40	1x		1x	1x	1x	2x	2x		2x	2x							
	50	1x	1x	1x	1x	1x				2x	2x							
	60	1x		1x	1x	1x	2x	2x		2x	2x							
	80	1x	1x	1x	1x	1x	2x	2x		2x	2x							
	100	1x	1x	1x	1x	1x	2x	2x		2x	2x							
	150	1x	1x	1x	1x	1x												
	200	1x			1x	1x												
	250	1x	1x		1x	1x												
	300	1x			1x	1x												
	500	1x	1x		1x	1x												
	750	1x	1x		1x	1x												
	1000	1x	1x	1x	1x	1x												
	Bot.	1x	1x	1x	1x	1x	2x	2x					1x					

* one sample preserved with formalin, and one with Lugol’s acidic solution

Table 2-5: Sampling details for water column biochemistry sampled by the KEBABB team during leg 2b and Leg 5a of the 2024 CCGS Amundsen at KEBABB Basic stations.

Leg	Depth (m)	DIC/TA	CH_4/N_2O	DOC	Salinity	^{18}O	Flow cytometry		Chlorophyll *a*		Phyto taxonomy	Phyto fatty acid	POC/PN	FRRF
							Bacteria	Protist	Total	> 5µm				
2b	**5**	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x*	2x	2x	1x
	10	1x	1x	1x	1x	1x			2x	2x				
	20	1x	1x	1x	1x	1x	2x	2x	2x	2x				
	30	1x	1x	1x	1x	1x			2x	2x				
	SCM	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x*	2x	2x	1x
	40	1x		1x	1x	1x	2x	2x	2x	2x				
	50	1x	1x	1x	1x	1x			2x	2x				
	60	1x		1x	1x	1x	2x	2x	2x	2x				
	80	1x	1x	1x	1x	1x	2x	2x	2x	2x				
	100	1x	1x	1x	1x	1x	2x	2x	2x	2x				
	150	1x	1x	1x	1x	1x								
	200	1x			1x	1x								
	250	1x	1x		1x	1x								
	300	1x			1x	1x								
	500	1x	1x		1x	1x								
	750	1x	1x		1x	1x								
	1000	1x	1x	1x	1x	1x								
	Bot.	1x	1x	1x	1x	1x	2x	2x						
5a	**5**	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x*	2x	2x	1x
	10	1x	1x	1x	1x	1x			2x	2x				
	20	1x	1x	1x	1x	1x	2x	2x	2x	2x				
	30	1x	1x	1x	1x	1x			2x	2x				
	SCM	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x*	2x	2x	1x

	40	1x		1x	1x	1x	2x	2x	2x	2x				
	50	1x	1x	1x	1x	1x			2x	2x				
	60	1x		1x	1x	1x	2x	2x	2x	2x				
	80	1x	1x	1x	1x	1x	2x	2x	2x	2x				
	100	1x	1x	1x	1x	1x	2x	2x	2x	2x				
	150	1x	1x	1x	1x	1x								
	200	1x			1x	1x								
	250	1x	1x		1x	1x								
	300	1x			1x	1x								
	500	1x	1x		1x	1x								
	750	1x	1x		1x	1x								
	1000	1x	1x	1x	1x	1x								
	Bot.	1x	1x	1x	1x	1x	2x	2x						

* one sample preserved with formalin, and one with Lugol’s acidic solution

Table 2-6: General information on Box Core deployment rationale and degree of success in Leg 2b of the 2024.Amundsen expedition

Station	Depth (m)	Comments / Push core recovery[1]
B1	115.10	Canceled due to time.
B2.5	882.25	Seal failed during recovery, the surface water drained slightly disturbing the surface of the core, two push cores taken. Push Core A 19.5 cm, Push Core B 19.5 cm
B3	1064.30	Canceled due to time.
B5	1196.56	Canceled due to time.
B1-C1	274.77	Too sandy, a bulk surface was taken.
C2.5	1303.20	Caught a rock in the frame causing the box to fail to close, some bulk "surface" was taken from the remaining material.
C3	1538.16	Canceled due to time.
C5	1342.54	Canceled due to time.
D1	677.19	Successful, Push Core 29 cm, samples taken for POC and Fatty Acids
D1.5	573.99	Successful, Push Core 34 cm
D2.5	~1188	Canceled due to ice.
D3	1536.57	Successful, Push Core 35cm
D5	~1835	Canceled due to ice.
TCA-QF3	600.96	Successful, Push Core 34cm, samples taken for POC and Fatty Acids

[1] All push cores have bulk surface samples taken as well.

2.3.3 *Zooplankton sampling*

Meso and macrozooplankton for stratified taxonomic composition were sampled using a "*Hydrobios*" closing net MultiNet Type Maxi (200 µm mesh size, 0.5 m^2 collection area, 9 nets) according to the strategy shown in Table 2-7. Samples were preserved in HDPE jars in 4 % v/v borate-buffered formaldehyde solution until further taxonomic analysis. Zooplankton for fatty acid biomarker and stable isotopes analyses were collected using a Double Square Net (DSN)

"*Tucker*" net (500, 750 and auxiliary 50 µm mesh size, 1 m^2 collection area), sampling the upper 100 m of the water column in an oblique V-shaped tow. The actual depth of the *Tucker* net during deployment was monitored using a Kongsberg Maritime HiPAP MiniS34 cNODE acoustic transponder system (S/N# 17570) attached to the cable just over the net. After collection, zooplankton were sorted and counted into abundant taxonomic groups down to the lowest taxonomic level possible (species or genus for most specimens and class for more difficult individuals): *Clione limacina*, *limacina helicina*, *Calanus hyperboreus*, *Calanus finmarchicus/glacialis*, *Metridia* sp., *Themisto libellula*, *Themisto abyssorum*, *Parasagitta elegans*, *Eukrohnia hamata*, *Paraeuchaeta* sp., *Boreomysis nobilis*, *Aglantha* sp., *Thysanoessa* sp., *Ostracoda*, *Onisimus littoralis*, *Meganyctiphanes norvegica*, *Hyperia galba*, Ctenophora, Cephalopoda, Cnidaria, *Hyperoche medusarum*, *Apherusa glacialis*, *Sarsia princeps*, *Eusirus cuspidatus*, Mysidae, *Pseudosagitta maxima*, Decapoda; using a dissecting stereomicroscope, and kept frozen at -80 °C in glass vials.

Table 2-7: Zooplankton stratified sampling strategy during leg 2b and Leg 5a of the 2024 CCGS Amundsen expedition. The distance between the sea floor and the tow depths for nets #1-2-3 varied depending on the station depth.

Strata/net #	Depth end (m)	Depth start (m)
9	2	20
8	20	40
7	40	60
6	60	100
5	100	150
4	150	250
3	250m-bottom divided into 3 strata of equal depth	
2		
1		
Trigger depth	N/A	Bottom -30
9	2m	20m
8	20m	40m
7	40m	60m
6	60m	100m

5	100m	150m
4	150m	250m
3	250m-bottom	
2	divided into 3 strata of equal depth	
1		
Trigger depth	N/A	Bottom -30

2.3.4 *Sediments biogeochemistry*

Push cores of 10 cm diameter were collected from the box core sampler and stored at 4 C. They were then sectioned in layers (Table 2-8) within 12 hours after collection and individually bagged. Sectioned samples were kept at -20 °C until further analysis. Analyses that will be performed on these layers include sedimentation rate, radioisotope dating, porosity, total mercury concentration, PAH, n-alkanes, PCBs, total carbon, total inorganic carbon, and C/N isotopes.

Table 2-8: Thickness of layers sectioned from push cores according to their depth in the core during Leg 2b of the 2024 Amundsen Expedition.

Section (cm)	Layer thickness (cm)
0-10	1
10-20	2
20-Bot	5

At a few stations, box core deployments were not successful (please see Table 2-9 for details on box core deployments).

Table 2-9: General information on Box Core deployment rationale and degree of success during Leg 2b of the 2024 Amundsen expedition.

Station	Depth (m)	Comments / Push core recovery[1]
B1	115.10	Canceled due to time.

B2.5	882.25	Seal failed during recovery, the surface water drained slightly disturbing the surface of the core, two push cores taken. Push Core A 19.5 cm, Push Core B 19.5 cm
B3	1064.30	Canceled due to time.
B5	1196.56	Canceled due to time.
B1-C1	274.77	Too sandy, a bulk surface was taken.
C2.5	1303.20	Caught a rock in the frame causing the box to fail to close, some bulk "surface" was taken from the remaining material.
C3	1538.16	Canceled due to time.
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D1	677.19	Successful, Push Core 29 cm, samples taken for POC and Fatty Acids
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TCA-QF3	600.96	Successful, Push Core 34cm, samples taken for POC and Fatty Acids

[1] All push cores have bulk surface samples taken as well.

2.3.5 *Carbon chemistry*

The carbon chemistry team collected three types of seawater samples from the CTD-Rosette: (1) 250 mL samples for the analysis of dissolved inorganic carbon (DIC) and total alkalinity (TA), (2) 50 mL samples for the analysis of dissolved methane (CH_4) and nitrous oxide (N_2O) concentrations, and (3) 30 mL samples for dissolved organic carbon (DOC) concentrations. Samples for all three parameters were collected at basic and full TCA stations. In the KEBABB grid all three parameters were sampled for at stations 1 to 3 on the B-, C-, and D- lines. At stations 4 and 5 of each line only DIC/TA samples were collected. Due to a limited number of bottles, we prioritized sampling of CH_4/N_2O and DOC over the continental shelf and slope off of Baffin Island. All carbon chemistry samples will be analyzed following the 2024 Amundsen cruise, either at the Freshwater Institute or by other collaborating laboratories. Immediately following collection samples for DIC/TA and CH_4/N2O were preserved with 100 µL of mercuric chloride, DOC samples were spiked with 100 µL of HCl, and all samples will be stored in the refrigerated container at 4 °C.

2.3.6 *Mooring deployment*

A mooring with a suite of oceanographic (CTDs, ADCP) and biogeochemical instruments (sediment trap, pCO_2 sensor, pH sensor) was deployed during leg 2b (August 3, 2024) at the C4-24 station. The deployment team consisted of Amundsen Science technicians with assistance from the crew and KEBABB team. The deployment was successful. The major problem encountered was difficulty with accessing last years' mooring location C4 due to sea ice conditions. Hence, recovery of the C4 mooring was not attempted and deployment was completed at a more accessible location.

A mooring with a suite of oceanographic (CTDs, ADCP) and biogeochemical instruments (sediment trap, pCO_2 sensor, pH sensor) was attempted to be recovered during leg 5A (October 15, 2024) at the C4-23 station. The recovery team consisted of Amundsen Science technicians with assistance from the crew and KEBABB team. The recovery was unsuccessful. The major problem encountered was lack of fully functional and reliable deck unit. There was only one deck unit onboard believed to be compatible with the releases (Edgetech 8011A deckbox). Communication with the releases was repeatedly attempted from the ship's foredeck, but was unsuccessful. Another deckbox (Edgetech PACS) was used, and was also unsuccessful, but it was not immediately clear whether this deckbox was compatible with the PORT LF releases (it was later determined that the PACS is compatible with PORT LFs). After several failed attempts, the only response received was 5-beeps (incomplete signal) from one release. The mooring technicians attempted to release the mooring, but just as the command was sent, the screen on the 8011A deckbox went dark. The unit was taken apart and found to have water inside, presumably from a previous leg, which was causing a short circuit. The deck unit was then worked on by the Amundsen engineers to solve the fuse problem and another communication attempt was conducted. The deck unit couldn't communicate with the releases at all. The deck unit was in a state which prevented it being taken on a zodiac to attempt communication from the zodiac (it was taken out of its case and connected to external devices by the Amundsen engineers). The deck box was able to communicate with another Edgetech release that was already on board the ship, and confirmed that the deckbox worked, but was not suitable for deployment on the zodiac. At this time, it was not clear that the other deckbox (PACS), which was dry and suitable for zodiac deployment, could even communicate with the releases, so the zodiac was never deployed. By the time the PACS was confirmed to be compatible, it was too dark to attempt zodiac deployment. It was then decided by the Chief Scientist that the recovery operation should be ended.

2.4 References

Parsons, T.R., Maita, Y., Lalli, C.M. (1984) A manual of chemical and biological methods for seawater analysis. Pergamon, Oxford.

3 Eastern Canada Seabirds at Sea (ECSAS) Program

Project leaders: Carina Gjerdrum (carina.gjerdrum@ec.gc.ca)

Cruise participants – Leg 2: Brendan Kelly and Lerena Ashevak

[1] *Canadian Wildlife Service, Department of Environment and Climate Change Canada*

3.1 Introduction and objectives

The east coast of Canada supports millions of breeding marine birds as well as migrants from the southern hemisphere and northeastern Atlantic. In 2005, the Canadian Wildlife Service (CWS) of Environment Canada initiated the Eastern Canada Seabirds at Sea (ECSAS) program with the goal of identifying and minimizing the impacts of human activities on birds in the marine environment. Since that time, a scientifically rigorous protocol for collecting data at sea and a sophisticated geodatabase have been developed, relationships have been established with industry and government to support offshore seabird observers, and over 400,000 km of ocean track have been surveyed by CWS-trained observers.

Data from at-sea surveys provide important information on pelagic seabird distribution throughout the year, including patterns of dispersal from breeding areas, migration routes and wintering areas. Over time, these data show trends in species abundance, diversity and distribution. This information can then be used to inform decisions regarding the protection of important marine areas, environmental assessment of proposed development projects, and appropriate response strategies to catastrophic events, such as oil spills and wildlife disease outbreaks (i.e., Highly Pathogenic Avian Influenza). In addition to the seabird data collected during surveys, data are also collected on marine mammals, sea turtles, sharks, and other marine organisms when they are encountered.

3.2 Methods

We conducted seabird surveys from the port side of the bridge of the CCG Amundsen between 29 July and 8 August 2024. We conducted surveys while the ship was moving at speeds greater than 4 knots, looking forward and scanning a 90° arc to one side of the ship. We recorded all birds observed on the water within a 300m-wide transect, and we used the snapshot approach for flying birds (intermittent sampling based on the speed of the ship) to avoid overestimating abundance of birds flying in and out of transect. We incorporated distance sampling methods to address variation in bird detectability. We also recorded marine mammal and other marine wildlife observations, although surveys were not specifically designed to detect marine mammals. Details of the methods used can be found in the CWS standardized protocol for pelagic seabird surveys from moving platforms (Gjerdrum *et al.* 2012).

3.3 Results

We surveyed 878.5 km of ocean track between 29 July and 8 August 2024 between Qikiqtarjuaq and Iqaluit (Figure 3-1). During this period, we counted a total of 5243 marine birds from 6 families (Table 3-1). Bird densities averaged 9.8 ± 32.2 birds/km^2. The highest densities of birds (> 100 birds/km^2) were observed near the community of Qikiqtarjuaq and through the Davis Strait (Figure 3-1). Seabird sightings were dominated by just three species, Dovekie (41%), Thick-billed Murre (26%), and Northern Fulmar (22%; Table 3-1). The Thick-billed Murre and Northern Fulmar breed in the eastern Canadian Arctic but the Dovekie breed primarily in northwestern Greenland.

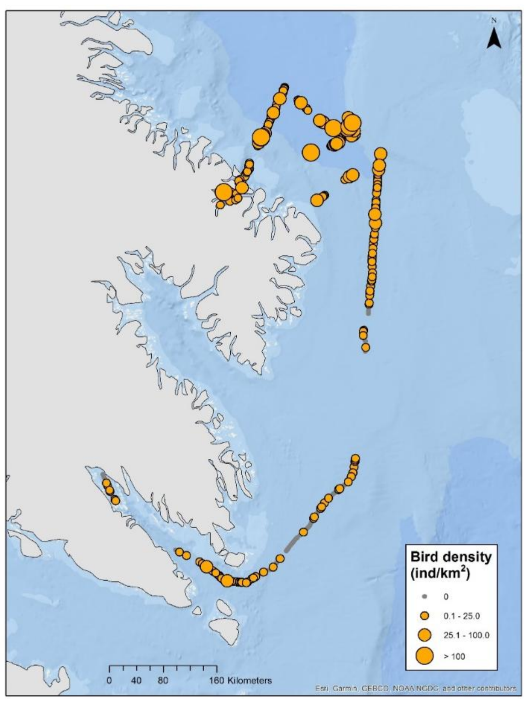

Figure 3-1: Density of birds observed during surveys from CCG *Amundsen* 9 July to 25 Oct 2024.

Table 3-1: List of bird species observed during surveys from CCG *Amundsen* 9 July to 25 Oct 2024.

Family	Common name	Latin	Total Sighted
Gaviidae	Pacific Loon	*Gavia pacifica*	1
Procellariidae	Northern Fulmar	*Fulmarus glacialis*	1149
Anatidae	Common Eider	*Somateria mollissima*	43
	Unidentified eider or scoter	*Somateria* or *Melanitta*	46
Scolopacidae	Red Phalarope	*Phalaropus fulicarius*	81
Laridae	Black-legged Kittiwake	*Rissa tridactyla*	117
	Iceland Gull	*Larus glaucoides*	3
	Ivory Gull	*Pagophila eburnea*	2
	Glaucous Gull	*Larus hyperboreus*	241
	Lesser Black-backed Gull	*Larus fuscus*	1
	Unidentified gull	*Larus*	14
	Parasitic Jaeger	*Stercorarius parasiticus*	4
	Pomarine Jaeger	*Stercorarius pomarinus*	2
	Long-tailed Jaeger	*Stercorarius longicaudus*	1
	Unidentified jaeger	*Stercorarius Jaegers*	1
Alcidae	Dovekie	*Alle alle*	2129
	Thick-billed Murre	*Uria lomvia*	1369
	Black Guillemot	*Cepphus grylle*	39
Total			5243

3.4 References:

Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. 2012. Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 36 pp.

4 Opportunistic Erratic Boulder Sampling

Project leaders: Patrick Lajeunesse[1] (Patrick.Lajeunesse@ggr.ulaval.ca)
Cruise participants – Leg 3: Kerstin Brembach[1]
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4.1 Introduction and Objectives

The extent and timing of the Greenland ice sheet on Ellesmere Island during the Last Glacial Maximum is still under debate. During Leg 3, opportunistic sampling of erratic boulders was carried out for post-cruise cosmogenic exposure dating. By determining when the boulders were deposited on Ellesmere, the timing of the retreat of the ice sheet can be inferred. In general, this will shed new light on the presence and, more importantly, the timing of the extent of the Greenland Ice Sheet on Ellesmere Island.

4.2 Methodology

Erratic boulders were sampled on the Judge Daly Peninsula. We accessed the area by helicopter and identified suitable boulders from the air. For a boulder to be suitable, several criteria must be met. Since the aim is to determine the timing of the retreat of the ice sheet, the sampled boulders should be in a low depositional environment to rule out the possibility that they have been moved after glacial deposition. In addition, the boulders should contain the quartz minerals on which the dating is based, and be large enough not to have been covered by other material over the years. In total, four boulders met the criteria and were sampled using an angle grinder with a diamond blade, a chisel and a hammer to sample the sky facing part of the boulder, which is most exposed to cosmogenic radiation. Approximately 1 kg of samples were collected for each boulder.

a) b)

Figure 4-1: A 2 cm deep grid was cut into the boulder using an angle grinder (a). Cubes of rock were then removed from the boulder using a chisel and hammer

Table 4-1: Erratic boulder sample locations.

Sample	Latitude (N)	Longitude (W)
RA202403-hr-RA11-01-cosm	81.371395	-65.369386
RA202403-hr-RA11-02-cosm	81.348741	-65.093234
RA202403-hr-RA11-03-cosm	81.347351	-65.106626
RA202403-hr-RA11-04-cosm	81.346602	-65.099199

5 Refuge Arctic atmosphere-ice-ocean interaction

Project leaders: Peter Sutherland[1,3] (peter.sutherland@ifremer.fr),
Cruise participants – Leg 4: Peter Sutherland[1,3], Antoine Villefer[1], Michel Hamon[1], Hugo Sellet[1], Sébastien Kuchly[2]

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[2]PMMH Laboratory, ESPCI Paris, 7 Quai Saint-Bernard, 75005, Paris, France

[3]Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, ESB 2020 - 2207 Main Mall, Vancouver, BC, V6T 1Z4, Canada

5.1 Introduction and Objectives

The last Ice Area (LIA) of the Lincoln Sea and Nares Strait is one of the few remaining areas in the Arctic that still has large quantities of thick multi-year sea ice. The goals of this part of the Refuge Arctic experiment were centred around understanding the evolution of sea ice and the upper ocean as they move through the LIA. This experiment was designed to characterize the changing ice conditions and the dynamics that force those changes. Our group's focus has been on small-scale interactions between the unique ice conditions in the LIA and the upper ocean, and the lower atmosphere. The guiding questions were:

1. What is the surface forcing that drives changes in LIA water masses on scales of minutes to weeks?
2. How do sea ice properties evolve as ice is advected from the Lincoln Sea through Nares Strait?
3. What are the contributions of air-sea fluxes to the modification of water masses and sea ice in the LIA?
4. How does the structure of ice (thickness, floe size, concentration) affect upper-ocean turbulence?
5. What is the contribution of surface wave effects to the ice/ocean evolution? How does this differ in thick vs thin ice?

A key theme of this work has been in attempting to capture and understand small-scale (metres to hundreds of metres, seconds to hours) variability and create links to larger-scale changes. This objective has guided the design of the unique ensemble of measurements described below.

Regrettably perceived danger of ice conditions precluded access to the Lincoln Sea and the northern half of the LIA. Consequently, the focus of our work was directed more towards the observed dynamical processes than initially planned.

5.2 Methodology

Our team's contributions to Refuge Arctic included both semi-continuous measurements and process studies conducted at specific stations. Semi continuous measurements included ship-launched radiosondes, wave buoys, and FLAMElite flux buoys. Deployments at full stations were primarily the Flux Catacitor USV (unmanned surface vehicle), UAV (unmanned aerial vehicle) flights, and one AUV (autonomous underwater vehicle) deployment.

5.2.1 *Atmosphere - Radiosonde deployments*

Atmospheric profiling micro radiosondes were deployed between 1 and 3 times daily. The radiosondes were equipped to measure wind velocity (GPS position), temperature, relative humidity, and pressure. These micro format balloons were designed to profile the lower 5000m of the atmosphere. Actual observed profile heights ranged between 400m and 9000m depending on atmospheric icing and telemetry losses. The following figures summarize lower-atmosphere (0-800m) conditions during the campaign. Note that the abscissa is given in time but the ship was not stationary, and the balloons were advected by air motion, so the data are also function of space.

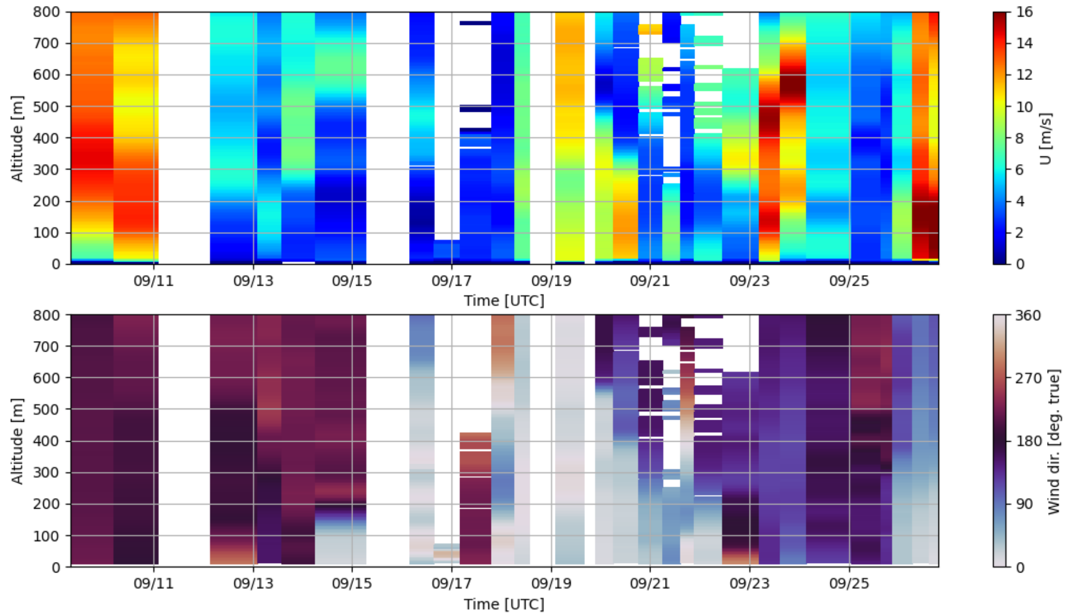

Figure 5-1: Atmospheric conditions in the lower 800m of the atmosphere. The upper panel is wind speed and the lower is wind direction (coming from atmospheric convention). Note the general NE/SW flow for the period of the cruise in Nares Strait.

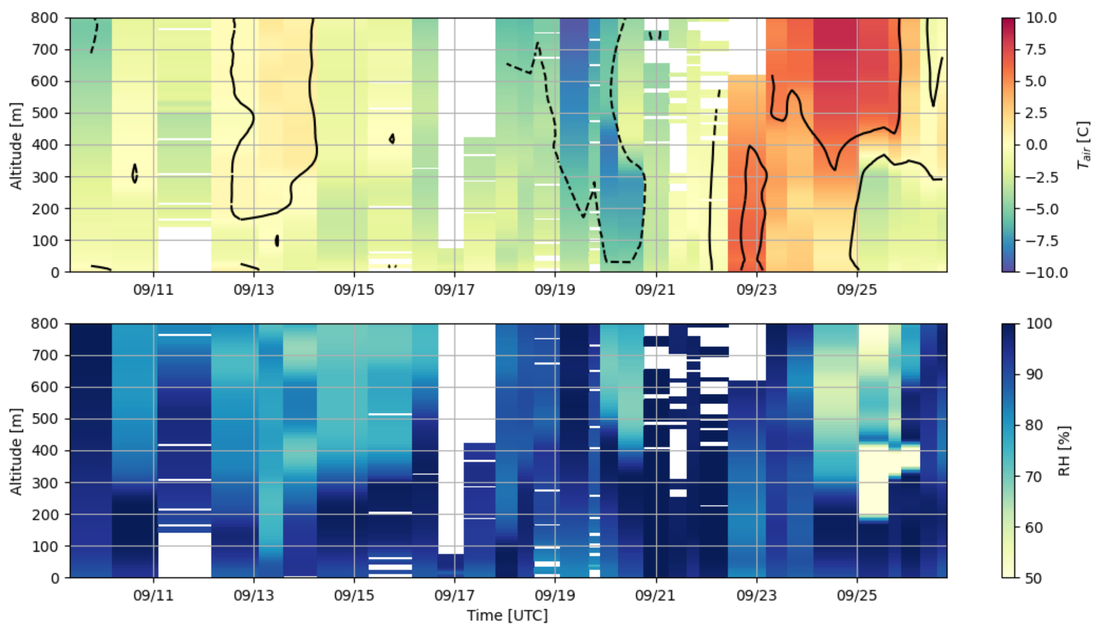

Figure 5-2: Atmospheric temperature (upper-panel) and humidity (lower panel) during Refuge Arctic.

5.2.2 *Wave buoys*

Wave buoys (Spotter buoys, SOFAR Ocean Technologies, San Francisco, USA) were deployed to characterize the surface wave field, water temperature, and drift. The deployment strategy was to 1) provide supporting information for ice and oceanographic stations 2) provide large-scale context. Buoys transmit 30-minute average wave energy, first five Fourier coefficients, and temperature. If buoys are recovered, high resolution (2.5 Hz) raw data are also available for reprocessing. During Refuge Arctic, 9 buoy deployments were made, of which 5 buoys were recovered and 4 were lost. As of writing, insufficient sunlight has caused 3 of the lost buoys to cease transmitting.

Figure 5-3 shows the deployment locations of the buoys for which data were recovered (either directly or by satellite).

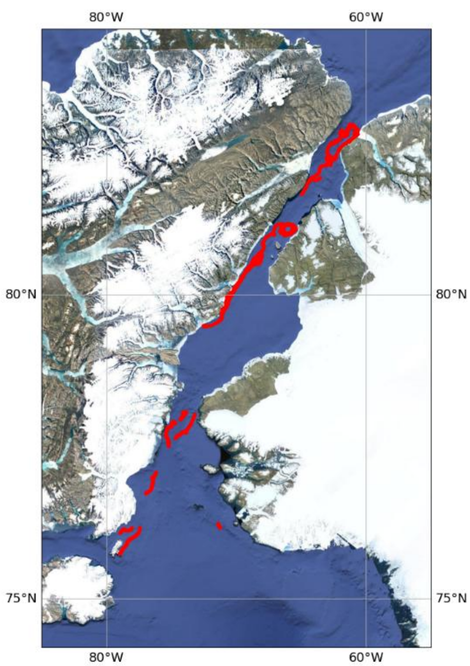

Figure 5-3: Trajectories (red curves) of all wave buoys deployed during Refuge Arctic

5.2.3 *FLAMElite buoy*

The FLAMElite buoy is equipped with a sonic anemometer at 2m altitude for measuring wind speed and stress, and a 70m underwater 12-node thermistor chain for measuring upper-ocean temperature structure. Regrettably, the FLAMElite was left behind when concern over ice conditions caused the Amundsen to not return to recover the buoy. The buoy was tracked until its positioning beacons failed and batteries were exhausted. The last accurate position was received on 2024-09-20 12:03Z, at which time it was located between Franklin Island and the Greenland coast.

Thus, the only data recovered from the FLAMElite was from a single 15-hour deployment made earlier in the cruise (2024-09-08 - 2024-09-09). The temperature record is given below. The thermistor chain tilted due to vertical shear and so the node depth was estimated using a pressure sensor mounted on the bottom of the thermistor chain and an assumption of uniform cable tilt angle. Atmospheric data are not shown as they require additional processing.

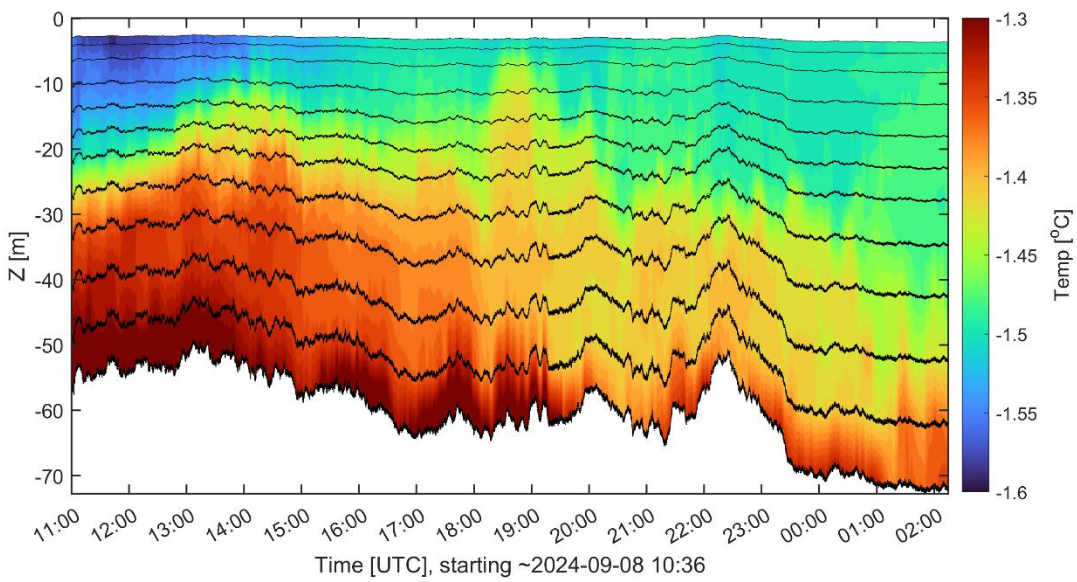

Figure 5-4: Upper-ocean temperature evolution during the first FLAMElite deployment. The colours are temperature and the black lines indicate the depths of the temperature nodes.

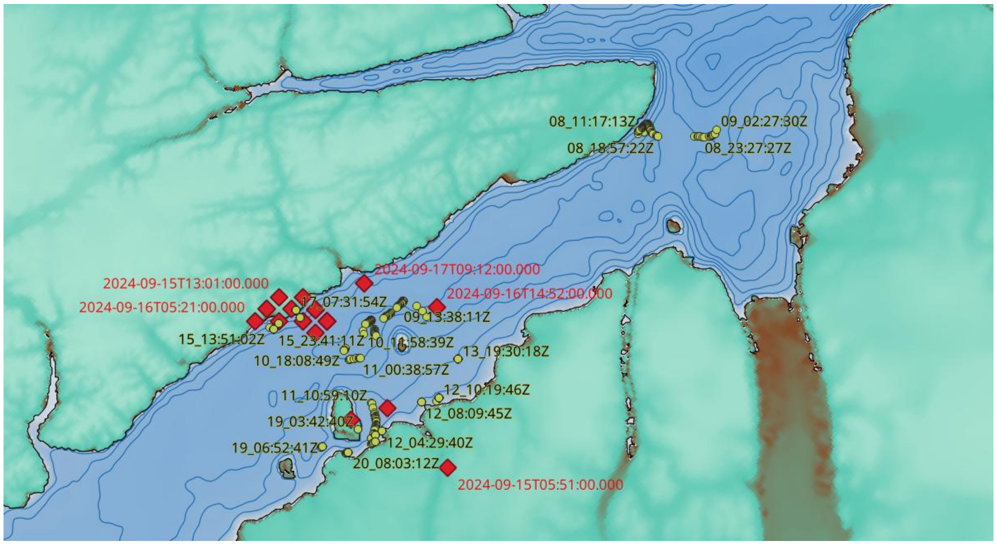

Figure 5-5: Track of FLAMElite buoy. The first deployment, from which data were recovered was in northern Kennedy Channel. The second deployment was in the vicinity of Hans and Franklin Islands. Yellow dots indicate buoy GPS position. Red diamonds indicate positions given by the iridium constellation, which are significantly less accurate.

5.2.4 *Flux Catacitor*

The autonomous surface vehicle, *Flux Catacitor*, was designed to measure the spatial variability of atmospheric air-sea fluxes and upper ocean turbulence in the vicinity of sea ice. Sensors include: sonic anemometer and open-path gas analyzer (fluxes of energy, momentum, and gas), met station (wind speed, direction, temperature, humidity), downward-looking ADCP and echo sounder, above and below water cameras, and a pulse coherent acoustic Doppler profiler for measuring near-surface turbulent kinetic energy dissipation.

The Flux Catacitor was deployed 10 times for a total of more than 53 hours of data acquisition. Conditions ranged between flat calm with zero waves and up to approximately 12 m/s wind with 1.2m waves.

All data require georectification and motion correction before they can be exploited scientifically. As such, only very preliminary data from a single deployment are shown below.

Table 5-1: Summary of Flux Catacitor deployments

Station	Date	Deploy	Recover	Duration
RA28	2024-09-11	14:03	19:10	05:07

RA36	2024-09-13	12:28	21:30	09:02
RA38	2024-09-15	11:10	15:25	04:15
RA41	2024-09-16	13:45	18:28	04:43
RA43	2024-09-17	12:58	15:23	02:25
RA45	2024-09-18	11:35	20:45	09:10
RA48	2024-09-19	15:20	16:55	01:35
RA50	2024-09-20	15:24	20:20	04:56
RA51	2024-09-21	14:18	20:33	06:15
RA54	2024-09-23	17:22	23:21	05:59

Figure 5-6: The Flux Catacitor. Left panel is the FC displaying icebreaking capabilities in thin nilas ice. Right panel is deployment by crane from Amundsen starboard bow. The Flux Catacitor was deployed and recovered from the deck of the vessel using a crane. It was capable of approaching and leaving the vessel under remote control and performing autonomous missions.

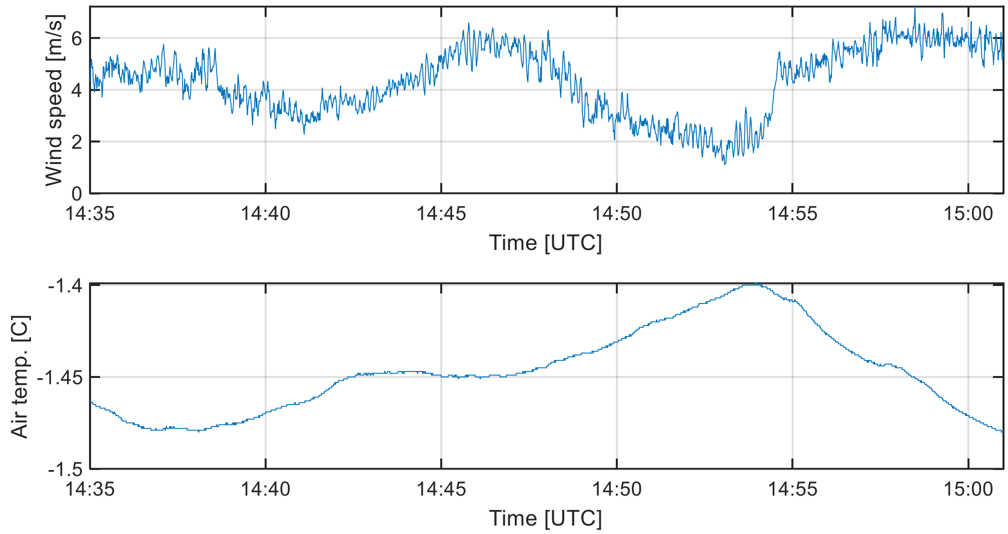

Figure 5-7: Flux Catacitor atmospheric data. Tops panel is uncorrected wind speed. Bottom panel is air temperature. The sampling period corresponds to that shown in Figure 5-8 below

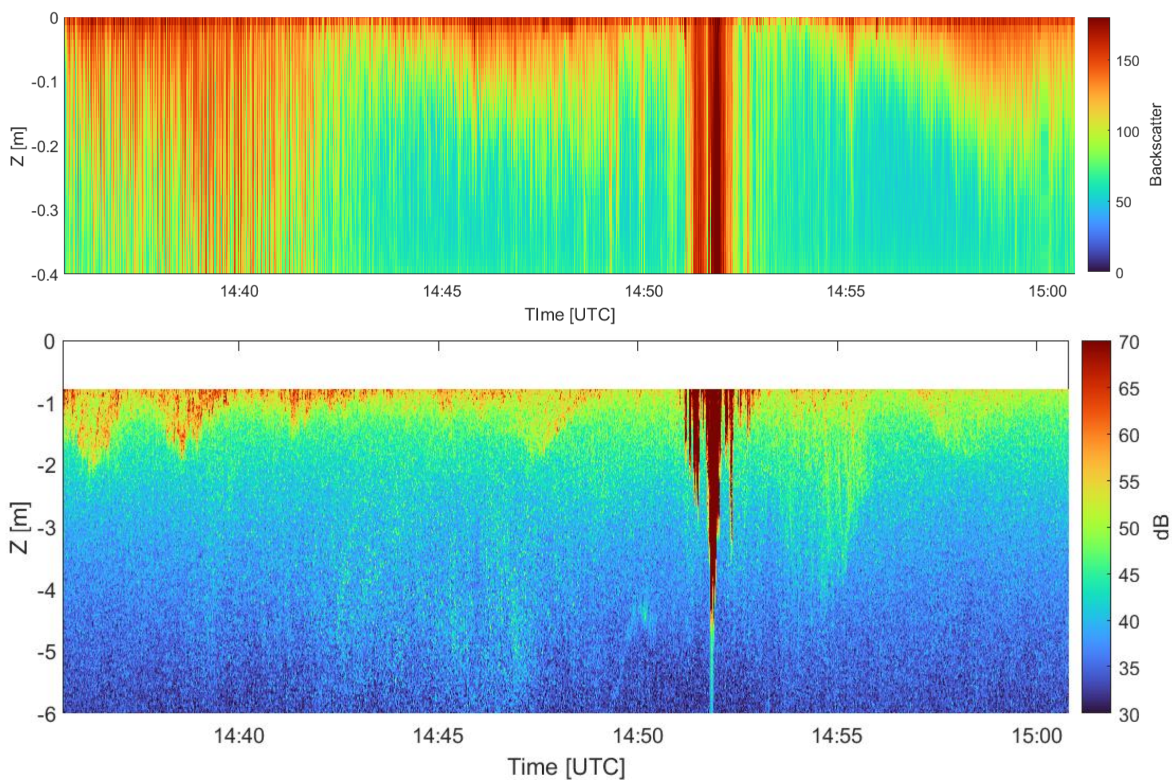

Figure 5-8: Acoustic backscatter return during Flux Catacitor deployment RA54. The top panel is from the upward-looking 2MHz Aquadopp HR Profiler (Nortek AS, Rud, Norway). The bottom panel is from a downward-looking 1MHz Nortek Signature ADCP in echo sounder mode. Note that the acoustic

frequencies, sampling modes, and units are not equivalent. The plumes of high near-surface backscatter are thought to be due to increased frazil ice concentration. Times are UTC 2024-09-21.

Figure 5-9: View from Flux Catacitor mast camera showing ice floe and Amundsen in the background

Figure 5-10: View from Flux Catacitor upward-looking underwater camera showing what is thought to be a mixture of slush and slush-derived shuga ice at the sea surface.

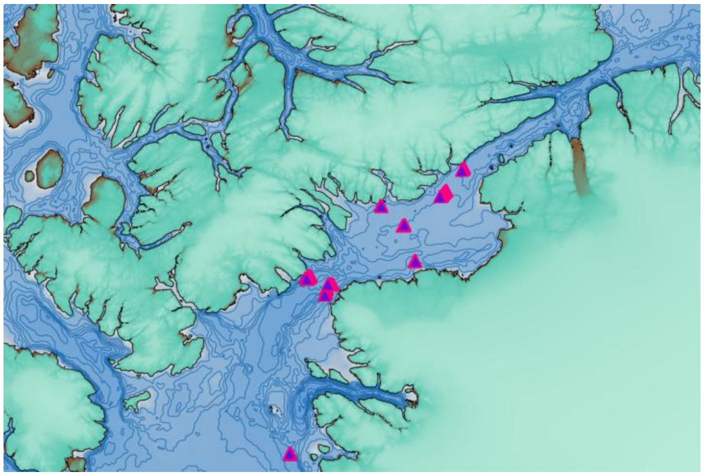

Figure 5-11: Geographic distribution of Flux Catacitor deployments. Deployment locations are indicated by filled pink triangles.

5.2.5 *AUV*

An autonomous underwater vehicle (AUV) was deployed to measure the horizontal variability of temperature and salinity in and around sea ice (CTD), as well as the under-ice/water roughness and depth (upward-looking side-scan sonar. Unfortunately, the AUV was not deployed under or near sea ice; the only deployment was in northern Baffin Bay (RA62). The AUV was navigated in a saw-tooth pattern (Fig.Figure 5-12) to observe the spatial evolution of the upper-ocean water properties. Since the deployment location was far offshore, without ice or other strong sources of variability, this spatial evolution was minimal. Nonetheless comparison of the AUV-derived near-surface CTD profile with the measurement from the shipboard rosette was illustrative of the mixing due to the ship - to approximately 7.5m in this case.

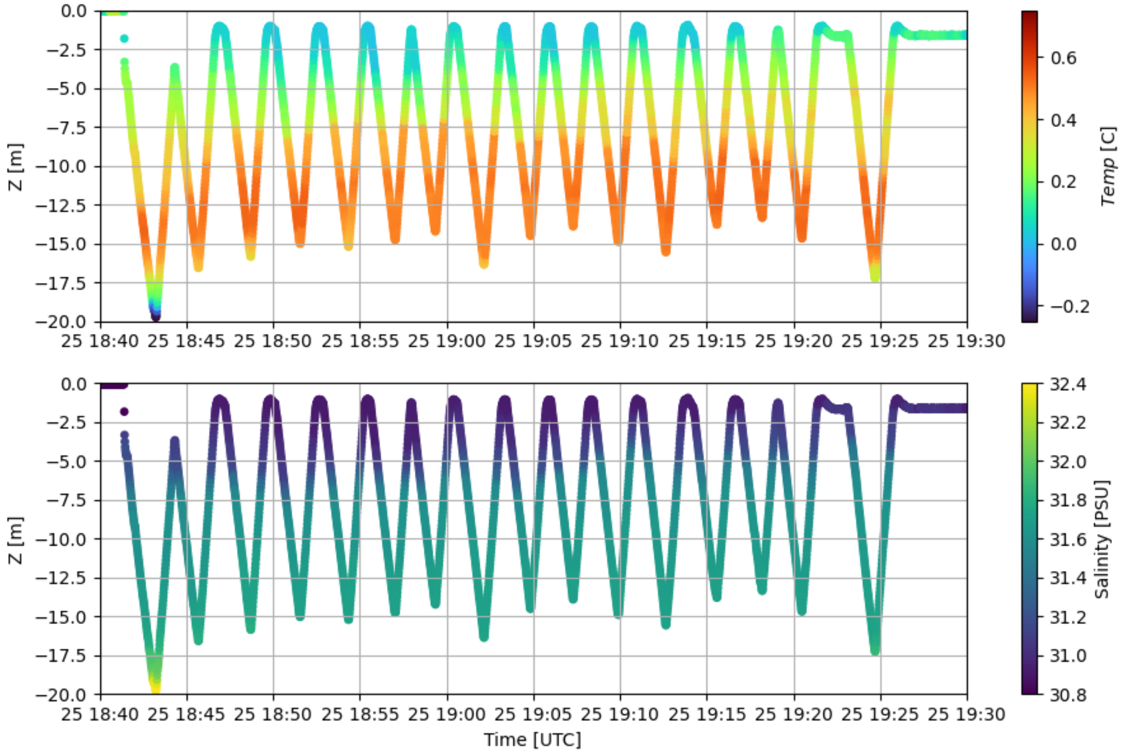

Figure 5-12: Temperature and salinity during AUV deployment 2024-09-25. The ordinates are depth and the abscissae are time. Colours correspond to temperature (top) and salinity (bottom).

5.2.6 *Geophones operations (Sébastien Kuchly, sebastien.kuchly@espci.fr)*

A total of four deployments of 16 geophones (velocimeters – 3 componants) have been performed on four different multiyear ice floes. First two deployments on the 9th and 10th September (respectively stations RA26 and RA27) were a line of 60 meters long. I generated mechanical waves at the two extremities of the line by jumping and knocking the ice with a hammer. Preliminary measurements of the effective values of the Young Modulus (E), Poisson coefficient (ν) and ice thickness (hice) are presented in the Table 1 below. Two squared arrays were deployed on the 14th and 18th September (respectively stations RA37 and RA45) their respective dimensions are 24 meters by 24 meters on the 14th and 12 meters by 12 meters on September 18. We plan to measure the horizontal variability of sea ice mechanical properties within the deployed arrays.

Date	**E (GPa)**	**ν**	**h_{ice} (m)**
09/09/2024 – RA26	5,3	0,34	2,8

09/10/2024 – RA27	4,8	0,4	2,4

5.2.7 *UAV*

UAVs were deployed at a subset of the stations at which the Flux Catacitor was deployed for mapping and instrument monitoring. They were also used for other tasks such as location scouting and ice navigation for the Flux Catacitor.

Flights using Mavic 2 Pro UAVs

- 20240909 RA26 LOPS6 f01 large floe
- 20240909 RA26 LOPS6 f02 AV brief ice inspection
- 20240909 RA26 LOPS6 f03 FL2 search
- 20240910 RA27
- 20240913 RA36 fl1 LOPS6 AV survey
- 20240913 RA36 fl4 LOPS6 CatamaranNavigation
- 20240914 JohnRichardsonBay IceSurvey
- 20240915 RA38 IceFloeInspection
- 20240916 RA41 Barge TempSensor
- 20240917 LOPS3 AV FC deployment
- 20240917 LOPS3 AV not science
- 20240918 LOPS3 AV large floe
- 20240918 RA45 CatAndFloeInspection
- 20240921 CatInFrazil
- 20240921 FloesWaves
- 20240921 LOPS3 AV FC deployment
- 20240923 RA54 Iceberg

Flights using NexTech ATLAS-V UAVs

- 20240913 RA36 fl2 KissovPayload survey
- 20240913 RA36 fl3 KissovPayload auto survey
- 20240918 RA45 fl1 KissovPayload IceSurvey Cat
- 20240918 RA45 fl2 KissovPayload IceOceanSurvey

Ice surveys

UAVs were used to provide context for several ice stations and catamaran deployments. The general goal was to provide a large-scale low-resolution map of the work area (floe or lead system), and then conduct higher-resolution mapping to produce digital elevation maps. This sampling plan was optimized for the Lincoln Sea. However, in Nares Strait and Baffin Bay where the flights took place, currents were typically high, making photogrammetry error prone (the ice moves a significant amount between images). This was surmountable for fast low-resolution scans, but high-resolution surveys necessary for accurate depth maps were largely unsuccessful.

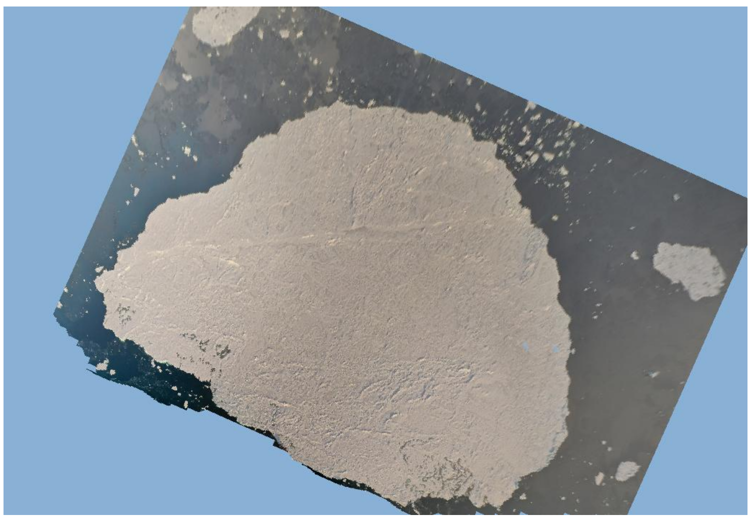

Figure 5-13: Georeferenced orthophoto of the ice floe studied in RA36

Floe size distributions - Sébastien Kuchly, sebastien.kuchly@espci.fr

I performed two drone flights sessions on the 17th and 21st September. These flights aim at documenting the expedition as well as measuring the Floe Size Distribution (FSD) of sea ice floes. Especially, on September 21, I plan to link this FSD to the fracture of a large ice floe (about 2 km of diameter) by an incoming swell. This FSD may be defined by parameters such as the ice thickness and the incoming swell amplitude and wavelength. A few flights were performed to measure swell amplitude and wavelength using Digital Image Correlation.

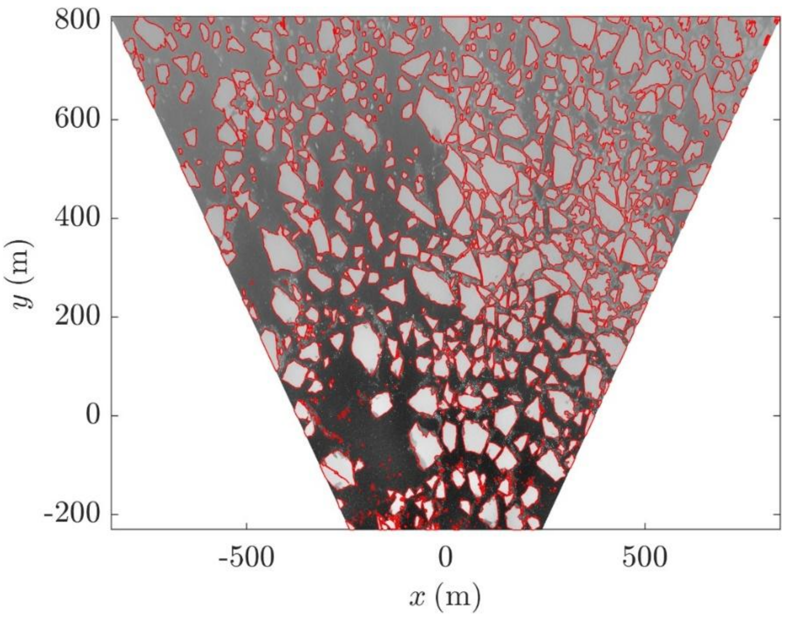

Figure 5-14: Preliminary detection of ice fragments, georeferenced image on September 21

Iceberg 3D reconstruction

An opportunistic survey of an iceberg was conducted on 2024-09-23 1540Z in the open water of Northern Baffin Bay (RA54, 76 20'N, 71 13 W). A 3D model was reconstructed which provided an approximate size of 150m x 110m, a horizontal water plane surface area of 9,500 m² and an above-water volume of 114,000 m³.

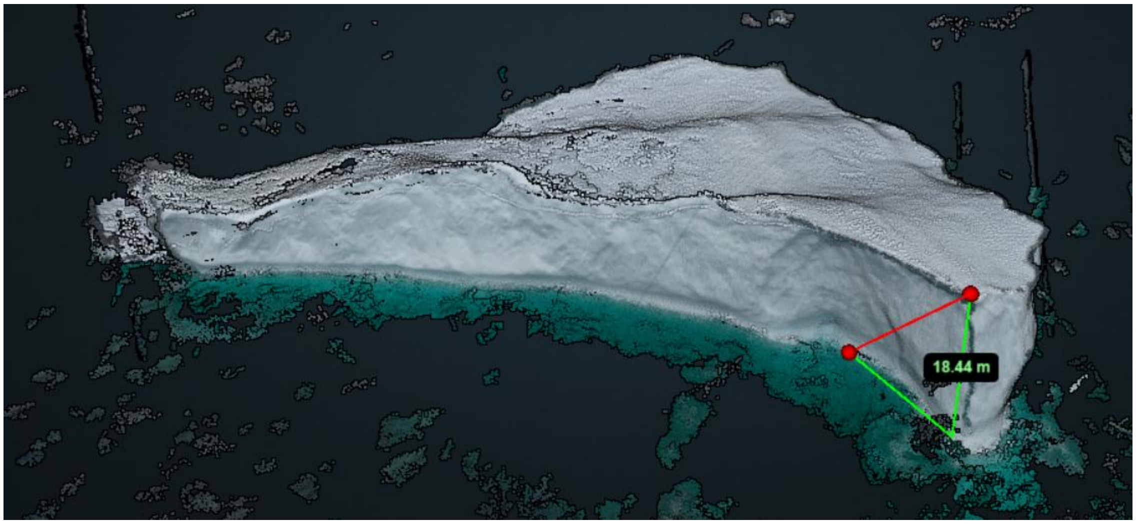

Figure 5-15: 3D reconstruction of the above-water portion of an iceberg. This shows the raw point cloud. The green surfaces are below the water surface, and the noise in the background is due to erroneous reconstructions of the surface wave field which is not static

5.3 Preliminary Results

The majority of the data produced by our group requires extensive post-processing in order to produce science-grade results.

5.3.1 *Wave field*

Two surface wave events were recorded during this experiment. This was largely due to available fetch at the sampling location. Figure 5-16 shows significant wave height as a function of time and latitude. The first event occurred on 2024-09-08 over a 100km ice free area on the west side of Kennedy Channel, aligned with SW winds. The second and third events occurred starting on 2024-09-21 in northern Baffin Bay. There are two main caveats to any conclusion drawn from this dataset: 1) the experimental zone was not sampled uniformly. 2) buoys display a tendency to become trapped in ice relatively quickly, which attenuates wave energy. This means that wave events were only observed at times and places during or shortly after the ship's passage.

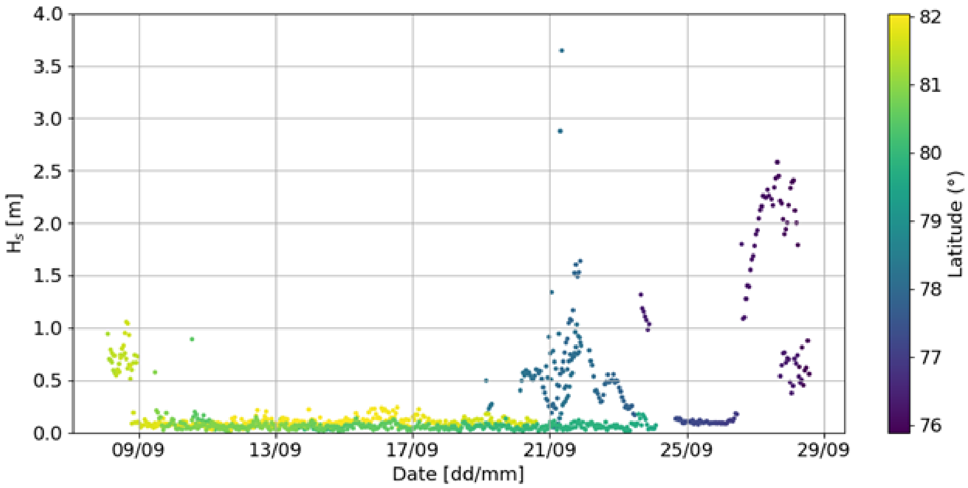

Figure 5-16: Significant wave height as a function of time recorded by wave buoys during Refuge Arctic. Each dot corresponds to a 30-min average period from a specific buoy and the colour is buoy latitude.

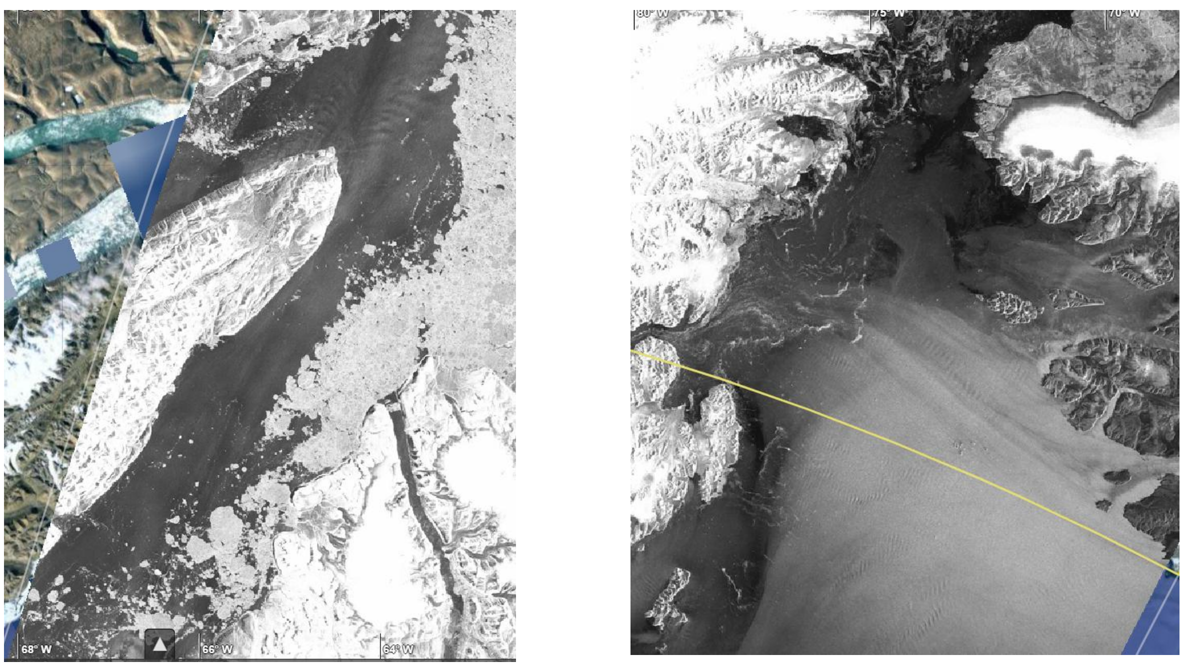

Figure 5-17: Sentinel-1 imagery showing ice conditions during observed wave events. Left panel is northern Kennedy Channel on 2024-09-08 showing an open water fetch of approximately 100km aligned with the SE wind. The right panel is northern Baffin Bay on 2024-09-21, showing ice-free conditions that provided fetch for wave development for S wind on 2024-09-21, and later NE wind. Images Sentinel-1 visualized using Ocean Data Labs Syntool https://ovl.oceandatalab.com/

6 Refuge-Arctic - Sampling glaciers in the fjords

Project leaders: Ardyna, Mathieu[1] (mathieu.ardyna@takuvik.ulaval.ca)

Cruise participants – Leg 3 : Ardyna, Mathieu[1], Mercier, Florence[1], Provencher, Juliette[1]

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6.1 Introduction and Objectives

The Refuge-Arctic project is addressing crucial knowledge gaps by focusing on one such emblematic arctic ecosystem, the "Last Ice Area" (LIA). The aims of Leg 3 are to elucidate the impact of the glacier-ocean continuum on the Nares Strait and moreover in the context of the rapidly arctic changing ecosystems. These systems are distinct from offshore systems by the presence of strong lateral gradients and high seasonal variability. Freshwater inflow leads to estuarine circulation in fjords (Meire et al., 2016; Mortensen et al., 2013). Freshwater mixes and exchanges salt, heat, and nutrients with oceanic-dominated waters during its downstream transport along the coast-wide continuum (Mortensen et al., 2014; Straneo and Cenedese, 2015). Yet gaps exist in understanding how glaciers affect marine biogeochemistry, primary production and biodiversity. Contrasting effects have been shown depending on the glacier terminus (marine or land) and the source of freshwater to the systems. The high export of organic matter limit the productivity of photosynthetic organisms through light availability (Murray et al., 2015) whereas significant enrichment of macro- and micronutrients in the upper 250 m of glacial fjords due to meltwater discharge could sustain and maintain high productivity (Kanna et al., 2022 ; Hopwood et al., 2020 ; Meire et al., 2016 ; Bhatia et al., 2013). Moreover, most of the knowledge comes from literature and studies on the Greenlandic glacier systems (Mortensen et al., 2013; Kanna et al., 2020; Meire et al., 2016). To date, few studies have focused on the Ellesmere Island glacier productivity. More specifically, our main objective is to characterize 5 different fjords, on the Canadian and Greenlandic sides, and thus characterize the important glacier/land/ice/ocean continuum.

During Leg 03, Refuge-Arctic, we (Mathieu Ardyna, Florence Mercier, Juliette Provencher) were able to make 6 helicopter flights to sample 5 glaciers, 6 rivers and 3 lakes (Table 6-1). At each sampling site, we were able to collect glacier water samples for all the laboratories on board so that they could carry out various analyses (Table 6-2, Table 6-3, Table 6-4, Table 6-5, Table

6-6). Glacier, lake and river water were sampled using a pole (Figure 6-1) or directly from a bottle. Some parameters required special attention, such as the analysis of plastics, which required that gloves not be used during sampling. We were also able to collect ice cores (Figure 6-2) and sediment samples at a few sites (

Table 6-7, Table 6-8).

Table 6-1: Glacier sampled during leg 03 – Refuge-Arctic

Station	Fjord	Latitude (N)	Longitude (W)	Sample type	Sampling date
RA02	Makinson	77° 25′ 30′′N	080° 47′ 05′′ W	Glacier	2024-08-14
RA02	Makinson	77° 15′ 08′′N	080° 46′ 39′′ W	River	2024-08-14
RA08	Dobbin	79° 51′ 13′′N	075° 04′ 53′′W	Glacier	2024-08-19
RA07	Dobbin	79° 48′ 43′′N	072° 50′ 16′′W	River	2024-08-19
RA08	Dobbin	79° 50′ 55′′ N	75° 02′ 08′′ W	Lake	2024-08-20
RA12	Archer	81° 47′ 38′′ N	70° 27′ 07′′ W	Lake	2024-08-24
RA12	Archer	81° 40′ 59′′ N	69° 00′ 55′′ W	River A	2024-08-24
RA13	Archer	81° 31′ 04′′ N	68° 46′ 55′′ W	River B	2024-08-24
RA13	Archer	80° 56′ 20′′ N	070° 48′ 54′′ W	Glacier	2024-08-25
RA13	Archer	81° 03′ 23′′ N	070° 03′ 40′′ W	Lake	2024-08-25
RA13	Archer	81° 04′ 35′′ N	070° 00′ 44′′ W	River	2024-08-25
RA17	Newman	81° 18′ 41′′ N	57° 13′ 57′′ W	Glacier	2024-08-29
RA17	Newman	81° 31′ 40′′ N	57° 59′ 01′′ W	River	2024-08-29
RA24	Cadogan	78° 07′ 39′′ N	75° 52′ 14′′ W	River	2024-09-04
RA24	Cadogan	78° 03′ 05′′ N	75° 40′ 43′′ W	Glacier	2024-09-04

Table 6-2: Makinson Fjord sampling

RA02 – Makinson Fjord - Glacier						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	MeHgTNF (Methyl-mercury unfiltered samples)	HgP (Total particulate mercury)		
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				

LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples					
TM - Couture	Total metalloid unfiltered samples					
Virus - RCC	MTB	ISOV				
Ardyna	HPLC	SPM	CDOM	POC	IFCB	
RA02 – Makinson Fjord - River						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	MeHgTNF (Methylmercury unfiltered samples)	HgP (Total particulate mercury)		
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Virus - RCC	MTB	ISOV				

Ardyna	HPLC	SPM	CDOM	POC	IFCB	

Table 6-3: Dobbin Fjord sampling

RA08 – Dobbin Fjord - Glacier						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	MeHgTNF (Methylmercury unfiltered samples)	HgP (Total particulate mercury)		
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Virus - RCC	qPCR	ANOD				
Ardyna	HPLC	SPM	CDOM	POC	IFCB	
RA07 – Dobbin Fjord - River						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	MeHgTNF (Methylmercury unfiltered samples)	HgP (Total particulate mercury)		
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				

LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Virus - RCC	qPCR	ANOD				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB
RA08 – Dobbin Fjord – Lake						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	HgP (Total particulate mercury)			
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Ardyna	HPLC	SPM	CDOM	POC	IFCB	

Table 6-4: Archer Fjord sampling

RA12 – Archer Fjord - Lake						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	HgP (Total particulate mercury)			
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB
RA12 – Archer Fjord – River A						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	HgP (Total particulate mercury)			
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	

Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Virus - RCC	qPCR	ANOD				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB
RA13 – Archer Fjord – River B						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	HgP (Total particulate mercury)			
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Virus - RCC	qPCR	ANOD				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB
RA13 – Archer Fjord – Glacier						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury	HgTF (Total mercury filtered samples)	HgP (Total particulate mercury)			

	unfiltered samples)					
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes				Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Virus - RCC	qPCR	ANOD				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB
RA13 – Archer Fjord – Lake						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	HgP (Total particulate mercury)			
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes				Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				

TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB
RA13 – Archer Fjord – River						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgTF (Total mercury filtered samples)	HgP (Total particulate mercury)			
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes				Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB

Table 6-5: Newman Fjord sampling

RA17 – Newman Fjord - Glacier						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgP (Total particulate mercury)				
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA

Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB
RA17 – Newman Fjord - River						
Team	**Analysis**					
Hg - Cossa	HgTNF (Total mercury unfiltered samples)	HgP (Total particulate mercury)				
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
LEGOS	dBe9 - tBe9	dBe10 - tBe10	D232Th - t232Th	D230Th - t230Th	D143Nd - t143Nd	dREE - tREE
RCC - Lopes	DNA 3	STX	FCM			
DFO - Matthes	FC-Bact	FC-Prostist	Cells lugol	Salinity	O18	
Plastic - Sonke	Plastic					
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid	Total metalliod filtered samples				

	unfiltered samples					
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB

Table 6-6: Cadogan Fjord sampling

RA24 – Cadogan Fjord - River						
Team	**Analysis**					
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB
RA24 – Cadogan Fjord - Glacier						
Team	**Analysis**					
Nutrients - JET	Nitrites	Nitrates	Orthophosphates	Orthosilicic acids		
OMIC - Lomic	DNA3	DNA02	Bacterial Production	DOC	FDOM	AA
Lansard	Total alcalinity	pH				
TM – Cullen	Total trace metal unfiltered samples	Total trace metal filtered samples				
TM - Couture	Total metalloid unfiltered samples	Total metalliod filtered samples				
Ardyna	HPLC	SPM	AP	CDOM	POC	IFCB

Figure 6-1: Water sampling

Figure 6-2: Ice core sampling

Table 6-7: Ice core sampling

RA – Ice Cores	
Team	**Analysis**
LOCEAN	d18O/d2H
Site	RA02 (Makinson Fjord)
	RA07 (Dobbin Fjord)
	RA17 (Newman Fjord)

Table 6-8: Glacier sediment sampling

RA – Sediments						
Team	**Analysis**					
LEGOS	tBe9	tBe10	t232Th	t230Th	t143Np	tREE
Site	RA02 (Makinson Fjord)					
	RA07 (Dobbin Fjord)					
	RA08 (Dobbin Fjord)					
	RA13 (Archer Fjord)					
	RA17 (Newman Fjord)					

6.2 Preliminary Results

As most of the analyses are carried out in the laboratory following the return from the field, we do not yet have any preliminary results. The samples were stored at Université Laval following the demobilisation and the majority will be sent to French laboratories during December.

6.3 Recommendations

Helicopter ditching training is very important when you're planning to use a helicopter to sample glaciers. We also took a climbing course before leaving on our mission and I think this is necessary training for anyone planning to go directly onto the glaciers to sample. Given the uncertain conditions on the glaciers, I think it's important to arrive prepared with the right equipment (crampons, rope, harness, etc.).

6.4 References

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7 Carbon Exchange Dynamics, Air-Surface Fluxes, Surface Climate and Benthic Carbonate Chemistry

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7.1 Introduction

Oceanic uptake of atmospheric CO_2 has been the largest sink of anthropogenic emissions, and is responsible for mitigating atmospheric CO_2 by one third, greatly reducing climate impacts. Ocean carbon storage is vulnerable to the impacts of climate change, particularly in rapidly-changing polar seas. Arctic ocean warming, stratification, altered primary production and diminishing sea ice and changes to freshwater cycles all impact CO_2 uptake, yet the magnitude and direction of these changes, and their cumulative impact on air-sea fluxes is largely unknown. Further, these factors are causing acute ocean acidification of the Arctic surface layer, impacting carbon cycling. High-resolution surface pCO_2 datasets on a multi-year time-scale will improve current estimates of Arctic Ocean carbon storage potential and provide insight into physical, chemical, and biological processes impacting pCO_2.

Oceanic uptake of CO_2 and ocean acidification may also reduce pH and carbonate saturation states in intermediate and deep-water masses, which has the potential to cause shell and skeleton dissolution of calcified organisms and hinder biocalcification and growth rates of ecosystem-engineering organisms in the deep sea such as cold-water corals (Puerta et al. 2020). Given the priority placed on cold-water corals in marine spatial planning and conservation initiatives in the Labrador Sea, Davis Strait, and Baffin Bay, long-term monitoring of the carbonate saturation state of sensitive benthic areas is critical for interpreting trends in the health and stability of these ecosystems. These areas represent a key connection between the Arctic and North Atlantic with undersaturated polar waters characterized by a shallow carbonate saturation horizon being transported southward across the Davis Strait along Baffin Island (Azetsu-Scott et al. 2010).

7.2 Specific objectives

1) Develop a process-level understanding of the exchange of CO_2 between the sea surface and atmosphere.

2) Continue a long-term monitoring program to understand how the Arctic marine CO_2 sink may be evolving as a result of climate change.

3) Identify areas at-risk for anthropogenically-induced ocean acidification, and collect long-term data to track rates of ocean acidification in the Arctic.

4) Characterize the carbonate chemistry and saturation state in the Labrador Sea, Davis Strait, and Baffin Bay relevant for ecosystem-engineering cold-water corals and other benthic species/habitats.

7.3 Methodology

Observation platforms have been utilized throughout the cruise to collect data pertaining to the atmosphere and surface ocean, including an underway pCO_2 system in the engine room. Table 7-1 lists the variables that are monitored, the location where the sensor is installed, the purpose for each variable, along with the sampling and averaging frequency (if applicable).

Table 7-1: Summary of variable inventory and application

Variable	Instrumentation	Location	Purpose	Sample/Average Frequency
upper sea water temperature (Tsw)	General Oceanics 8050 pCO_2	under-way system, forward engine room	air-sea flux and ancillary information	1 / 3 minutes
sea water salinity (S)	General Oceanics 8050 pCO_2	under-way system, forward engine room	air-sea flux and ancillary information	1 / 3 minutes
dissolved CO_2 in seawater	General Oceanics 8050 pCO_2	under-way system, forward engine room	air-sea flux and ancillary information	1 / 3 minutes
pH	General Oceanics 8050 pCO_2	under-way system, forward engine room	air-sea flux and ancillary information	1 / 3 minutes

dissolved O_2 in seawater	General Oceanics 8050 pCO_2	under-way system, forward engine room	air-sea flux and ancillary information	1 / 3 minutes

7.3.1 *Underway pCO₂ System*

A General Oceanics 8050 pCO_2 system was installed on the ship to measure dissolved CO_2 within the upper 7 m of the sea surface in near real time. The system is located in the engine room of the Amundsen, and draws sample water from the ship’s clean water intake. The water is passed into a sealed container through a shower head, maintaining a constant headspace. This set up allows the air in the headspace to come into equilibrium with the CO_2 concentration of the seawater, and the air is then cycled from the container into an LI-7000 gas analyzer in a closed loop. A temperature probe is located in the equilibrator to provide the equilibration temperature. The system also passes subsample of the water stream through an Idronaut Ocean Seven CTD, which measures temperature, conductivity, pressure, dissolved oxygen, pH and redox, though water was not running through the CTD for a portion of the leg due to insufficient water flow to equilibrator. All data is sent directly to a computer using software customized to the instrument. The LI-7000 gas analyzer is calibrated daily using ultra-high purity N_2 as a zero gas, and three gases of known CO_2 concentration as span gas. Spanning of the H_2O sensor is not necessary because a condenser removes H_2O from the air stream before passing into the sample cell. Underway calibration samples were taken in duplicate twice over the leg: 2024-07-21 and 2024-07-28.

Figure 7-1: General Oceanics 8050 pCO2 system

7.3.2 Discrete *Water Sampling*

To characterize carbonate chemistry in the Labrador Sea, Davis Strait, and Baffin Bay, discrete samples for Dissolved Inorganic Carbon (DIC)/Total Alkalinity (TA), salinity, and O18 (water mass tracer) were taken from the rosette. profiles of DIC/TA samples were taken at standard depths following the protocol developed by Dickson et al (2007). Standard sampling depths included: Surface, 10 m, 20 m, 30 m, Surface Chlorophyll Maximum, 40 m, 50 m, 60 m, 80 m, 100 m, 150 m, 200 m, 250 m, 300 m, 400 m, 500 m, 750 m, 1000 m, 1500 m, 2000 m, Bottom. Duplicate DIC/TA samples were collected within the stable water mass at 150 m. DIC/TA samples were collected in 300 mL borosilicate bottles, while salinity and O18 samples were collected in 125 mL and 30 mL High-density Polyethylene bottles, respectively. O18 and salinity samples were taken at the same standard depths as DIC/TA samples and stored at 4° C. DIC/TA samples were first spiked with 100 μl of saturated mercuric chloride solution prior to storage at 4° C. Samples will be analyzed at the DFO - Arctic Region, Winnipeg, MB.

In total we collected discrete water samples at 13 stations. At 12 stations, we sampled the full profile at standard depths: Makkovik Hanging Gardens, Hopedale Shelf, Sentinel, Okak Bay, Nachvak Fjord, Ramah Shelf, Kangalaksiorvik Shelf, Killinik, Davis Strait 2024, DS_500_B2, DS_600_A, and BB1_A. Due to bottle constraints and a more benthic focus at DS_500_B1, only bottom water was sampled.

7.4 Recommendations

During this leg there was one substantial issue and one minor issue with the underway system. Notably, an issue with the software where the path to the data file that was being written would self-delete. Without making any manual changes, between checks of the underway system the path would disappear and instead read "<Not a Path>". When this happened, the system would be running and appear to be logging data when looking at the 'Plot' tab but when clicked onto the 'Table' the data would disappear and would not be stored anywhere since the path disappeared. The data from those times were unrecoverable. The system had to be restarted to get a working file path. At first it seemed the issue may have been remote access where changes could be made (i.e. keyboard smashing accidentally deleting file path), so the remote access was changed to 'view only'. For a few days the problem did not happen again and it seemed solved, but on the last day of transit for Leg 2a the issue happened again. Through communication with General Oceanics it was determined that the issue must be with the software file writing, possibly linked to the new connection to the share and remote access. Further troubleshooting is in process during Leg 2b.

Secondly, a couple days into the cruise the flow speed to the equilibrator was slowly declining as shown by the flowmeter readings. Instead of being a pump or flow issue, the issue turned out to be the flowmeter itself slowing down/getting jammed up by the interior rust. This was surprising since the system had already been running for several days and this problem usually only occurs when the system is first started for the season (and the flowmeter does not turn at all). Flowmeter was taken apart and the rust was cleaned out and the problem did not happen again. See 'Underway Deployment Notes 2024' for detailed explanation of system function during this Leg.

7.5 References

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8 Optical measurements for ALG'O NORD / REFUGEARCTIC / RED-AO

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Cruise participants – Leg 3: David Doxaran[1], Edouard Leymarie[1]

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8.1 Introduction and Objectives

During Leg 3 of the 2024 Amundsen Science expedition, we deployed marine optics sensors to collect in situ data of radiometric parameters such as, e.g., multispectral irradiances and radiances, as well as inherent optical properties, such as, e.g., hyperspectral absorption and attenuation coefficients, light backscattering and fluorometers, along profiles ranging from surface to 50 m and up to 100 m. From the radiometric quantities, apparent optical properties, such as the remote sensing reflectance, will be derived to validate satellite observations. In addition to these optical measurements, water samples were taken with the barge and the CTD/Rosette, so that discrete analyses will be also performed for the calibration of ocean color algorithms in the study areas (fjords and turbid plumes of glaciers).

8.2 Objective

The main goal of this project is to measure and relate the water optical and biogeochemical properties in the major arctic fjords located in the Eastern part of the Canadian Arctic and western coast of Greenland, notably during the melt season, during which massive amounts of terrestrial matter ends up in the Arctic Ocean, for the calibration and validation of satellite ocean color algorithms. Vertical profiles are also used to characterize the water masses in terms of physical and optical properties, beyond the water depths viewed by ocean color satellite sensors. This work performed as a continuation of field measurements carried in 2023 in the same area during the Leg 3 onboard the Amundsen and its barge, in order to generate a complete database.

8.3 Methodology

8.3.1 *Marine Optics*

Apparent Optical Properties (AOPs) were derived from radiometric measurements collected from August 15, 2024 till September 04, 2024, using the C-OPS radiometer ("Compact-Optical Profiling System") from Biospherical Instruments (San Diego, CA, USA). This instrument is composed of 3 main optical units measuring each a different optical parameter in 19 wavelengths, namely 380, 395, 412, 443, 465, 490, 510, 532, 555, 560, 589, 625, 665, 683, 694, 710, 765, 780 and 875 nm. The 3 optical parameters that have been measured are:

- The downwelling irradiance above the surface, denoted "Ed0+", hereafter referred to as the atmospheric reference,

- The downwelling irradiance at depth (z), denoted "Ed(z)",

- The upwelling radiance at depth, denoted "Lu(z)".

While the atmospheric reference is fixed on a telescopic mast above the surface (and extended until the sensor is above the barge's highest point), both the Ed(z) and the Lu(z) units are installed on a kite-shaped frame and deployed at sea, free falling in the water column, with an electro-mechanical cable that is operated manually. Usually, the frame is allowed to reach a depth at which 1 % of the surface light remains, after which the frame is recovered by pulling manually on the cable. Most of the time, 3 profiles are performed at each station.

A moving mask, the so-called shadow band, constituted by a 1 inch wide metallic band automatically swiped from 0 deg. to 180° above the Ed0+ sensor, was brought to the site to perform regular measurements of diffuse vs. direct atmospheric irradiance. A GPS receiver also logs the exact position and UTC time of each measurement.

The AOP measurements are passive optics ones, i.e., they measure the natural light coming from the Sun and travelling through the atmosphere / ice layers / water column etc. They are therefore very sensitive to any optical pollution, and were performed from the barge, far away from the ship. Also, the frame is left drifting away from the barge (typically 30 m to 50 m) before the free fall begins, so that the barge's hull itself does not contaminate the measurements.

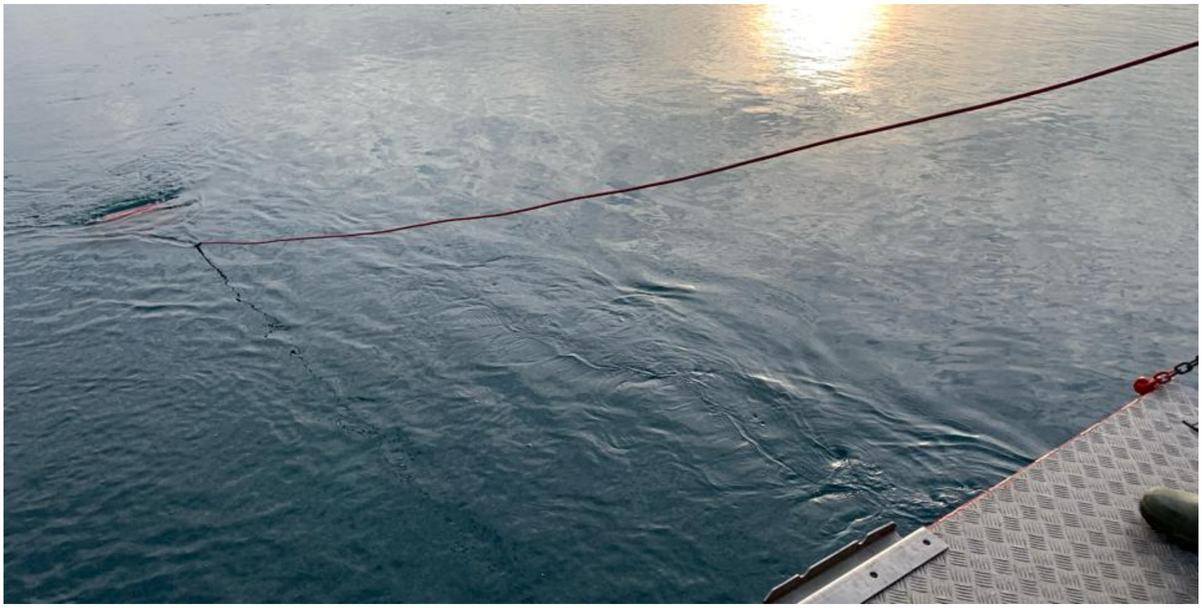

Figure 8-1: Top: The C-OPS is being from the barge. Bottom left: The GPS/shadow band/Ed0+ reference on the telescopic mast. Bottom right: The C-OPS after its recovery.

The code used to process the data was written by Bernard Gentili and updated by Simon Bélanger (https://github.com/belasi01/Cops), then modified in 2023 by Guislain Bécu.

Inherent Optical Properties (IOP) measurements have been collected at the same stations than the C-OPS, using an optical package called an "IOP frame", from Seabird Scientific, Inc. (Philomath, OR, USA). This unit is composed of a data logger onto which a set of optical instruments are connected. The data logger provides power to the instruments and synchronizes their data streams. The whole system is lowered in the water column, with the help of an electro-mechanical cable. These optical sensors are active, i.e., they emit a light signal and record the response of the medium. Their measurement range is very short (few cm maximum), so that they are not sensitive to any optical pollution; the frame can be lowered close to the ship. Nevertheless, the barge is still the best infrastructure to deploy the IOP frame, as it is barely not mixing the top of the water column. The goal of this cruise being to characterize the fjords /glacier plumes, which usually lie at the top of the water column, the barge use was crucial for the operations. In addition to data recorded by the CTD sensor, the following parameters have been collected between the surface and a depth of up to 150 m:

- Absorption and attenuation coefficients between 400 nm and 740 nm, every 3 nm approximately,

- Backscattering coefficients at 13 wavelengths, namely 412, 440, 488, 510, 532, 595, 650, 676, 700, 715, 720, 770 and 870 nm,

- Fluorescence of Chlorophyll-a (Chla),

- Fluorescence of CDOM (Coloured Dissolved Organic Matter).

Note that issues were encountered with the Wetlabs AC sensors: the first one (AC-S) showed inconsistent measurements in the lab and in the field; it was replaced by one AC-9 VIS-NIR sensors which also showed problems associated to absorption measurements, so that the AC-9 VIS (S/N-0182) was finally used.

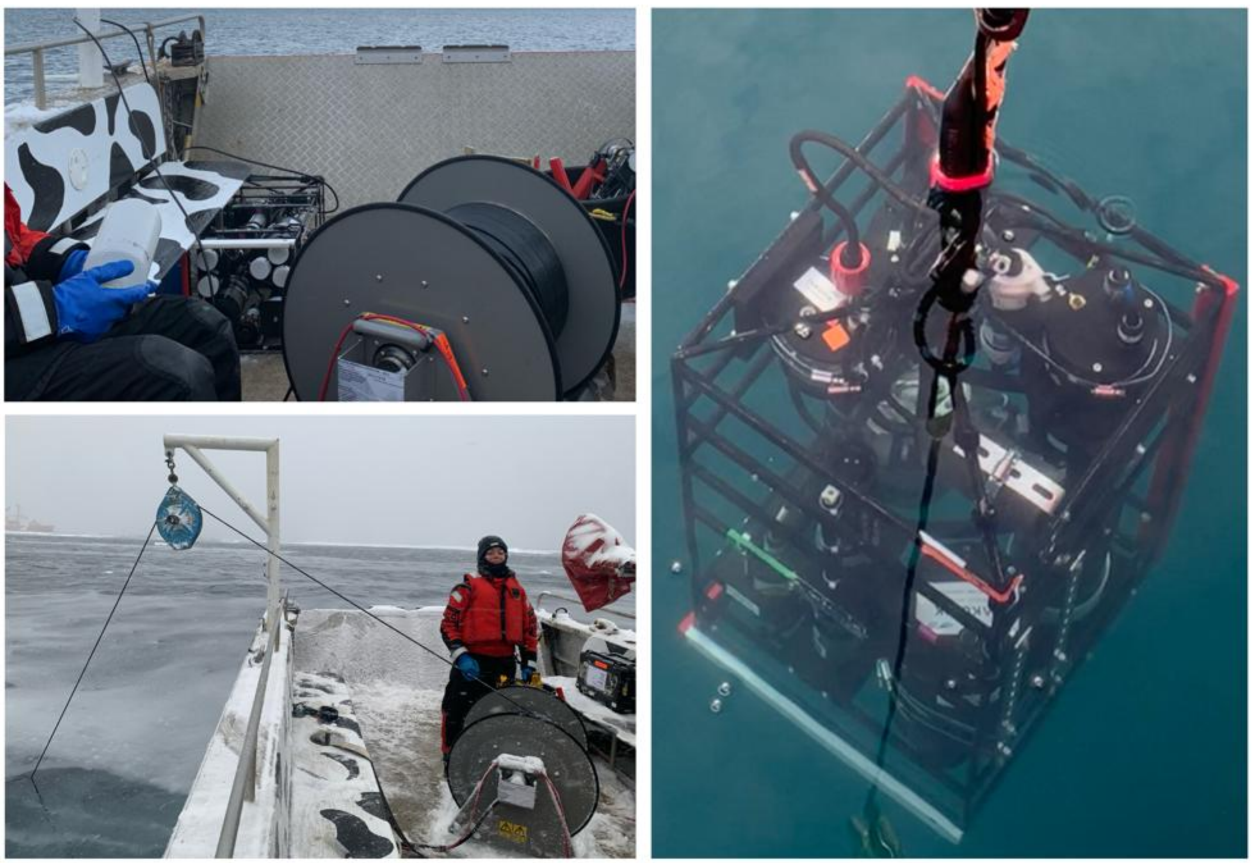

Figure 8-2: Top left: The IOP frame is lying flat on the barge deck, next to the winch. Bottom left: The IOP frame is lowered at sea using the drill-operated winch and the port side davit. Right: The IOP frame is warming-up/flushing its tubing system system just under the sea surface (after an initial descent for de-bubbling).

Briefly, the absorption and attenuation coefficients measured with the AC-S/9 will be corrected for temperature and salinity following Rottgers et al (2014) using the temperature and salinity data from the CTD. The absorption will also be corrected from the so-called residual scattering correction following Zaneveld et al (1994). Backscattering (b_b) coefficient from the ECO-PUCK will be processed following Dana and Maffione (2002) and Wetlabs protocols. The light attenuation correction for bb will be performed following the method described in Doxaran et al (2016) using the corrected absorption coefficient from the AC-S. Particle backscattering (b_{bp}) will be calculated removing the pure water contribution calculated using the method of Fewell and Trojan (2019).

Table 8-1: Marine optics stations.

date (UTC)	time (UTC)	station code	station	substation	Depth(m)	latitude	longitude	operation	number of casts	surface water sampling
15/08/2024	17:40	RA03A	RA03	NA	76,5	77°15'865N	80°44'350W	IOP	1	NA
15/08/2024	18:21	RA03A	RA03	NA	100	77°15'873N	80°44'327W	C-OPS	3	VRAI
15/08/2024	20:10	RA04A	RA04	N/A	67	77°23'391N	81°02'663W	IOP	1	N/A
15/08/2024	20:20	RA04A	RA04	N/A	67	77°23'391N	81°02'663W	C-OPS	3	VRAI
15/08/2024	20:42	RA04B	RA04	N/A	100	77,380	81,064	IOP	1	N/A
15/08/2024	21:19	RA04B	RA04	N/A	100	77°22."00	81°01.40	C-OPS	3	VRAI
18/08/2024	17:20	RA06A	RA06	N/A	180	79°41'789	73°06'489	IOP	1	VRAI
18/08/2024	17:31	RA06A	RA06	N/A	180	79°41'794	73°06'280	C-OPS	3	N/A
18/08/2024	18:35	RA06B	RA06	N/A	180	79°41'789	73°06'489	IOP	1	VRAI
18/08/2024	19:00	RA06B	RA06	N/A	180	79°40'050	73°00'993	C-OPS	3	N/A
20/08/2024	0:00/17:32/1	RA08A	RA08	N/A	36	79°504016	74°50'915	C-OPS	3	N/A
20/08/2024	17:40	RA08A	RA08	N/A	36	79°50'064	74°50'904	IOP	1	VRAI
20/08/2024	0:00/19:20/1	RA08B	RA08	N/A	140	79°50'016	74°32'421	C-OPS	3	N/A
20/08/2024	19:39	RA08B	RA08	N/A	140	79°49'622	74°34'380	IOP	1	VRAI
20/08/2024	20:25	RA08C	RA08	N/A	230	79°49'661	74°09'098	C-OPS	1	N/A
20/08/2024	20:35	RA08C	RA08	N/A	230	79°49'776	74°10'357	IOP	1	VRAI
22/08/2024	17:29	RA09	RA09	N/A	250	82°17,614N	60°53,116W	IOP	1	N/A
22/08/2024	10:07	RA09b	RA09	N/A	250	82°29,411N	60°88,737W	IOP	1	N/A
23/08/2024		RA12D	RA12	N/A	150			C-OPS	3	N/A
23/08/2024		RA12D	RA12	N/A	150			IOP	1	VRAI
23/08/2024		RA12A	RA12	N/A	6			IOP	1	VRAI
24/08/2024	10:55	RA12B	RA12	N/A	150	81°34'939	68°28'304	C-OPS	2	N/A
24/08/2024	11:07	RA12B	RA12	N/A	150	81°34'976	68°28'476	IOP	1	VRAI
24/08/2024	12:02	RA12C	RA12	N/A	90	81°31'318	68°30'353	C-OPS	2	N/A
24/08/2024	12:20	RA12C	RA12	N/A	90	81°31'353	68°30'396	IOP	1	VRAI
25/08/2024	:51/17:01/17	RA13	RA13	N/A	450	81°16,629	68°29'487	C-OPS	3	N/A
25/08/2024	17:22	RA13	RA13	N/A	450	81°16'648	68°28'860	IOP	1	VRAI
26/08/2024	:20/17:22/17	RA14A	RA14	N/A	437	81°34'724	65°59'226	C-OPS	3	N/A
26/08/2024	18:48	RA14B	RA14	N/A	437	81°31'353	68°30'396	IOP	1	VRAI
27/08/2024	:05/17:11/17	RA15	RA15	N/A	400	81°39,555	64°03'621	C-OPS	3	N/A
27/08/2024	17:30	RA15	RA15	N/A	400	81°39'578	64°03'541	IOP	1	VRAI
28/08/2024	17:30	RA16	RA16	N/A	400	?	?	IOP	1	N/A
29/08/2024	16:45/16:50	RA17B	RA17	N/A	85	81°36'645	58°41'621	C-OPS	2	N/A
29/08/2024	17:00	RA17B	RA17	N/A	88	81°36'714	58°41'461	IOP	1	VRAI
29/08/2024	:27/17:30/17	RA17C	RA17	N/A	57	81°37'886	58°49'226	C-OPS	3	N/A
29/08/2024	17:50	RA17C	RA17	N/A	57	81°38'003	58°51'094	IOP	1	VRAI

8.3.2 *Discrete samples.*

Water samples were systematically collected within surface water (20 cm depth) by hand using a 20L carboy previously rinsed 3 times. These water samples were straightaway filtered on the ship and filters were kept in freezers (-80°C). The following laboratory analyses will be made on these filters: dry mass of suspended particles, identification and quantification of phytoplankton pigments by HPLC, POC/PON analyses using a CHN analyzer, particulate absorption using a spectrophotometer. These laboratory analyses will complete the optical measurements and also generate the biogeochemical database.

8.4 Preliminary Results

The Figure 8-3 locates the statins sampled with the barge for optical measurements and associated to collection of surface water samples.

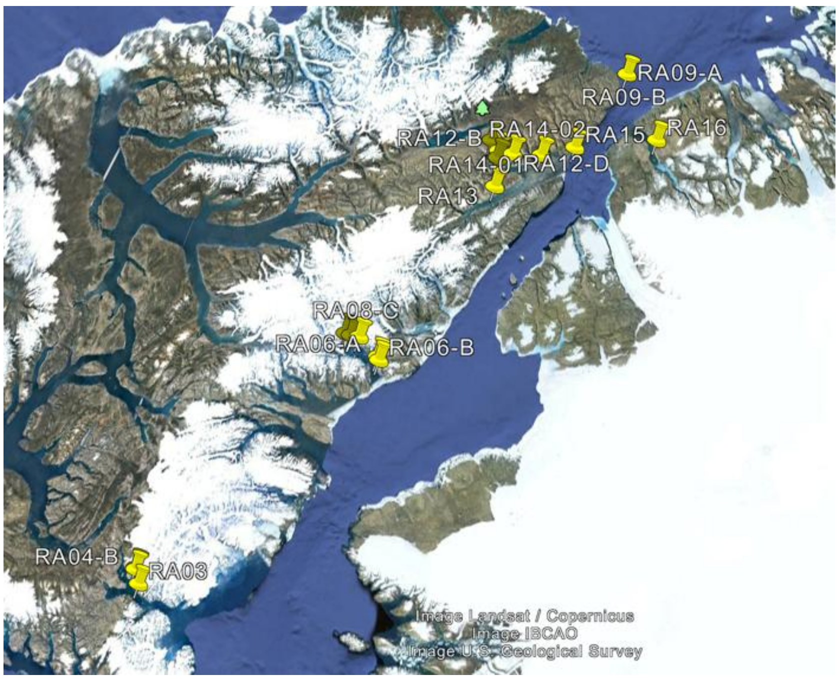

Figure 8-3: Location and name of stations sampled using the barge in 2023 (Leg 3).

The Figure 8-4 illustrates typical vertical profiles of turbidity and Chla concentration measured along a transect inside a fjord from the source of freshwater and terrestrial substances discharged by a glacier to offshore.

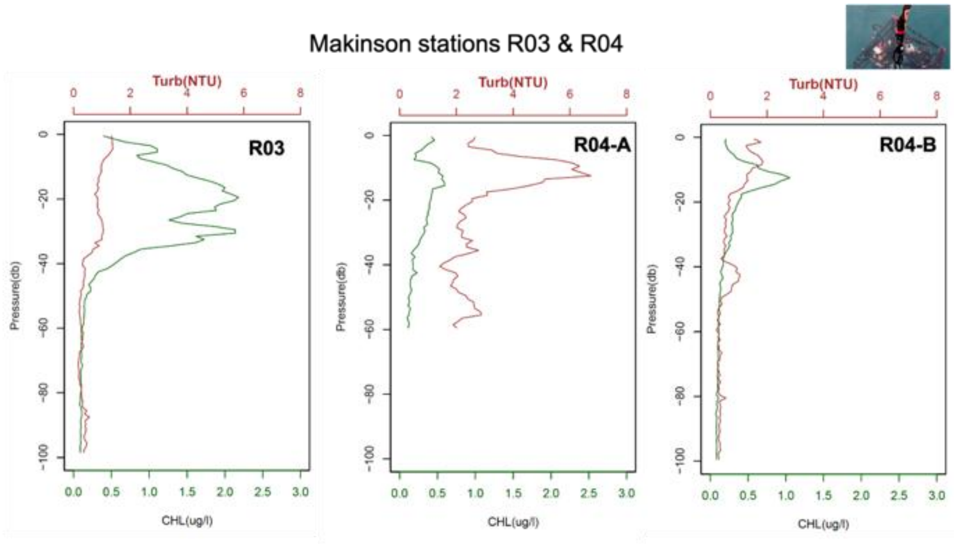

Figure 8-4: Variations of water turbidity and Chla concentrations along the water column measured from the barge on a transect inside the Makinson fjord.

Figure 8-5 shows typical remote-sensing water reflectance spectra derived from C-OPS measurements carried out in 14 stations representative of fjords and representative of clear to turbid waters.

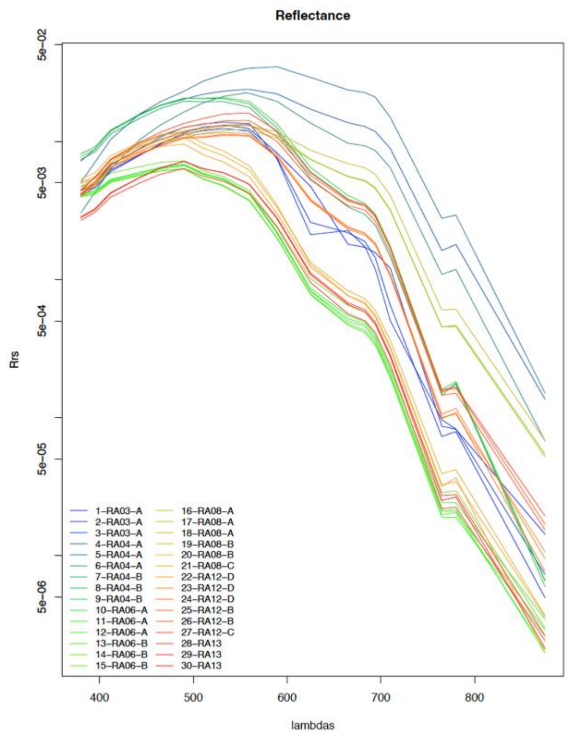

Figure 8-5: Typical remote-sensing reflectance (Rrs) spectra derived from radiometric measurements carried out from the barge in fjords.

8.5 Recommendations

The performance of the C-OPS system to record radiometric measurements was proved, as in 2023, to be highly satisfactory. These measurements have been used to accurately derive the optical depths within the water column and the water remote-sensing reflectance signal. Overall the IOP frame provided accurate and useful measurements along the water column concerning the physical properties of the water masses (temperature, salinity and density as a function of depth) but also key optical properties such as light backscattering, turbidity and fluorescence of Chla. By opposition the signal of CDOM absorption was systematically noisy, either due to a too low sensitivity of the sensor or to low CDOM concentrations. The main problem came once again (as in 2023) to the Wetlabs AC-S or -9 sensors which were proved to be highly sensitive to laboratory calibrations, air temperature and therefore not really reliable. Laboratory spectrophotometric measurements will complement the in-situ AC measurements.

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9 Optical and physical properties of multi-year sea ice

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9.1 Introduction and Objectives

The Arctic sea-ice cover has undergone a dramatic change over the past few decades. Notably, the multiyear ice regime, that dominated much of the high-Arctic landscape in the 21st century, is rapidly declining and giving way to a seasonal ice regime (Haas et al. 2008, Comiso 2012, Ardyna and Arrigo 2020). The region north of Nares Strait harbours some of the thickest multiyear ice and deformed seasonal sea ice in the Arctic. As part of Leg 4 of the Refuge Arctic mission, our main objective was to sample multiyear ice and characterize it from a physical and optical point of view. We also characterized the optical properties of the water column beneath the ice floes and in open waters. The interaction between light and sea ice plays an important role in climate regulation, especially during the summer season, as the sea ice surface layers reflect part of the incident solar radiation back to space and absorbs another fraction, contributing to ice melting and ocean warming. Ice optics also help us to understand the Arctic ecosystem, as pack ice effectively limits the amount of light available to photosynthetic organisms in the water column beneath the ice. Despite recent advances and the development of innovative tools for measuring optical properties (e.g., Perron et al. 2021, Larouche et al. 2023), the representation of radiative transfer in pack ice is a major uncertainty, both in climate modelling (Notz 2012, Lebrun et al. 2023) and in calculations of under-ice primary production (Stroeve et al. 2021). As part of a broader objective to study and characterize the under-sea ice environment, a fluorescence lidar developed at ULaval (Sentinel North) was deployed in conjunction to the primary ice optics measurements. This instrument was initially developed for underwater AUV surveying of underwater arctic substrates, such as sea ice and benthic environments, where spectral response such as fluorescence in ice algae and benthic micro and macrophytes can be generated and used for detection, quantification and characterization. This is the first opportunity to deploy and test the instrument under ice, where the focus is to gain deployment experience in cold arctic environments.

9.2 Methodology

9.2.1 *Sea ice physics*

Five large ice floes (stations RA26, RA27, RA36, RA37 and RA45) were sampled for ice physical properties during Leg 4. At each ice floe, ice cores were collected for determining vertical profiles of temperature, salinity, stable isotopic ratio of water, and ice texture analysis. Kovacs ice corers were used to obtain ice 9-cm diameter ice cores from the ice cover. Optics observations were conducted at a nearby site. Ice temperature profiles were determined from ice cores typically at 10-cm vertical intervals by inserting a temperature probe into ~2mm diameter holes that were drilled in towards the center of the ice core. The ice core was stored in WhirlPack bags and placed in a freezer for later cold room processing for ice texture. Vertical thick and thin sections were prepared following method described in Kawamura et al. (2001). Ice cores for salinity and stable isotope profile determinations were immediately sawed into 10-cm sections and placed into WhirlPack bags and stored in a cooler. Later onboard the ship, the ice in the bags were melted, 20 ml was subsampled for water stable isotopes, and the meltwater conductivity, temperature and salinity were measured using an AML Oceanographic AML-3 CTD. As there was limited time available for sampling at stations RA26 and RA37, the temperature ice core was also used for salinity and isotope sampling. These ice cores were split lengthwise with ~1/3 saved for texture analysis, and ~2/3 placed in bags for melting. When additional time was available, we also collected ice cores from refrozen melt ponds and the ice underlaying the melt ponds. These ice samples were processed for salinity and isotopes in the same was as described above. CTD casts were conducted through ice core holes at two sites: RA36 and RA45. We used an AML Oceanographic AML-3 LGR CTD, owned by Amundsen Science, to conduct profiles to > 100 m depth.

9.2.2 *Sea ice optics*

At the sea ice optical sites, the apparent optical properties of the pack ice were measured using a variety of instruments. First, reflectance was measured using a Biospherical spectral radiometer, then a 2" hole was drilled using a Kovacs Instruments drill bit. A calibrated 360-degree camera was then inserted to measure the vertically resolved radiance, to obtain the light profile inside the pack ice, from the atmosphere down to the water column. Finally, a 10-inch hole was drilled with a motorized auger to measure the light profile in the water column down to 50 meters.

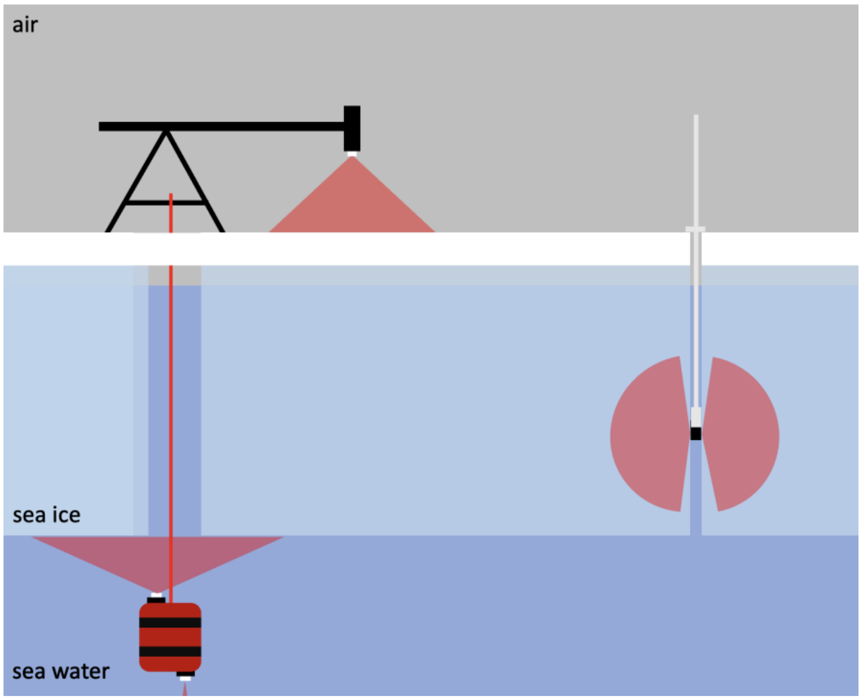

Figure 9-1: optical measurements conducted on sea ice

9.2.3 *Sea ice Lidar*

The lidar deployment consists of inserting the instrument vertically inside the ~25.4 cm diameter hole, initially drilled for ICE-Pro light transmittance measurements under sea ice. The system consists of an aluminium built, harness structure holding the cylindrical metal housing section of the lidar (Figure 9-2). This section is attached via 90-deg locking hinge (i.e. can take a vertical insertion position to horizontal position when in the open, by buoyancy effect) to a 3-section pole mount, in which a safety cable and electronics control and power are inserted. The lidar data acquisition is controlled via a surface computer and user interface.

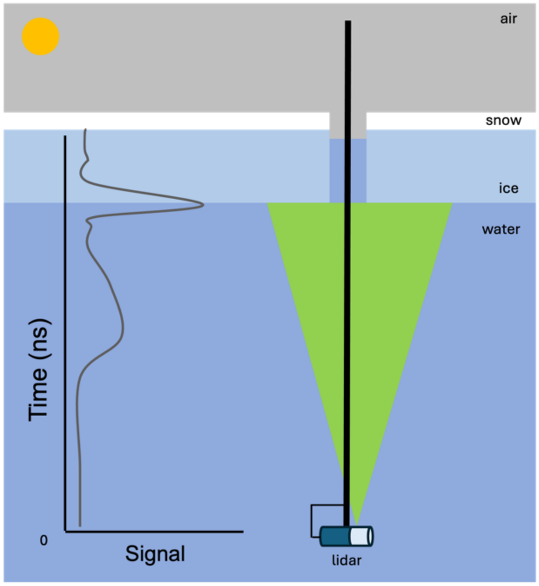

Figure 9-2: Under-ice fluorescence lidar deployment

Figure 9-3: Lidar setup prior to measurements under ice.

9.2.4 *Open water*

At the open water stations (RA28, RA31, RA41, RA50, RA54 & RA644), the barge was deployed to measure the apparent optical properties (AOP) and inherent optical properties (IOP) of the water column, as well as taking surface water samples. AOPs were measured using a freefalling kite manufactured by Biospherical Instruments, equipped with three radiometers measuring upwelling and downwelling vector illuminance and upwelling luminance. These three quantities are associated with the incident solar vector irradiance. This device, deployed facing the sun from the front of the barge, provides an AOP profile of up to 70 meters. The IOPs were then measured using a set of sensors mounted on a frame. Properties measured included spectral absorption and scattering coefficients, CDOM concentration, chla concentration, water density, pressure, salinity and temperature.

Figure 9-4: Optical frame deployment from the barge

9.3 Preliminary Results

This section brings together some preliminary results from the partial on-board analysis.

9.3.1 *Sea ice physics*

The figure below (left) shows the salinity profile of sea ice collected at station RA26. While the sub-figure on the right shows a photograph under polarized illumination and lens, highlighting the crystallography of ice 280 cm below the surface at station RA36, the vertical change in grain size can be seen.

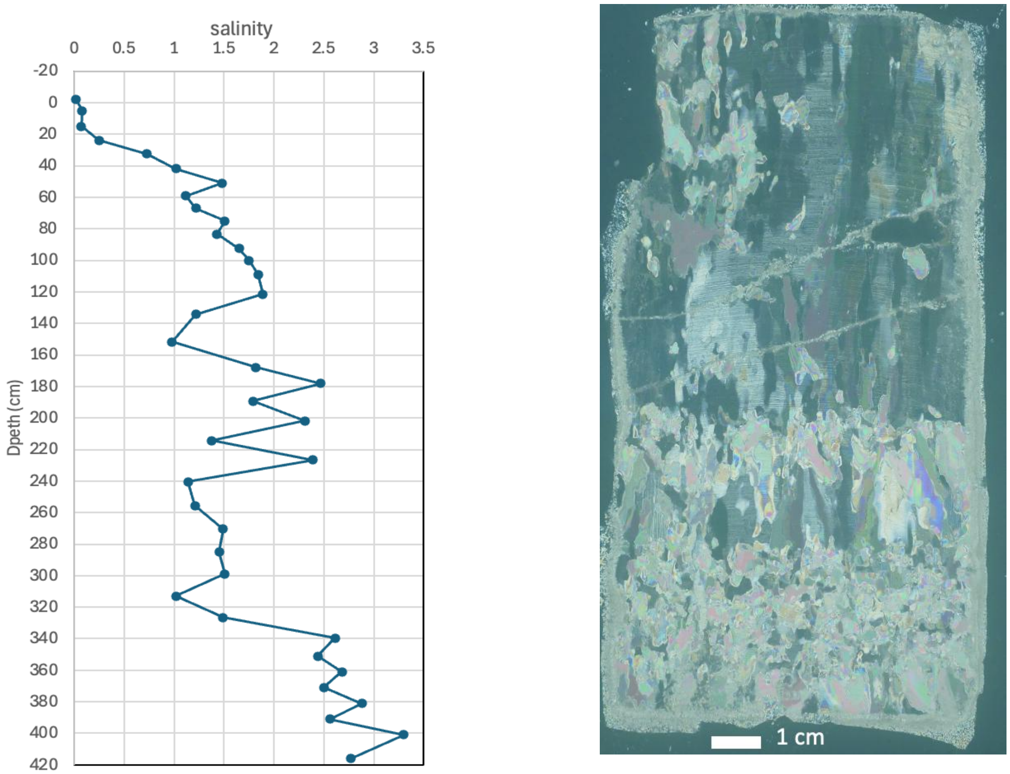

Figure 9-5: Salinity profile for station RA26, polarized cross section image for station RA36.

9.3.2 *Sea ice optics*

The figure below shows the spectral transmittance measured for a station on a sea ice floe (left panel, RA26) and one in open water (right panel, RA62). This transmittance is obtained by calculating the ratio between the downwelling irradiance at depth z and the incident solar irradiance. It can be seen that transmittance in open water at a depth of 50 meters is roughly equivalent to that measured 5 meters under the ice. This shows the extent to which the light environment in the water column is dictated by the presence of sea ice, hence the importance of studying radiative transfer in sea ice.

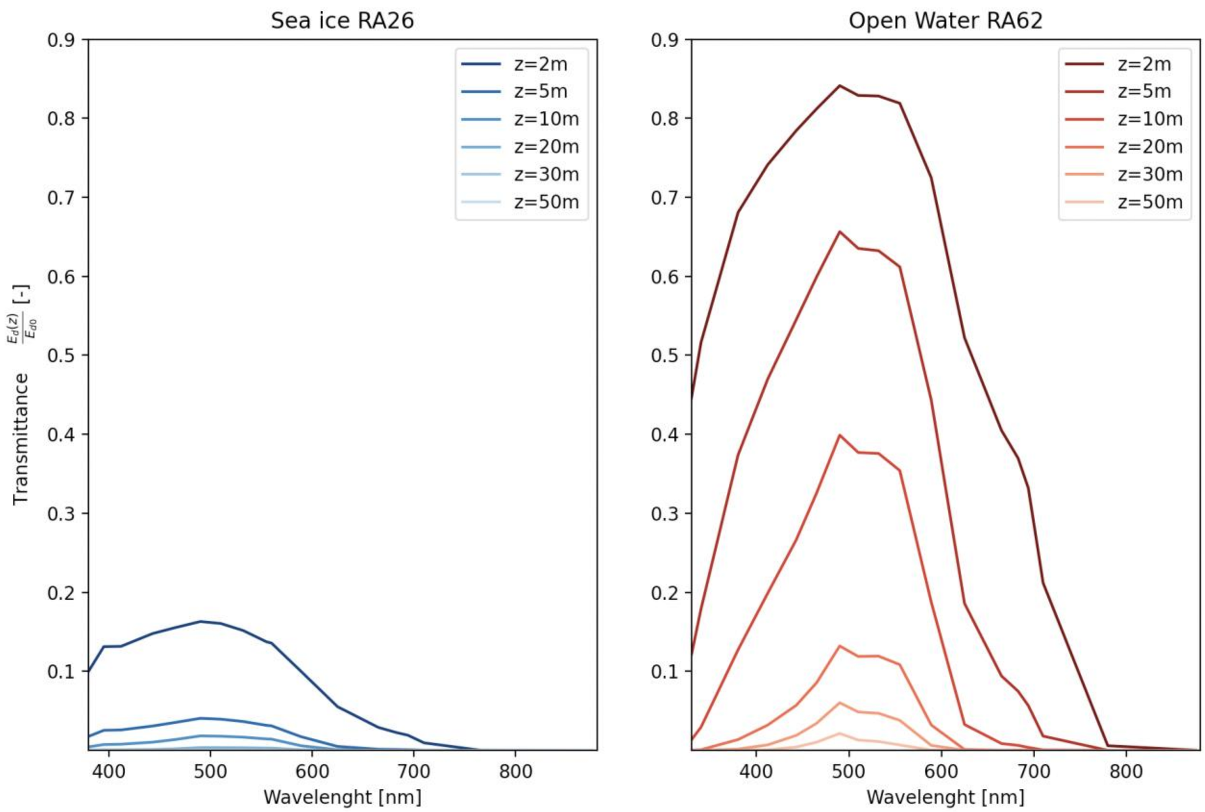

Figure 9-6: Optical visible transmittance under sea ice (left) and open water (right).

9.3.3 *Sea ice Lidar*

Lidar field deployment trials were attempted on 3 ice floes. However, due to time and weather-related constraints, time spent on the ice was in favor of ice physical properties and optics measurements (and coring). Therefore, lidar deployments consisted mostly of testing, adapting and validation of hardware and deployment setup for 4+ m ice thickness. Notably, the presence of melt ponds on most locations, characterized by a frozen top layer of 30 cm+ thickness, a variable size meltwater "cavity", and variable bottom ice thickness, in conjunction with drill hole diameter and angle variations, made vertical insertion and horizontal imaging alignment challenging. Work provided many useful insights for future ice-lidar deployment tests using this new instrument, such as for PC control hardware (i.e., software limitations, appropriate settings in this new environment), electronics cabling and connections (i.e., cable management), and power supply options. An example of lidar pulse return acquired during this mission is shown in Figure 9-7, where signal intensity is plotted vs time. Using the data from which these peak returns (i.e. location in time, position in line, intensity) were obtained, a 3D point cloud and images be reconstructed, following post-processing decomposition and deconvolution, rendering a surface model of the under-ice environment. Additionally, the fluorescence detection capability of this instrument should allow for ice algae detection, in the right conditions (i.e., suitable concentration and surface area).

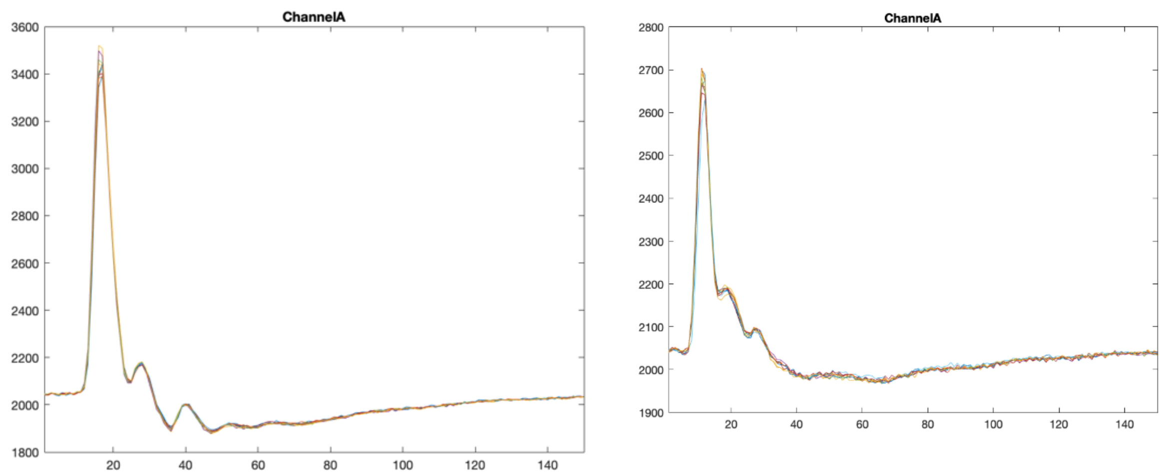

Figure 9-7: Example full waveform lidar pulse returns acquired during testing, each showing 10 successive pulse returns (overlapping), isolated from a single scanned line (y-axis: intensity, x-axis: time or distance). Pulse returns (left) acquired on uniform surface using the current system optical configuration, showing a single strong peak at 18 ns, and (right) weaker intensity peak return at 15 ns followed by a secondary (possible 3rd also) weaker returns at 19 – 29 ns, from secondary surfaces encountered.

9.3.4 *Open water*

The figure below shows the temperature and salinity profile measured using the CTD onboard the optical frame. This measurement is much finer than the one on the Amundsen's rosette, enabling us to finely characterize vertical changes.

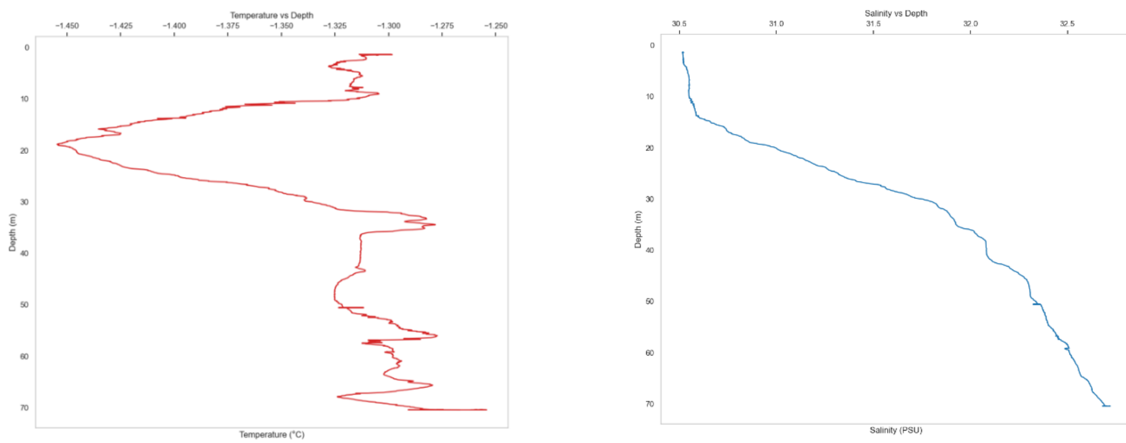

Figure 9-8: Station RA28 CTD instrument data, showing temperature and salinity gradient with depth

9.4 Recommendations

During operations on the ice, the radios supplied by Amundsen Science were often deffective and unusable. It would be important to consider renewing the fleet of VHF radios available to the scientists on board.

9.5 References

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10 Marine productivity: Carbon and nutrients fluxes

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10.1 Introduction and Objectives

The Arctic climate displays high inter-annual variability and decadal oscillations that modulate growth conditions for marine primary producers. Much deeper perturbations recently became evident in conjunction with globally rising CO_2 levels and temperatures (IPCC 2007). Environmental changes already observed include a decline in the volume and extent of the sea-ice cover (Johannessen et al. 1999, Comiso et al. 2008), an advance in the melt period (Overpeck et al. 1997, Comiso 2006), and an increase in river discharge to the Arctic Ocean (Peterson et al. 2002, McClelland et al. 2006) due to increasing precipitation and terrestrial ice melt (Peterson et al. 2006). Consequently a longer ice-free season was observed in both Arctic (Laxon et al. 2003) and subarctic (Stabeno & Overland 2001) environments. These changes entail a longer growth season associated with a greater penetration of light into surface waters, which is expected to favoring phytoplankton production (Rysgaard et al. 1999), food web productivity and CO_2 drawdown by the ocean. However, phytoplankton productivity is likely to be limited by light but also by allochtonous nitrogen availability. The supply of allochtonous nitrogen is influenced by climate-driven processes, mainly the large-scale circulation, river discharge, upwelling and regional mixing processes. In the global change context, it appears crucial to improve the knowledge of the environmental processes (i.e. mainly light and nutrient availability) interacting to control phytoplankton productivity in the Canadian Arctic. Also, changes in fatty acid proportions and concentrations will reflect shifts in phytoplankton dynamics including species composition and size structure, and will reveal changes in marine energy pathways and ecosystem stability.

10.2 Methodology

Samples for inorganic nutrients (ammonium, nitrite, nitrate, orthophosphate and orthosilicic acid) were taken at all stations to establish detailed vertical profiles. Samples were stored at 4°C in the dark and analyzed for nitrate, nitrite, orthophosphate and orthosilicic acid within a few hours on a Bran+Luebbe AutoAnalyzer 3 using standard colorimetric methods adapted for the analyzer (Grasshoff et al. 1999). Additional samples for ammonium determination were taken and processed immediately after collection using the fluorometric method of Holmes et al. (1999).

In order to support the trace metal teams (Cullen, Jeandel), nutrients were also sampled from the Trace Metal rosette. 15N-nitrate samples were also collected for water masses origins determination.

10.3 Preliminary Results

No preliminary results available yet.

Table 10-1: List of sampled stations during Leg 3 of the 2024 Amundsen

Stations	Nutrients	Nitrate isotopes	Ammonium
RA-01 (Bylot-23)	x		
RA-02	X	X	X
RA-03	X	X	X
RA-04	X	X	X
RA-05	X	X	X
RA-06	X	X	X
RA-07	X	X	X
RA-08	X	X	X
RA-09	X	X	X
RA-10	X	X	X
RA-11	X	X	X
RA-12	X	X	X
RA-13	X	X	X
RA-14	X	X	X
RA-15	X	X	X
RA-16	X	X	X
RA-17	X	X	X

RA-18	X	X	X
RA-19	X		
RA20	x	x	x
RA21	X	x	x
RA24	x	x	x

Table 10-2: List of sampling stations and measurements during leg 4 of the 2024 Amundsen

Date	Station sequence	Cast	Station ID	Type	Latitude (N)	Logitude (W)	nuts	NH4	isotopes NO3	isotopes Si
08/09	RA-25	73	RA-NS_07	Full	81.4132923	64.2278237	x	x	x	x
09/09	RA-26	75		Station glace	80.8260668	66.7653705	x			
10/09	RA-27	77		Station glace	80.5195567	68.4020773	x	x		
11/09	RA-28	80		Full	80.3450405	69.0284252	x	x	x	x
11/09	RA-29	82		Nutrient	80.3219822	68.5489517	x			
11/09	RA-30	83		Nutrient	80.2895242	68.1785133	x			
12/09	RA-31	85		Full	80.2589062	67.7564078	x	x	x	x
12/09	RA-34	89		Nutrient	80.3743543	69.2141562	x			
13/09	RA-36	91		Station glace	79.8809757	69.9169940	x			
14/09	RA-37	92		Station glace	79.9440655	70.2961357	x	x		
15/09	RA-38	94		Full - inside	79.4095925	71.1481075	x	x		
15/09	RA-39	95		Nutrient	79.4188358	71.7740813	x			
16/09	RA-40	96		Nutrient	79.4622135	72.3722450	x			
16/09	RA-41	98		Full - ends	79.4982148	73.0268760	x	x	x	x
16/09	RA-42	99		Nutrient	79.2782405	70.5945367	x			
17/09	RA-43	101		Full - ends	79.0837423	69.4638388	x	x	x	x
17/09	RA-44	102		Nutrient	79.1299887	69.8963030	x			
18/09	RA-45	103		Station glace	78.3296032	74.7815460	x	x		
18/09	RA-46	104		Nutrient	78.2971760	74.3415090	x			
18/09	RA-47	105		Nutrient	78.2997220	73.9985222	x			
19/09	RA-48	108		Full	78.3083853	74.7990788	x	x		
19/09	RA-49	111		Nutrient	78.2823308	73.1977738	x			
20/09	RA-50	113		Full	78.2933825	73.5942452	x	x		
23/09	RA-53	117	116	Nutrient	76.3806792	70.5258303	x			
23/09	RA-54	120	115	Full - ends	76.3339550	71.2087838	x	x	x	
24/09	RA-56	124	113	Nutrient	76.3194283	72.2167923	x			
24/09	RA-58	128	111	Basic	76.3080423	73.2186190	x			

24/09	RA-59	129	110	Nutrient	76.2997883	73.6372558	x			
25/09	RA-62	134	108	Full - inside	76.2638733	74.5992185	x	x		
24/09	RA-61	131	107	Nutrient	76.2809935	74.9853733	x			
26/09	RA-69	147	105	Basic	76.3181400	75.7602200	x			
25/09	RA-65	140	103	Nutrient	76.3532100	76.5769300	x			
26/09	RA-67	142	101	Full - ends	76.3869885	77.3961242	x	x	x	
26/09	RA-68	145	100	Nutrient	76.4075300	77.9596700	x			
27/09	RA-70	149	TCA-S3	Nutrient	73.7382400	78.6331100	x	x		
30/09	RA-73	152	TCA2-305d	Nutrient	74.2215900	93.5141000	x	x	x	x
30/09	RA-74	153	TCA2-305c	Nutrient	74.3516000	93.5834900	x	x		
30/09	RA-75	154	TCA2-305b	Nutrient	74.4828200	93.6410100	x			
30/09	RA-76	155	TCA2-305a	Nutrient	74.6024200	93.7093800	x			

Table 10-3: List of sampling stations and measurements during leg 5 of the 2024 Amundsen

Date	Station	Cast	Nitrites	Nitrates	Orthopho	Orthosilici	Ammoniu	Si	Particulat	Particulat	Particulat	Lipids	15N &	Taxonomy	Chlorophy
10-04	Keb-S10	2	x	x	x	x									
10-04	S8	4	x	x	x	x									
10-05	S5	7	x	x	x	x									
10-05	S3	9							x	x	x	x	x		
10-05	S3	11	x	x	x	x	x	x							
10-06	TCA-S3	14							x	x	x	x	x		
10-06	TCA-S3	16	x	x	x	x	x								
10-07	TCAT3-01	18	x	x	x	x	x	x							
10-07	T3-01	20	x	x	x	x	x		x	x	x	x	x		
10-07	TCAT3-03	21	x	x	x	x	x								
10-08	TCAT3-05	22	x	x	x	x	x								
10-08	TCAT3-07	25	x	x	x	x									
10-08	TCAT3-08	26	x	x	x	x	x	x							
10-08	T3-08	29	x	x	x	x	x		x	x	x	x	x		
10-09	T3-09	30	x	x	x	x	x	x							
10-09	T3-10	34	x	x	x	x									
10-09	BB2	35	x	x	x	x	x	x							
10-10	BB2	38	x	x	x	x	x		x	x	x	x	x		
10-10	T3-20	42	x	x	x	x									

10-10	T3-19	43	x	x	x	x	x	x							
10-11	TCAT3-17	47	x	x	x	x	x	x							
10-11	T3-17	50	x	x	x	x	x		x	x	x	x	x		
10-12	T3-16	52	x	x	x	x									
10-12	T3-15	53	x	x	x	x	x								
10-12	T3-13	55	x	x	x	x	x								
10-12	T3-11	56	x	x	x	x	x	x							
10-13	TCAT3-11	59	x	x	x	x	x		x	x	x	x	x		
10-15	CA23	60	x	x	x	x									
10-16	TCAT6-09	62	x	x	x	x	x	x	x	x	x	x	x		
10-16	TCAT6-08	65	x	x	x	x									
10-16	TCAT6-07	67	x	x	x	x	x	x							
10-17	TCAT6-06	68	x	x	x	x									
10-17	TCAT6-05	70	x	x	x	x	x	x							
10-17	TCAT6-05	71	x	x	x	x	x		x	x	x	x	x		
10-17	TCAT6-04	72	x	x	x	x									
10-17	TCAT6-03	74	x	x	x	x	x	x							
10-18	TCAT6-02	77	x	x	x	x									
10-18	TCAT6-01	78	x	x	x	x	x	x	x	x	x	x	x		
10-21	AR24-20	80	x	x	x	x	x								
10-21	AR24-19	81	x	x	x	x	x								
10-21	AR24-17	82	x	x	x	x	x								
10-22	LR24-05	83	x	x	x	x	x								
10-22	LR24-4	84	x	x	x	x	x								
10-23	UNG03	85	x	x	x	x	x								
10-24	GR24-17	86	x	x	x	x	x								
10-26	TCAT1-05	87	x	x	x	x	x								
10-26	TCAT1-03	88	x	x	x	x	x								
10-26	TCAT1-01	89	x	x	x	x	x	x	x	x	x	x	x	x	x

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11 Origi-Nd: Characterising the origin and transformationof water masses in Baffin Bay using neodymium isotopes

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11.1 Introduction

The Arctic and North Atlantic regions are highly sensitive to climate change. A mixture of fresh- and meltwater from Canada and Greenland feeds Baffin Bay. This seawater eventually mixes with North Atlantic waters in the Labrador Sea. Baffin Bay is therefore ideally located to track changes in environmental parameters, such as meltwater input, nutrients or changes in deep water mass formation, as water flows from the Arctic Ocean to the North Atlantic.

The objective is to characterise the provenance and mixing of Arctic waters as they transit through Baffin Bay using the isotope ratio of the rare earth element (REE) neodymium (143Nd/144Nd, expressed as eNd). The Nd isotope signature of seawater is mainly influenced by the lithology drained by the water input. Eastern Canada and Greenland are dominated by igneous and metamorphic rocks from the Precambrian, leading to a characteristic (i.e., unradiogenic) Nd isotopic composition in Baffin Bay (Stordal and Wasserburg, 1986). Thus, Baffin Bay waters can be distinguished from water masses sourced from other areas, allowing tracking of these waters on their way to the North Atlantic. Seawater samples were collected along two zonal transects from Canada to Greenland (TCAT3 at ~74° N and TCAT6 at ~57 ° N), partially pre-concentrated to Fe oxides on board. Elemental concentrations of trace metals and REE will be collected within the TCA project (Jay Cullen / Tia Anderlini, University of Victoria, Canada). The Nd isotope compositions will be analysed at the University of Lausanne (Switzerland). The outcome will improve our understanding of the response of the Nd isotope system to changing continental influx and outflow to the North Atlantic, with implications for the response of the biogeochemistry of seawater to climate change.

11.2 Methodology

The majority of the samples were collected using the trace metal rosette, which was deployed in the moon pool. Only samples from one station (Kebabb-S3) were sampled on the classic rosette (samples for Nd isotopes and REE concentrations). The trace metal rosette is equipped with twelve trace-metal-free Ocean Technology Equipment bottles. A full list of all collected samples is attached to the end of this document (Table 11-1).

All tubing, filter, and plastic material was pre-cleaned with 1 to 10 % HCl for several days. After recovery of the rosette, samples were filtered directly from the bottles using Teflon tubing and AcroPak cartridge filters (pore sizes of 0.8/0.45 μm or 0.8/0.2 μm) and collected in cubitainers (10 l volume). The filters were re-used for samples collected at similar depths. The volumes of the collected samples range between 5 and 9 l, typically averaging around 8 l. After filtration, all samples were acidified with HCl (30 %, Suprapur) to a pH of 2 within a few hours. All samples from stations Kebabb-S3, TCA-S3, TCAT3-01, -08, -17 and BB2 (45 samples) were coprecipitated on board, following e.g., Grenier et al., 2022. From station A9, two samples were collected in duplicates from two bottles (bottom and 50 m). One of each was precipitated on board, and the duplicate will be precipitated in the laboratory at the University of Lausanne. Samples were doped with 2–3 ml of a solution containing approximately 35 mg/ml of Fe. After an equilibration period of 12 to 24 hours, 15–17.5 ml of ammonia solution (25 %, Suprapur) were added to the samples to reach a pH of 8 to 9 (Figure 11-1a). After vigorous shaking, the samples were left to settle the precipitating Fe oxide for 12 to 24 hours. Subsequently, a large proportion of the supernatant was siphoned off using Teflon tubing (Figure 11-1b), and the precipitate along with the remaining fluid was transferred into LDPE bottles (500 ml). To remove any precipitates sticking to the container walls, the cubitainers were rinsed with MQ with a small amount of ammonia to reach a pH of 8 to 9, which was then added to the sample. The precipitate was allowed to settle again, before the supernatant was siphoned off to leave a final sample volume of approximately 100 ml. Two procedural blanks were processed along with the samples on board, as well as three blanks for each chemical that was used on board (HCl, Fe solution, ammonia).

Figure 11-1: A) Sample after adding Fe solution and shaking, b) siphoning, and c) final sample with a volume of > 500 ml

The remaining samples (n = 38) will be precipitated following the same procedure in the laboratories at the University of Lausanne. The precipitates will be centrifuged and rinsed, before dissolution in 6 M HCl. The samples will be processed through a three-step ion chromatography following Grenier et al. (2013). First, Fe will be separated from the samples (anion resin AG1-X8, 100-200 mesh, BioRad). Next, Nd and other REE will be isolated by processing through a cation (AG50W-X8, 200-400 mesh, BioRad), and subsequently, Nd will be separated from other REE using an anion exchange column (Ln-Spec). The resulting solutions will be first analysed for their Nd concentration to dilute them to a final concentration of approximately 20 ppb for Nd isotope analysis using MC-ICP-MS.

Table 11-1: Information on collected samples (ros = rosette, TM = trace metal).

Date	Sampling method	Lat	Long	Station	Cast	Niskin Bottle	Depth (m)
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	20	10
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	19	20
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	18	30
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	15	10
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	13	40
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	11	60
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	9	50
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	8	60
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	7	70
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	5	80
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	4	100
05.10.24	ros	74.0951	-91.0951	Keb-S3	10	1	bottom (~ 138 m)
06.10.24	TM ros	73.7382	-78.6763	TCA-S3	15	12	15
06.10.24	TM ros	73.7382	-78.6763	TCA-S3	15	9	60 tmin
06.10.24	TM ros	73.7382	-78.6763	TCA-S3	15	7	100
06.10.24	TM ros	73.7382	-78.6763	TCA-S3	15	6	200
06.10.24	TM ros	73.7382	-78.6763	TCA-S3	15	4	400 tmax
06.10.24	TM ros	73.7382	-78.6763	TCA-S3	15	2	800
06.10.24	TM ros	73.7382	-78.6763	TCA-S3	15	1	900
07.10.24	Zodiac	72.4978	-75.0145	TCAT3-01		Zodiac	surface Zodiac
07.10.24	TM ros	72.4978	-75.0145	TCAT3-01	19	11	15
07.10.24	TM ros	72.4978	-75.0145	TCAT3-01	19	9	30
07.10.24	TM ros	72.4978	-75.0145	TCAT3-01	19	7	40
07.10.24	TM ros	72.4978	-75.0145	TCAT3-01	19	3	60
07.10.24	TM ros	72.4978	-75.0145	TCAT3-01	19	1	Bottom (80 m)
08.10.24	TM ros	72.6388	-71.5780	TCAT3-08	27	12	15
08.10.24	TM ros	72.6388	-71.5780	TCAT3-08	27	10	30
08.10.24	TM ros	72.6388	-71.5780	TCAT3-08	27	7	100

08.10.24	TM ros	72.6388	-71.5780	TCAT3-08	27	4	500
08.10.24	TM ros	72.6388	-71.5780	TCAT3-08	27	2	900
08.10.24	TM ros	72.6388	-71.5780	TCAT3-08	27	1	Bottom (~ 1150 m)
09.10.24	Zodiac	72.7472	-67.0030	TCA-BB2		Zodiac	surface Zodiac
09.10.24	TM ros	72.7472	-67.0030	TCA-BB2	36	12	15
09.10.24	TM ros	72.7472	-67.0030	TCA-BB2	36	8	50
09.10.24	TM ros	72.7472	-67.0030	TCA-BB2	36	4	100
09.10.24	TM ros	72.7472	-67.0030	TCA-BB2	36	2	300
10.10.24	TM ros	72.7470	-66.9978	TCA-BB2	39	12	500
10.10.24	TM ros	72.7470	-66.9978	TCA-BB2	39	10	700
10.10.24	TM ros	72.7470	-66.9978	TCA-BB2	39	8	1000
10.10.24	TM ros	72.7470	-66.9978	TCA-BB2	39	7	1200
10.10.24	TM ros	72.7470	-66.9978	TCA-BB2	39	4	1800
10.10.24	TM ros	72.7470	-66.9978	TCA-BB2	39	2	2100
10.10.24	TM ros	72.7470	-66.9978	TCA-BB2	39	1	bottom (~2200 m)
12.10.24	TM ros	74.3149	-66.7404	TCAT3-17	51	12	15
12.10.24	TM ros	74.3149	-66.7404	TCAT3-17	51	8	50
12.10.24	TM ros	74.3149	-66.7404	TCAT3-17	51	3	200
12.10.24	TM ros	74.3149	-66.7404	TCAT3-17	51	1	400
11.10.24	TM ros	74.3133	-66.7221	TCAT3-17	48	11	600
11.10.24	TM ros	74.3133	-66.7221	TCAT3-17	48	8	1000
11.10.24	TM ros	74.3133	-66.7221	TCAT3-17	48	4	1800
11.10.24	TM ros	74.3133	-66.7221	TCAT3-17	48	2	2100
11.10.24	TM ros	74.3133	-66.7221	TCAT3-17	48	1	bottom (~ 2200 m)
12.10.24	Zodiac	75.8316	-66.5162	TCAT3-11		Zodiac	surface
12.10.24	TM ros	75.8316	-66.5162	TCAT3-11	57	12	15
12.10.24	TM ros	75.8316	-66.5162	TCAT3-11	57	10	30
12.10.24	TM ros	75.8316	-66.5162	TCAT3-11	57	6	80
12.10.24	TM ros	75.8316	-66.5162	TCAT3-11	57	4	200

12.10.24	TM ros	75.8316	-66.5162	TCAT3-11	57	2	430
12.10.24	TM ros	75.8316	-66.5162	TCAT3-11	57	1	bottom (~ 500 m)
16.10.24	Zodiac	67.0963	-54.2769	TCAT6-09 (A9)		Zodiac	surface Zodiac
16.10.24	TM ros	67.0963	-54.2769	TCAT6-09 (A9)	63	12	15
16.10.24	TM ros	67.0963	-54.2769	TCAT6-09 (A9)	63	9	30
16.10.24	TM ros	67.0963	-54.2769	TCAT6-09 (A9)	63	6	50
16.10.24	TM ros	67.0963	-54.2769	TCAT6-09 (A9)	63	5	50
16.10.24	TM ros	67.0963	-54.2769	TCAT6-09 (A9)	63	2	bottom (~ 72 m)
16.10.24	TM ros	67.0963	-54.2769	TCAT6-09 (A9)	63	1	bottom (~ 72 m)
16.10.24	TM ros	66.9828	-56.0619	TCAT6-07 (A7)	66	12	15
16.10.24	TM ros	66.9828	-56.0619	TCAT6-07 (A7)	66	10	30
16.10.24	TM ros	66.9828	-56.0619	TCAT6-07 (A7)	66	8	50
16.10.24	TM ros	66.9828	-56.0619	TCAT6-07 (A7)	66	5	80
16.10.24	TM ros	66.9828	-56.0619	TCAT6-07 (A7)	66	1	bottom (~ 72 m)
17.10.24	TM ros	66.8730	-57.9471	TCAT6-05(A5)	69	12	15
17.10.24	TM ros	66.8730	-57.9471	TCAT6-05(A5)	69	9	60
17.10.24	TM ros	66.8730	-57.9471	TCAT6-05(A5)	69	7	200
17.10.24	TM ros	66.8730	-57.9471	TCAT6-05(A5)	69	5	400
17.10.24	TM ros	66.8730	-57.9471	TCAT6-05(A5)	69	2	700
17.10.24	TM ros	66.8730	-57.9471	TCAT6-05(A5)	69	1	bottom (~ 817 m)
17.10.24	Zodiac	66.7287	-59.6099	TCAT6-03 (A3)	73	Zodiac	surface
17.10.24	TM ros	66.7287	-59.6099	TCAT6-03 (A3)	73	12	15
17.10.24	TM ros	66.7287	-59.6099	TCAT6-03 (A3)	73	9	40
17.10.24	TM ros	66.7287	-59.6099	TCAT6-03 (A3)	73	5	80
17.10.24	TM ros	66.7287	-59.6099	TCAT6-03 (A3)	73	2	120
17.10.24	TM ros	66.7307	-59.6021	TCAT6-03 (A3)	76	9	350
17.10.24	TM ros	66.7307	-59.6021	TCAT6-03 (A3)	76	6	500
17.10.24	TM ros	66.7307	-59.6021	TCAT6-03 (A3)	76	3	700
17.10.24	TM ros	66.7307	-59.6021	TCAT6-03 (A3)	76	1	bottom (~ 880 m)
18.10.24	ros	66.6045	-61.1948	TCAT6-01 (A1)	78	20	surface
18.10.24	ros	66.6045	-61.1948	TCAT6-01 (A1)	78	19	20
18.10.24	ros	66.6045	-61.1948	TCAT6-01 (A1)	78	12	50
18.10.24	ros	66.6045	-61.1948	TCAT6-01 (A1)	78	6	80
18.10.24	ros	66.6045	-61.1948	TCAT6-01 (A1)	78	11	bottom (~ 102 m)

11.3 Preliminary Results

No preliminary results are available at this point.

11.4 Recommendations

Laboratory space

The chemistry laboratory (553) requires transport of the samples (approx. 10 kg each) from the moon pool for quite a distance, including one flight of stairs. A laboratory space closer to the moon pool might be more practical for the future, and would facilitate keeping the samples cleaner, as shorter distances inside and outside of the ship would decrease the risk of contamination. The main requirement for a laboratory space is a fume hood, equipped with a filter for acids.

Filters for fume hoods

An acid filter is required as the samples for Nd isotopes (and most other REE or trace elements) need to be acidified, typically using concentrated or 6 M HCl, and was provided by Amundsen Science. To conduct the co-precipitation using ammonia solution, a fume hood equipped with an ammonia filter would have been useful. As the only alternative, an ammonia mask was used and the laboratory (chemistry lab, 553) was frequently aerated, although aeration compromises the cleanliness of the laboratory. However, it is unclear if both an ammonia and an acid filter can be installed in the fume hood of lab 553 at the same time, or if this work would require two separate fume hoods (one with an acid filter, another one with an ammonia filter).

11.5 References

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12 Baffin Bay: Artificial and Natural Tracers of Ocean Circulation and Ventilation Processes (14C, 39Ar, 85Kr,129I, 236U)

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Cruise participant – Leg 5a : Emmy Hieronimus[2]

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12.1 Introduction

The world's oceans are responding to the anthropogenically induced climate change, with the Arctic Ocean standing out as one of the most rapidly changing regions. Long-lived radionuclides of both natural and artificial origin (i.e. 129I, 236U, 14C, 85Kr and 39Ar) are excellent tools that bring insight to ocean circulation and ventilation processes. Amundsen offered the unique opportunity to sample water in the Baffin Bay and surroundings, to get more information about water mass circulation and its relation to climate change.

Specifically, the objectives of the work carried out on Leg 5a, were as follows:

- Understand the origin and composition of waters circulating in the Baffin Bay.
- Estimate the transport times of waters of Arctic-Atlantic origin that are present in the Baffin Bay.
- Constrain ages and ventilation times of intermediate and bottom waters.

12.2 Methodology

In order to meet the specific objectives, we collected water samples from Niskin bottles that are attached to a Conductivity-Temperature-Depth (CTD) rosette. Generally, samples for ^{129}I and ^{236}U focused on the upper 1000m. For ^{39}Ar, ^{85}Kr and ^{14}C samples, we concentrated our sampling effort to intermediate and bottom waters (from 1000m to 2400m).

We collected ~3L water samples for the analysis of ^{236}U and ^{129}I in plastic cubitainers. We collected seawater in empty 12L propane bottles for ^{39}Ar, that we filled with nitrogen gas before the cruise, and on the ship filled with vacuum to avoid contamination with atmospheric argon. We did the same for the ^{85}Kr samples, but with 27L propane bottles instead. For ^{85}Kr we needed three Propane bottles to fill them. To make sure that the samples would not get polluted by water that equilibrated with air we just took 10L from the Niskin bottles (the 1st Liter for rinsing the valves and tubes, the last Liter stayed in the Niskin bottle) and used the last Liter for the ^{14}C measurements. We used 120ml glass containers to collect 14C samples that we sealed air-tight right after the sampling process. After the sampling, we poisoned the ^{14}C samples with 100 µl mercury chloride ($HgCl_2$) to avoid organismic modifications to the ^{14}C-content.

In total 28 ^{39}Ar samples, 10 ^{85}Kr samples (one might be polluted), 38 ^{14}C samples and 108 samples for the analysis of ^{129}I and ^{236}U were taken at different locations (for detailed information please look at Table 12-1).

Figure 12-1: Sampling for ^{39}Ar samples, ^{14}C, and poisoning ^{14}C samples with mercury chloride

Table 12-1: Sample Information

Date (d/m/yr)	***Station***	***Cast***	***Niskin Bottle***	***NC-Ar***	***NC-Kr***	***NC-C14***	***NC-U/I***	***Coordinates***			
05.10.24	KEBABB-S3	009	1				x	BOTTOM POSITION			
05.10.24	KEBABB-S3	009	2				x	LAT (N):	74	°	5,892

05.10.24	KEBABB-S3	009	3		x			LON (W):	091	°	6,134
05.10.24	KEBABB-S3	009	4		x						
05.10.24	KEBABB-S3	009	5		x		x				
05.10.24	KEBABB-S3	009	9		x						
05.10.24	KEBABB-S3	009	10				x				
05.10.24	KEBABB-S3	009	15		x						
06.10.24	TCA-S3	17	1				x	BOTTOM POSITION			
06.10.24	TCA-S3	17	4				x	LAT (N):	73	°	44,442
06.10.24	TCA-S3	17	5				x	LON (W):	078	°	40,027
06.10.24	TCA-S3	17	7				x				
06.10.24	TCA-S3	17	8				x				
06.10.24	TCA-S3	17	9				x				
06.10.24	TCA-S3	17	20				x				
06.10.24	TCA-S3	17	24				x				
07.10.24	TCAT3-01	18	1				x	BOTTOM POSITION			
07.10.24	TCAT3-01	18	15				x	LAT (N):	72	°	30,151
07.10.24	TCAT3-01	18	20				x	LON (W):	075	°	1,202
07.10.24	TCAT3-01	18	24				x				
07.10.24	TCAT3-03	21	1				x	BOTTOM POSITION			
07.10.24	TCAT3-03	21	2				x	LAT (N):	72	°	32,467
07.10.24	TCAT3-03	21	4				x	LON (W):	074	°	19,468
07.10.24	TCAT3-03	21	13				x				
07.10.24	TCAT3-03	21	14				x				
08.10.24	TCAT3-05	22	1				x	BOTTOM POSITION			
08.10.24	TCAT3-05	22	4				x	LAT (N):	72	°	34,727
08.10.24	TCAT3-05	22	6				x	LON (W):	073	°	31,151
08.10.24	TCAT3-05	22	8				x				
08.10.24	TCAT3-05	22	12				x				
08.10.24	TCAT3-05	22	22				x				
08.10.24	TCAT3-05	22	24				x				
08.10.24	TCAT3-08	29	1				x	BOTTOM POSITION			
08.10.24	TCAT3-08	29	3				x	LAT (N):	72	°	38,378
08.10.24	TCAT3-08	29	4	x		x		LON (W):	071	°	33,370

08.10.24	TCAT3-08	29	5				x				
08.10.24	TCAT3-08	29	6				x				
08.10.24	TCAT3-08	29	7				x				
08.10.24	TCAT3-08	29	8				x				
08.10.24	TCAT3-08	29	10				x				
08.10.24	TCAT3-08	29	18				x				
08.10.24	TCAT3-08	29	24				x				
09.10.24	TCAT3-09	32	1				x	BOTTOM POSITION			
09.10.24	TCAT3-09	32	2	x		x		LAT (N):	72	°	41,261
09.10.24	TCAT3-09	32	3	x		x		LON (W):	070	°	6,554
09.10.24	TCAT3-09	32	4				x				
09.10.24	TCAT3-09	32	5				x				
09.10.24	TCAT3-09	32	6	x		x					
09.10.24	TCAT3-09	32	7	x		x					
09.10.24	TCAT3-09	32	8				x				
09.10.24	TCAT3-09	32	9				x				
09.10.24	TCAT3-09	32	10	x		x					
09.10.24	TCAT3-09	32	11			x					
09.10.24	TCAT3-09	32	12				x				
09.10.24	TCAT3-09	32	20				x				
09.10.24	TCAT3-09	32	21	x		x					
09.10.24	TCAT3-09	32	23				x				
10.10.24	TCA-BB2	37	2	x		x		BOTTOM POSITION			
10.10.24	TCA-BB2	37	7	x		x		LAT (N):	72	°	44,746
10.10.24	TCA-BB2	37	8			x		LON (W):	067	°	2,513
10.10.24	TCA-BB2	37	9	x		x					
10.10.24	TCA-BB2	37	10	x		x					
10.10.24	TCA-BB2	37	11				x				
10.10.24	TCA-BB2	37	12	x		x					
10.10.24	TCA-BB2	37	13	x		x					
10.10.24	TCA-BB2	37	14				x				
10.10.24	TCA-BB2	37	15			x	x				
10.10.24	TCA-BB2	37	16	x		x					
10.10.24	TCA-BB2	37	20			x					
10.10.24	TCA-BB2	37	22			x	x				
10.10.24	TCA-BB2	37	23	x		x					

10.10.24	TCA-BB2	37	24				x				
10.10.24	TCA-BB2	40	1		x			BOTTOM POSITION			
10.10.24	TCA-BB2	40	2		x			LAT (N):	72	°	44,796
10.10.24	TCA-BB2	40	3		x		x	LON (W):	067	°	0,124
10.10.24	TCA-BB2	40	4		x						
10.10.24	TCA-BB2	40	5		x						
10.10.24	TCA-BB2	40	6		x		x				
10.10.24	TCA-BB2	40	7		x						
10.10.24	TCA-BB2	40	8		x						
10.10.24	TCA-BB2	40	9		x		x				
10.10.24	TCA-BB2	40	10		x						
10.10.24	TCA-BB2	40	11		x						
10.10.24	TCA-BB2	40	12		x						
10.10.24	TCA-BB2	40	13		x						
10.10.24	TCA-BB2	40	14		x						
10.10.24	TCA-BB2	40	15		x		x				
10.10.24	TCA-BB2	40	16		x						
10.10.24	TCA-BB2	40	17		x						
10.10.24	TCA-BB2	40	18		x		x				
10.10.24	TCA-BB2	40	19		x						
10.10.24	TCA-BB2	40	20		x						
10.10.24	TCA-BB2	40	21		x						
10.10.24	TCA-BB2	40	22		x						
10.10.24	TCA-BB2	40	23		x						
10.10.24	TCA-BB2	40	24		x						
11.10.24	TCAT3-19	45	1	x		x		BOTTOM POSITION			
11.10.24	TCAT3-19	45	2				x	LAT (N):	73	°	47,059
11.10.24	TCAT3-19	45	4	x		x		LON (W):	066	°	50,897
11.10.24	TCAT3-19	45	5				x				
11.10.24	TCAT3-19	45	6	x		x					
11.10.24	TCAT3-19	45	7				x				
11.10.24	TCAT3-19	45	8	x		x					
11.10.24	TCAT3-19	45	9				x				
11.10.24	TCAT3-19	45	10	x		x					
11.10.24	TCAT3-19	45	11			x	x				
11.10.24	TCAT3-19	45	12				x				

11.10.24	TCAT3-19	45	13	x		x					
11.10.24	TCAT3-19	45	14			x	x				
11.10.24	TCAT3-19	45	22				x				
11.10.24	TCAT3-19	45	23	x		x					
11.10.24	TCAT3-17	49	3				x	BOTTOM POSITION			
11.10.24	TCAT3-17	49	5	x		x		LAT (N):	74	°	18,749
11.10.24	TCAT3-17	49	6				x	LON (W):	066	°	44,735
11.10.24	TCAT3-17	49	7				x				
11.10.24	TCAT3-17	49	8				x				
11.10.24	TCAT3-17	49	9				x				
11.10.24	TCAT3-17	49	10				x				
11.10.24	TCAT3-17	49	15				x				
11.10.24	TCAT3-17	49	18				x				
11.10.24	TCAT3-17	49	19				x				
12.10.24	TCAT3-15	53	3				x	BOTTOM POSITION			
12.10.24	TCAT3-15	53	5				x	LAT (N):	75	°	9,449
12.10.24	TCAT3-15	53	7				x	LON (W):	066	°	33,119
12.10.24	TCAT3-15	53	12				x				
12.10.24	TCAT3-15	53	21				x				
12.10.24	TCAT3-15	53	24				x				
12.10.24	TCAT3-11	56	3				x	BOTTOM POSITION			
12.10.24	TCAT3-11	56	5				x	LAT (N):	75	°	50,016
12.10.24	TCAT3-11	56	7				x	LON (W):	066	°	29,735
12.10.24	TCAT3-11	56	10				x				
12.10.24	TCAT3-11	56	15				x				
12.10.24	TCAT3-11	56	21				x				
12.10.24	TCAT3-11	56	23				x				
15.10.24	C4-23	61	1	x		x		BOTTOM POSITION			
15.10.24	C4-23	61	2				x	LAT (N):	67	°	58,819
15.10.24	C4-23	61	3				x	LON (W):	060	°	38,425
15.10.24	C4-23	61	4	x		x					
15.10.24	C4-23	61	5				x				
15.10.24	C4-23	61	6	x		x					
15.10.24	C4-23	61	7				x				

15.10.24	C4-23	61	8	x		x					
15.10.24	C4-23	61	11				x				
15.10.24	C4-23	61	12			x	x				
15.10.24	C4-23	61	13				x				
15.10.24	C4-23	61	14			x	x				
15.10.24	C4-23	61	15				x				
15.10.24	C4-23	61	16				x				
15.10.24	C4-23	61	22	x		x					
15.10.24	C4-23	61	23				x				
15.10.24	C4-23	61	24				x				
16.10.24	TCAT6-09	64	8				x	BOTTOM POSITION			
16.10.24	TCAT6-09	64	11				x	LAT (N):	67	°	5,731
16.10.24	TCAT6-09	64	19				x	LON (W):	054	°	16,031
16.10.24	TCAT6-09	64	24				x				
18.10.24	TCAT6-01 (A1)	79	10				x	BOTTOM POSITION			
18.10.24	TCAT6-01 (A1)	79	18				x	LAT (N):	66	°	35,967
								LON (W):	061	°	10,730

12.3 Preliminary Results

After the expedition all ^{39}Ar and ^{85}Kr samples will be sent to the University of Heidelberg for measurements. Traditional low-level counting would require very large volumes of water (up to 1500L) due to the low abundance of 10-16 moles ^{39}Ar in seawater. Therefore, the new technique Atom Trap Trace Analysis (ATTA) is applied. Instead of radioactive decay counting, single atoms are caught with a magneto-optical trap, counted and the ratio of dissolved $^{39}Ar/Ar$ is deduced for each sample. ^{39}Ar is produced in the atmosphere and becomes isolated from its source as it enters the ocean through air-sea gas exchange. ^{39}Ar decays thereafter with a half-life of 269 years leading to lower concentrations in water masses that have not been in contact with the atmosphere for a long time. This can be used to calculate isolation ages and residence times of the seawater samples.

Seawater samples collected for the analysis of ^{14}C, ^{129}I and ^{236}U will be sent to ETH Zurich for further processing in the laboratory and measurements with Accelerator Mass Spectrometry (AMS). As we want to measure the concentration of ^{14}C in DIC, we first have to degas the seawater samples. Then the $^{14}CO_2$ is graphitized to bring it into the desired form for AMS measurements. Similar as in a conventional mass spectrometers we separate ^{14}C from other compounds based on its mass to charge ratio. However, the unique feature of accelerating the ion beam to very high kinetic energies (millions of electron volts) allows us to suppress and strip off unwanted interfering isobars. Measurements of ^{14}C are conducted with the Mini radiocarbon Dating System (MICADAS) AMS system. The radioisotopes ^{129}I and ^{236}U are present as dissolved ions in seawater, so instead of being degassed from the sample, they have to undergo a pre-concentration step in the laboratory leading to silver and iron participates for ^{129}I and ^{236}U, respectively. These long-lived radionuclides are measured in Tandy and MILEA Accelerator Mass Spectrometry (AMS) systems in the Laboratory of Ion Beam Physics (ETHZ)., which can be measured with AMS as well. We will conduct the measurements of ^{236}U and ^{129}I at the Laboratory of Ion Beam Physics (ETH Zurich), using the for ^{129}I and ^{236}U, respectively.

Results of ^{129}I and ^{236}U concentrations will be used to understand the pathways of water masses flowing in and out the studied region. The combination of both tracers will serve to understand the provenance of water masses (Dale et al., 2024) and to ultimately calculate transport times and mixing of water masses (Casacuberta and Smith, 2023). Results on ^{14}C and ^{39}Ar will be very beneficial to estimate the ages (or ventilation times) of deep and bottom waters in the Baffin Bay. In particular, we are interested in understanding the formation areas of the deep and old waters that are sitting at the bottom of the Baffin Bay. Finally, ^{85}Kr tracer is a novel tracer that is now emerging thanks to the new advancements in Atom Trap Trace Analysis technologies. The two profiles taken during this expedition will be the first attempt of collecting and measuring this isotope in open ocean waters.

12.4 Recommendations

For the very heavy Argon and Krypton samples it would be better to have a lab and storage space close to the CTD-Rosette.

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13 Carbonate systems and the carbon cycle in Arctic fjords

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13.1 Introduction and Objectives

The oceans represent the largest carbon reservoir on Earth's surface. Due to their substantial capacity to store carbon, the oceans play a central role in the global carbon cycle and climate regulation, particularly by limiting the increase in atmospheric CO_2 concentrations. Recent estimates indicate that the oceans absorb approximately 2.9 ± 0.4 GtC annually (Friedlingstein et al., 2022), which corresponds to 25% of the annual CO2 emissions from human activities. However, this large-scale absorption of anthropogenic CO_2 leads to a gradual acidification of surface waters (Doney et al., 2009), with a potential pH decrease of 0.3 units by 2100 (IPCC, 2019). The oceanic carbonate system is influenced by various factors, including CO_2 exchanges at the air-sea interface, biological processes (photosynthesis and respiration), riverine inputs, as well as the precipitation and dissolution of $CaCO_3$. In this context, calcifying organisms, which use $CaCO_3$ to build their exoskeletons, are likely to face increasing difficulties in developing within a more acidic ocean environment (Orr et al., 2005). Beyond this global acidification, coastal areas play a strategic role in the carbon cycle, as they mediate the transition between terrestrial and oceanic environments. These coastal zones receive inputs of freshwater, dissolved elements, and particulate matter (sediments, organic and inorganic carbon, nutrients, contaminants...), which directly influence the productivity of coastal ecosystems. Consequently, these inputs modulate the distribution and characteristics of pelagic and benthic ecosystems. The effects of climate change are especially pronounced at high latitudes, notably in the Arctic Ocean, which has been warming 3 to 4 times faster than the global average since 1980 (IPCC, 2019; Rantanen et al., 2022). This increase in atmospheric temperatures leads to profound alterations in the carbon cycle in both terrestrial and marine environments (Bates et Mathis, 2009; McGuire et al., 2009), exacerbating the sensitivity of these regions to acidification (Bellerby, 2017; AMAP, 2018; Terhaar et al., 2021). Although the consequences of these disturbances are still poorly understood, they require particular attention given the Arctic Ocean's crucial role in absorbing atmospheric CO_2 and regulating the climate (AMAP, 2021). These transformations are profoundly affecting Arctic ecosystems, particularly phytoplankton communities (Ardyna and Arrigo, 2020; Lannuzel et al., 2020). In this context, Arctic fjords, which are subject to flows from various rivers and ice shelves, as well as to melting of coastal and offshore pack ice, are particularly sensitive areas of high primary production. It is essential to better understand how their biogeochemical cycle is affected by these multiple environmental pressures, which could have repercussions on ecosystem responses. Particular attention needs to be paid to the study of Arctic waters, especially fjords, to assess the impact of ocean acidification and characterize the contribution of different water sources and masses to this acidification and, more generally, to the carbon cycle.

13.2 Methodology

To have a good overview of the fjord ecosystem, 3 parameters (TA, DIC, pH) of the carbonate system were carried out on the water column and on the various adjacent water sources in the fjords (by barge and helicopter). The pH was determined colorimetrically at 25°C (Clayton and Byrne, 1993; Liu et al., 2011). on board by colorimetry at 25°C using a CARY UV 60 from Agilent Thechnologies in the UV Visible range with a 10cm cylindrical quartz cell, using purified mCp as the color indicator was used as indicator, and measurements were carried out at the wavelengths of maximum absorbance of the protonated and deprotonated mCP, 434 and 578 nm. All pH measurements Will be converted to in situ pHt (pH reported on the total proton scale) using CO2SYS. Total alkalinity was measured on board using an open-cell potentiometric titration (TitraLab 865, Radiometer®) with a combined pH electrode (pHC2001, Red Rod®) and diluted HCl (0.005 M) as a titrant. The DIC were poisoned with HgCl2 (2µL for the 10mL samples and 200µL for 500Ml samples) and stored at 4°C. The 10mL samples will be determined using cavity ring-down spectrometry (CRDS, Picarro G2131-i) using an automatic CO2 extraction system (Apollo SciTech AS-D1) which will also allow us to obtain complementary 13C measurements. In addition to these measurements, calcium measurements will be carried out in the water column to measure the response of this element to pH variations. Concentrations of Ca2+ will be analyzed on 25 µL aliquots (previously diluted by a factor of 200) with a liquid phase ion chromatography system (ICS 1000 $DionexTM$) with CGA6 precolumn, CS16 column and CRDS-600 88Ma suppressor, following He et al (2020). The eluent used is HMSA at 15 mM with a flow of 1.0 mL min-1. In addition, sediment cores were sampled to study pore water parameters such as DIC, TA and Ca2+.

Table 13-1: The sampled parameters

Leg	Stations	Water column	Barges-Helico	Sed. PW	Boxcore
3	RA01	TA, pH			
	RA02	TA, pH, DIC (BW)	TA, pH		
	RA03	TA, pH, DIC (BW)			
	RA04	TA, pH, DIC (BW)	TA, pH,		
	RA05	TA, pH, DIC (BW)			
	RA06	TA, pH, DIC (BW)		DIC, TA, Ca^{2+}	
	RA07	TA, pH, DIC (BW)	TA, pH (2xH)		
	RA08	TA, pH, DIC (BW)	TA, pH (3xbg,1xH)		
	RA09	TA, pH, DIC (BW)			
	RA12	TA, pH, DIC, TA, Ca^{2+}	TA, pH (3xbg, 3xH)	DIC, TA, Ca^{2+}	
	RA13	TA, pH, DIC, TA, Ca^{2+}	TA, pH (3xH)		
	RA14	TA, pH, DIC, TA, Ca^{2+}			
	RA15	TA, pH, DIC, TA, Ca^{2+}			
	RA16	TA, pH, DIC, TA, Ca^{2+}			
	RA17	TA, pH, DIC, TA, Ca^{2+}			
	RA18	TA, pH, DIC, TA, Ca^{2+}	TA, pH (2xbg, 2xH)	DIC, TA, Ca^{2+}	
4	RA25	TA, pH, DIC (bw)			
	RA26	TA, pH, DIC (bw)			
	RA28	TA, pH, DIC (bw)			
	RA31	TA, pH, DIC (bw)			
	RA37	TA, pH, DIC (bw)			
	RA38	TA, pH, DIC (bw)			Sediment overlaying water and porewaters
	RA41	TA, pH, DIC (bw)			
	RA43	TA, pH, DIC (bw)			
	RA48	TA, pH, DIC (bw)			
	RA50	TA, pH, DIC (bw)			Sediment overlaying water and porewaters
	RA51	TA, pH			

	RA54	TA, pH, DIC (bw)			Sediment overlaying water and porewaters
	RA58	TA, pH			
	RA62	TA, pH, DIC (bw)			Sediment overlaying water and porewaters
	RA67	TA, pH, DIC (bw)			Sediment overlaying water and porewaters
	RA69	TA, pH, DIC (bw)			
	RA70	TA, pH			

bw = bottom water

13.3 Preliminary Results

The results obtained require post-measurement processing and calculation before interpretation.

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14 Dissolved Organic Matter Cycling in Baffin Bay

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14.1 Introduction and Objectives

Dissolved organic matter (DOM) is a complex pool of carbon derived primarily from biological processes. Existing on a scale of reactivity from extremely labile (biologically or otherwise) to extremely unreactive (i.e. refractory), the chemical properties of DOM can be used to trace its origin and potentially predict its behaviour in the carbon cycle as either source of CO_2 or as a carbon sink in the deep ocean. Our objectives for this cruise were as follows:

a) Characterize and quantify the dissolved organic carbon in Baffin Bay
b) Collect samples for chemical characterization of different water masses in Baffin Bay
c) Develop a biodegradation potential for DOM in Baffin Bay
d) Collect samples for photochemical analysis in the Eastern Canadian Arctic surface waters.

14.2 Methodology

Four main data sets were collected each associated with different objectives, all samples were filtered directly from the Niskin bottles on the classic rosette using an Opticap XL cartridge filter. Dissolved organic carbon (DOC) and chromophoric dissolved organic matter (CDOM) were collected in ashed 40mL glass vials. Samples for solid phase extraction (~500mL) and for photochemistry (1-2L) were collected in acid-washed polycarbonate bottles. Samples for biodegradation were collected in 60ml HDPE bottles. Samples for full depth profiles DOC and CDOM were taken at stations Kebabb S3, TCA S3, all Basic and Full stations along TCA transect 6, and all full stations on TCA transect 3. These samples were collected to fulfill objective (a), and will be analyzed post-cruise at Memorial University. Samples for solid phase extraction (SPE, objective b) were collected targeting different water masses as follows: temperature minimum, temperature maximum, surface water and subsurface chlorophyll maximum. These samples were acidified with hydrochloric acid to a pH of 2 and then extracted on Agilent PPL solid phase cartridges on board and frozen for analysis at Memorial University. Samples for biodegradation (objective c) were collected at all depths on Full stations only (T6 and T3). Samples for biodegradation were filtered and then spiked with unfiltered water (2% of total volume i.e. 1.2 mL) from the same Niskin bottle. These are being incubated at room temperature and will be processed upon return to Memorial University. Samples for photochemistry (objective d) will be used to determine apparent quantum yields (AQYs) for the formation of CO_2. These samples were collected from surface water bottles only on Kebabb S3, TCA S3, Full Stations on T6 and T3. AQYs will be determined at Memorial University.

14.3 Preliminary Results

All sample analysis will occur post-cruise at Memorial University.

15 Water and carbon isotopes

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15.1 Introduction and Objectives

15.1.1 *Water isotopes*

The stable isotopic composition of seawater ($^{18}O/^{16}O$ and D/H ratios, expressed as $\delta^{18}O$ and δD, in per mil vs the VSMOW international standard) is an essential ocean tracer that has been widely measured since the 1960s. Seawater $\delta^{18}O$ and δD are used to investigate the hydrological cycle and the exchanges between the ocean, sea ice, ice sheets, the atmosphere and continental runoff. In particular, these tracers are a powerful tool for identifying the origin of salinity changes and establishing whether they are due to sea ice melting, ice sheet melting, or changes in precipitation, as these different sources of freshwater have distinct isotopic signatures (Akhoudas et al., 2020, 2023; Kim and Timmermann, 2024; Reverdin et al., 2022). In the current context of global warming, monitoring their evolution in high latitude regions is essential to: (i) constrain the amount of ice sheet melting in order to reduce uncertainties on sea level rise projections; and (ii) identify the processes at the origin of the observed decrease in surface water salinity in regions of dense water formation in order to reduce uncertainties on future changes in the global overturning circulation. The water samples that were collected during Leg 3 of the Refuge Arctic Amundsen 2024 expedition are especially promising because they encompass glacier ice, surface water on transects between the front of marine-terminating glaciers and the ship, as well as water retrieved by the rosette over the water column in different stations located on transects between the head and entrance of four different fjords. This very complete set of samples will allow us to produce a precise assessment of the isotopic signature of the different fresh water sources, whereas the latter are generally associated with very large uncertainties for lack of direct measurements (e.g. Akhoudas et al., 2020, 2023).

NB: it has been agreed between C. Waelbroeck and G. Reverdin (LOCEAN, Paris) on the one hand, and M. Ardyna (Takuvik) representing L. Matthes (DFO, Winnipeg), on the other hand, that the water isotope data that will be generated from the water collected during Leg 3 and Leg 4 of the Refuge Arctic Amundsen 2024 expedition, will be mutually shared in order to reach a better spatial and temporal coverage of the areas sampled during the campaign.

15.1.2 *The $^{13}C/^{12}C$ ratio of the dissolved inorganic carbon*

In surface waters, the stable isotopic composition of dissolved inorganic carbon ($^{13}C/^{12}C$, expressed as $\delta^{13}C$ in per mil vs the VPDB international standard) of dissolved inorganic carbon (DIC), noted $\delta^{13}C$-DIC, is governed by primary productivity (the preferential fixation of ^{12}C compared to ^{13}C by primary productivity leads to an increase in $\delta^{13}C$-DIC), and by temperature dependent air-sea carbon exchanges (Lynch-Stieglitz et al., 1995; Zhang et al., 1995). Importantly, surface water $\delta^{13}C$-DIC is directly impacted by the increase in atmospheric CO_2 concentration and associated decrease in atmospheric $\delta^{13}C$-CO_2 in response to fossil fuel combustion (called the Suess effect (Keeling, 1979)). The spatio-temporal distribution of $\delta^{13}C$-DIC can thus be used to assess the oceanic uptake of anthropogenic CO_2 (Eide et al., 2017; Kroopnick, 1985; Olsen et al., 2006). In deep waters, the $\delta^{13}C$-DIC decreases as deep water ages, due to progressive remineralization at depth of ^{13}C-depleted biogenic material. In the context of the ongoing large warming of the polar regions, it is particularly interesting to monitor the $\delta^{13}C$-DIC evolution in high latitude regions for two main reasons: (i) to assess to what extent the ongoing warming impacts the air-sea CO_2 exchanges; and (ii) to help constraining ongoing changes in the marine carbon cycle. The $\delta^{13}C$-DIC measurements on water samples collected during the Refuge Arctic Amundsen 2024 expedition, combined with DIC, total alkalinity (TA), pH, O_2 and nutrients data produced by the Refuge Arctic consortium, will provide a complete description of the marine carbonate system, as well as CO_2 air-sea fluxes in the Arctic region sampled during the campaign.

15.1.3 *The $^{14}C/^{12}C$ ratio of the dissolved inorganic carbon*

In water profiles, radiocarbon measurements of DIC, noted $\Delta^{14}C$-DIC, allow the characterization of the different water masses (Broecker et al., 1985) , the oceanic circulation and carbon cycle. In this context, this new set of $\Delta^{14}C$-DIC data in the different water masses will be compared with the previous $\Delta^{14}C$-DIC data existing in this zone to study the temporal variability of the circulation at the different depths. These new data will make it possible to determine whether there have been changes in the circulation patterns of the different water mass depths in this area by comparison with spatio-temporal Δ^{14}C-DIC data obtained in previous campaigns.

15.2 Methodology

For water isotopes, water was sampled from the Niskin bottles of the Amundsen's CTD rosette with a silicon tube into 20 mL amber glass bottles. A small headspace was left before closing the bottles in order to allow the water to expand with temperature increase. The cap was then screwed tightly and 1-2 turns of parafilm added at the junction between the cap and the bottle to improve the seal. For ·13C-DIC, water was sampled from the Niskin bottles of the Amundsen's CTD rosette the same way into 30 mL amber glass bottles, except that 30 ·l of supersaturated HgCl2 solution was added in order to prevent biological activity. The cap was then screwed tightly and 1-2 turns of parafilm added to improve the seal. For 14C/12C of the DIC, water was sampled from the Niskin bottles of the Amundsen's CTD rosette the same way into into 250 mL clear glass bottles and 600 ·l of supersaturated HgCl2 solution was added in order to prevent biological activity. The bottles were then closed by adding grease (piezon H or L) on the portion of the cap in contact with the bottle neck. The samples were stored at 4°C and preserved from sunlight. For 14C/12C of the DOC, water was collected from the Niskin bottles of the Amundsen's CTD rosette into 1-2 L glass bottles, then filtered, using pre-weighted 0.7 ·m GF/F filters. 250 mL of filtered water were transferred into 250 mL clear glass bottles and poisoned with 250 ·L HCl (37%) to prevent biological activity. The bottles were then closed by adding grease (piezon H or L) on the portion of the cap in contact with the bottle neck and stored at 4°C in the dark. For 14C/12C of the POC, the filtration started when collecting the DOC sample was continued using the remainder of the water sampled from the rosette as long as the filter was not saturated. Filters were then oven dried and stored at -20° Celsius.

15.3 Preliminary Result

Samples were collected during the cruise, but not measured, so there are no preliminary results.

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16 Sources and fluxes of chemical elements at the ocean interfaces

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16.1 Introduction and Objectives

The objectives of the LEGOS' team participating to Refuge Arctic is to characterize the sources and fluxes of chemical elements at the ocean interfaces, and the processes of chemical exchange between the dissolved and particulate phases (D-P exchange processes hereafter) in the ocean. In this goal, they associate the information brought by geochemical tracers with complementary properties: 1) the radioactive isotopes Beryllium-10, Thorium-230, Thorium-232 are used as chronometers and their different origin (10Be: atmospheric, 230Th: marine, 232Th: continental) will be used to quantify fluxes of atmospheric deposition, marine particle sinking, and continental fluxes, respectively; 2) the radiogenic isotope 143Nd traces the geographical origin of continental weathering, and 3) the stable 9Be isotope and Rare Earth Elements are lithogenic and used to complement continental fluxes and D-P exchange processes in seawater (Grenier et al, 2018; 2019; Pham et al, 2019, 2022; Lagarde et al, 2020). For each of these tracers, dissolved and total (i.e., dissolved + particulate) fractions will be analyzed, in the seawater as in the sea ice. Glaciers and rivers discharged to the fjords were sampled (Helicopter) during Leg 3. Sea ice floes were sampled during Leg 4, as well as Nares Strait sediment and pore waters. This will allow disentangling the atmospheric source directly transferred to the ocean surface or indirectly, through sea ice melting (10Be), from other vectors of land weathering (glacier, permafrost thawing, rivers; 9Be, REEs, and Th and Nd isotopes) as well as quantifying their relative importance (fluxes). With Nd isotopes, they will also contribute to identify the origin of the water masses circulating in the Lincoln Sea and Nares sound. Combining these observations with the ocean and sea-ice circulation and dynamics of the REFUGE-ARCTIC area will bring quantitative estimates of processes and transports that affect other elements including the nutrients and contaminants.

16.2 Methodology

One of the main difficulties regarding the measurement of these tracers is their very low abundances in seawater as well as in the sea ice (10^{-15} to 10^{-18} mol/l for Th isotopes, REEs and 9Be and 10^2 to 10^5 at/g for ^{10}Be). The challenge is to collect enough amounts as cleanly as possible in a contaminating area (metallic ship, paint, rust…).

16.2.1 *Seawater sampling*

The waters were sampled from the Trace Metal rosette (TMR) settled in the moon pool, directly from the pre-cleaned Go-Flo bottle using a Teflon connexion, using precleaned containers. For each sample, large water volumes are required, thus two Go-Flo bottles were closed at the same depth, when possible. In addition, the surface waters were sampled by hand with the barge or the zodiac or (exceptionally) using 2 bottles of the regular rosette, closed between 2 and 5 m depth.

16.2.2 *Ice sampling*

Ice samples were collected by coring (Takuvik corer used: 1.5 m length; 10-cm diameter) and subsampled on the ice, using a plexiglass home-made cutting table and a titanium snow saw (brand: SULUK). The core was sliced every 10 cm and each 10-cm sample was collected in a cleaned dedicated 1L PET bottle. Snow, melt pond water and ice were collected if possible, close by the core location. Snow and melt pond water samples were collected by hand, and melt pond ice using the corer, in a 1L PET bottle. Under ice water (4 to 10L) was collected using Lars-Eric Heimbürger pump, in a 10L jerrican.

16.2.3 *Sediment sampling*

Samples were collected from box coring (the GEO mostly) to characterize the chemical concentration in the sediment, pore waters and overlying (bottom) water and determine associated fluxes. When present, water overlying the sediment was collected by hand from the box core in 2 1L PET or Nalgene bottles. We also got pore waters from the 1, 3 and 5 cm layers (Bruno Lansard and Francois Thil) and the two upper layers of the core (0-1 cm and 1-2 cm, about 80 g each; Elizabeth Michel).

16.2.4 *Pre-treatment on board*

° Seawater: in the chemical aft laboratory, the two volumes were mixed in a 20 L cubitainer before being split in "large" and “small” aliquots, in other words ca 9L to be filtered (F), ca 9L kept non-filtered (NF) and small volumes of 500 ml and 250 ml, F and NF either.
The filtered aliquots were passing through cartridges "ACROPACK" (Pall corporation), 0,45µm mesh and cartridges were stored. The lake, glacier and river samples were split in two fractions (~ 5 l each, F and NF), acidified and stored.
Small aliquots (500 and 250 ml, F and NF) and 250mL were acidified and stored for the concentration analyses.
Filtered and non-filtered large aliquots were weighted on a very high precision OHAUS balance. A mixture of Be and Th spikes, dissolved in an acidic FeCl solution was added to the F and NF large aliquots, which are vigorously mixed.
A delay of at least 24 hours was then respected. The pH of these large aliquots was then brought to 8+/-0.2 by Suprapur concentrated NH4OH addition (ca 11 ml). A delay of at least 36 hours was then respected, to leave the iron hydroxide co-precipitate to develop and settle. The supernatant was thus siphoned, the remaining solution poured in a 1L decanter jar. After decantation, the remaining supernatant was poured from the jar to the sink. The final (and reduced) volume was centrifuged to obtain a precipitate pellet, easy to transport.
Sea ice: Ice samples were set to melt in the heated METOCEAN container. After melting they were brought back to the aft lab. From 40 cm core depth, 10-cm subsamples were pooled together as follows: 1) 20 to 40 cm, 2) 40 to 100 cm, 3) 100 to 160 cm, 4) 160 to 220 cm etc until the last subsample. A ~480 mL aliquot was taken on every huge volume (60 cm pooling layers) for trace metal analysis (Tia Anderlini). A small aliquot was also taken for delta18O analysis (Claire Waelbroeck, Francois Thil) from the upper (0-10 cm), middle and bottom layers (the two latter depending on the total core thickness). All samples were homogenized (in 1L PET bottle or 10L cubitainer, depending on the sample volume) and divided in two: one half was kept unfiltered, acidified to pH 2 and stored; the other half was filtered, on a filtration system lent by Tia Anderlini (manual pump for vacuum and polyethersulphone filters SUPOR of 0.22 µm pore size) for small volumes (snow, melt pond, ice samples from 0 to 40 cm) or as for seawater samples (0.45 µm pore-size filter cartridge, gravity filtration) for larger volumes (i.e. core samples collected at a depth >40 cm), and were then acidified to pH 2 and stored.

Sediment: Overlying water samples were homogenized when possible, half was kept unfiltered, acidified to pH 2 and stored; the other half was filtered, using Tia Anderlini's filtration system (see sea ice sample), acidified to pH 2 and stored. Pore water samples (filtered using a 0.2 µm pore size filter mounted on a syringe and collected in one or two acid-cleaned 50 mL centrifugation cones) were acidified to pH 2 and stored. Sediment samples were stored in sterile bags.

16.2.5 *Back to land*

Seawater, sea ice, snow, melt pond and pore water samples: Back in the laboratory in Toulouse, the different isotopes of interest (Be, Th, Nd isotopes and REEs) will be extracted after dissolution of the precipitate by liquid chromatography. This will be done in a clean laboratory. Once purified, their isotopic compositions will be determined by mass spectrometry: ASTER national facility at Cerege, Aix en Provence (Fr) for Be-10, MC-ICPMS (Neptune Thermo) for Th and TIMS (Triton+, Thermo) for Nd, both at Observatoire Midi-Pyrénées, Toulouse (Fr). The 9Be, 232Th and REE concentrations will be extracted from the 500 ml and 250 ml aliquots by liquid chromatography and measured by SF-ICPMS (Element, Thermo).

16.3 Preliminary results

No result yet. Indeed, the whole procedure described above requires between one week (for concentrations) and one month (for isotopic composition) per set of 8 samples. We estimate that 2 y after the cruise are necessary to get data published.

16.4 Recommendations

Because of the numerous potential contaminations while sampling and manipulating on the ship, the main recommendations on board were: stay away from the rosette, please respect the "bubble Lab" that we settled at the beginning of the leg.

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17 Investigating Nitrogen Cycling and Greenhouse Gas Dynamics in Baffin Bay

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17.1 Introduction and Objectives

The Arctic Ocean (AO) plays a key role in transporting nutrients, oxygen, and carbon into the Western North Atlantic (WNA) and the deep-convection areas driving the AMOC. Baffin Bay (BB) is a crucial gateway between the AO and the WNA, yet the biogeochemical processes in this region remain poorly understood, particularly regarding the origin, concentration, and transformation of nitrogen nutrients (e.g., nitrate, nitrite, ammonium).

Our main objective is to evaluate the potential fixation of dinitrogen or loss of fixed nitrogen using N2/Ar tracers at various locations in BB, including the Baffin Island Current, Davis Strait, and central BB. We also collected samples to measure N_2O concentrations, a potent greenhouse gas produced during incomplete denitrification or nitrification, particularly in low pH waters. The analysis of N_2O will also provide CH_4 concentrations.

17.2 Methodology

Water samples were collected at different depths from the classic rosette bottles and distributed into 12 ml glass vials. This maximum volume used per bottle 0.2 liter. The samples were then spiked with $ZnCl_2$ in the science laboratory (room 610) and stored at 4°C until analysis, which will be conducted using Membrane Inlet Mass Spectrometry (MIMS) for N_2/Ar and a Gas Chromatograph with Electron Capture and Flame Ionization Detectors (GC ECD/FID) for CH_4 and N_2O. All stations associated to the TCA program were sampled.

Station	Latitude	Longitude
Kebabs-S3	74°5.708'N	91°5.706'W

TCA-S3	73°44.239'N	78°40.267'W
TCAT3_01	72°30.158'N	75°1.195'W
TCAT3_05	72°34.613'N	73°30.950'W
TCAT3_08	72°38.375'N	71°34.559'W
TCAT3_09	72°41.334'N	70°5.545'W
TCAT3-BB2	72°44.858'N	67°0.226'W
TCAT3_19	73°47.381'N	66°50.099'W
TCAT3_17	74°18.811'N	66°43.274'W
TCAT3_15	75°9.449'N	66°33.133'W
TCAT3_13	75°29.658'N	66°29.340'W
TCAT3_11	75°50.003'N	66°29.490'W
C4-23	67°55.446'N	60°39.156'W
TCAT6-01 / A1	66°36.11'N	61°11.61'W
TCAT6-03 / A3	66°43.859'N	59°36.655'W
TCAT6-05 / A5	66°52.333'N	57°56.528'W
TCAT6-07 / A7	66°58.978'N	56°3.798'W
TCAT6-09 / A9	67°5.729'N	54°16.439'W

18 Investigating Carbonate Dynamics and Anthropogenic Impacts on Carbon, Oxygen, and Nitrogen

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Cruise Participant-Leg 5a : Claire Normandeau
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18.1 Introduction and Objectives

The cycling of the three key chemical elements essential for life in the ocean—carbon, oxygen, and nitrogen—is undergoing unprecedented changes due to human activities. Our goal is to observe, understand, and predict the complex interactions within these biogeochemical cycles through various ways. Specifically, on this cruise, we focused on collecting water samples to characterize the carbonate system, which includes dissolved inorganic carbon (DIC), DIC-$\delta^{13}C$, pH, and total alkalinity (TA). The DIC-$\delta^{13}C$ ratio, an anthropogenic tracer, will enable us to determine the presence of Suess effect and to describe any biological drawdown and remineralization of carbon in the water column.

The samples will be analyzed at the CERC.OCEAN laboratory and will be compared with replicate samples collected by other researchers. It will be interesting to compare the analyzed pH with the calculated pH derived from DIC and TA measurements made by David Cappelle's team at DFO. The DIC-$\delta^{13}C$ results will be compared with measurements made by Claire Waelbroeck and Gilles Reverdin at LOCEAN.

18.2 Methodology

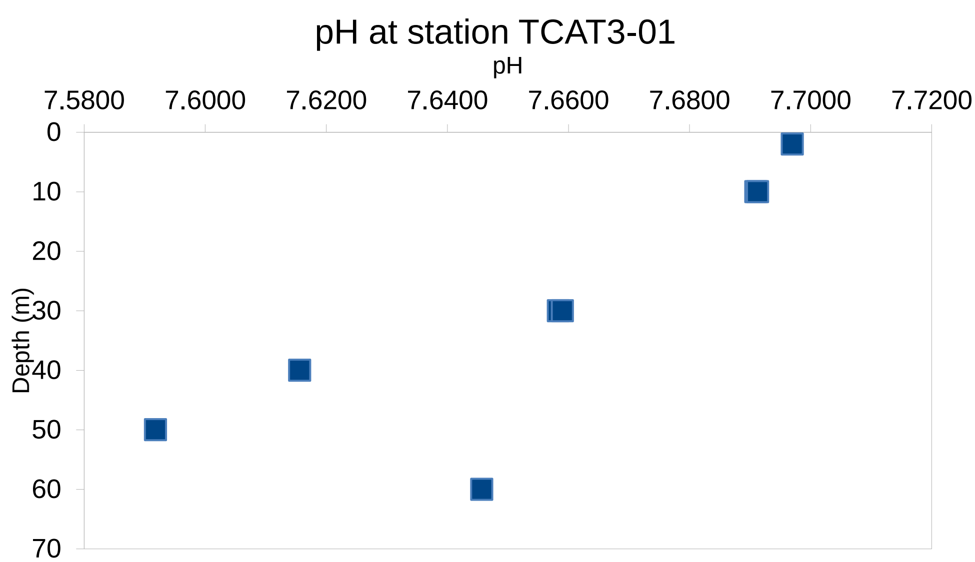
Water was collected at the rosette in 250 mL borosilicate glass bottles with screw caps (Fisher Scientific FB800250). A Tygon sampling tube was lowered to the bottom of the bottle, and the bottle was filled through the tube below the water level. The bottle was overflowed by one volume, and any bubbles were removed before capping. In the laboratory, 75 µL of saturated mercury chloride solution was quickly added to each sample.

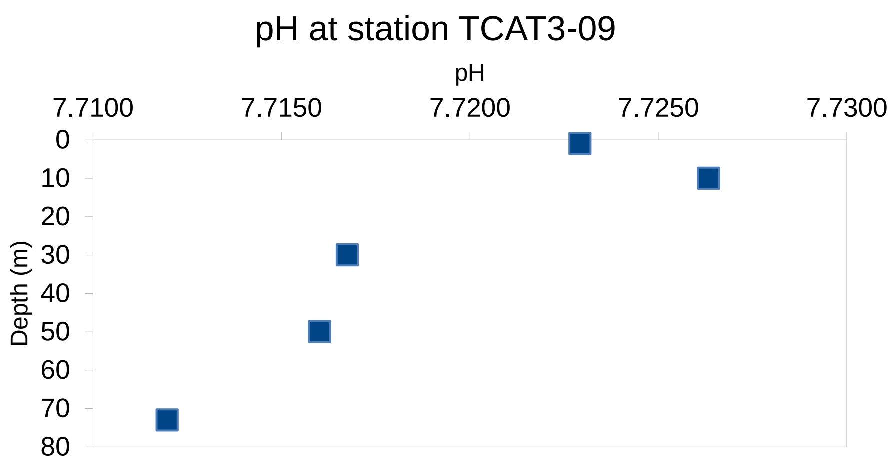
The pH of the samples was measured on board at five stations (TCAT3-01, TCAT3-11, TCAT3-17, TCAT3-19, TCAT6-09) using a Fisher Scientific spectrophotometer (model Evolution 60).

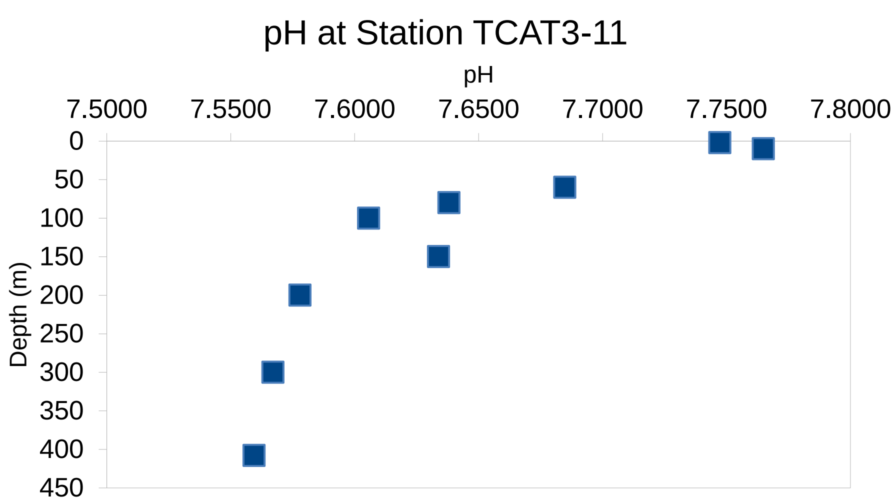
The samples were warmed to 25 °C in a water bath and then transferred to a 10 cm flat cuvette (rinsed twice with the sample). A blank reading was taken for each sample and subtracted from subsequent readings. Seventy-five µL of purified mCP dye (2 mM in 0.7 M NaCl) was added to each sample, which was then mixed gently and measured at 434 nm and 578 nm for station TCAT3-01. For the other stations, a third measurement was performed at the isosbestic wavelength (488 nm), which was used for dye correction. To perform the dye correction, a second addition of dye was made to the sample, which was then mixed and measured at the three wavelengths.

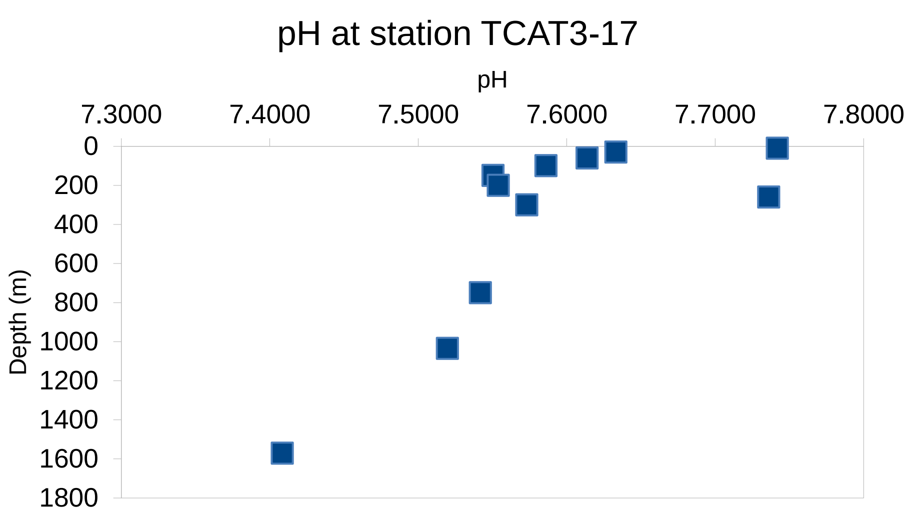
Calculation of pH was performed according to Douglas and Byrne (2017), and dye correction was carried out following Liu et al. (2011).

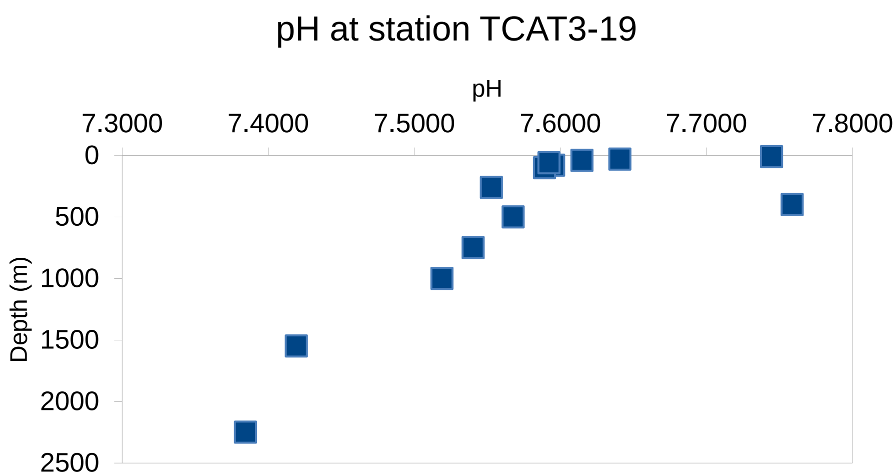
18.3 Preliminary Results




pH at station TCAT3-09
pH
7.7100
7.7150
7.7200
7.7250
7.7300
Depth (m)
0
10
20
30
40
50
60
70
80


pH at Station TCAT3-11
pH
7.5000
7.5500
7.6000
7.6500
7.7000
7.7500
7.8000
Depth (m)
0
50
100
150
200
250
300
350
400
450


pH at station TCAT3-17
pH
7.3000
7.4000
7.5000
7.6000
7.7000
7.8000
Depth (m)
0
200
400
600
800
1000
1200
1400
1600
1800



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19 Mercury sampling and measurement during Refuge Arctic Leg 4

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19.1 Introduction and Objectives

Mercury (Hg) is a toxic element of global concern, mainly due to the bioaccumulation of one of its chemical species, methylmercury (MeHg), in marine organisms and its subsequent biomagnification in food webs. Overexposure to MeHg through seafood consumption poses a significant health risk, particularly for Arctic populations. Despite the importance of this critical issue, some aspects of the Hg cycle in the Arctic Ocean remains poorly understood due to the complex entanglement of chemical and biochemical processes. Thus, several key questions remain unresolved, including (1) the Hg chemical speciation in fjords and sea ice adjacent environments, (2) the dynamics of gaseous Hg exchange between the troposphere and surface seawater, (3) the significance and the sources of Hg inputs from local glaciers and ice caps, and (4) the microbiological conversion of Hg species and its accumulation in the sediments. Answering these questions is the primary objective of the current project.

19.2 Methodology

Determining Hg speciation in the water column is a part of the ultra-trace methodological approach implemented by the international GEOTRACES program. All the methodology used in this project originates from the GEOTRACES techniques. Sea ice was sampled with the 9 cm Kovaks corer, sliced with a titanium saw and bagged into Ziplock bags. After melting at room temperature, samples were drawn into individual sampling bottles. The water column was sampled using Go-Flo bottles attached to a metal-free Rosette. GO-FLO bottles were sub-sampled in a clean room adjacent to the "moon pool" directly in Teflon and glass bottles for further treatments (filtration, acidification) in the PILMS clean lab. Samples for MMHg were purged with argon gas. Sediment samples were collected with a box-corer. Subsamples were collected directly from the box core and put in cryotubes immediately frozen at -80°C. a second push core was preserved at 4°C. Plankton samples were collected by the plankton team.

Hg speciation analyses (i.e. total mercury (HgT) and MeHg) unfiltered waters involve atomic fluorescence spectrometry (AFS) and gas chromatography associated with inductively coupled plasma mass spectrometry (GC-ICPMS), whereas, the analysis of HgT in sediments and plankton requires atomic absorption spectrometry (AAS). Multicollector ICPMS will be used to identify the isotopic composition of Hg in various matrices. Total gaseous Hg (TGM) in the air was measured "continuously", i.e., with a 15-minute step, with a Tekran 2537 automated detector. The samples collected are listed in Table 1. The microbiological approach will focus on identifying Hg-methylating and demethylating microorganisms in various redox sedimentary environments, as well as conducting further laboratory experiments to decipher the interplay of processes involved in anaerobic methane oxidation and MeHg demethylation.

Table 19-1: List of collected snow (SNOW), melt pond ice (MPI), melt pond water (MPW), multi year ice (CM), and under ice water (UIW) samples during the 2024 expedition.

Date	Sampling method	Station	Cast	Bottle/#	Depth (m)	tHg	MeHg	MMHg	pHg
	SNOW	RA26				x	x	x	x
	CM	RA26		1	0-10	x	x	x	
	CM	RA26		2	10-20	x	x	x	
	CM	RA26		3	20-30	x	x	x	
	CM	RA26		4	30-40	x	x	x	
	CM	RA26		5	40-50	x	x	x	
	CM	RA26		6	50-60	x	x	x	
	CM	RA26		7	60-70	x	x	x	
	CM	RA26		8	70-80	x	x	x	
	CM	RA26		9	80-90	x	x	x	
	CM	RA26		10	90-100	x	x	x	
	CM	RA26		11	100-110	x	x	x	
	CM	RA26		12	110-120	x	x	x	
	CM	RA26		13	120-130	x	x	x	
	CM	RA26		14	130-140	x	x	x	
	CM	RA26		15	140-150	x	x	x	
	CM	RA26		16	150-160	x	x	x	
	CM	RA26		17	160-170	x	x	x	
	CM	RA26		18	170-180	x	x	x	
	CM	RA26		19	180-190	x	x	x	
	CM	RA26		20	190-200	x	x	x	
09/09	CM	RA26		21	200-210	x	x	x	

	CM	RA26		22	210-220	x	x	x	
	CM	RA26		23	220-230	x	x	x	
	CM	RA26		24	230-240	x	x	x	
	CM	RA26		25	240-250	x	x	x	
	CM	RA26		26	250-260	x	x	x	
	CM	RA26		27	260-270	x	x	x	
	CM	RA26		28	270-280	x	x	x	
	CM	RA26		29	280-290	x	x	x	
	CM	RA26		30	290-300	x	x	x	
	CM	RA26		31	300-310	x	x	x	
	CM	RA26		32	310-320	x	x	x	
	CM	RA26		33	320-330	x	x	x	
	CM	RA26		34	330-340	x	x	x	
	CM	RA26		35	340-350	x	x	x	
	CM	RA26		36	350-360	x	x	x	
	CM	RA26		37	360-370	x	x	x	
	UIW	RA26				x	x	x	
	SNOW	RA27				x	x	x	
	MPI	RA27				x	x	x	
	MPW	RA27				x	x	x	
	CM	RA27		1	0-10	x	x	x	
	CM	RA27		2	10-20	x	x	x	
	CM	RA27		3	20-30	x	x	x	
	CM	RA27		4	30-40	x	x	x	
	CM	RA27		5	40-50	x	x	x	
	CM	RA27		6	50-60	x	x	x	
	CM	RA27		7	60-70	x	x	x	
	CM	RA27		8	70-80	x	x	x	
	CM	RA27		9	80-90	x	x	x	
	CM	RA27		10	90-100	x	x	x	
	CM	RA27		11	100-110	x	x	x	
	CM	RA27		12	110-120	x	x	x	
	CM	RA27		13	120-130	x	x	x	
	CM	RA27		14	130-140	x	x	x	
	CM	RA27		15	140-150	x	x	x	
	CM	RA27		16	150-160	x	x	x	
	CM	RA27		17	160-170	x	x	x	
10/09	CM	RA27		18	170-180	x	x	x	

	UIW	RA27				x	x	x	
	MPI	RA36				x	x	x	
	SNOW	RA36				x	x	x	
	CM	RA36		1	0-10	x	x	x	
	CM	RA36		2	10-20	x	x	x	
	CM	RA36		3	20-30	x	x	x	
	CM	RA36		4	30-40	x	x	x	
	CM	RA36		5	40-50	x	x	x	
	CM	RA36		6	50-60	x	x	x	
	CM	RA36		7	60-70	x	x	x	
	CM	RA36		8	70-80	x	x	x	
	CM	RA36		9	80-90	x	x	x	
	CM	RA36		10	90-100	x	x	x	
	CM	RA36		11	100-110	x	x	x	
	CM	RA36		12	110-120	N/A	N/A	N/A	
	CM	RA36		13	120-130	x	x	x	
	CM	RA36		14	130-140	x	x	x	
	CM	RA36		15	140-150	x	x	x	
	CM	RA36		16	150-160	x	x	x	
	CM	RA36		17	160-170	x	x	x	
	CM	RA36		18	170-180	x	x	x	
	CM	RA36		19	180-190	x	x	x	
	CM	RA36		20	190-200	x	x	x	
	CM	RA36		21	200-210	x	x	x	
	CM	RA36		22	210-220	x	x	x	
	CM	RA36		23	220-230	x	x	x	
	CM	RA36		24	230-240	x	x	x	
	CM	RA36		25	240-250	x	x	x	
	CM	RA36		26	250-260	x	x	x	
	CM	RA36		27	260-270	x	x	x	
	CM	RA36		28	270-280	x	x	x	
	CM	RA36		29	280-290	x	x	x	
	CM	RA36		30	290-300	x	x	x	
	CM	RA36		31	300-310	x	x	x	
	CM	RA36		32	310-320	x	x	x	
	CM	RA36		33	320-330	x	x	x	
	CM	RA36		34	330-340	x	x	x	
13/09	CM	RA36		35	340-350	x	x	x	

	CM	RA36		36	350-360	x	x	x	
	CM	RA36		37	360-370	x	x	x	
	UIW	RA36				x	x	x	x
	SNOW	RA37							x
	CM	RA37		1	0-10	x	x	x	
	CM	RA37		2	10-20	x	x	x	
	CM	RA37		3	20-40	x	x	x	x
	CM	RA37		4	40-60	x	x	x	x
	CM	RA37		5	60-80	x	x	x	x
	CM	RA37		6	80-100	x	x	x	
	CM	RA37		7	100-120	x	x	x	
	CM	RA37		8	120-140	x	x	x	
	CM	RA37		9	140-160	x	x	x	
	CM	RA37		10	160-180	x	x	x	x
	CM	RA37		11	180-200	x	x	x	x
	CM	RA37		12	200-220	x	x	x	x
	CM	RA37		13	220-240	x	x	x	
	CM	RA37		14	240-260	x	x	x	x
15/09	UIW	RA37				x	x	x	
	SNOW	RA45		1	0-5	x	x	x	
	SNOW	RA45		2	5-25	x	x	x	
	CM	RA45		1	0-10	x	x	x	
	CM	RA45		2	10-20	x	x	x	
	CM	RA45		3	20-30	x	x	x	
	CM	RA45		4	30-40	x	x	x	
	CM	RA45		5	40-50	x	x	x	
	CM	RA45		6	50-60	x	x	x	
	CM	RA45		7	60-70	x	x	x	
	CM	RA45		8	70-80	x	x	x	
	CM	RA45		9	80-90	x	x	x	
	CM	RA45		10	90-100	x	x	x	
	CM	RA45		11	100-110	x	x	x	
	CM	RA45		12	110-120	x	x	x	
	CM	RA45		13	120-130	x	x	x	
	CM	RA45		14	130-140	x	x	x	
	CM	RA45		15	140-150	x	x	x	
	CM	RA45		16	150-160	x	x	x	
18/09	CM	RA45		17	160-170	x	x	x	

	UIW	RA45				x	x	x	

Table 19-2: List of collected rosette (ROS), barge (BG) and zodiac (ZOD) samples during the 2024 expedition

Date	**Sampling method**	**Station**	**Cast**	**Bottle/#**	**Depth (m)**	**tHg**	**MeHg**	**MMHg**	***pHg***	**Hg iso**
	ROS	RA25	74	1	504	x	x	x	*x*	
	ROS	RA25	74	2	425	x	x	x		
	ROS	RA25	74	3	350	x	x	x		
	ROS	RA25	74	4	275	x	x	x		
	ROS	RA25	74	5	200	x	x	x		
	ROS	RA25	74	6	150	x	x	x	*x*	
	ROS	RA25	74	7	100	x	x	x		
	ROS	RA25	74	8	70	x	x	x		
	ROS	RA25	74	9	50	x	x	x		
	ROS	RA25	74	10	35	x	x	x		
	ROS	RA25	74	11	24	x	x	x	*x*	
	ROS	RA25	74	12	15	x	x	x		
08/09	ZOD	RA25	74			x	x	x		
	ROS	RA28	81	1	330	x	x	x	*x*	
	ROS	RA28	81	2	300	x	x	x		
	ROS	RA28	81	3	250	x	x	x	*x*	
	ROS	RA28	81	4	200	x	x	x		
	ROS	RA28	81	5	150	x	x	x		
	ROS	RA28	81	6	110	x	x	x		
	ROS	RA28	81	7	100	x	x	x	*x*	
	ROS	RA28	81	8	80	x	x	x		
	ROS	RA28	81	9	60	x	x	x		
	ROS	RA28	81	10	40	x	x	x		
	ROS	RA28	81	11	20	x	x	x		
11/09	ROS	RA28	81	12	15	x	x	x		
	BG	RA28	81			x	x	x	*x*	
	ROS	RA31	86	1	136	x	x	x		
	ROS	RA31	86	2	136	N/A	N/A	N/A		
	ROS	RA31	86	3	136	N/A	N/A	N/A		
	ROS	RA31	86	4	120	x	x	x		
	ROS	RA31	86	5	110	x	x	x		
	ROS	RA31	86	6	100	x	x	x		
	ROS	RA31	86	7	80	x	x	x		
12/09	ROS	RA31	86	8	60	x	x	x		

	ROS	RA31	86	9	50	x	x	x		
	ROS	RA31	86	10	40	x	x	x		
	ROS	RA31	86	11	20	x	x	x		
	ROS	RA31	86	12	15	x	x	x		
	BG	RA31							*x*	
	BG	RA48				x	x	x	*x*	
	TM	RA48	109	1	617	x	x	x	*x*	
	TM	RA48	109	2	600	x	x	x		
	TM	RA48	109	3	500	x	x	x		
	TM	RA48	109	4	450	x	x	x		
	TM	RA48	109	5	390	x	x	x		
	TM	RA48	109	6	300	x	x	x		
	TM	RA48	109	7	220	x	x	x		
	TM	RA48	109	8	150	x	x	x		
	TM	RA48	109	9	100	x	x	x		
	TM	RA48	109	10	70	x	x	x		
	TM	RA48	109	11	40	x	x	x		
19/09	TM	RA48	109	12	20	N/A	N/A	N/A	*x*	
	TM	RA50	114	1	638	x	x	x	*x*	
	TM	RA50	114	2	618	x	x	x		
	TM	RA50	114	3	550	x	x	x		
	TM	RA50	114	4	475	x	x	x		
	TM	RA50	114	5	375	x	x	x		
	TM	RA50	114	6	275	x	x	x	*x*	
	TM	RA50	114	7	200	x	x	x		
	TM	RA50	114	8	120	x	x	x		
	TM	RA50	114	9	80	x	x	x		
	TM	RA50	114	10	50	x	x	x		
	TM	RA50	114	11	28	x	x	x	*x*	
	TM	RA50	114	12	14	x	x	x		
20/09	BG	RA50	114			x	x	x	*x*	
	TM	RA54	121	1	670	x	x	x		
	TM	RA54	121	2	650	x	x	x	*x*	
	TM	RA54	121	3	500	x	x	x		
	TM	RA54	121	4	420	x	x	x		
	TM	RA54	121	5	295	x	x	x		
	TM	RA54	121	6	256	x	x	x	*x*	
	TM	RA54	121	7	200	x	x	x		
23/09	TM	RA54	121	8	100	x	x	x		

	TM	RA54	121	9	68	x	x	x		
	TM	RA54	121	10	50	x	x	x		
	TM	RA54	121	11	25	x	x	x	*x*	
	TM	RA54	121	12	15	x	x	x		
	BG	RA62			x	x	x	x	*x*	xx
	TM	RA62	135	1	btm	x	x	x		x
	TM	RA62	135	2	btm	x	x	x		x
	TM	RA62	135	3	btm	N/A	N/A	N/A		
	TM	RA62	135	4	300	x	x	x		x
	TM	RA62	135	5	300	x	x	x	*x*	x
	TM	RA62	135	6	300	x	x	x		x
	TM	RA62	135	7	160	x	x	x	*x*	x
	TM	RA62	135	8	160	x	x	x		x
	TM	RA62	135	9	160	x	x	x		x
	TM	RA62	135	10	28	x	x	x		x
	TM	RA62	135	11	28	x	x	x	*x*	x
24/09	TM	RA62	135	12	28	x	x	x		x
	TM	RA67	143	1	380	x	x	x		
	TM	RA67	143	2	360	x	x	x	*x*	
	TM	RA67	143	3	300	x	x	x		
	TM	RA67	143	4	200	x	x	x		
	TM	RA67	143	5	120	x	x	x		
	TM	RA67	143	6	100	x	x	x		
	TM	RA67	143	7	70	x	x	x		
	TM	RA67	143	8	60	x	x	x		
	TM	RA67	143	9	50	x	x	x	*x*	
	TM	RA67	143	10	40					
	TM	RA67	143	11	20	x	x	x	*x*	
26/09	TM	RA67	143	12	15	x	x	x		
	TM	RA69	145	1	317	x	x	x	*x*	
	TM	RA69	145	2	300	x	x	x		
	TM	RA69	145	3	200	x	x	x		
	TM	RA69	145	4	122	x	x	x	*x*	
	TM	RA69	145	5	100	x	x	x		
	TM	RA69	145	6	80	x	x	x		
	TM	RA69	145	7	60	x	x	x		
	TM	RA69	145	8	50	x	x	x		
	TM	RA69	145	9	40	x	x	x		
27/09	TM	RA69	145	10	30	N/A	x	x		

	TM	RA69	145	11	20	x	x	x		
	TM	RA69	145	12	15	x	x	x	*x*	

Table 19-3: List of collected plankton samples. See plankton report for further details.

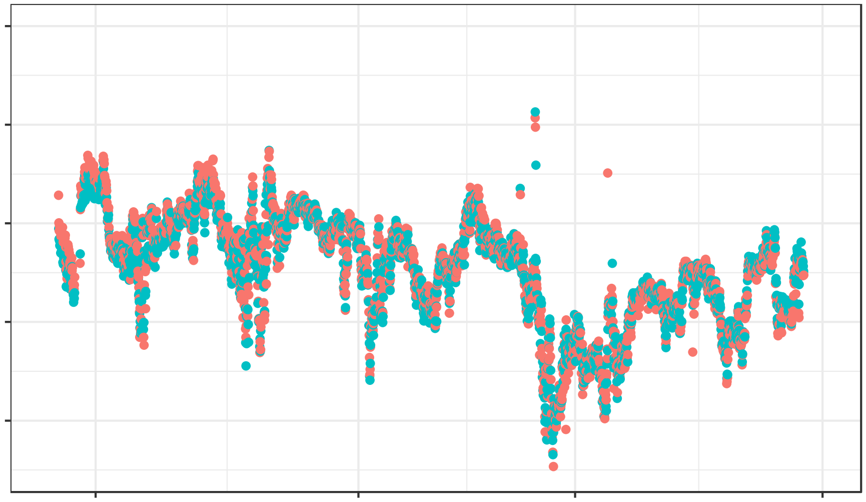
Station	Date	Tow
RA67	26/09/2024	O-Tow
RA67	26/09/2024	V-Tow
RA62	25/09/2024	O-Tow
RA58	24/09/2024	V-Tow
RA54	23/09/2024	O-Tow
RA54	23/09/2024	V-Tow
RA50	20/09/2024	O-Tow
RA45	18/09/2024	O-Tow
RA43	17/09/2024	V-Tow
RA41	16/09/2024	O-Tow
RA41	16/09/2024	V-Tow
RA38	15/09/2024	O-Tow
RA38	15/09/2024	V-Tow
RA36	13/09/2024	V-Tow
RA31	12/09/2024	V-Tow
RA28	11/09/2024	O-Tow
RA28	11/09/2024	V-Tow
RA27	10/09/2024	O-Tow
RA26	10/09/2024	O-Tow
RA25	08/09/2024	O-Tow

Table 19-4: List of collected sediment samples. See sediment report for further details

Station	Date	BC_GEO
RA25	2024/09/09	16
RA36	2024/09/13	17
RA38	2024/09/15	18
RA47	2024/09/21	20
RA54	2024/09/24	21
RA62	2024/09/25	23
RA67	2024/09/26	24

19.3 Preliminary Results

Gaseous elemental mercury (GEM) concentration in the atmosphere was the only parameter measured on board under the guidance of the Institute of Environmental Geosciences (IGE, Université de Grenoble Alpes, France). The results indicate that concentrations measured from the 5th of September to 1st of October 2024 ranged from 0.9 to 1.6 ng/m^3, which are in the range of previous measurements, especially from the ones obtained at the close-by Alert meteorological station (Ellesmere Island, Canada). Other measurements, including total Hg in water and sediment, MeHg in waters, and microbiology trials, will be performed in the laboratories at MIO (Aix-Marseille Université, France) and EM&G (Ottawa University, Canada). Stable Hg isotopes determination will be performed at GET (University of Toulouse, France).



19.4 Recommendations

We thank the crew and the Amundsen Science team for the fantastic work.

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20 Distributions of Trace Metals in the Lincoln Sea, Nares Strait and Select Fjords of Canada and Greenland

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20.1 Introduction and Objectives

This work, carried out in support of the Refuge Arctic project, will expand on results obtained in the eastern Arctic as part of the ArcticNet-supported project NTRAIN (Nutrient Transports and living marine Resources Across the Inuit Nunangat) and ongoing Canadian GEOTRACES (https://www.geotraces.org) activities in the Arctic. Refuge Arctic, NTRAIN and the international GEOTRACES program all aim, in part, to address how changes in physical fields in the Lincoln Sea, Nares Strait and Baffin Bay, due to ongoing regional climate change, impact chemical and biological fields within the Canadian Arctic and North Atlantic. By measuring the trace metal (micronutrient and toxin) concentrations and transports across the major gateways of the Canadian Arctic, potential changes in the nutrition and availability of marine foods within the Inuit Nunangat may be predicted.

The objectives of the work carried out on legs 3, 4 and 5a, in part, were as follows:

1. To determine the distribution of dissolved (<0.2 μm filtered) and acid labile (unfliltered) trace metals (Fe, Mn, Cu, Cd, Pb, Zn, Co, Ni, REEs) in seawater, snow, melt pond water, and ice core samples in Nares Strait.
2. To assess the change in micronutrient trace metal concentrations over time, building on previous years of sampling going back to 2007, as may be expected with regional Arctic warming, and subsequent sea ice and glacial melt.

3. To determine whether ongoing climate change may be increasing or decreasing the levels of legacy metal contaminants introduced to the Arctic through human activities.
4. To establish a baseline for trace metal distributions against which changes related to increased human activity in the Arctic might be measured.

20.2 Methodology

20.2.1 *Sample Collection*

Seawater was collected using a modified trace-metal rosette sampling system (Measures et al., 2008), consisting of a powder-coated aluminium frame equipped with twelve 10 L Teflon-coated C-Free Chamber Water Sampler, Model 114 Ocean Test Equipment bottles (OTE, FL USA) attached to a 1600 m 2-member conducting Vectran cable encased in polyurethane (Cortland Cable Co., Cortland NY USA). OTE bottles were deployed in the open position and lowered through the CCGS Amundsen moon pool, to below the deepest desired depth. Bottles were closed at the desired depth (Table 20-1) on the ascent, without stopping, to reduce the potential for contamination from the rosette and instrument payload. On deck, OTE bottles were relocated to a purpose built, HEPA-filtered clean laboratory for sample collection. Additionally, surface samples (reported in Table 20-1 as 0 m) were collected from the CCGS *Amundsen* Zodiac and from the CCGS *Amundsen* Barge, or in one case from the bow of the Amundsen, at a subset of stations

Seawater was gravity-filtered through 0.2 μm Acropak filters (Pall Corporation) for dissolved samples or collected directly in LDPE bottles for acid soluble/unfiltered samples and acidified on-board to pH = 1.7 with 12 M high-purity HCl (Seastar Chemicals) for storage. Low density polyethylene (LDPE) bottles (1L, 500 mL, 250 mL, and 125 mL) (Nalgene and VWR) were acid-washed according to GEOTRACES protocols (Cutter et al., 2010) and used for sample collection and storage. Nutrient samples were filtered through 0.2 μm Acropak filters and collected into 15 mL falcon tubes for comparison to the ship's Classic rosette samples to verify OTE bottle integrity. Sample bottles were double-bagged, then put together in a larger bag and placed in plastic buckets or totes for storage and transport.

20.2.2 *River and Glacial Meltwater*

At Sea Ice Stations (Table 20-1), snow was scooped directly into a clean 1L LDPE wide-mouth bottle. Seawater under the ice was pumped into a clean 1L LDPE narrow-mouth bottle via a hole in the ice with tubing and a peristaltic pump. Melt-pond water was collected directly to a clean 1L LDPE wide-mouth bottle by dunking the bottle through a hole in the melt-pond ice. Immediately after coring, ice cores were cut on a plastic ice core table in 10 cm sections with a titanium snow saw. Ice core sections were then scraped with a ceramic knife to remove all areas of contact with the saw and corer. The individual sections were stored in acid-cleaned 1 L PET wide-mouth bottles and set aside for melting at 24-27°C for approximately 24 hours. Ice, snow, melt-pond water and "under ice" seawater samples were filtered on a clean hand-vacuum filtration tower, through 0.2 μm Supor-200 filters (Pall Corporation) for dissolved samples or collected directly into acid-washed LDPE bottles for acid soluble/unfiltered samples. All sample bottles were triple-rinsed with sample prior to final sample collection. Samples were then acidified, double-bagged and stored following the same methodology as samples taken via the rosette.

20.2.3 *Trace Metal Analysis*

Trace metal analysis of all collected samples will be conducted at the University of Victoria School of Earth and Ocean Science, following a method similar to that of Jackson et al. (2018). Samples and standards for trace metal analysis are extracted and preconcentrated offline via the seaFAST-pico SC-4 DX system (ESI, Omaha, NE, USA). 10 mL per sample is loaded onto the seaFAST column, made up of the Nobias PA-1 resin which contains the functional groups ethylenediaminetriacetic acid and iminodiacetic acid. The column is rinsed with 2 M ammonium acetate solution (pH 6.0 ± 0.2), which is prepared by mixing Baseline grade glacial acetic acid and ammonium hydroxide (Seastar Chemicals) and diluting with double-deionised water (DDW). Samples are eluted in 800 µL of 1.6 M Baseline grade nitric acid (Seastar Chemicals) spiked with an Indium or Rhodium internal standard. The preconcentrated samples are analysed on an Agilent 8800 ICP-MS/MS. All vials (VWR Metal-Free Centrifuge Tubes, VWR International) used in trace-metal sample preparation are cleaned in 1N Instrument Quality grade hydrochloric acid (Seastar Chemicals) for at least one month and triple-rinsed with DDW prior to use. Sample preparation is completed in a class-100 clean room.

20.2.4 *Metalloid Analysis*

Metalloid analysis of all collected samples will be conducted at Université Laval Chemistry Department following the Method Development Guide: Seawater Introduction System for Agilent ICPMS (4SF-SP3-M5-MG79). Samples and standards for metalloid analysis are reduced into volatile hydrides online via the seaFAST-SP3 SC-4 EX system (ESI, Omaha, NE, USA.). 3 mL per sample is injected into the seaFAST-SP3 using the Hydride-only and low dilution mode. Metalloids contained into the injected sample (as As^{3+} and Se^{4+}) are mixed with ~3M hydrochloric acid (HCl), which is prepared by diluting concentrated Ultratrace grade (Aristar Ultra) HCl into DDW, and with a reductant, which is prepared by diluting ultrapure sodium hydroxide (NaOH) pellets into DDW and by adding sodium borohydride ($NaBH_4$). Volatile hydrides (as AsH_3 and SeH_2) are then generated and carried directly into the spray chamber by argon (Ar). The seawater matrix and reduction reaction by-product ($B[OH]_3$) are then drained out of the system. The volatile hydrides are analyzed online on an Agilent 8900 ICP-MS/MS with Ar as the carrier gas and H_2 as the collision gas in the reaction cell. Gallium (Ga) is used as an internal standard and follows the same hydride generation and analysis processes then Se and As. All vials (VWR Metal-Free Centrifuge Tubes, VWR International, Radnor, PA, USA) used in sample preparation are cleaned in 1M trace metal-grade HCl for at least one month and triple-rinsed with DDW prior to use. Sample preparation is completed under a certified laminar flow hood (ESCO Airstream, USA).

Table 20-1: List of Samples

Station Leg 3	Filtered (Dissolved TM)	Unfiltered (Total TM)	Macro-nutrients	R[1], G[2], L[3]	Barge	Station Leg 4	Filtered (Dissolved TM)	Unfiltered (Total TM)	Macro-nutrients	Station Leg 5a	Filtered (Dissolved TM)	Macro-nutrients
RA01	x	x	x			RA25	x	x	x	TCA-S3	x	x
RA02	x	x	x	R, G		RA28	x	x	x	TCAT3-01	x	x
RA03	x	x	x		x	RA31	x	x	x	TCAT3-05	x	x
RA04					x	RA48	x	x	x	TCAT3-08	x	x
RA06	x	x	x		x	RA50	x	x	x	TCAT3-09	x	x
RA07	x	x	x	R, G		RA54/115	x		x	BB2	x	x
RA08	x	x	x	L	x	RA58/111	x		x	TCAT3-19	x	x
RA09	x	x	x			RA62/108	x		x	TCAT3-17	x	x
RA12	x	x	x	R, L	x	RA67/101	x		x	TCAT3-15	x	x
RA13	x	x	x	R, G, L	x	RA69/105	x		x	TCAT3-11	x	x
RA14	x	x	x		x					A9	x	x
RA15	x	x	x		x					A7	x	x
RA16	x	x	x		x					A5	x	x
RA17	x	x	x							A3	x	x
RA18	x	x	x	R, G	x							
RA24	x	x	x	R, G								
R[1]: River sampling, G[2]: Glacier sampling, L[3]: Lake sampling												

Table 20-2: List of samples (Sea Ice Stations) during Leg 4 of the 2024 Amundsen expedition

Station	Filtered (Dissolved TM) Sample Type	Unfiltered (Total TM) Sample Type
RA26	Under ice water	Under ice water
RA27	Ice core (40cm to bottom) Under ice water Snow	Ice core (40cm to bottom) Under ice water Snow
RA36	Ice core (full) Under ice water Snow Melt-pond ice Melt-pond water	Ice core (full) Under ice water Snow Melt-pond ice Melt-pond water
RA37	Ice core (full) Under ice water Snow	Ice core (full) Under ice water Snow
RA45	Ice core (full) Under ice water Snow	Ice core (full) Under ice water Snow

20.3 Recommendations

Thank you to the crew and captain of the Amundsen and the hard and skilled work of the Amundsen Science team who made trace element sampling from the ship possible on Leg 3. Preliminary indications are that deployment of the Trace Metal Rosette through the moon pool is a unique and successful approach to achieve our scientific goals and maximize the use of CCGS *Amundsen* infrastructure for science. Leg 3 of the 2024 Amundsen Science/Refuge Arctic expedition is the first where the Trace Metal Rosette (TMR) system was deployed from the moon pool. The rosette frame, SeaBird Electronics including SBE 32 pylon, SBE 33 deck unit, 19plus CTD, Wetlabs Transmissometer and 15 Ocean Test Equipment 10L sampling bottles were purchased by Cullen through the NSERC RTI Program. Amundsen Science invested considerably in infrastructure to support trace element sampling from the moon pool hangar including but not limited to: 12 x 10L OTE sampling bottles, 2600 m of conducting synthetic sea cable, refurbishing and repurposing the Hawboldt Winch, supply of an altimeter and SBE 43 Oxygen sensor for the rosette, the fabrication of a world class clean laboratory in the hangar for sampling of the rosette. Considerable effort, work hours, coordination and collaboration occurred between Amundsen Science staff and academic partners occurred in the lead up to the 2024 season to make the TMR facility operational. The quality of the planning and work of the Amundsen Science team was exceptional. Some progress on the procedure for the operation of the TMR was made on sea trials in June 2024 but much of this work was reserved for the beginning of Leg 3 given time and space constraints on the ship during Sea Trials in June 2024. We recommend that the testing of new equipment jointly purchased and maintained by Amundsen Science and academic partners and the development of new procedures for the deployment of such gear be prioritized in sea trials in the future to limit the time used on science missions for such purposes. Proper development of deployment and recovery procedures and testing of ship infrastructure related to the procedures before the ship departs for the Arctic will limit the potential for injury, help to prevent the loss or damage of research equipment, and ensure efficient use of ship time in the Arctic.

Operation of the TMR was initially limited by ongoing electronic issues where communication between the deck computer, deck unit, pylon and CTD on the rosette was incomplete, unreliable and generally unacceptable. This led to problems closing bottles on the deck and in the water and the inability of the software to generate bottle files for example. Scan length errors and unsupported modem communication errors suggested either problems with power from the deck unit to the pylon or communication faults in the pylon and/or the deck unit. Stepwise troubleshooting of the problem, with some input from technical support at SeaBird Electronics, led us to take the following steps:

1. Extensive testing of the sea cable for problems with continuity or insulation that gave confidence that the sea cable was sound and functioning as expected in and out of the water. Indeed problems with communicating with the pylon and CTD were observed on the deck using the deck cable provided by SBE.
2. Isolation of the CTD from the pylon by removing power and communication from the CTD. During these tests a pressure sensor (RBR) was affixed to the rosette frame to provide information at which pressure bottles were closed. Under these conditions we were able to close bottles by communicating with the pylon. Bottles were fired with the deck unit rather than with the software. Operations were possible but less than ideal.
3. Amundsen technical support fabricated a cable to allow data to move from the CTD to the pylon but no power to flow from the pylon to CTD. The CTD was powered with

its own battery. This step was taken thinking that power drain by the CTD might but undue demands on the SBE 32 pylon and lead to communication errors. Communication errors still occurred. Unsatisfactory.

4. Power, given that it did not appear power was the problem but rather communication was the issue, was restored to the CTD by replacing the original cable from the CTD to the pylon. To simplify the data coming up from the CTD and pylon auxillary sensors (SBE 43, Wetlabs Transmissometer and Altimeter) were turned off. This limited the hexadecimal packet for each scan from the CTD to the pylon from 46 to 22 characters (only encoding data from the T, P and Conductivity sensors on the CTD). Communication errors persisted but the operation of the TMR was more reliable and real time CTD data improved performance.
5. In an effort to provide an alternative to the 19plus CTD and SBE 32 pylon Amundsen staff investigated whether or not one of the Amundsen Science spare 9plus CTD units might be mounted on the TMR frame and connected to the SBE 32. The SBE 32 has three ports. One port allows the sea cable to provide power and send and receive communications between the SBE 33 deck unit and the SBE 32 pylon. Another port connects the pylon to the 19plus CTD. Both of these ports were in use and had been changed and inspected as part of the troubleshooting process and when initially setting up the system. The third port allows for a SBE 9plus CTD to be connected to the SBE 32 and came from the factory with a dummy plug in place. Removing this plug as part of exploring the use of the 9plus with the system indicated that seawater had been penetrating this poorly manufactured and installed plug, causing faults which fouled the communication pin on the SBE 32 pylon. Cleaning, drying and replacing the faulty plug with a better fitting dummy resolved the communication problem. There is now reliable communication between the computer, deck unit, SBE 32 and 19plus on the deck and in the water. Bottles fire from the software or deck unit, closure is confirmed, a full suite of data returns from the CTD and the software registers bottles firing and generates bottle files as is expected. We expect normal operation of the rosette on Leg 4 and going forward.

During deployment of the TMR in Makinson Fiord there was a failure or fault discovered in the control unit for the motor that raises and lowers the cable guide in the moon pool. An incident occurred because of this defect where slack in the hoist cable that controls the ascent and decent of the wire guide was allowed to form. The weight of the wire guide arm was held up by a support member of the rail that the arm travels upon while the slack in line developed. Return of the weight as the arm became free parted the slack line and sent the wire guide down into the moon pool toward the rosette in an uncontrolled manner. Quick action by the crew avoided damage or loss of the rosette and both the wire guide arm and TMR were successfully recovered after considerable effort. Amundsen Science staff worked with the crew to refurbish and improve the operation of the wire guide and deployments for the rest of the leg continued to more efficient and successful with each station.

The Trace Metal Team can't overstate how critical the expertise and hard work of Amundsen Science staff Simon Morisset and Antonin Drouet were in solving the electronic issue with the TMR, dealing with the wire guide issue and developing a procedure for deployment and retrieval of the TMR. Their work was key to the success of our scientific mission on Leg 2. They were outstanding. The deck crew of the Amundsen were professional and extremely skilled as always. Senior Engineer Gabriel Breton and Electrician Simon Lavoie were key in troubleshooting the wire guide control system and reconfiguring the system after the initial failure in Makinson. We recommend that the wire guide system, which was designed and engineered for a much heavier and larger ROV sea cable, be reevaluated for use with the TMR to simplify, streamline and improve operations through the moonpool.

Thus far ice or slush in the moonpool has not been a problem for the operation of the TMR. The Senior Engineer has arranged for water, heated by the boiler, to be continually diverted to the moonpool during transit and when the moonpool is not being used for operations on station. A call to the engine room is place about 30 minutes prior to TMR deployment so the flow of hot water can be stopped during operations. Whether the ice conditions have simply not led to the accumulation of slush or ice in the moonpool or the hot water diversion is very effective at melting ice getting is not clear. However, we recommend that for Leg 4 this practice of diverting boiler heated water to the moonpool to limit ice and slush accumulation continue.

On September 8th (station RA25) (Leg 4), the wire for the trace metal rosette shifted out of the rollers of the wire guide and became lodged beside a roller (Figure 20-1). This may have been due to excessive speed in feeding out the wire in the downcast. The problem was immediately spotted by the Chief Officer, and the crew worked efficiently to retrieve the wire guide and reposition the cable. Amundsen Science technicians Louis Wilmotte and Quentin Lahaye ensured the cable would not shift out of the rollers in the future with the addition of blocks beside the rollers (Figure 20-2). While no damage to the cable was observed at this time, on September 11th (station RA28) a tear in the wire was found. Given the length of cable out at the tear, this was most likely due to the wire being caught beside the roller, or from scraping against the corner of the moonpool when the wire guide was repositioned on September 8th. Subsequently, roughly 250 m of cable was removed. Thank you to Louis and Quentin for their immediate action in creating a new cable termination, allowing us to continue sampling the next day. Although the incident on September 8th was largely rectified, this and ongoing issues with deploying the wire guide (resulting in added time to the TMR operation), indicate a need to re-evaluate the use of this wire guide system with the TMR. We recommend that for all future deployments of the trace metal rosette, the Chief Officer informs the TM scientific personnel immediately before deployment can take place so that the scientific personnel can proceed with the final step of arming the trace metal niskin bottles. This was the practice for the majority of this Leg and ensured the bottles were not left open and exposed to contamination longer than necessary (e.g. left open while the ship was repositioned).

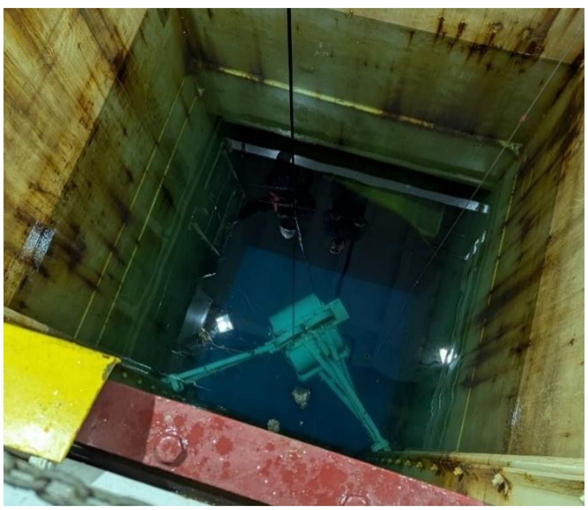

Figure 20-1: Separation of the sea cable from the rollers of the wire guide

Figure 20-2: Addition of blocks beside the rollers of the wire guide

20.4 References

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21 Photosynthetic Parameters measurements in Arctic Fjords

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21.1 Introduction and Objectives

With the accelerated melting of the arctic glaciers (Ellesmere Island, Baffin Island, Greenland), their biogeochemical influence on the Arctic marine ecosystems is becoming of great importance. The amount of sediments and potential nutrients dragged by their massive structures to the numerous fjords of the Canadian Archipelago and Greenland, might have a major impact on primary production and all the higher levels of the fjords food chain. To evaluate this impact, our group adopted a systematic sampling strategy in each of the fjords we visited during the cruise. Three “FULL” stations were visited successively, one at the mouth of the fjords and 2 more between the entrance and the glacier (as far as safety allowed to enter). We visited 4 fjords, Makinson Inlet, Dobbin Inlet, Archer Fjord and Newmann XXX in Greenland (Figure 21-1).

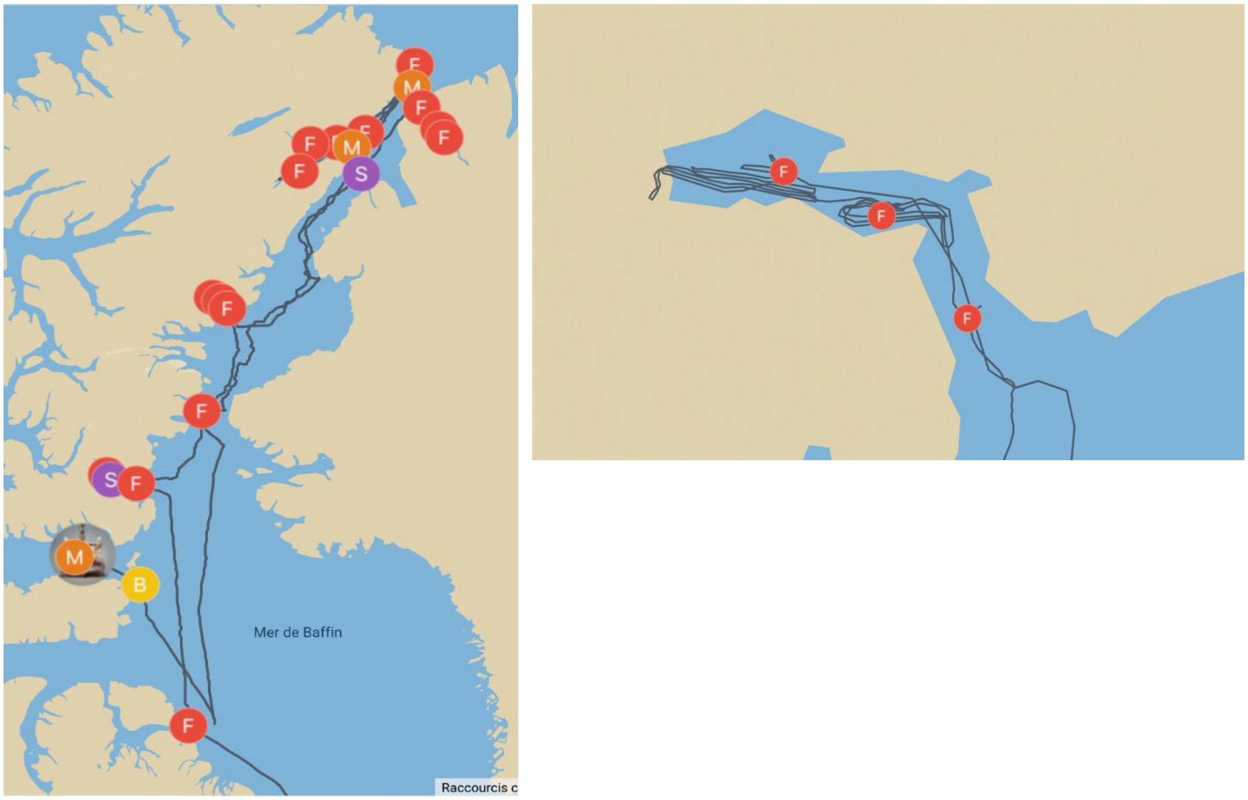

Figure 21-1: On the left, general track of the cruise, on the right, example of a fjord sampling strategy with 3 Full stations covering the length of the fjord.

To identify the influence of the glaciers melting on primary production and phytoplankton physiology, photosynthetic parameters (potential maximum carbon fixation rate, low light carbon fixation rate efficiency and saturation parameter) were determined using the P *vs.* E curve method. We sampled 4 depths at each Full station (5m, 20m, SCM and 60m) using the rosette (see Table 21-1 for full list).

Table 21-1: Full list of station and depth sampled.

Station	***Cast #***	***# of depth sampled***
RA_01	002	4
RA_02	006	4
RA_03	009	4
RA_04	013	4
RA_06	018	4
RA-07	022	4
RA_08	026	4
RA_09	030	4
RA_12	036	4
RA_13	040	4
RA_14	044	4
RA_15	048	4
RA_16	052	4
RA_17	057	4
RA_18	060	4
RA_24	068	4

21.2 Methodology

During the cruise, sea water samples were treated according to Babin et al. (1994) to determine the photosynthetic parameters. Briefly, sea water samples are inoculated with radioactive sodium bicarbonate ($NaH^{14}CO_3$) and incubated at 24 different light levels in temperature-controlled growth chambers for 2 hours. After incubation and filtration, inorganic carbon is removed from the samples by acidification, then the amount of radioactive ^{14}C incorporated into phytoplankton cells during incubation is counted on board using a liquid scintillation counter. Further calculations allow the fitting of a model (we use Jassby and Platt, 1976) describing photosynthesis from irradiance and the determination after normalization of the photosynthetic parameters, the specific maximum carbon fixation rate (P^b_{max}, mg C mg Chl *a*

^{1} h^{-1}), the initial slope of the curve (α^b, mg C mg Chl $a^{-1}h^{-1}$ (µmol Quanta $m^{-2}s^{-1})^{-1}$) describing the low light efficiency of the photosynthesis and the saturation parameter (Ek, µmol Quanta $m^{-2}s^{-1}$), an indicator of the light acclimation state of the phytoplankton population contained in the sample.

21.3 Preliminary Results

Even though radioisotope samples can be counted on board, other data are necessary to interpret ours, including pigments concentrations and corrected absorption spectra which are not available yet. The only parameter we can look at is Ek (the saturation parameter, µmol quanta $m^{-2}s^{-1}$) which is only affected by the light level. Ek presents values that are higher at the surface and lower at higher depths which is expected. We measured values of Ek up to 60 µmol quanta $m^{-2}s^{-1}$ which is around the ambient light intensity in late summer. The most striking part of our experiment was the amount of light that was necessary to obtain samples to present photoinhibition (up to 700 µmol quanta $m^{-2}s^{-1}$, which is far above the summer ambient light). Note that this was already observed during Dark-Edge, in the fall of 2021.

21.4 Recommendations

The new fume hood is amazing ! Thanks a lot for this major improvement. For the first time I slipped on the wooden step in front of the radvan (it was snowing). May be a metallic step (like the one on the PAWL) would be a good idea (especially considering that wood would absorb radioactivity). The radioactive fridge has no leg anymore. Consequently, the door cannot open fully. A new floor was necessary, and it is great to have a clean lab. However, the new floor is very difficult to clean! The structure of the floor (Figure 21-2) makes it hard to reach the "lower" surface with regular cleaning supplies, while water (and radioactivity) will definitively reach both levels. I have asked my colleagues from Leg 4 to try and find something different than what we use in general to clean. I will let you know how it goes.

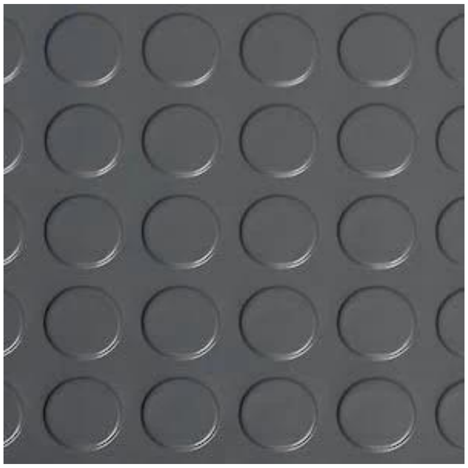

Figure 21-2: Structure of the floor

It is quite a pain to remove our coverall to leave the radvan and then put another one before we arrive in the control rosette to watch the profiles. For the set-up of the incubator, we do need to see the PAR values and the fluorescence profile, which require to get back to the radvan, set things up and go back to the rosette (each time switching coverall and booties). This makes the installation of a TV with the ship channel even more important. I know this is coming, just a reminder. Also, the wifi does not reach the radvan which prevents us to check which operation is going on.

21.5 References

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22 Arctic microplastics exploration

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22.1 Introduction and Objectives

Microplastics (MPs) are recognized as ubiquitous contaminants, as there are subject to long range transport, particularly by the atmosphere, ocean currents, and rivers [1]. The Arctic region is thought to be a major endpoint of long range MP transport, but its quantification is still largely unknown [2]. High MP concentrations were reported in sea ice [3], [4], snow and sediment [4], [5] in the Arctic region. However, quantitative data is still sparse and the Arctic MP mass budget is still largely unconstrained [4].

22.2 Objectives

This study aims to (1) characterize ocean emission of MP by confronting wind speed with atmospheric and sea surface MP concentrations; (2) evaluate deep sea and sediment MP stock and (3) quantify MPs runoff from glaciers. This information will be used to calibrate a mass budget model. Our approach will focus on small microplastics (typically 1 to 50 um) which are often underestimated not analyzed in traditional microplastic sampling campaigns, but which can cause serious health impacts.

22.3 Methodology

22.3.1 *Atmospheric sampling:*

A high-volume sampler (Tisch) was installed on top of the bridge. Air was filtered through a quartz fiber filter during 12h to 48h. To prevent contamination from the ship's exhaust, sampling was active only when the wind speed exceeded 4 Kts (7 kmh), and wind direction was between 90° and 270° relative to the ship. Filters were stored in aluminum foil for latter analysis. The sampling track of Leg 3 can be found in Figure 22-1.

22.3.2 *Water sampling:*

CTD rosette samples (Ros.) were collected at 4 depths (10L at bottom, and 5L at 100m, SCM and 5m), filtered on PVDF 0.65 µm filters and stored in aluminum foil at 5°C for later analysis. Blanks were sampled to evaluate potential contamination during sampling and analysis.

Glacier surface meltwater (Gla.), river (Riv.) and lake (Lak.) water were collected by helicopter and filtered as above. Surface water (Sur.) samples were collected from the barge, near glacier, plumes of river mouths, and processed as above.

Sampling location of Leg 3 are presented in Figure 22-1 and detailed by sampling type in Table 22-1 for Leg 3 and Table 22-2 for Leg 4.

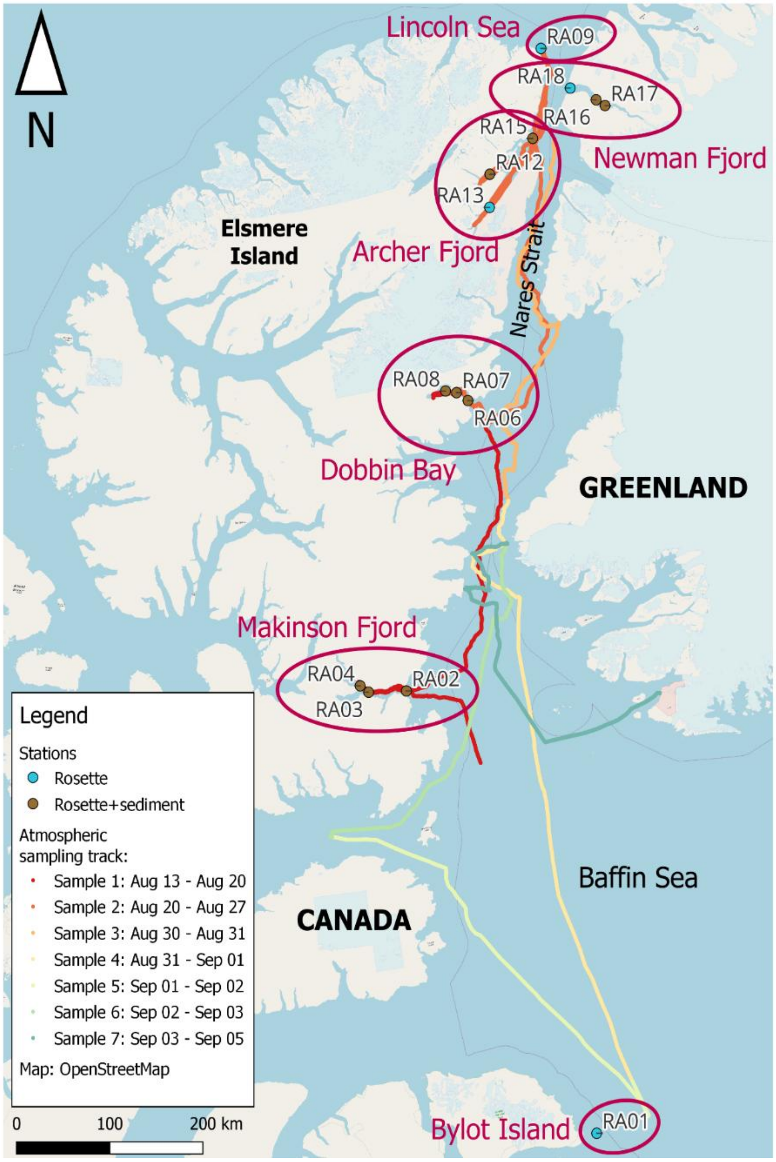

Figure 22-1: Map of the study area.

Table 22-1: List of all microplastics sampling stations

Localisation	Station	Latitude	Longitude	Date (UTC)	Ros.	Sed.	Gla.	Lak.	Riv.	Sur.
Bylot Island	RA01	72 52.88 N	075 39.17 W	Aug 12	X					
Makinson Fjord	RA02	77 14.42 N	079 07.71 W	Aug 14	X	X	X		X	
	RA03	77 17.51 N	080 45.08 W	Aug 15	X	X				X
	RA04	77 21.76 N	081 04.38 W	Aug 16	X	X				X
Dobbin Bay	RA06	79 41.03 N	073 05.69 W	Aug 18	X	X				
	RA07	79 47.10 N	073 34.09 W	Aug 19	X	X	X		X	

	RA08	79 49.72 N	074 06.82 W	Aug 20	X	X		X		X
Lincoln Sea	RA09	82 23.55 N	060 51.92 W	Aug 22	X					
Archer Fjord	RA12	81 34.07 N	067 37.27 W	Aug 23	X	X			X	X
	RA13	81 17.24 N	068 23.60 W	Aug 25	X		X	X	X	X
	RA15	81 41.95 N	064 06.85 W	Aug 27	X	X		X		
Newman Fjord	RA16	81 43.21 N	059 13.89 W	Aug 28	X	X				
	RA17	81 37.79 N	058 54.76 W	Aug 29	X	X	X		X	
	RA18	81 56.29 N	060 21.89 W	Aug 29	X					

Table 22-2: List of all Leg 4 microplastics sampling stations

Station	Latitude	Longitude	Date	Ros.	Sed.	Ice.	Nets.
RA70	73.729	-78.552	27/09/2024	X			
RA67	76.379	-77.403	26/09/2024	X	X		X
RA62	76.274	-74.627	25/09/2024		X		X
RA58	76.309	-73.222	24/09/2024		X		X
RA54	76.343	-71.227	23/09/2024	X	X		X
RA50	78.296	-73.592	20/09/2024	X			X
RA48	78.303	-74.813	19/09/2024	X			
RA47	78.301	-74.004	21/09/2024		X		
RA45	78.296	-73.592	18/09/2024		X	X	X
RA43	79.083	-69.454	17/09/2024	X			X
RA41	79.495	-73.041	16/09/2024	X			X
RA38	79.381	-71.162	15/09/2024		X		X
RA36	79.879	-69.918	13/09/2024			X	X
RA31	80.263	-67.752	12/09/2024	X			X
RA28	80.340	-69.040	11/09/2024	X			X
RA27	80.388	-68.954	10/09/2024			X	X
RA26	80.907	-66.723	10/09/2024	X		X	X
RA25	81.413	-64.228	08/09/2024	X	X		X

22.3.3 *Sediment sampling:*

Surface sediment samples were collected in the box core GEO, in a 15 cm by 15 cm square, 5 cm deep, temporarily protected by aluminum foil to prevent atmospheric contamination. The samples were stored for later analysis at 5°C in glass jars, covered with aluminum foil, and plastic lids.

22.3.4 *Plankton sampling*

Tucker and monster nets were deployed by Lucie and Zoe. Unfortunately the net collectors are made of plastic, and samples are transferred to plastic buckets for quartering. One-quarter aliquots were poured into 40ml glass vials and frozen at -80C.

22.3.5 *Sea ice sampling*

Sea ice was cored with a 14cm diameter orange fiberglass corer; cores were cut in the field in 25cm sections with a stainless-steel core guide and saw; cores sections were scraped with a steel knife, wrapped in aluminum foil and stored in an alu Zarges box for transport to the ship. Operators wore cotton lab coats on the ice and used bare hands to manipulate ice sections. On the ship core sections were molten in 5L glass jars on a hotplate, and filtered for MP using the same procedure as for water samples.

Identification and characterization of sampled MPs will be done at the GET laboratory using Raman microscopy. Targeted size range is 1 to 50 um, except for plankton net samples (200-5000um). Details of the sampling type in Table 22-2.

22.4 Preliminary Results

The samples will be analysed in GET laboratory in Toulouse after the mission. Therefore, no (preliminary) results are available yet.

22.5 Recommendations

Preventing MP contamination during sampling is challenging. Therefore, extreme care must be employed when sampling (cotton lab coat, aluminum foil to protect bottle opening, no plastic gloves during sampling…). After filtration is completed, glassware must be rinsed 3 times using the previously filtered sea water.

It is recommended to do a public announcement during the first scientific meeting to inform that the Tisch on the bridge should not be approached, especially when active (it is very loud, turns on/off unexpectedly, and is easy to contaminate by clothing fibers). Air filters from the sea water MP filtration system must be kept in order to assess indoor ambient air contamination. Blancs must be regularly sampled, especially on the CTD rosette as it is partly made of plastics. The Tisch high volume sampler was moved on 11 Sep from the bridge roof to the small Starlink platform in order to reduce noise.

22.6 References

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23 Nanoplastics and potential hetero-aggregation with algae in Arctic Ocean

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23.1 Introduction and Objectives

The fragile Arctic environment accumulates a wide variety of anthropogenic contaminants transported from all over the world. Microplastics (MPs<5 mm) have already polluted all environmental systems on Earth, including the Arctic [1]. Concerning oceanic transportation of plastic debris, thermohaline circulation is a major route from the North Atlantic to Greenland and the Barents Sea. Model simulations coupled to field measurements have demonstrated that these regions represent 95% of the total plastics accumulated in the Arctic [2]. MPs are tended to fragment to nanoplastics (NPs<1 μm) which are probably more harmful to human and other environmental organisms [3]. However, there is no data or scientific proof of NPs in the Arctic at present.

Microplastic and microorganisms' interaction, also named the plastisphere occurs in the environment [4]. Yet, nanoplastics and microplastics behavior distinguish from nanoscale because of the gap of physicochemical proprieties. In fact, nanoplastics are capable of heteroaggregation with other particles such as ions, dissolved organic matters, and colloids. This eco-corona could bind with phytoplankton in sea water. Analysing this binding through confocal microscopy would be a groundbreaking observation, while only a few studies has been done on nanoplastics and phytoplankton interaction.

During Leg 2b of the 2024 Amundsen Science expedition, we sampled from the CTD-rosette at 12 stations. During each station, water samples from surface layer and subsurface chlorophyll maximum (SCM) were collected to compare any concentration differences of nanoplastics between depths. Except that, we took sediments in Box Core from 5 stations, plankton net samples from 7 stations, and Tucker net samples from 12 stations (Table 23-1).

Table 23-1: Sampling stations and samples taken from leg2b expedition.

station	rosette	tucker	plankton	box core
TCA-QFC1	×	√	×	×
TCA-QFA2	surface, scm	×	×	×
TCA-QFA1	surface, scm	√	×	×
TCA-5.3	×	×	×	√
TCA-QF3	surface, scm	√	√	√
TCA-QFB2	surface, scm	×	×	×
TCA-QFB1	surface, scm	√	×	×
TCA-QF4	surface, scm	×	×	×
D1	surface, scm	√	√	√
D1B	surface, scm	×	×	×
D3	surface, scm	√	√	√
C5	×	√	√	×
C4-24	×	√	×	×
C3	surface, scm	×	×	×
C1	surface, scm	√	√	×
B1	surface, scm	√	√	×
B4	×	√	×	×
B5	×	√	√	×

The water samples, tucker net samples, and box core samples will be stored in 4 °C fridge and for analysis in lab after demobilization. The plankton net samples were injected into customized microfluid device (MFD), and we will take back MFD for subsequent analysis. Our main objective is to analyze the occurrence, concentration, and source of nanoplastics, and potential interaction with algae which could explain occurrence and transport behavior of nanoplastics in different depth in seawater. We will provide a systematic characterization and spatial distribution of nanoplastics and their environmental behaviors in Arctic Ocean.

23.2 Methodology

The water samples, tucker net samples, and box core samples will be stored for lab analysis after demobilization. Generally, water and sediment will be freeze dried and then resuspended in 0.1M of KOH solution for a 24h digestion. A 1mL out of 10 mL will be extracted by dichloromethane (DCM) to dissolve and concentrate plastics in the solution. Dynamic Lighting Scattering and Asymmetric flow field flow fractionation will be employed to analyze the size distribution and separated fractions. Pyrolysis–gas chromatography–mass–mass spectrometry will be used to analyze the polymer types in DCM fraction. The tucker net samples will be digested and then analyzed by micro-FTIR, which is aimed on microplastics.

The plankton net samples were firstly transferred to a beaker, then we removed copepods using pipette. Secondly, algae were injected into our customized MFD to retain algae and organic matters in designated cells. Thirdly, standard polystyrene nanoplastics and environmental polystyrene nanoplastics (generated in lab) suspended in filtered seawater at same station (10 μm in pore size) were injected into MFD. Lastly, 2% of formaldehyde was injected to fix algae. In these cells, we are able to observe and take picture of algae trapped and aggregation status later in lab under high-resolution microscope such as confocal laser scanning microscope. Figure 23-1 is the MFD we designed beforehand.

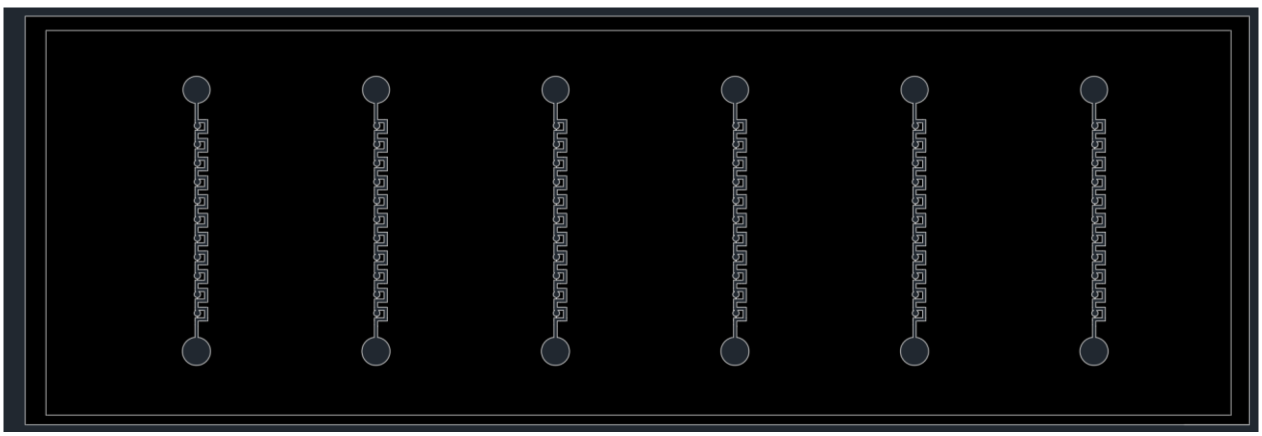

Figure 23-1: Microfluid device for trapping algae and nanoplastics

23.3 Preliminary Results

The results of characterization of nanoplastics will be generated after lab analysis, there are no preliminary results for occurrence of nanoplastics now.

We had a preliminary progress on application of MFD to Artic algae. Arctic algae were trapped successfully in the cells within the channels. Most of the algae trapped in the MFD were diatoms. A rough estimate shows that out MFD trapped 8 species of different algae, Figure 23-2 shows 4 kinds of typical suspected diatoms we obtained from plankton net.

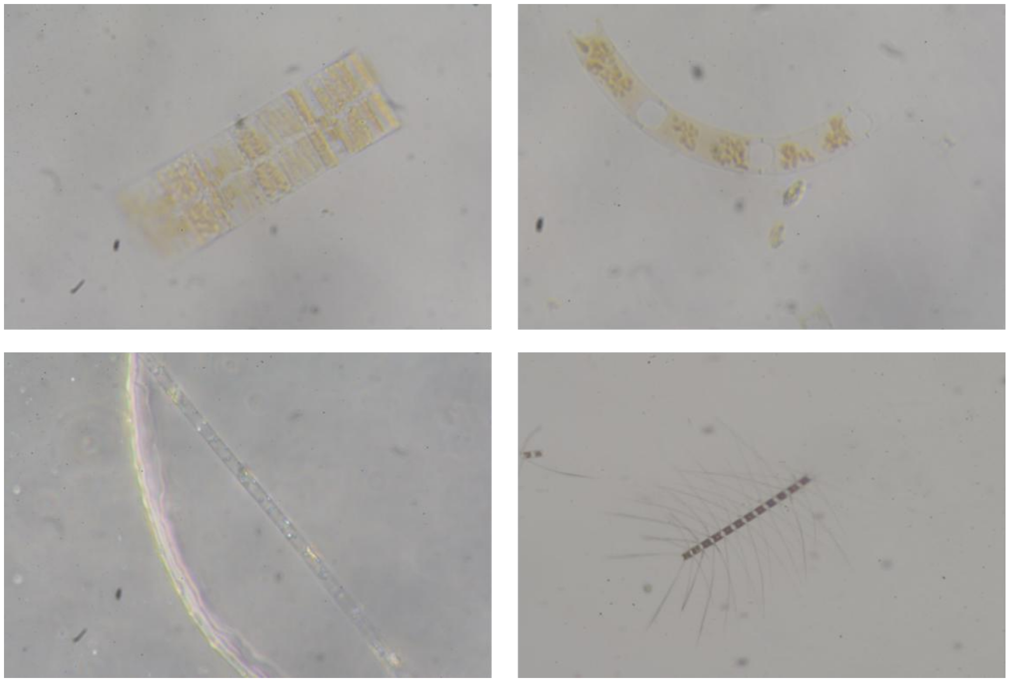

Figure 23-2: Four types of typical algae in MFD

23.4 Recommandations:

In the future for the MFD experiment, a temperature and humidity-controlled box could improve our operations under microscope in the cold room (Aft cold lab). In fact, the steam used to warm the lab creates a water layer on the lens and the MFD glass slides. Thus, some of our pictures were blurred by the condensation of water.

23.5 References

[1] **I. Peeken, S.** Primpke, B. Beyer, J. Gütermann, C. Katlein, T. Krumpen, M. Bergmann, L. Hehemann, G. Gerdts, Arctic sea ice is an important temporal sink and means of transport for microplastic, Nature Communications, 9 (2018) 1505.

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24 (Nano)Particles in Polar seawater

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24.1 Introduction and Objectives

Particles in seawater can originate from terrestrial, atmospheric and biological sources. Studying their distribution in seawater is important to understand their role in biogeochemical cycles (Boyd et al., 2019; Bridgestock, 2023). Particles will behave differently depending on their size. Specifically, colloids (1nm to 1 μm) are particles that can remain in suspension due to their small size and Brownian diffusion (Buffle et al., 1998; Hassellv and Kaegi, 2009). They are also highly susceptible to aggregate and deposit onto other surfaces, which can modify their transport pathways (e.g.: settle out of suspension). Furthermore, due to their small size they have a very high specific surface area onto which dissolved and colloidal species can adsorb. Therefore, colloidal species can participate to the transport of natural and anthropogenic species in the ocean.

The objectives of this study were:

1. To apply methods for the size-fractionation of matter between dissolved (<1nm), colloidal (1 nm to 1μm) and particulate phases (>1 μm) to the study of polar seawater directly in the field (Hassellv and Kaegi, 2009).
2. To quantify iron in the dissolved, colloidal and particulate phase, and characterize/quantify the natural organic matter with which it is associated. To characterize the size distribution of the colloidal phase using high-end analytical techniques (A4F).
3. To study the aggregation rate of colloids and particles (1 nm to 100 μm) alone and with nanoparticulate contaminants (TiO2, soot and plastic).

24.2 Methodology

Water and sediments were sampled in order to study the composition and behavior of the colloidal and particulate phases. Colloids and particles were pre-concentrated in the water phase by tangential flow filtration (TFF) (Objective 1). Then, the size-fractionation of iron is studied, with a special focus on the characterization of the colloidal phase ("Iron Study", Objective 2). Finally, the aggregation behavior of colloids and particles, alone and with anthropogenic nanoparticles is assessed ("Aggregation study", Objective 3). A summary of the workflow can be seen in Figure 24-1.

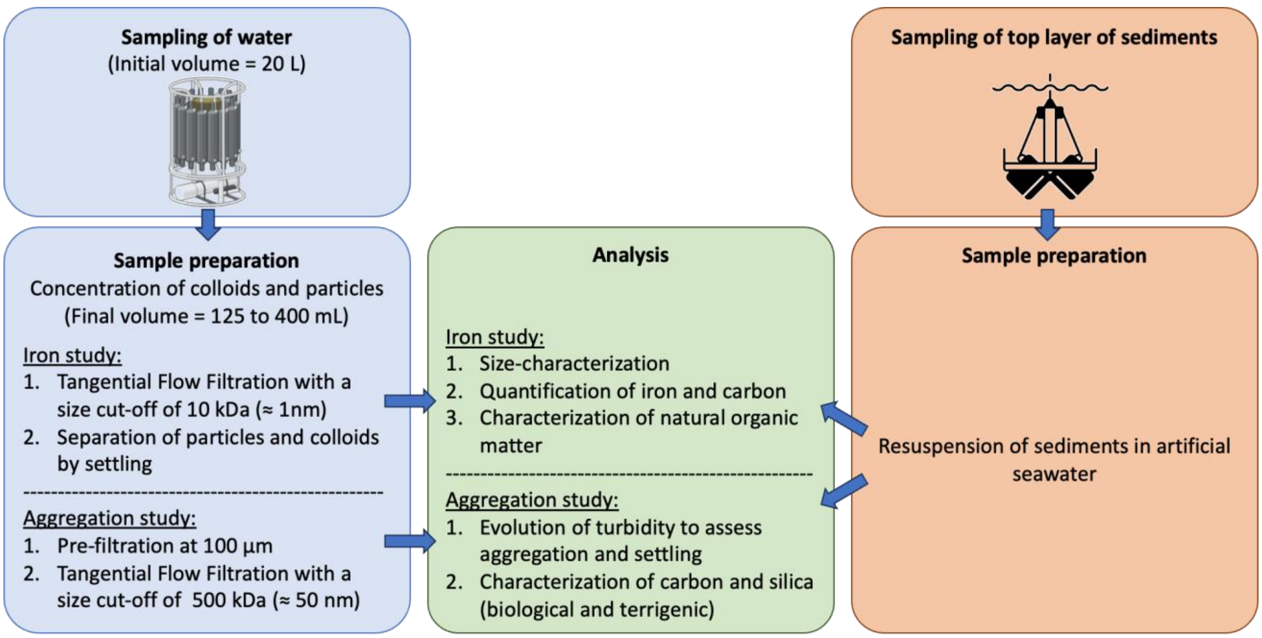

Figure 24-1: Schematic of the workflow

For the iron study, samples were taken at the surface and at 100m. For the aggregation study, samples were taken at the surface chlorophyll maximum (SCM) and at the bottom. A summary of stations which were sampled and analysis performed can be seen in Table 24-1.

Table 24-1: Summary of stations sampled, depth of water and sediment sampled and analysis performed.

Date	Sampling method	Station	Depth (m)	Aggregation study	Iron study
04/10/2024	Rosette	KEBBAB S10	20	x	x
06/10/2024	Rosette	TCA S3	880	x	NA
			20	x	NA
07/10/2024	Rosette	TCA T3-01	10	x	NA
			71	x	NA
			2	NA	x
			71	NA	x
	Box core		83	x	x
08/10/2024	Rosette	TCA T3-08	10	x	NA
			1134	x	NA
			2	NA	x
			100	NA	x
	Box core		1143	x	x
10/10/2024	Rosette	TCA T3-BB2	26	x	NA
			2349	x	NA
			2	NA	x
			100	NA	x
	Box core		2366	x	x
11/10/2024	Rosette	TCA T3-17	2189	x	NA
			25	x	NA
			2	NA	x
			100	NA	x
	Box core		2210	x	x
12/10/2024	Rosette	TCA T3-11	20	x	NA
			522	x	NA
			2	NA	x
			100	NA	x
16/10/2024	Rosette	TCA T6-09 (A9)	20	x	NA
			67	x	NA
			2	NA	x
			100	NA	x
17/20/2024	Rosette	TCA T6-05 (A5)	2	NA	x
		TCA T6-05 (A5)	100	NA	x
	Box core		817	x	x
18/10/2024	Rosette	TCA T6-01 (A1)	45	x	NA
		TCA T6-01 (A1)	119	x	NA
		TCA T6-01 (A1)	119	NA	x
		TCA T6-01 (A1)	2	NA	x

24.3 Preliminary Results

Some preliminary results show that phytoplankton remain alive after the TFF pre-concentration. While the effect of TFF on phytoplankton fitness was not analyzed quantitatively, this was assessed qualitatively by microscopy observations (Figure 24-1). Also, it appears that the addition of model anthropogenic nanoparticles (TiO2, Soot and plastic) does not modify the aggregation behavior of colloids and particles (500 kDa to 0.1 mm).

24.4 Recommendations

Here are a few recommendations for our work in the PILMS lab:

- More hooks on the walls to secure material. Specifically, the open space at the bottom could use some hooks on the floor to secure boxes stored there.
- Drainage of water directly outside of the lab instead of in a bucket.
- It would be great to mQ water in the lab or on the same floor. We had to go get mQ water two floors below and it was quite tiring.

Recommendations for extra-comfort:

- Being able to adjust the temperature in the laboratory would be helpful. We wanted to keep it cool (circa 13 degrees Celsius) so we turned the heat off during the day and back on during the night.

24.5 References

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25 ArcticCORE (Conservation, Observation, Research, Engagement)

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25.1 Introduction and Objectives

In August 2019, Fisheries and Oceans Canada established Tuvaijuittuq as a Marine Protected Area (MPA) with interim protection. In an Arctic Ocean with rapidly declining sea ice, the Tuvaijuittuq area retains the oldest and thickest sea ice, and can act as a refuge for icedependant species. However, important knowledge gaps persist because of the remote location of the area. Fisheries and Oceans Canada works with its northern partners to develop long term protection in Tuvaijuittuq according to the best scientific knowledge. The Government of Canada created a unique ecosystem research program to study the Tuvaijuittuq region, starting with the establishment of the Multidisciplinary Arctic Program (MAP)-Last Ice, and now the ArcticCORE (Conservation, Observation, Research, Engagement) program. ArcticCORE is a 5-year program aiming to characterize Tuvaijuittuq's unique ecosystem and its influence and connectivity with the adjacent ecosystems to inform sustainable management and conservation initiatives in Tuvaijuittuq and the eastern Arctic. The *CCGS Amundsen* research expedition, including mooring deployments for long term data collection and collection of biochemical data from the water column, enables the characterization of the marine ecosystem in the Tuvaijuittuq region and adjacent areas, and the characterization of key physical, chemical, biological and export/food web processes.

In collaboration with the Alg'O Nord, RED-AO and Refuge-Arctic projects (PI Mathieu Ardyna), we collected water samples for the calibration and validation of optical data and remote sensing products from high resolution satellite imagery. The objective is to build a strong and unique biogeochemical dataset to support, calibrate and validate the remote sensing and radiometric measurements that were accomplished concurrently.

25.2 Methodology

Water was collected from the CTD-Rosette at multiple depths for the analysis of various biogeochemical parameters (see Table 25-1, Table 25-2). Fractionated chl *a* concentration (total and >5µm) were measured onboard using a Turner Designs 10-AU fluorometer (Parsons et al. 1984). Particulate organic carbon and particulate nitrogen (POC/PN) were filtered on pre-combusted GF/F filters, dried overnight at 65°C, and then kept frozen at -80 °C until further analysis. Phytoplankton fatty acid (FA), samples were filtered on pre-combusted GF/F filters and kept frozen at -80 °C until further analysis. Samples for salinity and $\delta^{18}O$ were collected, sealed, and stored at 4 °C. Duplicate samples for taxonomy were collected at the surface and SCM depths, and preserved with 1% lugol or formol, respectively, and sealed and stored at 4 °C. Samples for dissolved inorganic carbon and total alkalinity (DIC/TA), and methane and nitrous oxide (CH_4/N_2O) were collected and spiked with 100 µL of saturated mercuric chloride solution, before being sealed and stored in the dark at 4 °C. Samples for dissolved organic carbon (DOC) were collected and spiked with 300 µL of HCl before being sealed and stored at 4 °C.

Opportunistic surface water samples (and freshwater samples) were collected from the barge and helicopter in the various fjord systems of Nares Strait visited on Leg 3. Table 25-3 describes the sampling of the ArcticCORE team at such opportunistic sites.

Four moorings were recovered as part of the ArcticCORE program by the mooring team onboard the ship. One near Bylot Island (Bylot-23), which was recovered and also re-deployed for another year. One in Archer Fiord (AF-23), which was also recovered and re-deployed. Two in Nares Strait at Smith Sound (Nares-E and Nares-W), which were recovered. For more information please refer to the mooring team report.

Table 25-1: Sampling activities conducted by the ArcticCORE team during leg 3 of the 2024 CCGS Amundsen expedition. Coordinates presented are from the biological cast.

Station name	Station number	Latitude (N)	Longitude (W)	Rosette Cast (biological)	Rosette Cast (chemistry)	Date (UTC)	Carbon chemistry	Water bio-geochemistry	Barge Sampling	Helicopter glacial sampling
Bylot-23 / RA01	18	72.8801903	75.6481865	2	4	12-Aug	X[1]	X		
AC12 / RA02	19	77.2334037	79.1049937	6	8	14-Aug	X	X		X
RA03	20	77.2925508	80.7373140	9	11	15-Aug	X	X	X	
RA04	21	77.3610172	81.0819947	13	15	16-Aug	X	X	X	
Nares West WBAT / RA05	22	78.3119878	74.7739185	17	17	17-Aug	X	X[2]		
RA06	23	79.6831647	73.0871727	18	20	18-Aug	X	X	X	
RA07	24	79.7855387	73.5580207	22	24	19-Aug	X	X	X	X
RA08	25	79.8290557	74.1005407	26	28	20-Aug	X	X	X	X
LSea-24 / RA09	26	82.3984407	60.8476893	30	32	22-Aug	X[1]	X		
LSea-23 / RA10	27	82.1233755	61.2347670	34	34	22-Aug	X[1]	X		
AF-23 / RA11	28	81.5370568	64.9530353	35	35	23-Aug	X[1]	X		
AC-CB / RA12	29	81.5702320	67.6127397	36	38	23-Aug	X[1]	X	X	X
AC3B / RA13	30	81.2865022	68.3999880	40	42	25-Aug	X[1]	X		X
AC2 / RA14	31	81.5891795	65.9264087	44	46	26-Aug	X[1]	X		
AC1 / RA15	32	81.7002615	64.0851075	48	50	27-Aug	X[1]	X		
RA16	33	81.7209642	59.2285197	52	54	28-Aug	X	X		
RA17	34	81.6308983	58.9165470	57	59	28-Aug	X	X	X	X
RA18	35	81.9393385	60.3560187	60	62	29-Aug	X	X		
AC4B / RA19	36	81.2521917	64.3240987	63	63	30-Aug	X[1]	X		
AC14 /RA20	37	75.5700267	78.8628017	64	64	2-Sept	X	X		
AC16/RA21	38	76.0302493	83.1170315	65	65	2-Sept	X[1]	X		
RA24	39	78.0320037	75.6004525	68	70	4-Sept	X	X		X

[1] – DIC/TA collected [2]– Phyto fatty acid not collected

Table 25-2: Sampling details for water column biochemistry sampled by the ArcticCORE team during leg 3 of the 2024 *CCGS Amundsen*.

Depth (m)	Chemical cast					Biological cast								
	DIC/TA	CH_4/N_2O	DOC	Salinity	^{18}O	Flow cytometry		DAPI	Chlorophyll *a*		Phyto taxonomy	Phyto fatty acid	POC/PN	FRRF
						Bacteria	Protist		Total	> 5µm				
5	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	2x	1x	1x
10	1x	1x	1x	1x	1x				2x	2x			1x	
20	1x	1x	1x	1x	1x	2x	2x		2x	2x			1x	
30	1x	1x	1x	1x	1x				2x	2x			1x	
SCM	1x	1x	1x	1x	1x	2x	2x	2x	2x	2x	2x*	2x	1x	1x
40	1x		1x	1x	1x	2x	2x		2x	2x			1x	
50	1x	1x	1x	1x	1x				2x	2x		2x	1x	
60	1x		1x	1x	1x	2x	2x		2x	2x			1x	
80	1x	1x	1x	1x	1x	2x	2x		2x	2x			1x	
100	1x	1x	1x	1x	1x	2x	2x		2x	2x			1x	
150	1x	1x	1x	1x	1x									
200	1x			1x	1x									
250	1x	1x		1x	1x									
300	1x			1x	1x									
500	1x	1x		1x	1x									
750	1x	1x		1x	1x									
1000	1x	1x	1x	1x	1x									
Bot.	1x	1x	1x	1x	1x		2x							

* one sample preserved with formalin, and one with Lugol's acidic solution

Table 25-3: Sampling details for opportunistic helicopter and barge sampling by the ArcticCORE team during leg 3 of the 2024 *CCGS Amundsen*.

Type	Sampled at sampling site				Subsampled upon return from sampling site						
	DIC/ TA	CH_4/ N_2O	Salinity	^{18}O	DOC	Flow Cytometry		Chlorophyll *a*		Phyto taxonomy	POC/ PN
						Bacteria	Protist	Total	> 5µm		
Helicopter	1x	1x	1x	1x	1x	1x	2x			1x*	1x
Barge	1x	1x	1x	1x	1x	1x	2x	2x	2x	1x*	1x

Only with Lugol's acid solution

25.3 Preliminary Results

25.3.1 *Phytoplankton Biomass*

Depth profiles of chlorophyll *a* concentrations measured in each fjord system of Leg 3 are shown in Figure 25-1. The more northerly fjord systems of Archer Fiord and Newman Fjord displayed relatively high chl *a* concentrations associated with their sub-surface chlorophyll maxima (SCM's), having peak values of approximately 5 mg m^{-3}.

In comparison, Dobbin Bay and Mackinson Inlet did not display SCM's inside the fjord systems. Station RA02 associated with Mackinson Inlet was actually located just outside of the fjord system in Nares Strait, and did display an SCM with a maximum chl *a* concentration of approximately 3.5 mg m^{-3}. The maximum chl *a* concentration in Dobbin Bay was approximately 1.7 mg m^{-3}, located in the surface waters (approximately 5m depth).

Depth-integrated chl *a* concentrations for each station sample during Leg 3 are presented in Figure 25-2. Chl *a* concentrations were integrated over 100 m or the entire water column if the station was shallower than 100 m. Cells larger than 5 µm dominated all sampled stations, with the exception of station RA04 in Mackinson Inlet. Although integrated chl *a* was very low overall at station RA04.

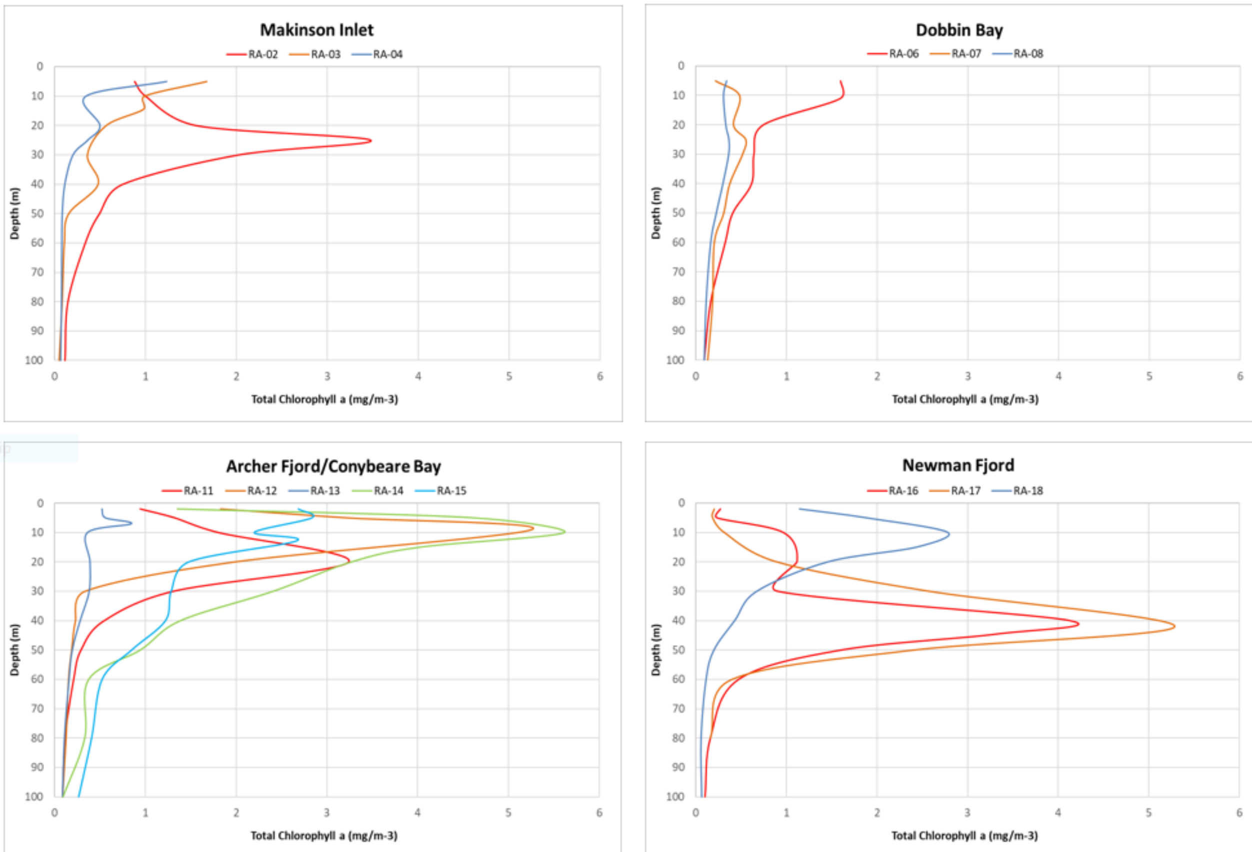

Figure 25-1: Depth profiles of chlorophyll a concentrations in the fjord systems sampled during Leg 3 of the 2024 Amundsen expedition

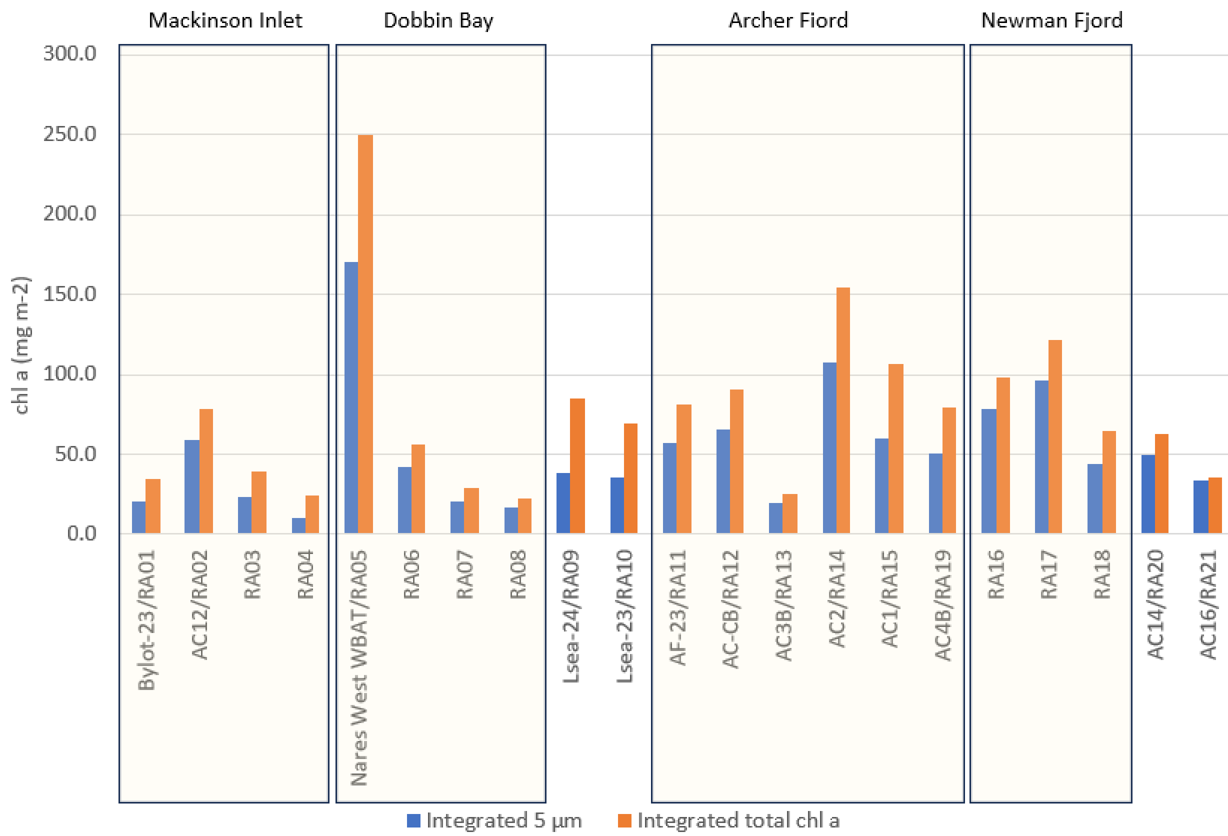

Figure 25-2: Integrated chlorophyll a biomass (mg m^{-2}) at stations sampled by the ArcticCORE team during Leg 3 of the 2024 Amundsen expedition.

25.4 Recommendations

Our team encountered difficulties in proper disposal of glass waste onboard. We were given different instructions between Legs 2b and 3. There should be a standard protocol for disposing of glass waste, similar to chemical waste. Our team produces glass waste associated with our chlorophyll *a* measurements. The glass vials have only been exposed to acetone, which evaporates away if the glass is left to vent for a short period of time before disposal.

25.5 References

Parsons, T.R., Maita, Y., Lalli, C.M. (1984) A manual of chemical and biological methods for seawater analysis. Pergamon, Oxford.

26 Environmental DNA and Plankton Profiling

Principal Investigators: David Cote[1], Jennica Seiden[1], John O'Brien[2]

Cruise Participants- Leg 2: Kathleen Lalor[1], Letitia Chen[3], Jennifer Higdon[1], Jennica Seiden[1], Sheena Roul[1], David Cote[1], Janelle Laing[2], John O'Brien[2]

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26.1 Introduction

Environmental DNA (eDNA) is an emerging scientific tool that uses DNA fragments shed from living organisms into the water column to characterize biotic community composition. Multicellular organisms constantly shed cells containing DNA into their environment (skin cells, feathers, hair, feces, urine, saliva, etc.) that can be collected, filtered, and sequenced for analysis of species occurrence. The technique has promise as a non-invasive approach that is complementary to other conventional methods, particularly in remote marine areas where it is difficult or costly to maintain regular biodiversity surveys or in protected areas to minimize disturbance to sensitive habitats and threatened species. The Leg 2a Amundsen mission had three primary objectives regarding eDNA: 1) to extend previous collections of eDNA in coastal, shelf, a slope area of the Labrador Sea, Davis Strait, and Baffin Bay for assessing eukaryotic biodiversity for comparison with more direct sampling methods (e.g., nets, drop camera, ROV, boxcore); 2) to evaluate the impacts of methodological changes related to filter pore size, replication, and filtered water volume. If the methods show comparable results, the newest method can potentially be compared with previous years collection methods for assessing biodiversity with the benefit of reducing waste and replicates needed during sampling in future years.

26.2 Methods

26.2.1 *eDNA*

Water was collected with the Rosette at a total of 15 stations during Leg 2a of the 2024 Amundsen Expedition (11th – 29th July). At all stations in the Labrador Sea (10 total; Table 26-1 white cells), one 4.5 L sample of bottom water (approximately 10 m from bottom) was collected for eDNA for filtration on a single 1.2 µm filter (Smith-Root Inc.) as well as triplicate 1.5 L samples of surface (2 m), and bottom water (approximately 10 m from bottom) for filtration on 0.22 µm filters (Sterivex^{TM}) (to ensure comparability to previous years collection methods that used a similar technique) (Figure 26-1). The results of each technique used for bottom water will be compared to assess whether results of the two methods are comparable. The sample depths were selected to assess the effectiveness of the eDNA technique compared with more traditional approaches such as oblique midwater trawl or vertical nets that are deployed at similar depths (Cote et al. 2024). For the Davis Strait and Baffin Bay stations (5 total; Table 26-1 grey cells), the number of 4.5 L bottom replicates for the 1.2 µm filters (Smith-Root Inc.) was increased to 3 to keep consistent for previous DFO Arctic Region protocols, while sampling with the 0.22 µm filters continued as above (except for sites DS_500_B1 and DS_600_A1, in which no 0.22 µm filters were used, Table 26-1).

For all eDNA samples, the Niskin bottles were decontaminated using a 10% bleach solution 30 min prior to each deployment. During deployment, the CTD-Rosette was lowered from the vessel using a winch system. The Niskin bottles were open during the down-cast and programmed to close at specified depths during the upcast. The CTD-Rosette stopped at each sampling depth for a period of 1 minute to ensure the Niskins were filled with water from the desired position in the water column. Sampling equipment was handled using clean gloves and frequently decontaminated using a combination of Eliminase solution and distilled water. Sterile, disposable 2 L Whirlpak bags were used to collect and store water prior to filtration of the 1.5 L samples, whereas a 5 L plastic cannister was decontaminated using 10% bleach solution and then rinsed with distilled water 3 times before filling with 5 L of sample water for 4.5 L sample filtration. For Davis Strait and Baffin Bay, the 4.5L samples were collected using multiple sterile Whirlpaks. Once the samples were filtered, the 0.22 µm filters required the addition of Longmires buffer (2.5 mL) for preservation of eDNA, whereas the 1.2 µm filters did not require any preservation techniques. Both types of filtered samples were stored in a cooler at room temperature until ready for transfer to the laboratory. One blank sample consisting of distilled water (MilliQ® water for Davis Strait/Baffin Bay samples) was filtered on each filtration day. Once in St. John's, the samples will be delivered to the Centre for Environmental Genomic Analyses (St. Johns, NL) for analysis. The resulting data will be used to characterize both benthic and pelagic marine communities, compare the different sampling techniques, and investigate concordance with traditional sampling approaches.

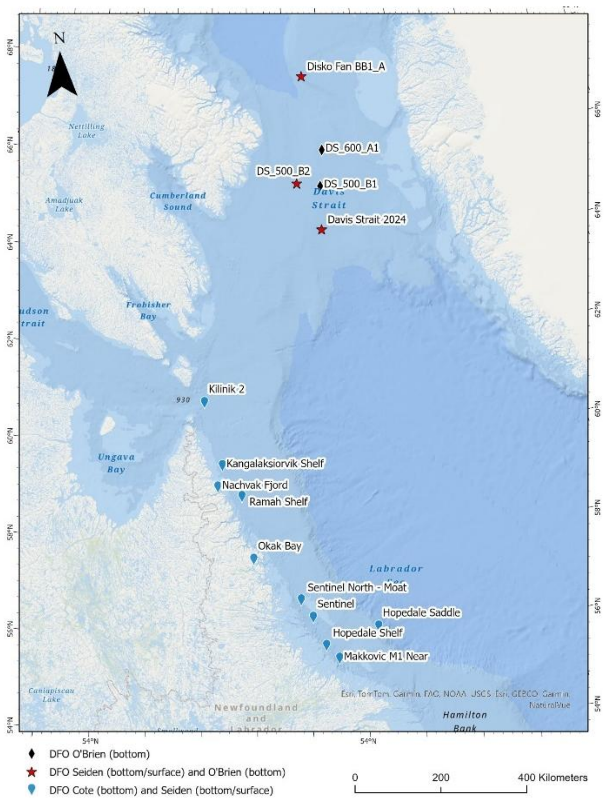

Figure 26-1: Map of eDNA water samples collected in the Labrador Sea and Baffin Bay for DFO Newfoundland and Labrador (Cote and Seiden) and DFO Arctic (O'Brien).

Table 26-1: List of Sampling Stations for eDNA Water Sampling for Leg 2a of the 2024 Amundsen Expedition. White cells are the Labrador Sea stations, and grey cells are the Davis Strait and Baffin Bay stations.

Date (UTC)	St ID	St Depth (m)	Deployment GPS Position	Bottom GPS Position	Recovery GPS Position	Sample Depth (m) (water column location)	Filter Size (µm)	Rep	Vol per Pep (L)
13-07	Hopedale Saddle	658	56.05368 -57.41179	56.05017 -57.40977	56.04705 -57.40893	647.766 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	0.22	3	1.5
16-07		686	55.43402 -58.93675	55.43348 -58.93639	55.43245 -58.93700	675.762 (bottom)	0.22	3	1.5
							1.2	1	4.5

Date (UTC)	St ID	St Depth (m)	Deployment GPS Position	Bottom GPS Position	Recovery GPS Position	Sample Depth (m) (water column location)	Filter Size (µm)	Rep	Vol per Pep (L)
	MAK-2024-M1 (Near)					2 (surface)	0.22	3	1.5
17-07	Hopedale Shelf	203	55.71742 -59.39371	55.71733 -59.39358	55.71690 -59.39358	192.610 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	0.22	3	1.5
19-07	Sentinel	567	56.31905 -59.83758	56.31834 -59.83799	56.31668 -59.83651	557.307 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	0.22	3	1.5
19-07	Sentinel North - Moat	492	56.69197 -60.26082	56.69231 -60.26233	56.68979 -60.26312	481.571 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	0.22	3	1.5
20-07	Okak Bay	89	57.56972 -62.04975	57.56955 -62.05034	57.57 -62.04984	79.131 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	0.22	3	1.5
22-07	Nachvak Fjord	207	59.0852773 -63.4689188	59.08528 -63.46870	59.0857 -63.4689	197.426 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	0.22	3	1.5
23-07	Ramah Shelf	200	58.8876215 -62.4911375	58.8875 -62.49100	58.88879 -62.48709	189.650 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	0.22	3	1.5
23-07	Kangalaksiorvik Shelf	179	59.5342193 -63.287527	59.53424 -63.28866	59.535219 -63.295795	168.743 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	0.22	3	1.5
24-07	Kilinik 2	407	60.84857 -64.065088	60.84956 -64.06852	60.85571 -64.07479	397.026 (bottom)	0.22	3	1.5
							1.2	1	4.5
						2 (surface)	1.2	1	4.5
25-07	Davis Strait 2024	695	64.54625 -58.51838	64.54448 -58.51839	64.5383 -58.52424	684.773 (bottom)	0.22	3	1.5
							1.2	3	4.5
						2 (surface)	0.22	3	1.5
26-07	DS_500_B2	494	65.53456 -59.60994	65.53555 -59.60715	65.5393 -59.59811	483.763 (bottom)	0.22	3	1.5
							1.2	3	4.5
						2 (surface)	0.22	3	1.5
26-07	DS_500_B1	496	65.4508113 -58.4370738	65.4500 -58.43747	65.446694 -58.4444	486.385 (bottom)	1.2	3	4.5

Date (UTC)	St ID	St Depth (m)	Deployment GPS Position	Bottom GPS Position	Recovery GPS Position	Sample Depth (m) (water column location)	Filter Size (µm)	Rep	Vol per Pep (L)
26-07	DS_600_A1	626	66.2024217 -58.2183035	66.20188 -58.22047	66.2044 -58.23007	615.526 (bottom)	1.2	3	4.5
27-07	Disko Fan BB1_A	582	67.7692967 -59.0421613	67.7681 -59.0410	67.764070 -59.042015	572.121 (bottom)	0.22	3	1.5

27 Environmental DNA from Arctic waters: Insights into fish communities

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27.1 Introduction and Objectives

The Arctic faces a multitude of concurrent threats to its vast marine ecosystems and its associated biodiversity. Human activities directly impact a range of species through targeted fishing and bycatch, whereas climate change is rapidly transforming glacier and ice sheet extent (AMAP, 2021). This will likely result in increased human activities in the high Arctic, causing local disturbances and result in decreased habitat suitability for Arctic specialists. On top of these mounting challenges to the arctic biodiversity, boreal species are establishing in the higher arctic as temperatures increase, possibly resulting in interspecific competition and thus trophic changes in arctic food webs (Andrews et al., 2019; Heide-Jørgensen et al., 2023; Post et al., 2021).

West and Southeast Greenland offshore waters are surveyed annually with respect to commercially important species (i.e. selected fish species and shrimps, carried out by Greenland Institute of Natural Resources, GINR). However, despite concerns for the high arctic biodiversity, frameworks for continuous monitoring of marine biodiversity in remote areas such as the Northeast Greenland National Park, the Baffin Bay area and the Nares Strait have been logistically challenging and lacking in standardization. Due to lack of basic biological data, these communities are still beyond credible assessment (Christiansen et al., 2014). In this project, we wish to demonstrate how the use of environmental DNA (eDNA) can serve as an efficient and standardized method for describing vertebrate communities in remote Arctic areas, especially where conventional monitoring methods are not feasible.

The objective of Mads' participation in the Amundsen Leg 4 cruise has been to collect eDNA samples from surface waters, subsurface chlorophyll maximum (SCM), and near the bottom. These samples will be used to characterize the fish communities that exist in these areas, and to compare results against samples collected in NE Greenland at the same time on another vessel.

27.2 Methods

Water samples were collected from rosette casts. At each station, 6 L of water was collected from surface waters, SCM and bottom (3x2 L at each depth, triplicate sampling, resulting in nine 2 L samples from three depths for each station). The water request from the rosette was set at 7 L per depth to ensure enough sample water for rinsing. Water was filtered through sterile 0.22 μm Sterivex-GP filters (Merck Life Science), using a custom-made peristaltic pump (Figure 27-1) inside the 7 °C PAWL lab (not a necessity to filter at 7 °C, more of a practical convenience).

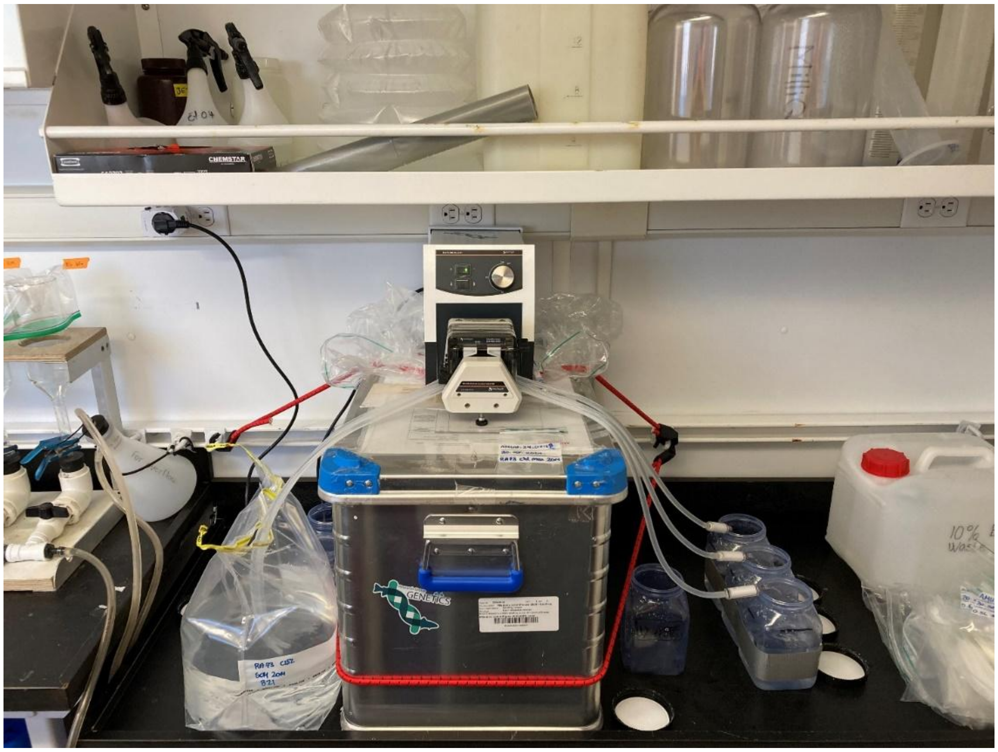

Figure 27-1: An image of the filtering station in the PAWL lab. Here, sample water was collected in whirlpak bags from the rosette, and carried into the lab. Using a peristaltic pump, the three tubes are here pumping water from the sample bag through the triplicate filters on the right. The bottles on the right-hand side were used to measure the amount of water filtered. All tubing was cleaned with a 10 % bleach solution, MilliQ water and sample water prior to attaching the filters.

Water containers and tubes were cleaned with a 10 % bleach solution, rinsed with MilliQ water and lastly rinsed with sample water prior to filtering. All water samples were filtered within two hours of collecting the water from the rosette. Furthermore, field blanks (0.5 L of filtered MilliQ water) and air blanks (0.6 L of air blown through a filter using sterile syringes) were collected throughout the cruise to account for potential contaminants arising from the lab or its surroundings. After filtering, all samples were stored in a -80 °C freezer. In total, 245 samples (including 14 blanks) were collected from 26 stations (Figure 27-2), with one station missing surface water samples (RA69).

Figure 27-2: Sampling stations where eDNA sampling was carried out. Note that two stations were also sampled near Resolute Bay.

After Leg 5 is done, samples will be sent to Tromsø, where the plan is to perform DNA extractions, PCR amplification, library preparation and sequencing. Here, we will use fish primers to amplify vertebrate DNA from the water samples following UiT's standard protocols. Fish eDNA will also be compared to community samples from nets and trawls.

27.3 Preliminary Results

No preliminary results are available.

27.4 Recommendations

As a general rule when working with DNA, try to think of potential sources of contamination that can interfere with your project goals. As the goal here is to find DNA traces from fishes, keep in mind that working with fish catches directly prior to filtering eDNA samples carries a high chance of contamination risk from the specimens you have just handled. Mads was also working with fish catches onboard this cruise, but kept separate "clean clothes" and "dirty clothes" for the two tasks. Similarly, showering and thorough hand washing was carried out before filtering eDNA samples. The primers that will be used for DNA amplification also amplify human DNA, and this is especially crucial when you expect low DNA content of your target organisms. Human DNA will always be detected in the final sequencing data, but good practices while sampling can reduce the extent of this problem (i.e. 10 % human DNA is acceptable, but 90 % is not).

27.5 References

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28 Hydrocarbon Baseline Data Collection

Principal Investigators: J. Seiden[1], J. Higdon[1], K. Lalor[1]
Cruise Participants Leg 2: J. Seiden[1], J. Higdon[1], K. Lalor[1]
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28.1 Introduction

One of the objectives of the newly formed Integrated Marine Response Planning (IMRP) Program in Newfoundland and Labrador is to capture the baseline measure of hydrocarbons present in marine sediment. In the event of an oil spill, this data will provide information on ecosystem impacts and help inform decisions surrounding the recovery of the region. With its annual survey of the Labrador Sea and Arctic waters, partnering with Amundsen Science to collect such information will help address data gaps on the Labrador Shelf. The Labrador Shelf is characterized by the presence of sea ice and cool Arctic waters carried by a nutrient rich Labrador Current. Given that there is potential for an increase of vessel traffic in the region as sea ice conditions continue to decrease, the IMRP Program has identified the Labrador Shelf as a high priority area. As such, a continued partnership with Amundsen Science would provide a time series of hydrocarbon data.

28.2 Methods

To accomplish this objective, box cores were deployed to collect samples for hydrocarbon analysis. Using a metal spatula, the upper layer of sediment (0 to 2 cm depth) was collected in a glass 250 mL jar. A blank sample was also collected by leaving an empty jar open while collecting the samples. Both the sediment samples and the blank samples were frozen at -20OC. Sample analysis will be completed by The Centre for Offshore Oil, Gas and Energy Research (COOGER) located at the Bedford Institute of Oceanography (BIO) who also provided the sediment sampling protocols. COOGER has partnered with a large number of organizations since 2002 to provide science-based knowledge and advice as well as conduct research on the fate and behaviour of petroleum-based spills. A summary of samples collected for the 2024 season are outlined in the following table (Table 28-1).

Table 28-1: Metadata for the box cores sampled for hydrocarbon baseline by the IMRP program during Leg 2a of the 2024 Amundsen expedition

Station	**Station ID**	**Date | Time (UTC)**	**Latitude (N)**	**Longitude (W)**	**Depth (m)**	**Samples Collected**
Hopedale Saddle	Hopedale Saddle	13 July, 23:05	55.98777	57.315594	1188.16	1x sediment 1 Blank
Makkovik	MAK-2024-M1 (M1 Far)	16 July 01:06	55.43343	58.939490	702.63	1x Sediment
Makkovik	MAK-2024-M1 (M1 Near)	16 July 00:46	55.43365	58.937230	681.59	1x Sediment
Hopedale Shelf	Hopedale Shelf	17 July 11:07	55.71758	59.394361	212.21	1x Sediment
Sentinel	Sentinel	19 July 04:14	56.31961	59.839907	541.76	1x Sediment
Sentinel North	Sentinel North - Drift 2	19 July 19:22	56.69212	60.28454	479.11	1x Sediment
Sentinel North	Sentinel North - Drift 1	19 July 20:05	56.69307	60.26793	492.06	1x Sediment
Sentinel North	Sentinel North - Sidewall 1	19 July 21:23	56.70020	60.21379	759.78	1x Sediment
Sentinel North	Sentinel North - Sidewall 2	19 July 22:06	56.70584	60.18386	299.44	1x Sediment 1x Blank
Sentinel North	Sentinel North - Moat	19 July 23:25	56.69416	60.25853	498.69	1x Sediment
Okak Bay	Okak Bay	20 July 17:20	57.56951	62.04820	92.11	1x Sediment
Nachvak Fjord	Nachvak Fjord	22 July 16:13	59.0856785	63.46927517	209.74	1x Sediment
Ramah Shelf	Ramah Shelf	23 July 4:28	58.88754667	62.49185817	201.82	1x Sediment
Kangalaksiorvik Shelf	Kangalaksiorvik Shelf	23 July 14:02	59.534051	63.28573667	180.25	1x Sediment
DS_500_B2	DS_500_B2	26 July 07:17	65.5229597	59.5976768	487.26	1x Sediment

DS_500_B1	DS_500_B1	26 July 15:19	65.4517100	58.4344738	498.25	1x Sediment
DS_600_A1	DS_600_A1	27 July 03:00:04	66.2004267	58.2081370	624.52	1x Sediment

29 Microbial Baselines, Hydrocarbon Degradation, and Sulfate Reducing Bacteria

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29.1 Introduction

Microbes play a vital role in all ecological niches on earth, driving biogeochemical cycles and occupying a large fraction of the food web (Falkowski et al., 2008; Moran 2015). It is hence very important to investigate microbial communities in the sub-Arctic marine regions to obtain a comprehensive overview of these ecosystems.

As climate change reduces the extent and duration of sea ice cover, shipping and industrial development in (sub)Arctic marine environments are expected to escalate, increasing the risk of oil and fuel spills in this extreme marine environment. Diesel re-supply to remote northern communities also poses a risk of spillage that could affect the marine environment. Microbial communities can be heavily impacted by the presence of oil, acting as indicators for post-spill changes in the environment. Moreover, microorganisms living in marine environments can act as nature's 'first responders' to oil spills possessing metabolic pathways to degrade toxic hydrocarbons into innocuous CO2 (ZoBell 1946; Atlas 1981). Baseline data enhances the expedient understanding of the structure, diversity, and complexity of bacterial communities and their potential to respond to an oil spill (Angelova et al. 2021) or other environmental perturbations that would similarly provoke a re-organization of resident microbial communities. Therefore, understanding hydrocarbon-degrading populations within the marine microbiome is important with respect to (1) the potential that these microorganisms have to contribute to clean-up and mitigating the negative effects of oil spills, and (2) providing an environmental signature for the state of the ecosystem, i.e., the presence of or exposure to an input of hydrocarbons. This work can provide critical ecological and epigenomic insights (Beaulaurier et al. 2019) into the Arctic Ocean microbiome responses to environmental changes, contributing to our understanding of this essential ecosystem and its vulnerability to anthropogenic impacts.

29.2 Objectives

The goal of Nunatsiavut Government's marine management project, Imappivut, is a community-driven marine planning in the coastal and marine zones of Nunatsiavut (Saunders and Hubert 2023). Imappivut uses a comprehensive approach to understanding the marine environment, including sequencing of marine microbiomes. A microbiome dataset for the region will allow for monitoring of changes in marine habitats undergoing chronic or acute disruptions, such as those resulting from climate change or oil spills (Saunders and Hubert 2023). Our sampling and research objectives along the Nunatsiavut coast and beyond are:

1) To collect sediment samples to establish microbiological baselines to inform the Nunatsiavut Imappivut ocean management plan;2

2) To filter seawater for the collection of (a) bacterial DNA, (b) picoeukaryote DNA and (c) viral DNA to obtain a complete overview of the microbial trophic levels in marine waters;

3) To establish microcosm experiments exposing sediment microbial communities to crude oil to simulate an oil spill and closely monitor their molecular and ecological responses during the initial stages of contamination, both in the presence and absence of nutrient enrichment;

4) To measure the activity of in situ sulfate reducing bacteria in the upper layers of sediment, both in the presence and absence of oil contamination.

5) Investigate the effects of high faunal biodiversity areas on the activity of microbial communities by measuring their sulfate reducing activity relative to distance from one of the "Makkovik Hanging Gardens" coral walls.

29.3 Methodology

29.3.1 *Water Sampling*

The *CCGS Amundsen* was equipped with a CTD-Rosette fitted with twenty-four 12 L Niskin bottles. Sensors on the CTD captured profiles of chlorophyll fluorescence, dissolved oxygen concentrations, water temperature, and salinity. Samples from the water column were taken at several depths from 13 sampling stations using the CTD-Rosette (Table 29-1). At each station, surface and bottom water were sampled, as well as an intermediate depth halfway to the seafloor. Additionally, a surface pump was deployed to collect true surface water in addition to the surface water from the Rosette, which corresponds to about 2 m below the sea surface. All samples were obtained in triplicate; i.e., three Niskin bottles from the rosette for each sampling depth, and the surface pump was used to fill three separate carboys.

Table 29-1: Water sampling locations.

Station	Date	Latitude (N)	Longitude (W)	Station depth (m)	Cast	Depths sampled (m)	Analyses
Hopedale Saddle	Jul 13	56.054	57.411	661	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						300	
						661	
Makkovik Hanging Gardens (M1-Near)	Jul 15	55.433	58.936	707	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						300	
						688	
Hopedale Shelf	Jul 17	55.432	58.945	226	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						100	
						190	
Sentinel	Jul 18	56.318	59.838	554	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						275	
						569	
Sentinel North	Jul 19	60.472	61.251	486	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						250	

						499	
Okak Bay	Jul 20	57.569	62.050	91	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						40	
						80	
Nachvak Fjord	Jul 22	59.085	63.468	208	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting and viral genomics
					CTD-Rosette	Rosette surface	
						100	
						191	
Ramah Shelf	Jul 22	58.887	62.491	205	Surface pump	True surface	Microbial DNA, Cell counting
					CTD-Rosette	Rosette surface	
						40	
						199	
Kangalaksiorvik Shelf	Jul 23	59.534	63.286	164	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						80	
						179	
Killinik 2	Jul 24	60.848	64.063	390	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting and viral genomic
					CTD-Rosette	Rosette surface	
						200	
						407	
DS_500_B2	Jul 26	65.535	59.607	500	Surface pump	True surface	Microbial DNA, Cell counting

					CTD-Rosette	Rosette surface	
						250	
						490	
DS_500_B1	Jul 26	65.446	58.444	500	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						250	
						486	
BB1_A	Jul 27			630	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						300	
						590	

29.3.2 *Sediment Sampling*

Surface sediment was collected at 18 different stations with three replicates per station using the box cores aboard the Amundsen (Table 29-2). Once the box core came back on deck, the overlying water was siphoned off and the surface sediment temperature was recorded. For each box core, ~2 mL of surface sediment (0-3 cmbsf) was collected using sterilized spatulas in two sets of triplicate into 2 mL cryovials and frozen at -80 °C. The first set is meant for metagenomic analyses, while the second set is meant for epigenetic sequencing using Nanopore technology. From some cores, an additional set of triplicate cryovials were collected for onboard sequencing analysis. ~15 mL 'bulk' surface sediment (0-3 cmbsf) was also collected into 50 mL conical tubes for microcosm incubations. From some sites, sub-cores were taken for radiotracer analysis. Two sets of duplicate plexiglass coring tubes (31 cm long, 29 mm diameter) with 27 holes sealed with silicone along one side were used to subsample from box cores while preserving stratigraphy. Where multiple box cores were scheduled for a site, only one of the box cores was sampled. Makkovik Hanging Gardens was an exception to the rule, where samples were collected from all three box cores within the "M1" transect.

29.3.3 *Water filtering for prokaryotic DNA and cell counting*

A volume of 2 L of water collected in triplicate for each sampled depth (bottom, middle and surface) from the rosette and surface pump was aseptically vacuum filtered on two manifolds over 0.2 um filters (47 mm, Pall) using 250 mL disposable filter cups. The filters were then folded, stored in individual Whirl-Pak bags, and frozen at -80°C for future downstream analysis.

29.3.4 *Water filtering for eukaryotic DNA and cell counting*

The protocol utilized a bottle-top filter unit connected to a vacuum pump. A volume of 2 L of sea water collected in triplicate for each depth from the rosette and surface pump was filtered through a 47 mm 20 µm nylon membrane pre-filter and filtered once more through a 3.0 µm mixed cellulose ester (MCE) filter. Filter fractionation isolated nanoplankton microbial communities, primarily composed of protists (Caron et al., 2012), while excluding many prokaryotes and zooplankton. Captured biomass was preserved on the MCE filters using 500 µL of DNA/RNA Shield, preserving the nucleic acids. Filter discs were then stored at 4°C until high molecular weight (HMW) extraction and the subsequent generation of long-reads via

Oxford Nanopore sequencing. Ultimately, hybrid assembly will be used to construct a targeted eukaryotic marker gene region (Goankar & Campbell, 2024). The curated genome assemblies will contribute to the growing database of protistan reference genomes available to researchers and add detail to the understanding of (sub)Arctic microbial diversity.

Table 29-2: Sediment sampling locations.

Station	Date	Depth (cmbsf)	Latitude (N)	Longitude (W)	Station depth (m)	Analyses
Hopedale Saddle	Jul 13	0-3	56.066	57.460	273.86	Microbial DNA, Cell counting
Makkovik Hanging Gardens M1-Far	Jul 15	0-3	59.077	63.528	204.12	Microbial DNA, Cell counting, oil microcosm incubations
		0-25				Sulfate reduction cores
Makkovik Hanging Gardens M1-Near	Jul 16	0-3	58.149	62.777	254.17	Microbial DNA, Cell counting
		0-25				Sulfate reduction cores
Makkovik Hanging Gardens M1E	Jul 17	0-3	58.150	62.776	254.07	Microbial DNA, Cell counting, oil microcosm incubations
		0-25				Sulfate reduction cores
Hopedale Shelf	Jul 17	0-3	58.149	62.777	254.28	Microbial DNA, Cell counting
Sentinel	Jul 18	0-3	58.119	63.001	130.45	Microbial DNA, Cell counting, oil microcosm incubations
		0-25				Sulfate reduction cores
Sentinel North	Jul 19	0-3	60.47196	61.25127	479.11	Microbial DNA, Cell counting
Okak Bay	Jul 20	0-3	57.56955	62.05035	92.11	Microbial DNA, Cell counting
Nachvak Fjord	Jul 22	0-3	59.08528	63.4687	209.74	Microbial DNA, Cell counting, oil microcosm incubations
Ramah Shelf	Jul 22	0-3	58.88754	62.49101	201.82	Microbial DNA, Cell counting
Kangalaksiorvik Shelf	Jul 23	0-3	59.5344	63.28672	180.25	Microbial DNA, Cell counting
DS_500_B2	Jul 26	0-3	65.53555	59.60715	488.37	Microbial DNA, Cell counting
DS_500_B1	Jul 26	0-3	65.44669	58.4444	498.25	Microbial DNA, Cell counting
DS_600_A1	Jul 26	0-3	66.20043	58.20814	624.52	Microbial DNA, Cell counting

BB1_A	Jul 27	0-3	67.76814	59.04109	579.74	Microbial DNA, Cell counting

29.3.5 *Water filtering for viral analysis and microbial trophic levels*

Microbial trophic levels were separated from 20 L samples of CTD-Rosette bottom and surface water at Nachvak Fjord and Killinik. A Geopump Peristaltic Pump was used to filter each 20 L water sample through a series of filter units containing a 20 µm, 47 mm, nylon membrane filter, a 3 µm, 47 mm, polycarbonate and a 0.22 µm Sterivex filter unit. Each filter was stored at -80°C after the addition of 2.5 mL DNA/RNA Shield. Nucleic acids from these filters will be extracted and sequenced to determine the diversity of picoeukaryotes and prokaryotes present. The filtrate was saved and 2 mL of 10 g/L iron chloride was added to each 20 L sample. The iron chloride was used to flocculate the viruses to prevent them from passing though the filter (Poulos et al., 2018). After 1 hour of incubation at room temperature, the water was filtered using the same Geopump Peristaltic Pump through a 0.1 µm, 142 mm, polycarbonate membrane filter on top of a 0.8 µm, 142 mm, Supor support filter. The 0.1 µm polycarbonate membrane filter was stored at 4°C and the 0.8 µm Supor support filter was disposed. The nucleic acids will be extracted and sequenced to determine the viral diversity.

29.3.6 *Radiotracer experiments for sulfate reducing bacteria*

Aliquots of 150 kBq of 20 uL 35S-SO4 were injected through the holes of plexiglass cores tubes (31 cm long, 29 mm diameter) at 2 cm intervals. For half of the cores, each injection was followed by a 20 uL 0.1% crude oil injection through the same hole. The cores were incubated at 3°C temperature for 12 hours, after which the cores were sectioned into 2 cm sections and stored at -20°C in 20% zinc acetate (Jørgensen & Fenchel 1974). The sediment sections will be analyzed at the University of Calgary for the calculation of in situ sulfate reduction rates through cold chromium distillation ((Jørgensen & Fenchel 1974). These rates will be paired with geological and geochemical analyses performed on these sites by other groups present on the vessel.

29.3.7 *Oil microcosm sediment incubations*

For some sites, up to eight treatment groups were set up, comparing different concentrations of crude oil and different nutrient-amended media. From the box cores in Sentinel and Nachvak Fjord, 14 samples of ~10mL/15g surface sediment were obtained and placed in glass serum bottles to make triplicates of four treatments and two controls. An additional sediment-free control was prepared. The first two treatment groups contained 0.1 % crude oil and either only ambient seawater or ambient seawater amended with ammonium chloride and potassium phosphate. The third and fourth treatment group contained 0.01 % of crude oil with either ambient seawater or ambient seawater amended with Ammonium Chloride and Potassium Phosphate. Seven more microcosms were set up for the Sentinel site that included the same treatment groups as described above along with the addition of 320 kBq of 35S radiotracer solution to each bottle. An additional crude oil free control was prepared. Triplicate microcosms were only established for the treatment group with 0.1 % crude oil and ambient seawater amended with ammonium chloride and potassium phosphate and the 35S radiotracer solution. The concentrations of the Ammonium Chloride and Potassium Phosphate in each microcosm were 4.67 mM and 1.46 mM respectively. All microcosms were incubated at 4°C. Subsamples of slurry were taken on day 5, and day 10. Gas subsamples of ~10 mL were taken at day 10 to measure the oxygen depletion induced by bacteria in the microcosms. Downstream analyses include gas chromatography for gas composition assessments, cold-chromium distillations for the calculation of sulfate reduction rate in the radiotracer-spiked incubations (Jørgensen & Fenchel 1974), and DNA extractions for the evaluation of community composition and shifts.

29.4 Recommendations

Regularly equipping the box cores with a HiPAP beacon is beneficial as it allows us to more accurately determine the origin of the sediment samples. This practice should continue in the coming years.

29.5 References

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30 Microbial diversity and use of organic matter in high Arctic fjords

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30.1 Introduction and Objectives

Microorganisms play a pivotal role in the functioning of marine ecosystems. They are the main drivers of nutrient cycling, primary production, and organic matter decomposition. They facilitate the breakdown of organic material, thereby recycling nutrients that are essential for the growth of larger marine organisms. Moreover, these microorganisms influence the oceanic carbon cycle, affecting both carbon sequestration and flux. The presence of these microorganisms is vital for maintaining the ecological balance and productivity of marine environments, underscoring their critical role in sustaining ocean health and biodiversity. Microorganisms are just as important in the Arctic as in the other world's oceans. They support the food web in a region that is characterized by seasonal variations in light and ice cover. Furthermore, their impact on carbon sequestration processes impact global carbon cycles and climate regulation. The health and functionality of Arctic marine ecosystems are thus heavily dependent on these microorganisms, highlighting their importance in the face of climate change and environmental shifts.

Microbial communities have been regularly described across the Canadian Arctic through the Amundsen summer cruises, which have been conducted for more than 20 years (works of C. Lovejoy and colleagues). The diversity of open water communities and their functions through the water column is now better understood, however, the communities inhabiting the numerous high Arctic fjords remain poorly known.

30.2 Objectives:

The primary objective of this leg of the expedition was to describe the microbial communities inhabiting the northern most fjords of the Canadian and Greenland arctic, to measure their activity, and to characterise the organic material and types of carbon that they cycle. We will describe these parameters along glacier to open sea transects. Additionally, water from the glacier, adjacent lakes and rivers were sampled to obtain a full continuum of communities, functions and organic substrates from land to sea. The overarching aim is to understand how organic matter originating from melting glaciers and permafrost can fuel the productivity of the ocean after passing through microbial mineralisation. This is an important question as glacier are melting under a warming earth.

30.3 Methodology

All our analysis is based on sea water sampling. At each station sampled from the Amundsen, samples were taken from 6 different depths: 5m, 2 0m, scm, 60m, 200m and bottom. At shallower station, the 200m sample was replaced by 150m if available, or 2m. During Leg 3, samples were also taken with the barge at the surface of sea following glacier to sea gradients (Table 30-2). Finally, samples were taken at places reached by the helicopter. They included glacier melt water, lakes and rivers (Table 30-3). Samples collected during Leg 5 are detailed in Table 30-4.

30.3.1 *Microbiology*

Water is sampled from the rosette and then filtered to concentrate microbial biomass on filters (Figure 30-1). The filters are flash frozen in liquid nitrogen and then stored at -80 before being shipped to our laboratory in France. Once in the laboratory, DNA will be extracted from the filters and sequenced for metabarcoding and metagenomics. Water was also sampled to quantify bacterial production (BP). BP is measured on board by tracing the specific incorporation of radioactive 3 H-leucine.

30.3.2 *Chemistry*

Water from the rosette is also used to prepare samples that will be used to quantify bacterial production (BP), dissolved organic matter (DOM), dissolved organic carbon (DOC), fluorescent dissolved organic matter (FDOM) and amino acids (AA). For DOM, water is filtered through a GFF filter and samples are then processed by solid phase extraction (SPE) through PPL cartridges, and then stored at -80 until characterization on ***Fourier-transform ion cyclotron resonance mass spectrometer***. For FDOM and AA, sampled filtered on GFF are stored in amber glass flask at -20. For DOC, samples are acidified with H_2SO_4 before being sealed in glass ampoules for storage in the dark at room temperature. Samples will be then analyzed at the home laboratory.

30.3.3 *Experiments.*

30.3.4 *Leg 3*

Two “regrowth” incubation experiments were conducted to assess the degradability of the dissolved organic matter. The principal is to dilute the abundance of bacteria to promote bacterial growth, and see which compounds are preferentially consumed, and which bacterial group grow. One experiment was conducted with water collected from Makinson Inlet (RA04) and the other with water from the Lincoln Sea (RA09). Each incubation was conducted at 0 ^{o}C and 4^{o}C, and lasted for 14 days during which samples for bacterial abundance and production were taken as well as for DOC, FDOM, and aa.

30.3.5 *Leg 5*

No experiment on board during the leg5.

Table 30-1: Stations sampled from the Amundsen at which water samples were taken for microbial analysis, BP, DOM, DOC, FDOM and AA quantifications.

Station	Location	Date	Latitude (N)	Longitude (W)
RA01	Bylot	12/08/2024	72.8819650	75.6568045
RA02	Makinson Inlet	14/08/2024	77.2326540	79.0912658
RA03	Makinson Inlet	15/08/2024	77.2932432	80.7404213
RA04	Makinson Inlet	15/08/2024	77.38985	81.0443833
RA06	Dobbin Bay	18/08/2024	79.6834997	73.0893218
RA07	Dobbin Bay	19/08/2024	79.7856013	73.5589922
RA08	Dobbin Bay	20/08/2024	79.8296283	74.1052780
RA09	Lincoln Sea	22/08/2024	82.4081650	60.8566197
RA12	Conybeare Fjord	23/08/2024	81.5701537	67.6096413
RA13	Archer Fjord	25/08/2024	81.2862772	68.4032877
RA14	Archer Fjord	26/08/2024	81.5887715	65.9347113
RA15	Lady Franklin Bay	27/08/2024	81.7001647	64.0787962
RA16	Newman Fjord	28/08/2024	81.7193792	59.2269845
RA17	Newman Fjord	28/08/2024	81.6299023	58.9213448
RA18	Newman Fjord	29/08/2024	81.9385173	60.3489057

a) **b)**

c)

Figure 30-1: a. The rosette coming out of the water, b. filtration system in the aft lab on board the Amundsen, and c. chemistry bench to process samples for DOM, FDOM, DOC and aa analysis.

Table 30-2: Stations sampled with the helicopter at which water samples were taken for microbial analysis, BP, DOC, FDOM and AA quantifications.

Station	Location	Date	Latitude (N)	Longitude (W)	Sample type
RA02	Makinson Inlet	14/08/2024	77.2522222	80.77750	River
RA02	Makinson Inlet	14/08/2024	77.4250000	80.78472	glacier melt water
RA07	Dobbin Bay	19/08/2024	79.8119444	72.8377778	River
RA07	Dobbin Bay	19/08/2024	79.8536111	75.0813889	glacier melt water
RA08	Dobbin Bay	20/08/2024			Lake
RA12	Lake Hazen	24/08/2024	81.7938889	70.4519444	Lake
RA12	Hazen River	24/08/2024	81.6830556	69.0152778	River
RA12	Hazen River	24/08/2024	81.5177778	68.7819444	River
RA13	Archer Fjord	25/08/2024	81.0563889	70.0611111	Lake
RA13	Archer Fjord	25/08/2024	81.0763889	70.0122222	River
RA13	Archer Fjord	25/08/2024	80.9388889	70.815	River
RA17	Newman Fjord	28/08/2024	81.3113889	57.2325	glacier melt water
RA17	Newman Fjord	28/08/2024	81.5277778	57.9836111	River

Table 30-3: Stations sampled from the barge at which water samples were taken for microbial analysis, BP, DOM, DOC, FDOM and AA quantifications.

Station	Location	Date	Latitude (N)	Longitude (W)	Sample type
RA03	Makinson Inlet	15/08/2024	77.2644167	80.7391667	sea surface
RA04	Makinson Inlet	15/08/2024	77.38985	81.0443833	sea surface
RA04	Makinson Inlet	15/08/2024	77.37565	81.03525	sea surface
RA08	Dobbin Bay	20/08/2024	79.8344	74.8484	sea surface
RA08	Dobbin Bay	20/08/2024	79.8270333	74.573	sea surface
RA08	Dobbin Bay	20/08/2024	79.8296	74.1726167	sea surface
RA12	Conybeare Fjord	23/08/2024	81.5692833	67.6433667	sea surface
RA12	Conybeare Fjord	24/08/2024	81.5829333	68.4746	sea surface
RA12	Conybeare Fjord	24/08/2024	81.52255	68.5066	sea surface
RA13	Archer Fjord	25/08/2024	81.2774667	68.481	sea surface
RA14	Archer Fjord	26/08/2024	81.5749333	66.0275833	sea surface
RA15	Lady Franklin Bay	27/08/2024	81.6596333	64.0590167	sea surface
RA17	Newman Fjord	28/08/2024	81.6119	58.6910167	sea surface

RA17	Newman Fjord	28/08/2024	81.6333833	58.8515667	sea surface

Table 30-4: Station sampled during Leg 5a

Date	Station	Cast / Core pool	Niskin Bottle	DNA3	DNA02	FCM	DOC	FDOM	AA	MS (DOM)
2024-10-04	**KEBABB-S08**	4	1			X	X	X		
	KEBABB-S08		6			X	X	X		
	KEBABB-S08		9			X	X	X		
	KEBABB-S08		12	X	X	X	X	X	X	
	KEBABB-S08		18			X	X	X		
	KEBABB-S08		24	X	X	X	X	X	X	
2024-10-05	**KEBABB-S05**	7	1			X	X	X		
	KEBABB-S05		7			X	X	X		
	KEBABB-S05		10			X	X	X		
	KEBABB-S05		15	X	X	X	X	X	X	
	KEBABB-S05		19			X	X	X		
	KEBABB-S05		24	X	X	X	X	X	X	
	KEBABB-S03	10	2			X	X	X		
	KEBABB-S03		3			X	X	X		
	KEBABB-S03		8			X	X	X		
	KEBABB-S03		16	X	X	X	X	X	X	
	KEBABB-S03		19			X	X	X		
	KEBABB-S03		24	X	X	X	X	X	X	
2024-10-06	**TCA-S3**	17	1			X	X	X		
	TCA-S3		5			X	X	X		
	TCA-S3		8			X	X	X		
	TCA-S3		16	X	X	X	X	X	X	X
	TCA-S3		20			X	X	X		
	TCA-S3		23	X	X	X	X	X	X	X
2024-10-07	**TCA-T3-1**	20	5			X	X	X		
	TCA-T3-1		8	X	X	X	X	X	X	
	TCA-T3-1		15			X	X	X		
	TCA-T3-1		16			X	X	X		
	TCA-T3-1		17			X	X	X		
	TCA-T3-1		24	X	X	X	X	X	X	
	TCA-T3-5	22	1			X	X	X		
	TCA-T3-5		4			X	X	X		
	TCA-T3-5		10	X	X	X	X	X	X	X
	TCA-T3-5		11	X	X	X	X	X	X	X
	TCA-T3-5		12			X	X	X		

	TCA-T3-5		21			X	X	X		
2024-10-08	**TCA-T3-8**	29	2			X	X	X		
	TCA-T3-8		3			X	X	X		
	TCA-T3-8		6			X	X	X		
	TCA-T3-8		16	X	X	X	X	X	X	
	TCA-T3-8		17			X	X	X		
	TCA-T3-8		19	X	X	X	X	X	X	
2024-10-09	**TCA-T3-9**	32	1				X	X		
	TCA-T3-9		8				X	X		
	TCA-T3-9		11				X	X		
	TCA-T3-9		19				X	X		
	TCA-T3-9		17				X	X		
	TCA-T3-9		23				X	X		
2024-10-10	**TCA-BB2**	37	1			X	X	X		
	TCA-BB2		4			X	X	X		
	TCA-BB2		14			X	X	X		
	TCA-BB2		21	X	X	X	X	X	X	
	TCA-BB2		22			X	X	X		
	TCA-BB2		24	X	X	X	X	X	X	
	TCA-T3-19	43	1				X	X		
	TCA-T3-19		12				X	X		
	TCA-T3-19		18				X	X		
	TCA-T3-19		20				X	X		
	TCA-T3-19		23				X	X		
	TCA-T3-19		24				X	X		
2024-10-11	**TCA-T3-17**	49	1			X	X	X		
	TCA-T3-17		7			X	X	X		
	TCA-T3-17		10			X	X	X		
	TCA-T3-17		16	X	X	X	X	X	X	
	TCA-T3-17		18			X	X	X		
	TCA-T3-17		20	X	X	X	X	X	X	
	TCA-T3-17		24	X	X					
	TCA-T3-15	53	1				X	X		
	TCA-T3-15		9				X	X		
	TCA-T3-15		10				X	X		
	TCA-T3-15		12				X	X		
	TCA-T3-15		17				X	X		
	TCA-T3-15		24				X	X		
	TCA-T3-13		6				X	X		

	TCA-T3-13	55	9				X	X		
	TCA-T3-13		11				X	X		
	TCA-T3-13		15				X	X		
	TCA-T3-13		16				X	X		
	TCA-T3-13		18				X	X		
	TCA-T3-11	56	1			X	X	X		
	TCA-T3-11		3			X	X	X		
	TCA-T3-11		13			X	X	X		
	TCA-T3-11		15			X	X	X		
	TCA-T3-11		18	X	X	X	X	X	X	X
	TCA-T3-11		24	X	X	X	X	X	X	X
2024-10-15	**CA-23**	61	2			X	X	X		
	CA-23		7			X	X	X		
	CA-23		15			X	X	X		
	CA-23		16			X	X	X	X	
	CA-23		21			X	X	X		
	CA-23		24	X	X	X	X	X	X	
2024-10-16	**TCA-T06-09**	64	1			X	X	X		
	TCA-T06-09		7			X	X	X		
	TCA-T06-09		8			X	X	X		
	TCA-T06-09		10			X	X	X		
	TCA-T06-09		12	X	X	X	X	X	X	
	TCA-T06-09		23	X	X	X	X	X	X	
	TCA-T06-07	67	2			X	X	X		
	TCA-T06-07		5			X	X	X		
	TCA-T06-07		9			X	X	X		
	TCA-T06-07		12			X	X	X		
	TCA-T06-07		13			X	X	X	X	
	TCA-T06-07		17	X	X					
	TCA-T06-07		20			X	X	X	X	
	TCA-T06-07		23	X	X					
	TCA-T06-05	70	2			X	X	X		
	TCA-T06-05		6			X	X	X		
	TCA-T06-05		12			X	X	X		
	TCA-T06-05		16			X	X	X	X	
	TCA-T06-05		20			X	X	X		
	TCA-T06-05		22			X	X	X	X	
	TCA-T06-05		11	X	X					
	TCA-T06-05		18	X	X					

	TCA-T06-03	71	1			X	X	X		
	TCA-T06-03	74	6			X	X	X		
	TCA-T06-03		12			X	X	X		
	TCA-T06-03		18			X	X	X	X	
	TCA-T06-03		20			X	X	X		
	TCA-T06-03		22			X	X	X	X	
	TCA-T06-03	75	8	X	X					
	TCA-T06-03		12	X	X					
2024-10-18	**TCA-T06-01**	79	1			X	X	X		
	TCA-T06-01		5			X	X	X		
	TCA-T06-01		7			X	X	X		
	TCA-T06-01		10	X	X	X	X	X	X	
	TCA-T06-01		17			X	X	X		
	TCA-T06-01		21	X	X	X	X	X	X	

30.4 Preliminary Results

30.4.1 *Leg 3*

Samples for microbial diversity and chemistry will be processed back in the home laboratory. The only parameter that was fully analysed on board is bacteria production. Figure 30-2 illustrate the high bacterial productivity observed in fjords (illustrated by Archer Fjord) compared to open sea (here the Lincoln Sea).

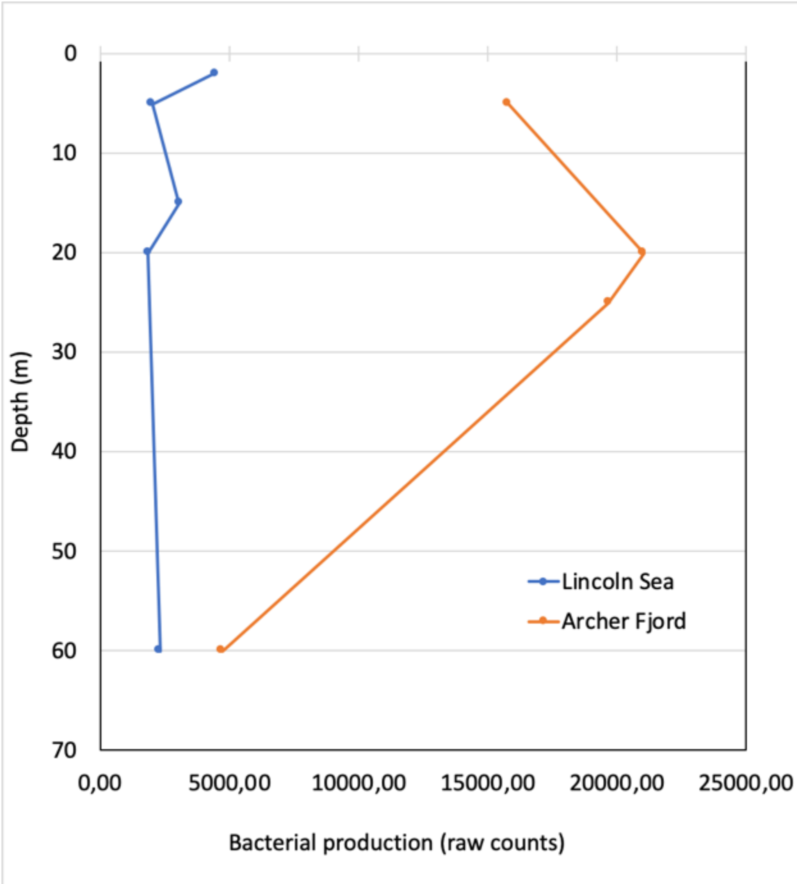

Figure 30-2: Preliminary results illustrating the differences in bacterial production observed between the Lincoln Sea and the Archer fjord.

30.4.2 *Leg 5:*

Preliminary results are not yet available

31 Planktonic microbial eukaryotes (protists)

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31.1 Introduction

Planktonic microbial eukaryotes (protists) at the ocean surface sustain virtually the whole polar food web using energy from the sun, impacting the nutritional and energetic flow from the surface to the deep ocean, where microbial communities adapted to the dark thrive. The diversity, structure, and activity in the sunlit surface and in the deep of these organisms dictate how much carbon will be assimilated and sequestered within the ocean floor. The presence of icescapes - such as glaciers and sea ice - alters the physicochemical properties of the surrounding environment and the development and connectivity of microbial communities. Melting ice sheets change the salinity gradients, impacting water column stability and promoting phytoplankton blooms, therefore altering the carbon flux to the deep layers. Glacier melting affects energy transfer in benthic environments. Additionally, sea ice plays a crucial role in the Arctic food web by providing microhabitats for microbial communities. The overarching idea behind the activities developed is to prospect the connectivity of planktonic protists in environments close to icescapes (e.g. glaciers) and land-fast ice, from the surface to the deeper layer.

31.2 Objectives:

Our primarily objectives are to:

1. Provide an overview of the taxonomic diversity of the planktonic protists at micro diversity level by using metabarcoding of 18s rRNA gene
2. Establish and characterize new phytoplankton strains

3. Bench mark a list of environmental reference sequences covering more resolutive gene markers (18S-ITS-28S) capable of distinguishing cryptic genotypes of the key species found

31.3 Methodology

31.3.1 *Morphology and Establishment of cultures of phytoplanktonic groups*

We aimed to isolate and cultivate new strains of phytoplankton from resident communities and morphologically identified groups by scanning electron microscopy (SEM). This step will be performed in collaboration with Dr. Ian Probert and Priscilia Gouvril from the Roscoff Culture Collection (RCC, France).

i. **Scanning Electron Microscopy (SEM).** Samples for analysis of nano-phytoplankton communities (0.8–100 µm) from two depths, SCM and 60m, were collected at every full station. We filtered 200 ml of seawater from 2 depths on 0.8 µm Isopore 25 mm filters. Filters were rinsed 3 times with MilliQ water, left open to dry at the bench and stored at room temperature. These samples will be analysed by SEM with a focus on diatoms and dinoflagellates. *[Total number of samples obtained: 23]*.
ii. **Concentration by tangential flow filtration, enrichment and Isolation by serial dilution**. Several isolation strategies were performed to maximize the number, and the diversity of the cultures retrieved. Samples were collected every full station, from 2 depths (SCM and 60m) and followed three different approaches: TFF concentration, enrichment and dilution. Net samples were target to single-cell isolation by hand picking.
    - **Enrichment cultures**: samples were enriched by mixing 25 ml of non-filtered and pre-filtered (3 µm) sea water with 1ml distinct culture media (K, L1, PCRS11). Diatom proliferation was prevented in some cultures by the addition of Germanium oxide.
    - **Isolation by serial dilution and single cell pipetting**: Isolation by serial dilution was performed with L1. Pre-filtered water sample from 2 depths (SCM and 60) at every full station was added to 15 ml of media, transferred

to 48-wells plates. Back in the laboratory, wells will be screened by optical microscopy and with flow cytometer for wells containing unialgal population. Cells target for hand-picking with microscope were obtained by deployment of 10 um mesh net.

- **Concentration by tangential flow filtration**: To keep the phytoplankton community stable for reasonable period, 3.5 liters of seawater were concentrated to a volume of ~30– 50 ml by tangential flow filtration using a Vivaflow 0.2 µm PESE (Sartorius Biotechnologie SAS, France).
- **Isolation**

All cultures were incubated at 2°C with continuous light during the campaign. Back on land, we will follow two complementary approaches for cell isolation: manual isolation and flow cytometry sorting. The new cultures obtained will be integrated in the Roscoff Culture Collection (http://www.roscoff-culture-collection.org/). Twenty percent of the samples obtained at this step have already been transferred to the department of biosciences, University of Oslo (Norway) for further isolation *[Total number of samples obtained: 137]*

A. Pico/Nano – phytoplankton, bacterioplankton and viroplankton abundances by flow cytometry

Duplicate samples (1.0 mL) for flow cytometry (FCM) were collected into cryotubes, preserved with 0.5% glutaraldehyde (final concentration), flash-frozen in liquid nitrogen and stored at −80 ◦C until analysis. *[Total number of samples obtained: 234]*

B. Taxonomic composition of planktonic microbial eukaryotes

In all full stations 6 depths from rosette were sampled in addition to barge and helicopter samples, to assess the molecular taxonomic composition of the microbial eukaryotic community. A serial filtration of 6L seawater or freshwater onto 47 mm 3 µm polycarbonate disc followed by 0.2 µm were performed. All filtrations were performed using the peristaltic pump. The filters were then flash frozen in liquid nitrogen and stored at -80°C. *[Total number of samples obtained: 234]*

31.4 Preliminary Results

No preliminary results were obtained onboard. All processing will be done once back in the lab.

32 Primary production in the high Arctic Fjords

Project leaders: Ardyna Mathieu[1] (mathieu.ardyna@takuvik.ulaval.ca)

Cruise participants – Leg 3 : Provencher Juliette[1], Barut Guillaume[1] Bruyant Flavienne[1]

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32.1 Introduction and Objectives

The Refuge-Arctic project is addressing crucial knowledge gaps by focusing on one such emblematic arctic ecosystem, the "Last Ice Area" (LIA). The aims of Leg 3 are to elucidate the impact of the glacier-ocean continuum on the Nares Strait and moreover in the context of the rapidly arctic changing ecosystems. These systems are distinct from offshore systems by the presence of strong lateral gradients and high seasonal variability. Freshwater inflow leads to estuarine circulation in fjords (Meire et al., 2016; Mortensen et al., 2013). Freshwater mixes and exchanges salt, heat, and nutrients with oceanic-dominated waters during its downstream transport along the coast-wide continuum (Mortensen et al., 2014; Straneo and Cenedese, 2015). Yet gaps exist in understanding how glaciers affect marine biogeochemistry, primary production and biodiversity. Contrasting effects have been shown depending on the glacier terminus (marine or land) and the source of freshwater to the systems. The high export of organic matter limit the productivity of photosynthetic organisms through light availability (Murray et al., 2015) whereas significant enrichment of macro- and micronutrients in the upper 250 m of glacial fjords due to meltwater discharge could sustain and maintain high productivity (Kanna et al., 2022 ; Hopwood et al., 2020 ; Meire et al., 2016 ; Bhatia et al., 2013). Moreover, most of the knowledge comes from literature and studies on the Greenlandic glacier systems (Mortensen et al., 2013; Kanna et al., 2020; Meire et al., 2016). To date, few studies have focused on the Ellesmere Island glacier productivity. Focusing on the contributions of Canadian Arctic glacier systems would help to understand the net effects of glacier discharge on a system such as Nares Strait and associated productive regions (i.e., North Water Polynya).

32.2 Methodology

32.2.1 *Phytoplankton productivity and assemblages*

- **Primary production (Leg 3)**

Primary production (PP) of phytoplankton communities were determined using the ^{14}C assimilation method and applying photosynthesis–irradiance (P-E) relationships. Sea water samples were treated according to Babin et al. (1994) to determine the photosynthetic parameters. Briefly, sea water samples are inoculated with radioactive sodium bicarbonate ($NaH^{14}CO_3$) and incubated at 24 different light levels in temperature-controlled growth chambers for 2 hours. After incubation and filtration, inorganic carbon is removed from the samples by acidification, then the amount of radioactive ^{14}C incorporated into phytoplankton cells during incubation is counted on board using a liquid scintillation counter. Further calculations allow the fitting of a model (we use Jassby and Platt, 1976) describing photosynthesis from irradiance and the determination after normalization of the photosynthetic parameters, the specific maximum carbon fixation rate (P^{b}_{max}, mg C mg Chl a^{-1} h^{-1}), the initial slope of the curve (a^{b}, mg C mg Chl $a^{-1}h^{-1}$ (µmol Quanta $m^{-2}s^{-1}$) describing the low light efficiency of the photosynthesis and the saturation parameter (Ek, µmol Quanta $m^{-2}s^{-1}$), an indicator of the light acclimation state of the phytoplankton population contained in the sample.

- **Abundance and composition (Leg 3 and 5a)**

For the HPLC, AP, SPM and POC measurements, sea water samples were collected directly from the rosette and filtered, in the dark, on different filter types. For HPLC and AP, 25mm filters GF/F were used and for SPM and CHN, pre-ashed GFF 24mm filters. For HPLC, we performed this experiment at 11 depths (100m, 80m, 60m, 50m, 40m, SCM, 30m, 20m, 10m, 5m and 2m) and after filtration, the samples were flash-frozen in nitrogen before being stored at -80°C. For AP, 5 depths were studied (60m, SCM, 20m, 5m and 2m), and the samples were stored directly at -80°C. Finally, for SPM, three depths were used (SCM, 5m and 2m) and POC (100m, 80m, 60m, 50m, 40m, SCM, 30m, 20m, 10m, 5m and 2m), the samples, following filtration, underwent a 24-hour treatment in a 60-degree study before being stored in airtight bags to avoid contact with air. Phytoplankton identification and enumeration was performed using the Imaging FlowCytobot (IFCB; Olson and Sosik, 2007). Samples were collected in 50-

mL tubes at the 2 m, 5 m, SCM, 20 m and 60 m depth from rosette operation et measure onboard. Glacier, river, and lake samples were collected, preserved in - 80°C freezer after adding 1/1000 glutaraldehyde solution (v/v) to be measure later. The IFCB is a combined flow cytometry and imaging system that acquires images of suspended particles in the size range of approximately 10 to 150 µm. Seawater samples of approximately 5 mL were injected through flow cells and pre-filtered through a 150-µm Nitex screen at the intake to prevent clogging of the flow cell. The cell concentration count and image taking were triggered by scattering, which was emitted by particles that crossed a 635-nm laser directed at the flow cell. A modified version of open-source IFCB software (https://github.com/OceanOptics/ifcb-tools, Sosik and Olson, 2007) was used for post-processing.

Absorption of Colored Dissolved Organic Matter (aCDOM) samples were collected directly from Niskin bottle with amber glass bottle to prevent light exposure at 2 m and 5 m depth. Samples were filtered by hand within 4 hours after sampling onto 0.2 µm Acrodisc filter and then stored in the dark at 4 °C.

Table 32-1: List of stations and parameters

Site	Fjord	Site	Latitude	Longitude	Type	Date	HPLC	SPM	AP	CDOM	POC	IFCB	PvsE
RA01	NA	Bylot cast 002	2,80720000062,8072000000		Rosette	2024-08-13	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA02	Makinson fjord	Cast 006	N 77°13,961	O 079° 5,489	Rosette	2024-08-14	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA02	Makinson fjord	Glacier	N 77°25’ 30’’	O 080° 47’ 05’’	Glacier	2024-08-14	Oui	Oui	No	Oui	Oui	Oui	Non
RA02	Makinson fjord	River	N 77°15’08’’	O 080° 46’ 39’’	River	2024-08-14	Oui	Oui	No	Oui	Oui	Oui	Non
RA03	Makinson fjord	Cast 009	N 77°17,594	O 080° 44,423	Rosette	2024-08-15	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA03	Makinson fjord	A	77°15'865N	80°44'350W	Surface water	2024-08-15	Oui	Oui	No	Oui	Oui	Non	Non
RA04	Makinson fjord	Cast 013	N 77°21,641	O 081° 4,848	Rosette	2024-08-16	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA04	Makinson fjord	A	77°23'391N	81°02'663W	Surface water	2024-08-15	Oui	Oui	No	Oui	Oui	Non	Non
RA04	Makinson fjord	B	77,38N	81,064W	Surface water	2024-08-15	Oui	Oui	No	Oui	Oui	Non	Non
RA05	Mooring station	Cast 017	N 78°18,352	O 074° 44,964	Rosette	2024-08-17	Oui	Oui	No	Oui	Oui	Non	Non
RA06	Dobbin fjord	Cast 018	N 79°41,005	O 073° 5,359	Rosette	2024-08-18	Oui	Oui	Oui	Oui	Oui	Non	Oui
RA06	Dobbin fjord	A	79°41'789	73°06'489	Surface water	2024-08-18	Oui	Oui	No	Non	Oui	Non	Non
RA06	Dobbin fjord	B	79°41'789	73°06'489	Surface water	2024-08-18	Oui	Oui	No	Non	Oui	Non	Non
RA07	Dobbin fjord	Cast 022	N 79°47,135	O 073° 33,494	Rosette	2024-08-19	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA07	Dobbin fjord	River	79° 48’ 43’’N	072° 50’ 16’’W	River	2024-08-19	Oui	Oui	No	Oui	Oui	Oui	Non
RA08	Dobbin fjord	Cast 026	N 79°49,777	O 074° 6,317	Rosette	2024-08-20	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA08	Dobbin fjord	A	79°504016	74°50'915	Surface water	2024-08-20	Oui	Oui	No	Oui	Oui	Non	Non
RA08	Dobbin fjord	B	79°50'016	74°32'421	Surface water	2024-08-20	Oui	Oui	No	Oui	Oui	Oui	Non
RA08	Dobbin fjord	C	79°49'661	74°09'098	Surface water	2024-08-20	Oui	Oui	No	Oui	Oui	Oui	Non
RA08	Dobbin fjord	Glacier	79° 51’ 13’’N	075° 04’ 53’’W	Glacier	2024-08-19	Oui	Oui	No	Oui	Oui	Oui	Non
RA08	Dobbin fjord	Lake	N79° 50' 59.7	W75° 02' 07.9"	Lake	2024-08-20	Oui	Oui	No	Oui	Oui	Oui	Non
RA09	Lincoln Sea	Cast 030	N 82°24,553	O 060° 51,378	Rosette	2024-08-22	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA09	Lincoln Sea	Cast 032	N 82°23,239	O 060° 50,382	Rosette	2024-08-22	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA10	ncoln Sea Moorir	Cast 034	N 82°6,859	O 061° 17,383	Rosette	2024-08-22	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA11	Mooring station	Cast 035	N 81°32,270	O 064° 55,055	Rosette	2024-08-23	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA12	Miller Island	Cast 036	N 81°34,216	O 067° 36,631	Rosette	2024-08-23	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA12	Miller Island	Cast 038	N 81°33,994	O 067° 37,924	Rosette	2024-08-23	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA12	Miller Island	A	81°40'000	68°58'291	Surface water	2024-08-23	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA12	Miller Island	B	81°34'939	68°28'304	Surface water	2024-08-24	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA12	Miller Island	C	81°31'318	68°30'353	Surface water	2024-08-24	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA12	Miller Island	D	81° 34'140	67° 39'313	Surface water	2024-08-23	Oui	Oui	Oui	Oui	Oui	Non	Non
RA12	Archer Fjord	Hélico	81° 47’ 38’’ N	70° 27’ 07’’ W	Lake	2024-08-24	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA12	Archer Fjord	Hélico	81° 40’ 59’’ N	69° 00’ 55’’ W	River A	2024-08-24	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA13	Archer Fjord	Hélico	81° 31’ 04’’ N	68° 46’ 55’’ W	River B	2024-08-24	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA13	Archer Fjord	Cast 040	N 81°17,177	O 068° 24,197	Rosette	2024-08-25	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA13	Archer Fjord	Cast 042	N 81°17,279	O 068° 23,815	Rosette	2024-08-25	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA13	Archer Fjord	Barge	81°16,629	68°29'487	Surface water	2024-08-25	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA13	Archer Fjord	Hélico	N 80° 56’ 20’’	W 070° 48’ 54’’	Glacier	2024-08-25	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA13	Archer Fjord	Hélico	N 81° 03’ 23’’	W 070° 03’ 40’’	Lake	2024-08-25	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA13	Archer Fjord	Hélico	N 81° 04’ 35’’	W 070° 00’ 44’’	River	2024-08-25	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA14	Archer Fjord	Cast 044	N 81°35,327	O 065° 56,083	Rosette	2024-08-26	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA14	Archer Fjord	Cast 046	N 81°35,068	O 065° 55,920	Rosette	2024-08-26	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA14	Archer Fjord	Barge	81°34'724	65°59'226	Surface water	2024-08-26	Oui	Oui	Oui	Oui	Oui	Non	Non
RA15	Archer Fjord	Cast 048	N 81°42,010	O 064° 4,748	Rosette	2024-08-27	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA15	Archer Fjord	Cast 050	N 81°41,670	O 064° 7,351	Rosette	2024-08-27	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA15	Archer Fjord	Barge	81°39'555	64°03'621	Surface water	2024-08-27	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA16	Newman Fjord	Cast 052	N 81°43,163	O 059° 13,619	Rosette	2024-08-28	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA16	Newman Fjord	Cast 054	N 81°43,094	O 059° 13,993	Rosette	2024-08-28	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA17	Newman Fjord	Cast 057	N 81°37,794	O 058° 55,280	Rosette	2024-09-29	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA17	Newman Fjord	Hélico Glacier	81° 18’ 41’’ N	57° 13’ 57’’ W	Glacier	2024-09-29	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA17	Newman Fjord	Hélico River	81° 31’ 40’’ N	57° 59’ 01’’ W	River	2024-09-29	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA17	Newman Fjord	Barge B	81°36'645	58°41'621	Surface water	2024-09-29	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA17	Newman Fjord	Barge C	81°37'886	58°49'226	Surface water	2024-09-29	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA18	Newman Fjord	Cast 060	N 81°56,309	O 060° 20,938	Rosette	2024-09-29	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA18	Newman Fjord	Cast 062	N 81°56,290	O 060° 21,848	Rosette	2024-09-29	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA19	Arctic Core	Cast 063	N 81°14,579	O 064° 22,915	Rosette	2024-09-30	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA20	AC14	Cast 064	N 75°34,109	O 078° 52,332	Rosette	2024-09-02	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA21	AC16	Cast 065	N 76°1,801	O 083° 6,769	Rosette	2024-09-02	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA24	Cadogan	Cast 068	N 78°1,752	O 075°35,952	Rosette	2024-09-04	Oui	Oui	Oui	Oui	Oui	Oui	Oui
RA24	Cadogan	Hélico River	78° 07’ 39’’ N	75° 52’ 14’’ W	River	2024-09-04	Oui	Oui	Oui	Oui	Oui	Oui	Non
RA24	Cadogan	Hélico Glacier	78° 03’ 05’’ N	75° 40’ 43’’ W	Glacier	2024-09-04	Oui	Oui	Oui	Oui	Oui	Oui	Non

- **Physiology status, chlorophyll a fluorescence sampling based (Leg 5a):**

The sampling protocol was constructed according to Schuback et al, 2021 and Tortell & Suggett 2021. Briefly, the samples were taken shortly at the rosette and were relaxed for 20 or 30 min (depending on previous experiments) in low light (3 µmol photon m^2 s^{-1}) at 1°C. Primary ChlF parameter values in the relaxed state and under actinic light were obtained by applying a saturing Single Turnover flash (ST-ChlF) using a Fast Induction and Relaxation excitation benchtop fluorometer (FIRe, Satlantic, CA). The ST-ChlF consisted of an induction phase of 110µs with one flash of blue light (450nm ± 20) per µs followed by a relaxation phase of 40 flashes every 60 µs. Fluorescence Light Curves were performed using the blue ASL lamp with 20 30-second steps ranging from 0 to 150 or 200 µmol photon m^2 s^{-1} depending on the environmental conditions. Due to the very low biomass concentration in the water column, 15 samples were averaged at each acquisition in order to increase the signal:noise ratio of the method. Maximum electron transfer rates and photosynthetic parameters were determined from ChlF vs irradiance curves and calculated with the model according to Webb et al., 1974.

32.2.2 *Phytoplankton incubations: Response of the assemblage to silicate limitation and grazing pressure during fall*

During fall in Arctic, the storms mix the water column, advecting nutrients at the surface, enabling phytoplankton growth. Phytoplankton incubations were set up to access the effect of silicate limitation combined with grazing pressure on the assemblage. To do so, the water sampled at the SCM of the mooring station 1 are filters on a 200 µm mesh to remove all mezo zooplankton, and a muster net was done from 100m to the surface to collect mezo zooplanktons. A triplicats of filtered rosette water is taken as a control (grey in fig 1). Except the controls, all conditions were enriched with 30 µmol.L^{-1} of nitrate, 6 µmol.L^{-1} of phosphate and trace metals. 30 µmol.L-1 of silicate is added to 2 triplicats (dark blue in fig 1). 10 times the mean in situ concentration of meso zooplankton are added to 2 triplicats (light orange in Fig 1). The jugs are incubated in the deck incubator at 0.5°C, with blue filters and 0.9DN filters (respectively Lee filters 165 and Lee filters 211). The jugs are sampled at T1 (day after the rosette and muster sampling), T3, T6, T9 and T12. The pigments are measured with HPLC, particulate organic carbon by CHN, nutrients (silice, nitrate, phosphate) by autoanalyzer on board, variable chlorophyll a fluorescence using the FIRe on board, phytoplankton taxonomy using the IFCB and Mini Ion on board, and fixed with lugol and formol (50ml each) for microscopy later in the lab.

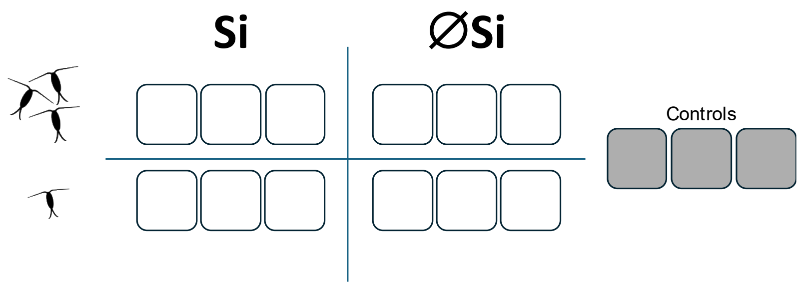

Figure 32-1: Inbubation forcing factors. Dark blue for addition of 30 µmol.L-1 silicate, light blue for no addition of silicate, dark orange for addition of grazing pressure, and light orange for no addition of grazing pressure.

32.3 Preliminary Results

- **Primary production**

Even though radioisotope samples can be counted on board, other data are necessary to interpret, including pigments concentrations and corrected absorption spectra which are not available yet. The only parameter we can look at is Ek (the saturation parameter, µmol quanta $m^{-2}s^{-1}$) which is only affected by the light level. Ek presents values that are higher at the surface and lower at higher depths which is expected. Although values of Ek are in general higher than expected at the surface (we measured values up to 60 µmol quanta $m^{-2}s^{-1}$ which is higher than the ambient light). The most striking part of our experiment was the amount of light that was necessary to obtain samples to present photoinhibition (up to 800 µmol quanta $m^{-2}s^{-1}$, which is far above the summer ambient light). For the HPLC, AP, SPM, aCDOM and POC measurements, all filter analyses will be carried out in the laboratory back in Quebec City.

- **Phytoplankton community structure**

The preliminary results from the IFCB provide access to particle abundances and the distinction between fluorescent and non-fluorescent particles (Figure 32-2). At the time of data processing, the highest phytoplankton abundances for the chlorophyll maximum were observed at Dobbin Fiord (station RA07) at a depth of 5 m and Archer Fiord (RA11) at a depth of 15 m at 8 x 10^5 particles L^{-1} and 5 x 10^5 particles L^{-1}, respectively. The lowest were observed for Makinson Fiord (RA02) around 3.5 x 10^5 particles L^{-1}. Maximum abundances were found at the surface at Makinson and Dobbin Fiords whereas Archer and Newman Fiord stations exhibit a clear subsurface maximum at 15 m and 20 m, respectively. It noteworthy to take into consideration that abundance is estimated by using simply the images and can be underestimated because particle counts per picture require in-depth analysis. Phytoplankton communities were largely dominated by centric-diatoms species mainly genus Chaetoceros (Figure 32-3 b, d, e). We've also at almost two stations observed some large Phaeocystis *sp.* colony (Figure 32-3 a), making its first observation in the region.

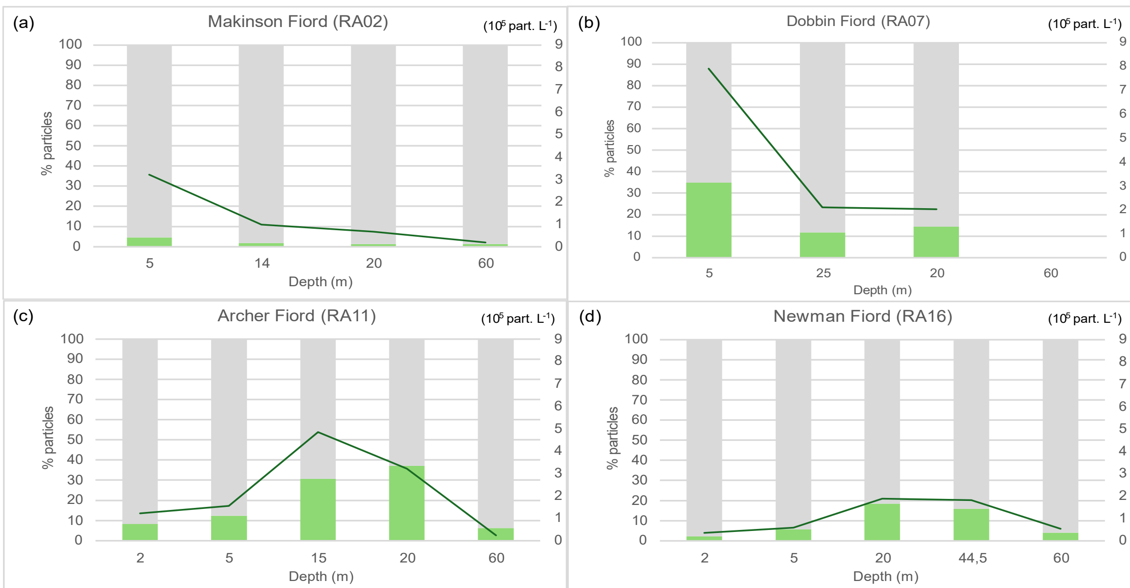

Figure 32-2: Abundance (105 particles L-1) and percentage of fluorescent particles per depth in fiord stations (a) Makinson Fiord, (b) Dobbin Fiord, (c) Archer Fiord and (d) Newman Fiord.

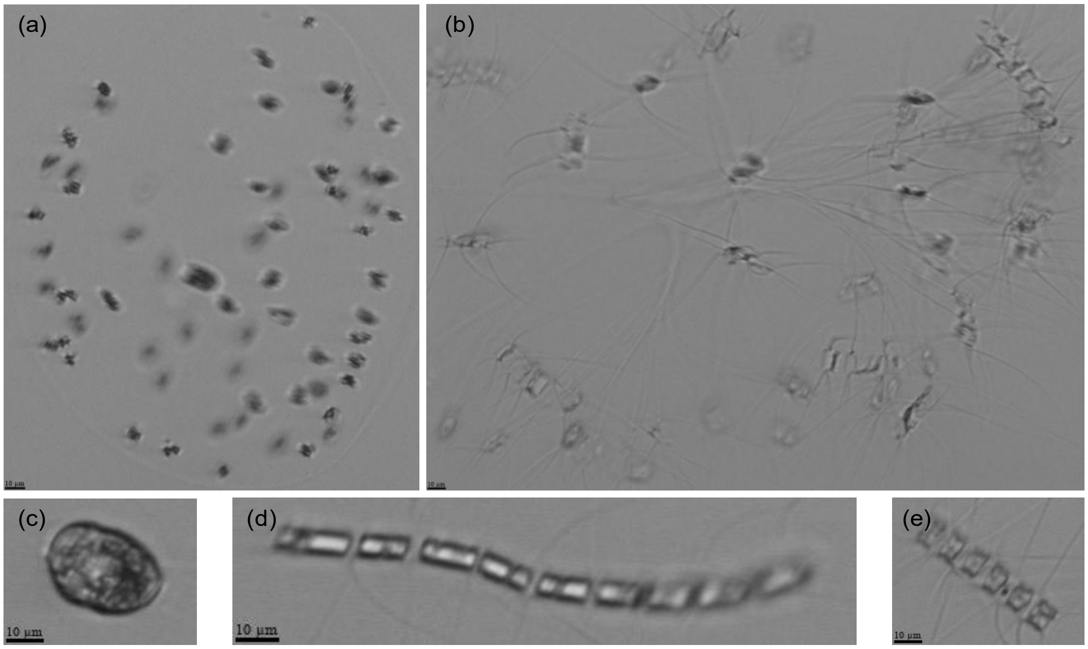

Figure 32-3: Example of Imaging FlowCytobot images of phytoplankton cells and colonies: (a) Phaeocystis *sp*; (b) Chaetoceros *sp*; (c) unidentified dinoflagellates; (d) Chaetoceros gelidus; (e) Chaetoceros neogracile

32.4 References

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33 Phytoplankton community composition and molecular physiology in Arctic glacierized marine regions

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33.1 Introduction and Objectives

The Canadian Arctic is experiencing rapid environmental change due to climate warming. This warming causes glacial retreat, increased riverine influx, and alters seasonal ice cover which may impact marine ecosystems through shifting salinity stratifications and altered nutrient influxes throughout the year. Marine phytoplankton are especially susceptible to changes in physical and chemical variability in the water column. These phytoplankton form the base of marine food webs, thus changes in their composition may impact regional food chains. During Leg 2b of the 2024 Amundsen Science expedition, our focus was to capture and characterize the microbial communities within glaciated and unglaciated fjords and in the coastal and open water areas of Baffin Bay. Samples for nitrate isotope, metagenomic, metaproteomic and metabolomic analyses were collected to capture the community composition and molecular biology of the Canadian Arctic. Our group aims to connect these biological data to the physical and chemical data that was collected in tandem onboard the Amundsen to characterize the structure, status, and drivers of the microbial community in the region.

33.2 Methodology

1.2.1 **General Methodology**

At each station where water was available, we collected large volumes (12-24 liters) of water from four depths of the euphotic zone using the CTD rosette. The depths chosen were based on the CTD profile at each station. Generally, we targeted the surface (1-5 meters), the subsurface chlorophyll maxima (15-60 meters), the base of the nitracline (40-100 meters), and a depth 50 meters below the last chlorophyll-a signal (100-200 meters). Once the CTD-rosette was recovered, water was collected from the Niskin bottles without prefiltering, and immediately transported to the starboard-side temperature controlled aft lab set to 4 °C for sample processing (i.e. filtration for DNA/Proteins/Metabolites). DNA, protein, metabolite, and nitrate isotope samples were taken from the same Niskin bottle. All samples will be analyzed at Dalhousie University after demobilization.

1.2.2 **Nitrate Isotopes**

One 60 mL syringe was rinsed 3 times with sample water from a single Niskin bottle before fitting a 0.22 μM PES filter onto the syringe and pushing a small amount of sample water through the filter (~5 mL). If samples were at or above 200 meters, they were syringe-filtered to the fill line in 60 mL high density polyethylene bottles. If samples were below 200 meters, polyethylene bottles were filled to the shoulder to allow room for water expansion during freezing. Tops of bottles were wiped with Kim wipes to dry the bottle threads before capping. All samples were frozen upright at -20 °C.

1.2.3 **Protein Filtration**

One 10-liter HDPE jerrycan was rinsed 3 times with sample water from a single Niskin bottle before collecting 8-10 liters of seawater sample. Each sample was filtered onto a 3 μM (large) and 0.2 μM (small) polycarbonate filter to capture two size fractions of the microbial community using a peristaltic pump. The filtrate was collected in a LDPE cubitainer and measured via 2-liter graduated cylinder. The filtration ended when all the sample had passed through the unit or 2 hours had elapsed since the beginning of filtration, whichever came sooner. All polycarbonate protein filters were frozen at -80 °C immediately after processing.

1.2.4 **DNA Filtration**

Water for DNA samples was collected in the same 10-liter, triple-sample-rinsed HDPE jerrycan that the 8-10 liters of seawater for protein samples was collected. For each DNA sample, 1 liter of sample water was filtered onto a 3 μM polycarbonate filter using a peristaltic pump. The filtrate was collected in a LDPE cubitainer and measured via 2-liter graduated cylinder. The filtration ended when all the sample has passed through the unit. All DNA filters were frozen at -80 °C immediately after processing.

1.2.5 **Metabolite Filtration**

One 1-liter HDPE amber bottle was rinsed 3 times with sample water from a single Niskin bottle before collecting 1 liter of seawater sample. Back in the 4 °C laboratory, samples were mixed gently by turning bottles upside down slowly a couple of times to ensure a homogeneous sample. A 500 mL graduated cylinder was used to measure 1 L of sample water from each depth and pour into filtration funnels. Samples were filtered onto 0.2 μM nylon filters using a vacuum pump manifold keeping vacuum pressure below 7in. Hg. Filtration funnels were covered with a thick, black garbage bag as samples are photo sensitive and water was filtered into 1L amber glass pyrex bottles. Particulate metabolite samples (collected on 0.2 μM nylon filters) were stored in cryovials in -80 °C freezer separately from protein and DNA samples immediately after filtration. ~40–45 mL of filtrate from each sample collected in 1L glass amber pyrex bottles was poured into 50 mL amber falcon tubes as the dissolved metabolite samples. These were stored immediately upright in the -20 °C freezer.

1.2.6 **Deep Dissolved Metabolites**

In the CTD room, underneath a thick, black garbage bag, ~ 200 mL of seawater sample was collected in glass amber bottles from each depth. Back in the 4 °C lab, one 60 mL syringe was rinsed 3 times with sample water from a single Niskin bottle before fitting a sterivex filter onto the syringe and pushing a small amount of sample water through the filter (~5 mL) to rinse the sterivex cartridge. 2 50 mL amber centrifuge tubes were filled to the 40-45 mL mark with sample. These deep dissolved metabolite samples were sampled at depths deeper than those for the protein, DNA, and metabolite samples and were only taken at stations where the water column depth was greater than 600 m. All samples were capped and frozen upright in the -20 °C freezer.

Table 33-1: Overview of samples taken by the Bertrand and Buchwald Lab groups aboard the CCGS *Amundsen* during Leg 2B, 2024.

Station Name	Region	Date	Latitude (N)	Longitude (W)	Cast N°	Bottom Depth	Depths (m) for Protein, DNA, Metabolites	Depths (m) for Nitrate Isotopes	Depths (m) for Deep Dissolved Metabolites	DNA	Protein	Metabolites (Particulate & Dissolved)	Deep Dissolved Metabolites	Nitrate Isotopes
TCA-QFC1	Maqtaq Fjord	30/07	67° 20.152′	64° 38.995′	26	117	1.79, 20, 40, 105	1.79, 10, 20, 30, 40, 50, 60, 80, 100		•	•	•		•
TCA-QFC2	Maqtaq Fjord	30/07	67° 18.759′	64° 22.596′	27	232	1.67, 40, 70, 100	1.67, 10, 20, 30, 40, 50, 60, 70, 80, 100, 150, 200		•	•	•		•
TCA-QFA2	Coronation Fjord	31/07	67° 14. 343′	64° 22.023′	29	321	2.19, 20, 60, 150	2.19, 10, 20, 30, 40, 50, 60, 70, 80, 100, 150, 200, 250, 300		•	•	•		•
TCA-QFA1	Coronation Fjord	31/07	67° 13.230′	64° 43.434′	30	193	1.76, 20, 60, 180	1.76, 10, 20, 30, 40, 50, 60, 80, 100, 150, 183		•	•	•		•
TCA-QF3	Baffin Island Coast	31/07	67° 16.347′	63° 52.791′	31	514	1.75, 30, 60, 150	1.75, 10, 30, 40, 50, 60, 80, 100, 150, 200, 250, 300, 500, 514		•	•	•		•
TCA-QFB2	North Pangnirtung Fjord	31/07	67° 10.099′	64° 17.511′	33	351	1.70, 65, 100, 150	1.70, 10, 20, 30, 40, 50, 60, 65, 70, 80, 100, 150, 200, 250, 300, 351		•	•	•		•
TCA-QFB1	North Pangnirtung Fjord	01/08	67° 03.825′	64° 39.760′	34	162	1.74, 33, 70, 152	1.74, 10, 20, 30, 33, 40, 50, 60, 80, 100, 70, 152		•	•	•		•
TCA-D1B	Baffin Island Coast	02/08	67° 40.560′	63° 27.022′	37	520	2.60, 27, 60, 150	2.60, 10, 20, 27, 30, 40, 50, 60, 70, 80, 100, 150, 200, 250, 300, 400, 500, 520		•	•	•		•

D3	Baffin Bay	02/08	68° 14.491′	62° 35.638′	40	1560	1.50, 25, 40, 150	1.50, 10, 20, 25, 30, 40, 50, 60, 80, 100, 150, 200, 250, 300, 400, 500, 750, 1000, 1560		•	•	•		•
C5	Baffin Bay	04/08	68° 08.765′	59° 58.486′	43	1368	1.80, 20, 30, 150	1.80, 10, 20, 30, 40, 50, 60, 80, 100, 150, 200, 250, 300, 500, 750, 1000, 1380		•	•	•		•
C3	Baffin Bay	04/08	67° 44.980′	61° 16.586′	44	1555	1.56, 23, 60, 150	1.56, 10, 20, 23, 30, 40, 50, 60, 80, 100, 150, 200, 250, 300, 750, 1000, 1567	300, 500, 750, 1000	•	•	•	•	•
C1	Baffin Bay	05/08	67° 20.917′	62° 31.376′	47	133	3, 40, 60, 123	3, 10, 20, 30, 40, 50, 60, 70, 80, 100, 123		•	•	•		•
B1	Baffin Bay	05/08	67° 03.544′	61° 30.964′	48	111	2.80, 18, 50, 105	2.80, 10, 18, 20, 30, 40, 50, 60, 70, 80, 100, 105		•	•	•		•
B3	Baffin Bay	05/08	67° 19.758′	60° 16.703′	49	1071	1.70, 25, 50, 150	1.70, 10, 20, 25, 30, 40, 50, 60, 80, 100, 150, 200, 250, 300, 500, 750, 1000, 1071	300, 500, 750, 1000	•	•	•	•	•
B5	Baffin Bay	06/08	67° 35.238′	59° 01.151′	51	1200	3.34, 32, 60, 150	3.34, 10, 20, 30, 32, 40, 50, 60, 80, 100, 150, 200, 250, 300, 500, 750, 1000, 1205	300, 500, 750, 1000	•	•	•	•	•

33.3 Preliminary Results

No results are available at this time.

33.4 Recommendations

As a group collecting large water volumes from the rosette, we always sampled last from the rosette which was often 45 minutes to 1 hour after the CTD recovery time. Due to the long filtration times required for our samples (~2 hours for protein, 30 minutes for DNA, ~1 hour for metabolites), it would be very helpful to have the schedule of operations available on a 24-hour basis rather than a 12-hour basis in order to better schedule filtration times and allow time for rest in between stations. Earlier on in the leg, there were periods where we would finish filtering and anticipate getting to sleep after working 12+ hours to discover that the next station was coming up within an hour or two and we would have to clean bottles and prepare for another 3-5 hours of work.

34 Phytoplankton Identification and Enumeration

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34.1 Introduction and Objectives

The objective of the Leg 5B was to conduct an international school on the emergence of an innovative blue economy in the Arctic, with scientists and sociologists onboard. The school is a joint initiative of the WAGE Circumpolar Partnership and Université Laval's Sentinelle Nord program. The TCA (Transforming Climate Action) program also had a sampling plan during this leg, with the objective of characterizing the water masses and ecosystems of Labrador Sea.

34.2 Methodology

34.2.1 *Phytoplankton abundances and composition :*

Phytoplankton identification and enumeration was performed using the Imaging FlowCytobot (IFCB; Sosik and Olson, 2007). Samples were collected in 50-mL tubes at the surface, SCM, 20 m and 60 m depth from the Niskin bottles of the CTD rosette and analyzed onboard. Samples that were not analyzed onboard due to lack of time were preserved in 4°C after adding 2% formaldehyde buffered with hexamethylenetetramine. The IFCB is a combined flow cytometry and imaging system that acquires images of suspended particles in the size range of approximately 10 to 150 µm. Seawater was pre-filtered through a 150-µm Nitex screen from the Niskin bottle to prevent clogging of the flow cell, and samples of 5 mL were injected through the flow cell. The cells counting and imaging were triggered by scattering (PMT-A), which was emitted by particles that crossed a 635-nm laser directed at the flow cell. A modified version of open-source IFCB software (https://github.com/OceanOptics/ifcb-tools, Sosik and Olson, 2007) was used for post-processing.

34.2.2 *Absoption of Colored Dissolved Organic Matter :*

Absorption of Colored Dissolved Organic Matter (aCDOM) samples were collected directly from the surface Niskin bottle of the CTD rosette with amber glass bottles to prevent light exposure. Samples were filtered by hand within 4 hours after sampling onto 0.2 µm Acrodisc filter and then stored in the dark at 4 °C following IOCCG recommendations.

34.3 References

Sosik, H.M., Olson, R.J., 2007. Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry: Phytoplankton image classification. Limnol. Oceanogr. Methods 5, 204–216. https://doi.org/10.4319/lom.2007.5.204

35 Morphological and molecular characterization of arctic dinoflagellates

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Cruise participants Leg 2a+2b: Alfred Champigny[1]
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35.1 Introduction and Objectives

Dinoflagellates are protist found in all aquatic ecosystems (freshwater, brackish, marine). They belong to the pico-, nano-, micro-, and meso-planktonic size fractions (Le Bescot et al., 2016). They form the basis of many trophic chains from equatorial to polar regions. They can be autotrophic, mixotrophic, heterotrophic, parasitic, benthic (cysts), or pelagic, making them one of the most diverse and essential plankton groups in marine ecosystems (Gómez, 2020; Stoecker, 1999). In arctic and subarctic regions, dinoflagellate diversity is significantly different from the other oceans, as shown by various samplings and large-scale metabarcoding campaigns (TaraOceans) (Vernette et al., 2021). This project continues the sampling efforts of PR André Rochon, who has been working on the taxonomy and distribution of arctic dinoflagellates for many years, it also fits into my doctoral project on the morphological and molecular characterization of arctic dinoflagellates. The objective is to isolate, sequence, and morphologically characterize individuals to study dinoflagellates and their specific richness in greater detail.

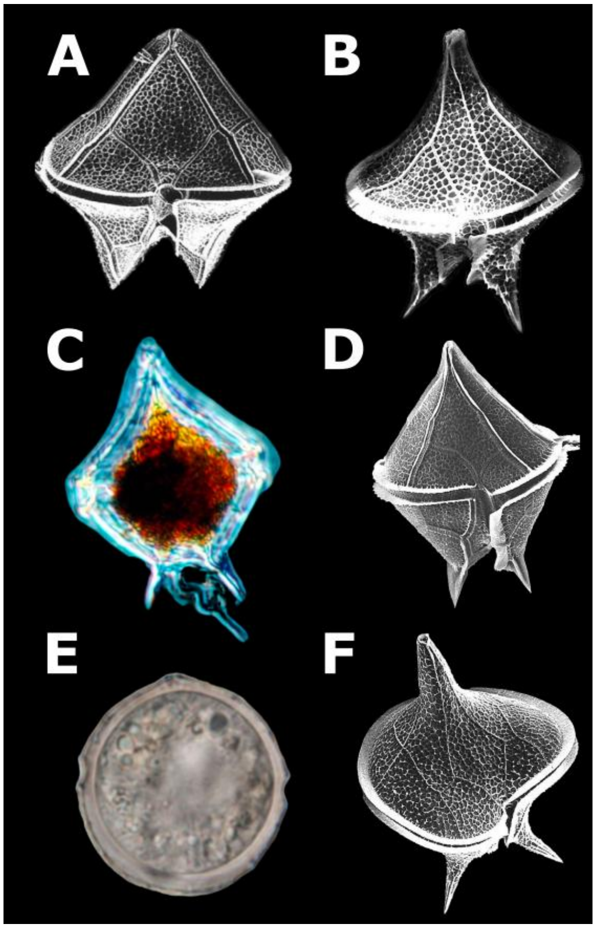


Figure 35-1: A. P. conicum (M. Kuylenstierna) B. P. divergens (M. Kuylenstierna) C. P. pellucidum (Lars Edler) D. P. pallidum (M. Kuylenstierna) E. P. fukuyoi (K. mertens) F. P. depressum (M. Kuylenstierna), nordicmicroalgae.org.

Within dinoflagellates, one genus stands out for its high diversity and significant number of species (332): Protoperidinium (Ahyong et al., 2024) (Figure 35-1). The morphological characteristic of this genus is the number of apical intercalary plates of the dinoflagellate epitheca (3) (Balech, 1974). However, this criterion does not reflect the phylogeny of the species, as the genus is not monophyletic (Gu et al., 2015; Yamaguchi et al., 2011). There are three to four clades among the dinoflagellate phylogenetic tree (Figure 35-2) demonstrating that the criterion for the establishment of this genus does not represent phylogenetic relationships (Liu et al., 2015).

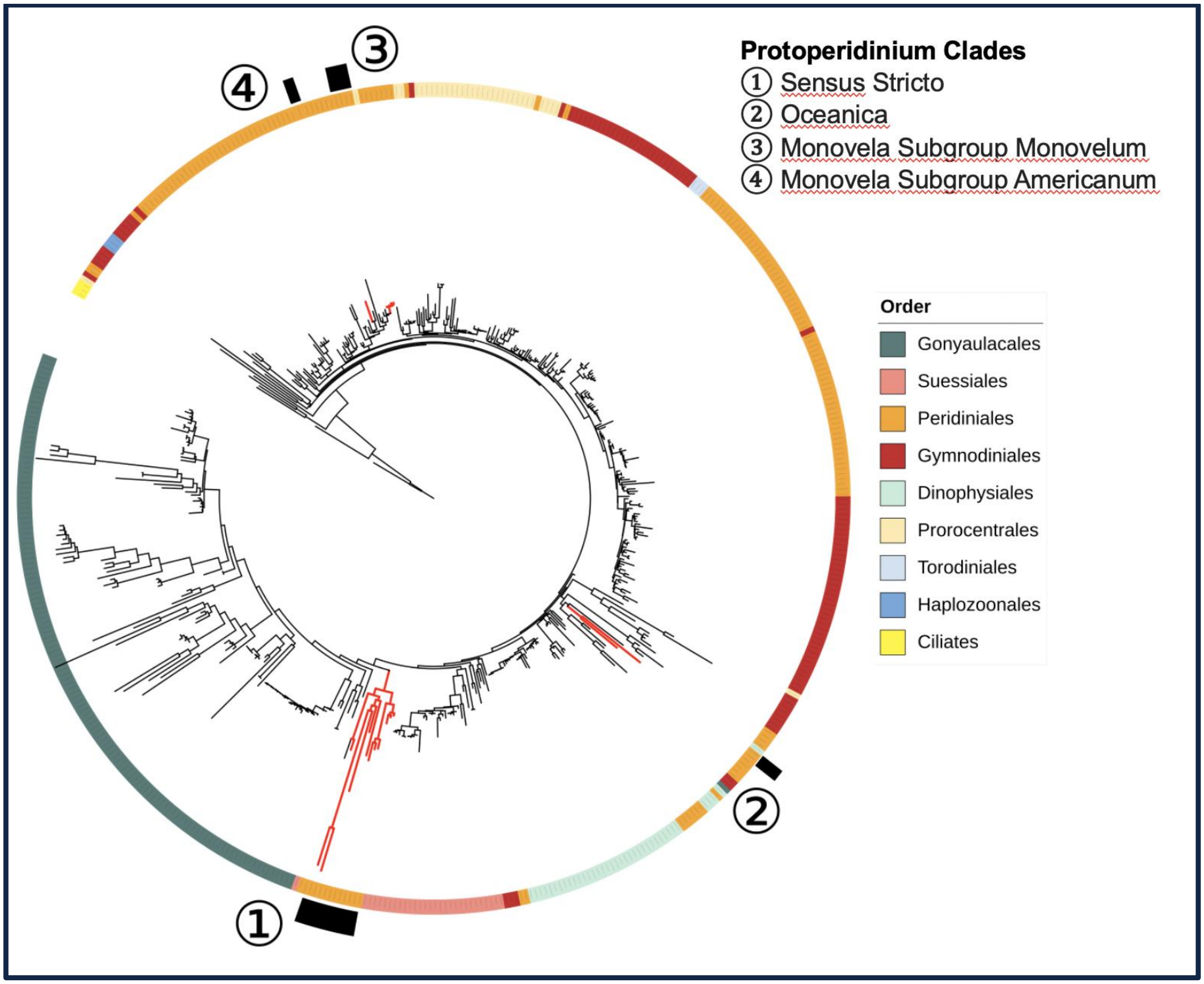


Figure 35-2: phylogenetic tree of dinoflagellates based on 18S rRNA Protist Ribosomal Reference (PR2) V5.0.0.

It is therefore necessary to establish a classification that considers the evolution of dinoflagellates, particularly in the Arctic ecosystem, which presents a significant proportion of cryptic species (species sharing the same morphology but having different DNA) (Bickford et al., 2007; De Luca et al., 2021; Fiser et al., 2018; Struck et al., 2018). The high rate of cryptic or pseudo-cryptic species distorts current biodiversity estimates, as many articles misidentify species due to their morphological resemblance. Having the most complete molecular database possible combined with specific morphological criteria will help better identify dinoflagellate species. Moreover, some parts of the sequences that will be obtained will be used as barcodes (18S - V4; V9), enhancing studies that use metabarcoding and thereby more accurately reflecting Arctic diversity. Additionally, the DNA and RNA of dinoflagellates, being among the most complex and large in terms of base pairs among eukaryotes, will help us better understand the dinoflagellate genome (Hackett & Bhattacharya, 2006; Hoppenrath et al., 2009; Wisecaver & Hackett, 2011). The stations surveyed during this leg are important for sampling the greatest number of arctic species. For this project, we are collaborating with Mona Hoppenrath from the Senckenberg am Meer Institute, Wilhelmshaven, Germany, and Sarah Romac and Ian Probert from the Biological Station of Roscoff, CNRS, Sorbonne University.

35.2 Methodology:

A plankton net with a mesh size of 20 µm (Figure 35-3) is used to collect dinoflagellates. To account for diel migration, a vertical trait of 100 meters depth is performed, thus covering the entire photic zone. The organisms are then preserved in 95% ethanol and stored at 4ºC to conserve their DNA. After the campaign, individuals will be isolated and examined using optical and scanning electron microscopes to accurately identify the species. Finally, we will sequence the 18S, 28S, and ITS regions using specific primers.

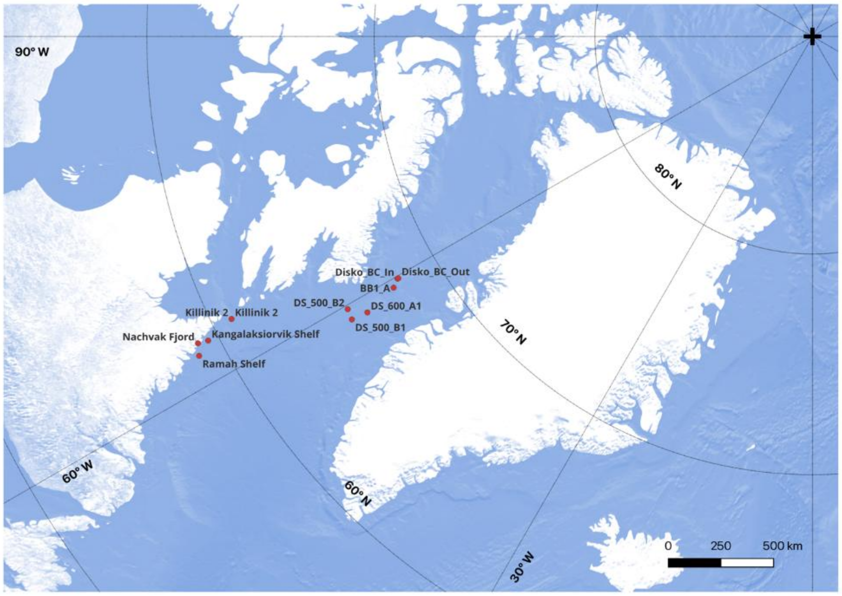
Figure 35-3: Plankton net on the A-frame of the CCGS *Amundsen*.

Table 35-1: Stations sampled with a plankton net during leg 2a and 2b.

Time (UTC)	Station ID	Latitude	Longitude	Sampling depth (m)
2024/07/28 07:55:19	Disko_BC_In	68,1186432	-59,7267992	100
2024/07/28 04:30:42	Disko_BC_Out	68,1539642	-59,7218538	100
2024/07/28 00:25:04	BB1_A	67,7636493	-59,0443283	100
2024/07/27 03:28:31	DS_600_A1	66,2009257	-58,2064343	100
2024/07/26 16:28:58	DS_500_B1	65,4519353	-58,4366270	100
2024/07/26 07:44:05	DS_500_B2	65,5306537	-59,5917978	100
2024/07/24 03:18:12	Killinik 2	60,8486028	-64,0614890	100
2024/07/24 03:08:06	Killinik 2	60,8488167	-64,0615167	100
2024/07/23 14:26:13	Kangalaksiorvik Shelf	59,5340385	-63,2855157	100
2024/07/23 04:51:34	Ramah Shelf	58,8885355	-62,4913142	100
2024/07/22 20:19:54	Nachvak Fjord	59,0858620	-63,4667743	100

Time (UTC)	Station ID	Station Type	Latitude	Longitude	Water Temp	Water Salinity
2024/08/06 08:27:33	B5	KEBABB Full	67,5861940	-59,0137920	2,912	31,082
2024/08/06 08:19:56	B5	KEBABB Full	67,5867058	-59,0142737	2,898	31,038
2024/08/05 22:00:19	B3	KEBABB Full	67,3331153	-60,2884938	0,738	29,846
2024/08/05 13:05:57	B1	KEBABB Full	67,0587780	-61,5137310	1,498	30,773
2024/08/05 05:50:00	C1	KEBABB Full	67,3478902	-62,5217593	1,822	30,571
2024/08/04 19:00:47	C3	KEBABB Full	67,7446385	-61,2708965	0,474	30,215
2024/08/04 04:25:00	C5	KEBABB Full	68,1608307	-59,9678665	0,216	29,796
2024/08/02 13:49:08	D3	KEBABB Full	68,2401618	-62,5929460	0,187	29,831
2024/08/01 21:28:40	D1	Full	67,4719425	-63,6982277	1,532	31,137
2024/08/01 08:11:15	TCA-QFB1	Basic	67,0953735	-64,6573438	5,932	25,845
2024/07/31 19:30:07	TCA-QF3	Full	67,2719095	-63,8781733	3,584	28,295
2024/07/31 07:22:56	TCA-QFA1	Basic	67,2207007	-64,7227127	2,047	27,81
2024/07/30 10:04:39	TCA-QFC1	Basic	67,3542767	-64,7576427	1,361	30,47

a)



b)

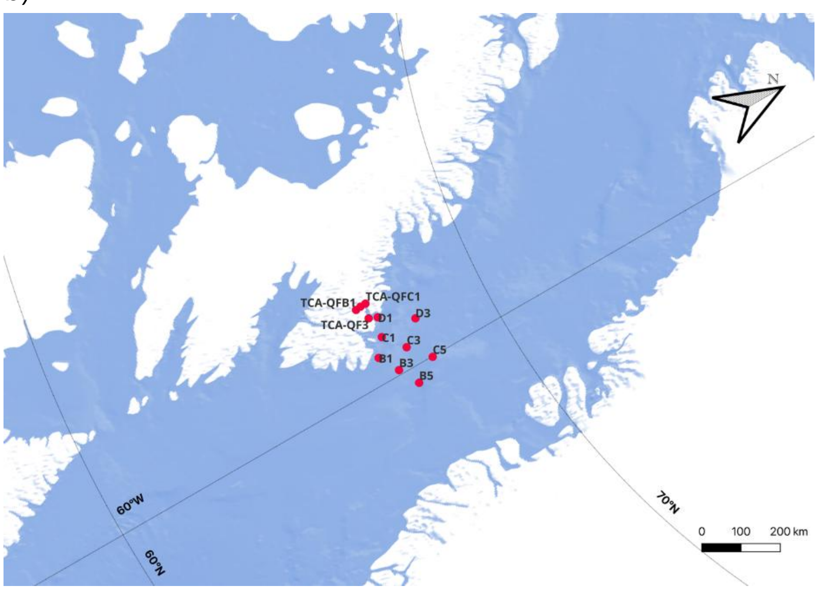


Figure 35-4:Stations sampled with a plankton net during a) Leg 2a and b) Leg 2b

35.3 Recommandations:

To optimize sampling time, it would be feasible to deploy two nets side by side (bongo nets) to collect twice as many samples within the same time on deck.

36 Fish and Zooplankton Ecology and Acoustics

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36.1 Introduction and Objectives

36.1.1 *Leg 2*

The Labrador Sea is a zone of remarkable oceanographic, biogeochemical and ecological importance. It's a cold and convective area that has global significance for ocean circulation and carbon sequestration (DeGrandpre et al. 2006, Körtzinger et al. 2008, Duke et al. 2023). This mixing of waters also allows surface water to be replenished with nutrients annually, which supports a strong biological productivity. In particular, we can find hotspots of benthic productivity along its great depth variations (Rangeley et al. 2022, Cote et al. 2023). In the pelagic environment, the arctic-origin Labrador Current and the subarctic West Greenland Current meet along a strong oceanographic front at a depth of around 150m (Fratantoni and Pickart 2007). The transfer of matter and energy in pelagic food webs is supported by mesozooplankton, with the dominance of lipid-rich copepods, large macrozooplankton (amphipods, krill, mysids) (Daase et al. 2021), and foraging fish like myctophids and Arctic cod (Geoffroy et al. 2023). Zooplankton and mesopelagic fish are a key node of biomass in subarctic food webs, storing and transferring algal organic matter to species of high nutritional and cultural value (arctic char, bowhead whales, seals) (Pedro et al. 2023). The mesopelagic organisms form dense mid-water aggregations that are widely detected by vessel-based echosounders and are known as deep sound scattering layers (DSLs). These layers are presumed to include the largest biomass aggregations of animal life on the planet. Through daily vertical migrations, mesopelagic animals transfer energy and carbon to the deep ocean (Proud et al. 2017, Priou et al. 2021). Zooplankton and mesopelagic community diversity and abundance in the Labrador Sea have been poorly documented despite the importance of the region. Our research group's objectives are:

(1) to understand if an onshore—offshore connectivity exists, or if the Labrador Current front forms a barrier between two different pelagic ecosystems (Darnis et al. 2022);
(2) to document fish distribution in fjords through acoustic analysis;
(3) to assess diversity of gelatinous organisms, poorly studied in this subarctic region, by genetic analyses;
(4) to continue the time series of sampling in the Labrador shelf to understand seasonal and interannual variations; and

(5) to coordinate the collection and sharing of fish and invertebrate samples with other research groups to complement and extend their sampling (i.e. lipids and isotopes analyses led by R. Amiraux, Université Laval).

All these research questions are included in the Imappivut initiative, a Marine Plan designed to manage and protect Labrador Inuit interests in the coastal and marine areas of Labrador (Government of Canada, 2024). This plan covers zones included in the Labrador Inuit Land Claims Agreement (LILCA), and its goal is to ensure that important areas, uses and activities are safeguarded for Labrador Inuit use, and that Labrador waters support healthy ecosystems and the well-being of Labrador Inuit. For this plan, the biodiversity and distribution of habitat and marine life is assessed by the collaboration of Inuit knowledge and western science (Rodd Laing, pers. comm.). The Statement of Intent between the Nunatsiavut Government and the Government of Canada for the marine plan was announced in 2017. After a series of learning and knowledge studies from Indigenous organizations and groups, the Torngat Area of Interest Inuit Protected Area was deemed feasible in March 2024 by the two governments. Assessing pelagic communities in and around this future protected area is an overall objective of this research. Sampling of dense mid-water aggregations may be biased by traditional net sampling techniques which introduce selectivity bias based on avoidance behaviour and size of organisms.

This study therefore combined high resolution acoustic imaging (hull-mounted EK80) with traditional mid-water and benthic trawls (Isaac-Kidd Midwater Trawl –IKMT and Beam Trawl, respectively). We also used depth-stratified plankton net sampling (Hydrobios net) to better understand the biodiversity and distribution of mesozooplankton according to water masses. Finally, to have a complete picture of the pelagic environments, underwater images of mesozooplankton and particles (“marine snow”) were taken by the Underwater Vision Profiler 6 (Picheral et al. 2022) at each rosette deployment, which provides imaging of mesozooplankton with high vertical resolution (i.e., one images every 5cm). These data will be further complemented by eDNA collections of mesopelagic organisms.

36.1.2 *Leg 3 and Leg 4*

The Canadian Arctic, as the rest of the Arctic, is highly vulnerable to the consequences of climate change. Arctic Amplification, a positive feedback loop of rapid warming due to the increased solar absorption caused by retreating sea ice, has led to the Arctic warming 4 times faster than the rest of the planet (England et al. 2021, Rantanen et al. 2022). The most visible consequence of this warming is the rapid decline of sea ice, both in extent and age (Meredith et al. 2019). The now prolonged open-water period has been attributed to an extended episode of primary production and an overall decrease in algal bloom amplitude over the last 17 years (Marchese et al. 2017). Nares Strait and its fjords are known as a refuge zone for old ice, due to the circulation of water and sea ice from the Lincoln Sea as well as the various glaciers. Nares Strait is an Arctic passage linking the North Water Polynya to the Lincoln Sea from 78°N to 82°N, bordered by the Canadian Ellesmere Island on the west side, and by Greenland in the east. This strait is an outlet for several water masses mixing in the Arctic basin: Polar Mode Water, Arctic Pacific Winter Water, and Canadian basin Atlantic Water (Burgers et al. 2023) (Barut et al. *in prep*). The relative prevalence of these water masses when they reach Nares Strait depends on regional climatic variations (Arctic Oscillations, AO) which influence the size of the Beaufort Sea gyre and the strength of the Transpolar Drift water from the Russian seas (Burgers et al. 2023). Once in Nares Strait, these Arctic waters flow southwards where contact with the modified Atlantic waters present in Baffin Bay leads to changes in chemical and physical properties (Baffin Bay Polar Water and SubPorlar Mode Water). Arctic pelagic food webs are uniquely suited for extreme climatic conditions and solar energy availability. A significant portion of the energy transfer from primary production to higher trophic organisms and carbon storage in pelagic food webs is attributed to a few mesozooplankton species, primarily lipid-rich copepods and large macrozooplankton (Daase et al. 2021) as well as to forage fish like myctophids and Arctic cod (Geoffroy et al. 2023). Zooplankton and mesopelagic fishes are a key node of biomass in subarctic food webs, storing and transferring algal organic matter to species of high nutritional and cultural value (arctic char, bowhead whales, seals) (Pedro et al. 2023). These mesopelagic organisms form dense mid-water aggregations, known as deep sound scattering layers (DSLs), which are presumed to be responsible for the largest biomass aggregations of animal life on the planet. Through daily vertical migrations, these animals transfer energy and carbon to the deep ocean (Proud et al. 2017, Priou et al. 2021). In ice-covered shallow Arctic waters and in Arctic fjords, energy transfer from surface primary producers to benthic species is related to grazing pressure of pelagic species (Stasko et al. 2018), as well as sea ice cover (Grebmeier et al. 2006, Wassmann et al. 2011). Ice algae, in particular, is an important food source to many benthic organisms (McMahon et al. 2006). While sea ice is of high importance to both pelagic and benthic species (Grebmeier et al. 2006, McMahon et al. 2006) it does pose many challenges for researchers to study biological processes below it. The overall aim of the Arctic Refuge mission in Nares Strait and its fjords is to study the physical, biogeochemical, biological and paleoclimatic components of this “Last Ice Area”, in order to define baseline functioning of these ecosystems (Ardyna et al. *in prep*). In Leg 3 in particular, these questions are focused on fjord and glacier specific conditions (Cottier et al. 2010). The influence of glacier type, freshwater and sediment inputs on bottom geomorphology, light penetration, nutrients and trace elements, and presence of contaminants were studied and will be related to the abundance and diversity of plankton, benthic invertebrates and, if applicable, marine mammals. The objective of the second leg of this program (Leg 4) was to reach the Lincoln Sea to carry out sea ice stations and Full Stations (during which nets would be deployed). Due to ice conditions, it was not possible to reach the area initially planned, and the mission plan had to be adapted accordingly. Four transects were completed in Nares Strait, in addition to several opportunistic stations, often for sea ice sampling.

For the legs 3 and 4 of Refuge Arctic, the research group's objectives and those of our collaborators are:

(1) to assess the abundance and diversity of fish and zooplankton in the fjords of Nares Strait, influenced by glaciers melting, freshwater inputs and sea ice dynamics to have a baseline of the ecosystem state,
(2) to combine the information given by various and complementary instruments (acoustics nets, underwater videos and images) to best characterization of the secondary production
(3) to assess diversity of gelatinous organisms by genetic analyses for the project of Eugenie Jacobsen,
(4) to continue the time series of sampling in the Arctic to understand seasonal and interannual variations; and
(5) to coordinate the collection of samples with other research groups to complement and extend their sampling (lipids and isotopes analyses led by R. Amiraux, Université Laval.

We used depth-stratified plankton net sampling (Hydrobios net) to better understand the biodiversity and distribution of mesozooplankton according to water masses and depth, as well as classic vertical tows according (Monster Net). Depth and station importance dictated when each net was used. Sampling of dense mid-water aggregations with nets may be biased, as it introduces selectivity based on avoidance behavior and size of organisms. This study therefore combined high hydroacoustic data collection (hull-mounted EK80) with traditional mid-water and benthic trawls (Isaac-Kidd Midwater Trawl –IKMT and Beam Trawl, respectively). Finally, to have a complete picture of the pelagic environments, underwater images of mesozooplankton and particles ("marine snow") were taken by the Underwater Vision Profiler 6 (Picheral et al. 2022) at each rosette deployment, which provides imaging of mesozooplankton with high vertical resolution (i.e. one images binned every 5cm). Benthic underwater videos were also recorded through the use of the "Drop camera", a combination of one front facing and one bottom facing camera.

36.1.3 *Leg 5*

Mesopelagic organisms, who form dense mid-water aggregations across the global ocean known as deep sound scattering layers (DSLs), are presumed to be responsible for the largest biomass aggregations of animal life on the planet and provide a crucial energy link to the deep ocean (Proud et al. 2017). Because of harsh light regimes and lack of food supply, these organisms were previously thought to be void in the Arctic until the presence of a mesopelagic sound scattering layer was observed across the circumpolar Arctic in recent years (Priou et al., 2022).

Baffin Bay is a unique basin in that it supports both the Arctic and Atlantic mesopelagic fish and macrozooplankton assemblages. Previous cruises on the CCGS *Amundsen* have shown that both Atlantic and Arctic fish converge in the waters in southern Baffin Bay around Davis Strait, but due to seasonal limitations in sampling, the northern extent of the Atlantic mesopelagic layer has been less documented. During this cruise, our aim was to resolve the extent of Atlantic fish advected by the West Greenland Current into Baffin Bay and identify the areas where both the Atlantic and Arctic communities intersect. In addition, we compared this to a more southern region in Ungava Bay to contrast differences in the zooplankton communities to those in Baffin Bay where Arctic and Atlantic water masses are absent.

36.2 Methodology:

36.2.1 *Acoustic sampling*

The *CCGS Amundsen* is equipped with a hull mounted EK80 broadband echo sounder operating at 38, 120 and 200 kHz. The EK80 operated continuously during the leg in narrowband mode which allowed our group to monitor the spatial and vertical distribution of zooplankton and fish, thus providing a widespread mapping of where the fishes and zooplankton are along the ship track. The calibration of the EK80 echosounder was done prior to departure. The pulse duration setting was set at 2000W for 38kHz, 250W at 120kHz and 105W at 200kHz. Recording depth range was set to 1000m for 38kHz, 600m for 120kHz and 150m for 200kHz. EK80 settings were checked twice daily to ensure data was properly recorded. When ocean mapping was being completed and the stated settings of the EK80 prevented accurate processing of the bathymetry, the recorded depths were changed to record to at least 100m past the sea floor.

36.2.2 *Multi-net plankton sampler (Hydrobios)*

Mesozooplankton was sampled with a Hydrobios multinet plankton sampler (Figure 36-1C). The sampler was equipped with nine 200 µm mesh nets (opening $0.5m^2$) allowing for depth-specific sampling of the water column. The Hydrobios is also equipped with a CTD to record temperature and salinity while collecting biological samples. The multinet is deployed vertically from 10 m off the bottom to the surface, with a maximum reach of 1000m. The nets open and close sequentially while the sampler is pulled up through the water column. The depth at which the different nets open and close is programmed before deployment and the depths programmed are based on bottom depth. Once retrieved, the zooplankton samples are preserved in 10% formalin solution and stored for further taxonomic identification at Laval University.

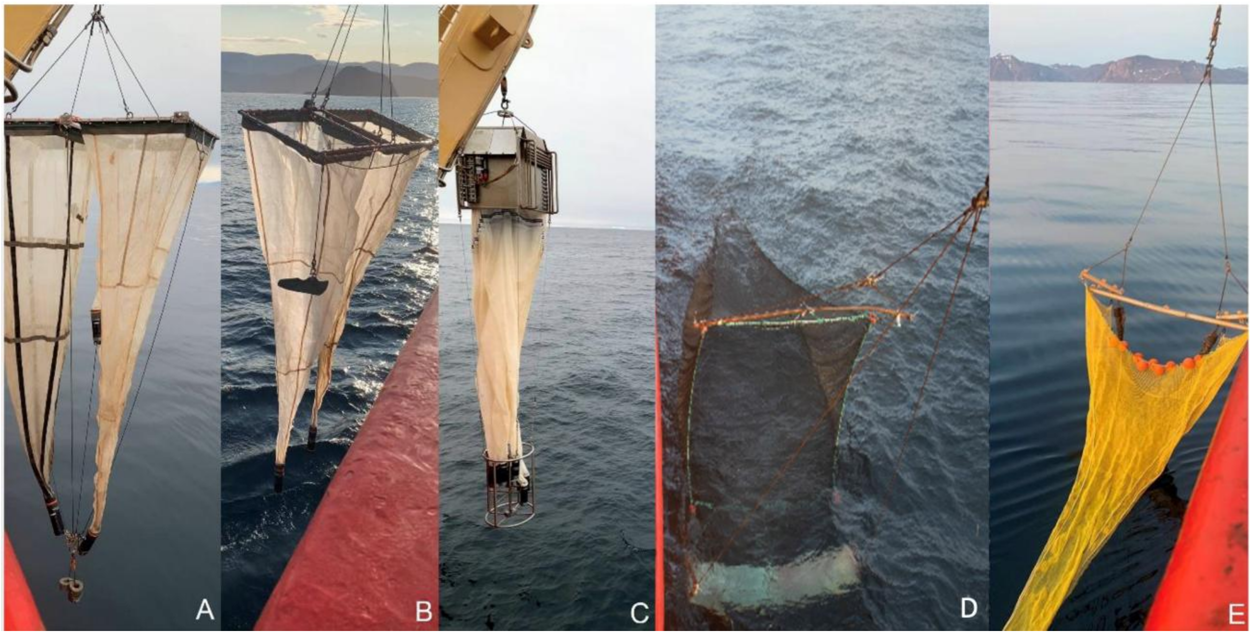


Figure 36-1: The V-Tow net (A), the O-Tow net (B), the Hydrobios net (C), the IKMT net (D), and the beam trawl net (E) which were used to sample the fish and zooplankton communities during legs 2 and 3

36.2.3 *Isaac-Kidd Midwater Trawl (IKMT)*

The IKMT sampled pelagic fish and macro-zooplankton (Figure 36-1D). The rectangular net has a 13.5 m^2 (4.5m x 3m) mouth aperture and mesh size of 11 mm in the first section and 5 mm in the last section. The net was lowered at a target depth, which was determined by the echosounder EK-80 signal, and towed at that depth for 20-30 minutes at a speed of 3 knots. All samples were sorted by species, counted, measured and weighed before being frozen at -80°C for further analyses, including compound specific isotope analysis of amino acids and molecular stomach content analysis.

36.2.4 *Beam trawl*

Demersal and benthic adult fish were sampled with a benthic beam trawl (headline = 4.27 m, footrope= 4.27 m, 9.5 mm codend mesh) (Figure 36-1E). The net was lowered using the 500T cable winch to the bottom depth. Two times the bottom depth of cable was provided to ensure that the beam trawl was securely on the bottom. The nets were deployed from the vessel at two knots and then were trawled along the bottom at the same speed for 3-10 min.

All fish samples were sorted at minimum by family, if species identification could not be made. Once identified, the samples were stored in a -80°C freezer until further analysis.

36.2.5 *Double Square Net (DSN or Tucker)*

Ichthyoplankton, meso- and macro-zooplankton were sampled using a double square net (DSN or Tucker net and Monster Net) carrying two 1m^2 aperture nets (mesh size 500 µm) and one small net (50 µm) was deployed obliquely at maximum sampling depths of 100m with a ship speed of two knots (Figure 36-1B) and 0knts for the vertical tow (Figure 36-1A); The Monster net was deployed only once at the shallow Okak station (Figure 36-1). If caught, fish larvae were sorted out and individually preserved in 95% ethanol while the rest of the contents in the net were stored in 10% formalin for further analyses.

36.2.6 *Underwater Vision Profiler (UVP)*

An Underwater Vision Profiler 6 High Frequency (UVP6-HF) was mounted on the CTD-rosette to take pictures of zooplankton and marine snow. The UVP took pictures during the CTD-rosette profile casts, which means that a precise depth is associated with each picture. The UVP consists of a camera with an illuminated laser diode emitting constant-power red laser flash (635nm) that takes images at a determined frequency in a precise volume of water (0.7L). The images are then extracted from the UVP with the help of UVP. Subsequently, the metadata for each station are added. The data containing living organisms will then be classified by taxonomy on the EcoTaxa application for further analyses.

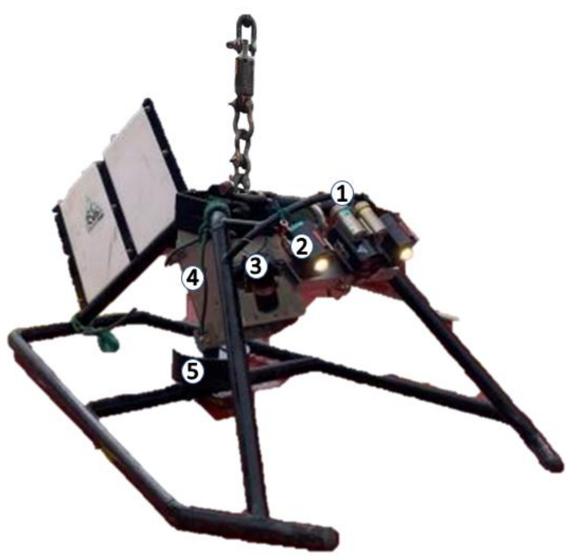
36.2.7 *Lab analyses for other teams during Leg 3:*

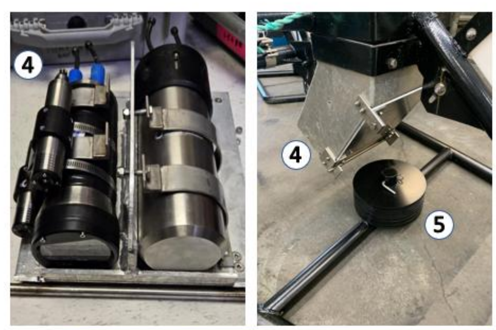
Tucker (oblique net) samples were split after larvae were removed and counted. The samples were then split for several teams. A split from the red Tucker was kept in formalin in 500 mL containers for taxonomic analysis made by Cyril Aubry (Takuvik Université Laval). The second half was kept frozen at -80°C for isotopes analysis for the team of Rémi Amiraux (Takuvik - Université Laval). Same for Monster net: a split from the red Tucker was kept in formalin in 500 mL containers for taxonomic analysis made by Cyril Aubry (Takuvik Université Laval). The second half was kept frozen at -80°C for isotopes analysis for the team of Rémi Amiraux (Takuvik - Université Laval). The yellow nets were discarded (larvae were sorted first from the Yellow Tucker). We did that (i) to earn some times as we always need to split at least in half the sample, so it's easier to process one net; to be sure that taxonomy and isotopes could be directly comparable as it's the half of the same net, that might sample a little bit different.

36.2.8 *Drop Camera*

The "drop camera" (Drop cam) is an instrument composed of two underwater cameras deployed to record benthic faunal communities. The instrument is composed of a front facing camera and lights (GoPro within Anglerfish protective housing) and a bottom facing camera (SubC Rayfin) with lights and lasers. Both cameras are mounted on a weighted metal frame. The metal frame is equipped with a fiberglass fin to ensure proper orientation during deployment (

Figure 36-2). Deployment involves the lowering of the frame into the water until it has contacted the sea floor, the frame is then lifted one to two meters off the bottom and held for 30 seconds. After the 30 seconds have elapsed, the frame is again lowered to allow contact with the sea floor and raised one or two meters above the sea floor for 30 seconds. These 30 second "bounces" are repeated over a period of 30 minutes as the boat drifts slowly (no more than 0.5 kn).





Nombre	Équipement
1	Anglerfish (GoPro)
2	Forwards facing lights
3	Downwards facing lights
4	SubC camera and battery
5	Adjustable weights

Figure 36-2: Drop camera setup with all components labeled.

36.3 Preliminary results

36.3.1 *Leg 2a*

A total of 28 net deployments were conducted to sample the fish and zooplankton communities (Beam trawl n=5, IKMT n = 4, Tucker n = 9, Monster n = 1, Hydrobios n = 9; Table 36-1). In trawls, fish and macrozooplankton were abundant and diverse, with numerous shrimp species on the Labrador Shelf. We saw numerous redfish, unidentified slender fish and myctophyds and some less abundant fishes such as skate, barracudina and Boa dragonfish. Larvae abundance was variable between stations with a large peak in Nachvak Fjord. For Tucker and Monster nets, samples were split after larvae were counted and a part of the sample (¼ or ½) from each station was kept and frozen for the team of Rémi Amiraux (Université Laval).

Table 36-1: Sampling sites with their latitude, longitude and associated net activity for legs 2a of the Amundsen expedition 2024 (latitude and longitude for the deployment of the first net).

Station ID	Date (UTC)	Latitude	Longitude	Monster	Tucker	Hydrobios	Beam Trawl	IKMT
Hopedale Saddle	2024/07/14	56,0416985	-57,3892808		x	x		x
MAK-2024-M1	2024/07/16	55,4358897	-58,9396795		x	x		x
Hopedale Shelf	2024/07/17	55,7219515	-59,3968492		x	x	x	
Sentinel	2024/07/19	56,3203118	-59,8480278		x	x		x
Okak Bay	2024/07/20	57,5674238	-62,0640790	x	x		x	
Nachvak Fjord	2024/07/22	59,0866947	-63,4846002		x	x	x	
Ramah Shelf	2024/07/23	-63,2856222	-62,4909552		x	x	x	
Kangalasiorvik Shelf	2024/07/23	59,5323612	-63,2856222		x	x	x	
Kilinik 2	2024/07/24	60,8504253	-64,0452003		x	did not trigger		
DS-500-B2	2024/07/26	65.52849	-59.58883			x		
DS-500-B1	2024/07/26	65.45144	-58.43767			x		x
Total Leg 2a				1	9	9	5	4

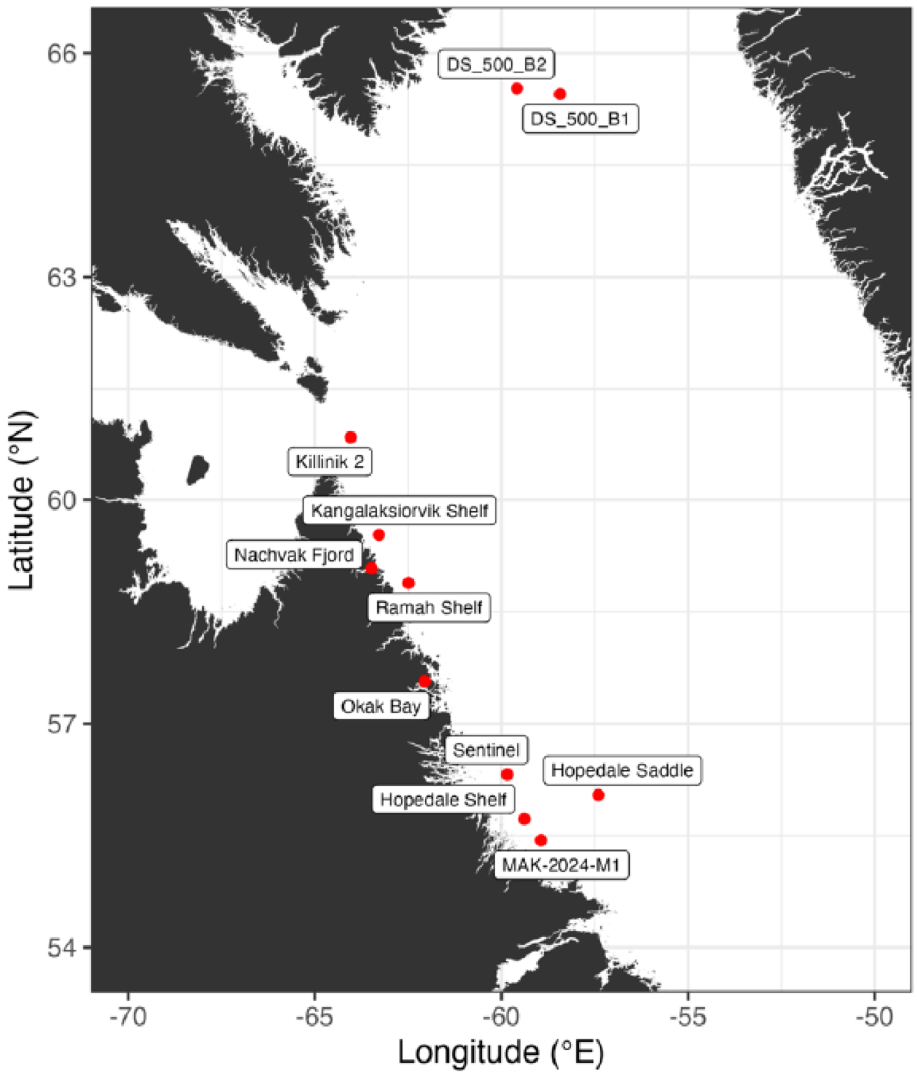


Figure 36-3: Sampling sites where nets were deployed during Leg 2a

- *Adult fish (IKMT and Beam Trawl)*

There were 310 fish from 14 families caught in the IKMT (n = 71) and Beam trawl (n = 239) nets. The most frequently caught species were in the families: and Myctophidae, Stichaeidae and Sebastidae (Figure 36-4). There was a high abundance of fish on shelf stations, especially in the Beam Trawl for Hopedale and Ramah shelves (Figure 36-5).

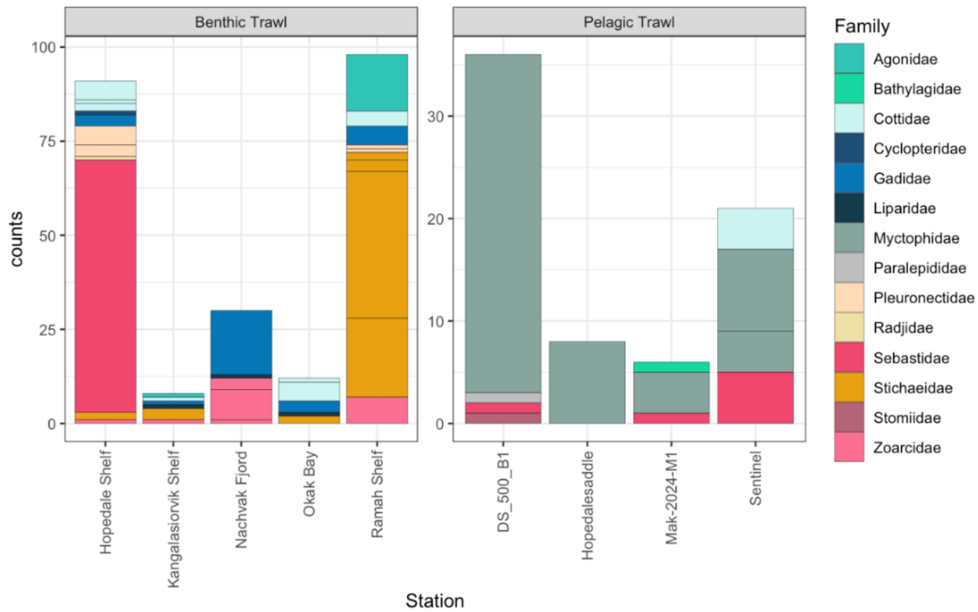


Figure 36-4: Abundance of fish families by stations for the Beam Trawl and the IKMT. Thin black lines divide colour bars if there are several species within families

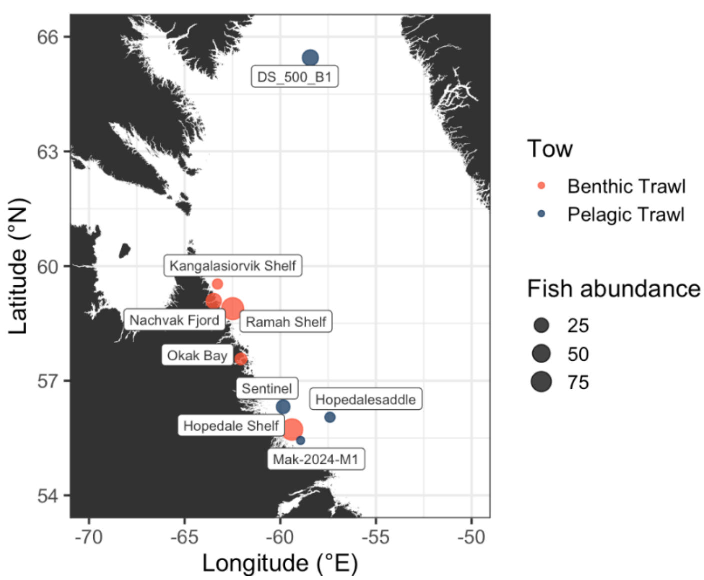


Figure 36-5: Total fish abundance by stations for the Beam Trawl and the IKMT

- *Larval Fish (Tucker)*

There were 733 larval fish collected from the Tucker from 5 different families identified, counted, and preserved. Abundance in fjords was elevated compared to the shelf or offshore (Figure 36-6, note the log transformed axis). The most frequently occurring species were

Stichaeidae, Cottidae, Liparidae and Gadidae (high diversity in fjords). The average length of larval fish are summarized in Table 36-2.

Table 36-2: Lengths of sampled fish larvae from Leg 2a of the 2024 Amundsen Expedition. (SD = standard deviation)

Family	Mean Length (mm)	SD Length (mm)
Agonidae	18.98400	12.927326
Cottidae	19.61265	4.022924
Gadidae	13.43713	3.008041
Liparidae	14.90028	3.156588
Stichaeidae	20.93940	16.897139

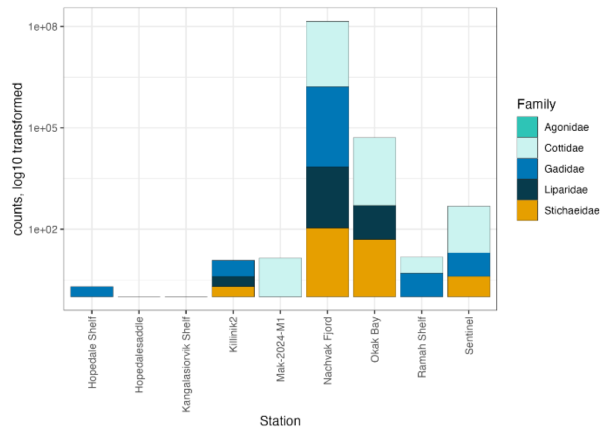


Figure 36-6: Abundance of fish larvae families by stations, sampled by the Tucker net (log-transform y-axis).

- *Macrozooplankton (IKMT)*

There were 13588 specimens of zooplankton from 4 main phyla identified, counted, and preserved from the IKMT net (Figure 36-7). Most abundant zooplankton specimens were Euphausidae, Themisto sp., A. digitale and Chaetognatha. Among them, 870 Cnidarians and 17 Ctenophora were also captured and enumerated and at least one specimen per species was preserved for Eugenie Jacobsen’s genetic analysis. Abundances were elevated next to the Makkovik Hanging Gardens (Figure 36-8), and note that the helmet jelly Periphylla peryphylla was found frequently (Figure 36-8, pink numbers).

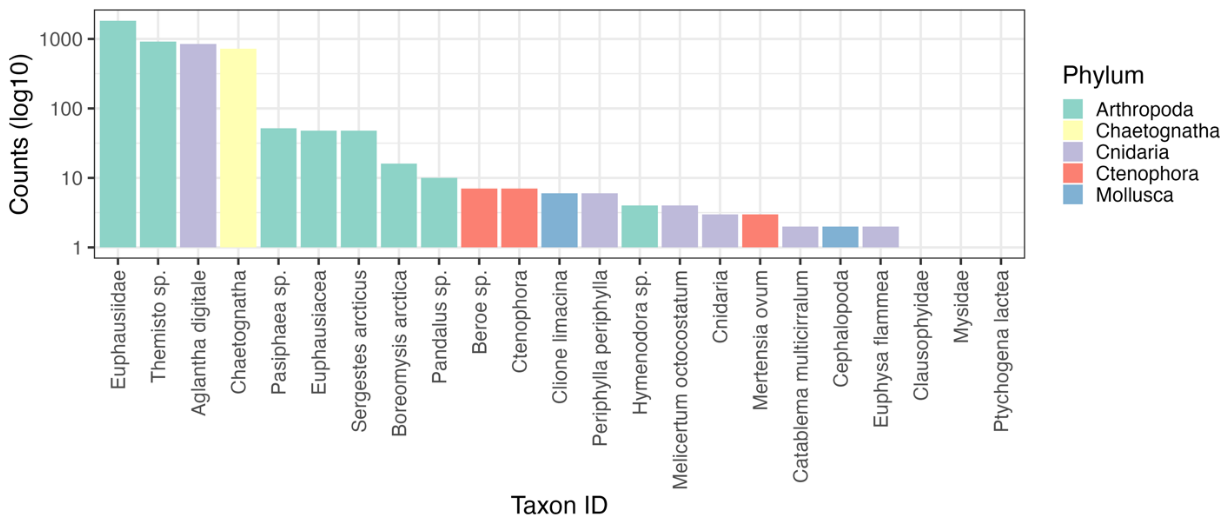


Figure 36-7: Abundance of macrozooplankton taxa colored by phylum, sampled by the IKMT net (log-transform y-axis).

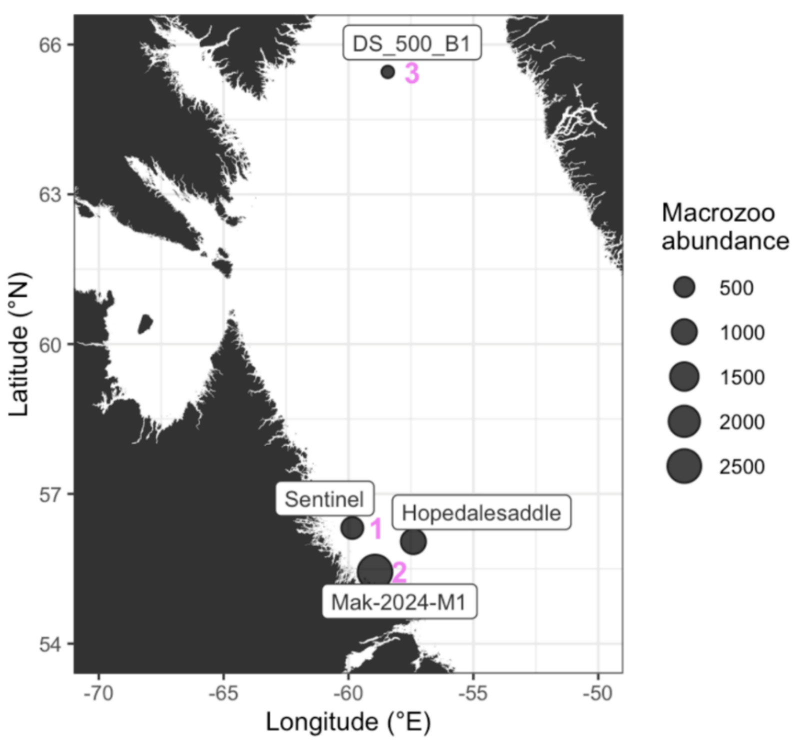


Figure 36-8: Abundance of total macro-zooplankton sampled by the IKMT net. In pink, the number of *Periphylla peryphylla* found in each IKMT.

- *Mesozooplankton (Hydrobios and Monster)*

Some deployments were difficult in the Labrador Current. We ultimately conducted 9 successful Hydrobios deployments. Notably, we sampled locations in Davis Strait to be able to quantify the connectivity of communities between the Labrador Sea and Baffin Bay, extensively sampled during KEBBAB.

- *Underwater Vision Profiler*

The Underwater Vision Profiler 6 recorded images and particles counts at each rosette deployment (24 casts in total) and they will be saved on the Ecotaxa platform in the project uvp6_sn000006hf_2024_am_leg2.

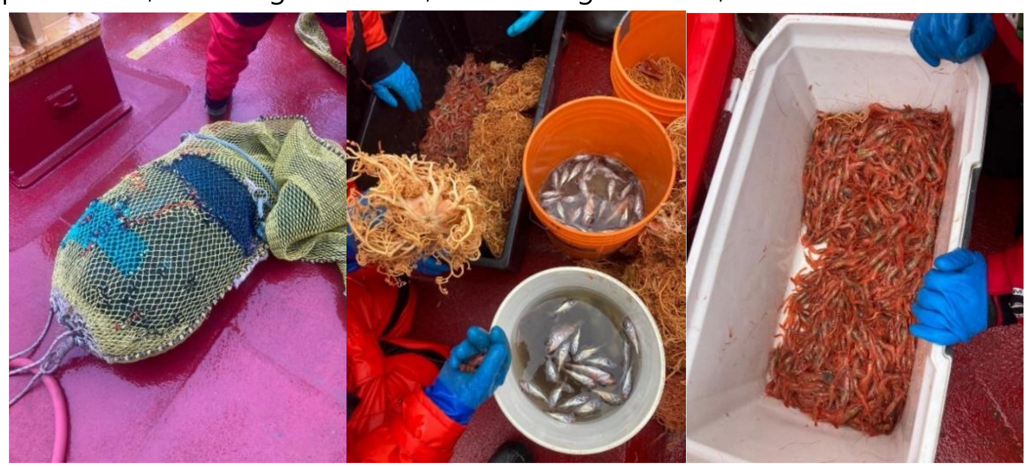
- *Stations Notes*

Hopedale Saddle: some large myctophids in the IKMT, also one in the Tucker

Nachvak Fjord: the BeamTrawl caught a lot of mud in the fjord, many benthic organisms (large white isopods, anemones, sea snails) and many fish, mostly cod, sculpins and eelpouts. Large numbers of fish larvae, very diverse. Lots of jellies with them.

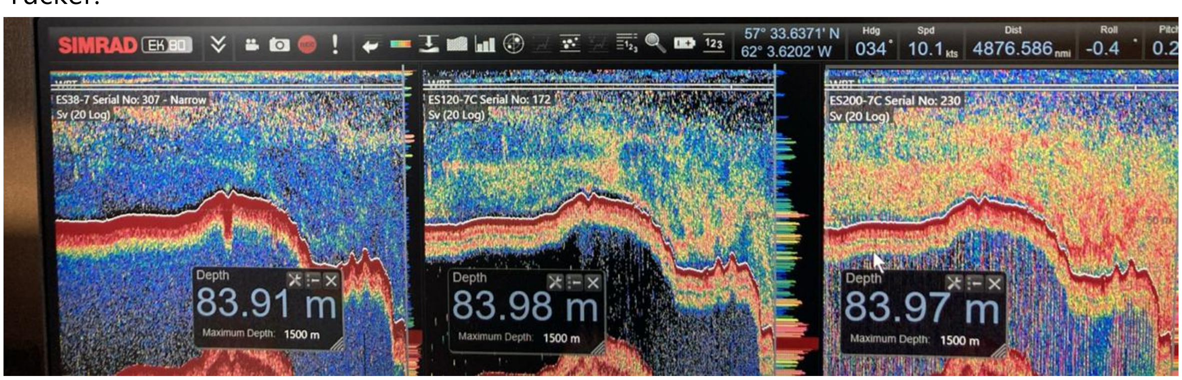
MAK-2024-M1: Ecologically rich location, high abundance of meso- and macro-zooplankton. Many shrimp-like species in the IKMT, including larges ones (~10 cm).

Hopedale Shelf: enormous catch from the Beam Trawl: benthic basket stars, corals, many shrimps and fish, including one skate, several large flat fish, and lots of red fish.



Sentinel: many jellies including P. periphyla, *Sebastes*, small myctophyds.

Okak Bay: mostly shrimps, very few fish and very small ones, but a lot of larvae in the Tucker.



Ramah Shelf: productive, lot of shrimps, and large diversity of fish with many slender fish, alligator fish, sculpins, flat fish. Kangalaksiorvik Shelf: few fish and few fish larvae, lot of shrimps

Killinik 2: only a Tucker done, the Hydrobios did not trigger probably because of the current (did not reach the trigger depth). Conditions were not ideal and an iceberg was close, so a second Hydrobios was not conducted and Beam Trawl was canceled.
DS-500-B2: only one Hydrobios deployed because of time constraints. This net was chosen to study mesozooplankton connectivity at the outflow of Baffin Bay.
DS-500-B1: one Hydrobios deployed for the same reason as in DS-500-B2, and one IKMT deployed to make sure we can validate the acoustic signal.

36.3.2 *Leg 3*

A total of 38 net deployments from 17 stations were conducted to sample the fish and meso- and macrozooplankton communities (Beam trawl n=3, IKMT n = 5, Tucker n = 14, Monster n = 6, Hydrobios n = 11; Figure 36-9, Table 36-3). Because sea ice conditions were changing rapidly in response to meteorological conditions and especially wind patterns, several of the stations planned initially were cancelled, while other fjords than those initially targeted were sampled. During the Amundsen transit towards a mooring recuperation in Nares straight the 31st of August, the ship was called for a rescue mission and the remaining scientific activities were canceled for the next 48h. Moreover, owing to the overall abundance of ice, some oblique net sampling (Tucker, IKMT and Beam trawl) was not always possible while in station. In general, the biodiversity of macrozooplankton and fish (larvae and adults) observed in pelagic and benthic trawls was low, especially in comparison with the Labrador and southern Baffin Bay regions. The first station RA01, off Bylot Island, seems to mark a clear delimitation in terms of communities' composition and abundances. The diversity of fish larvae was the lowest among all categories, since almost only Gadidae were observed. Regarding macrozooplankton, we found less shrimp and a lot of jellies (ctenophores and hydrozoans) in our trawls.

Table 36-3: Sampling sites with their latitude, longitude and associated net activity for Leg 3 of the Amundsen expedition 2024 (latitude and longitude for the deployment of the first net).

Station ID	Date (UTC)	Latitude (N)	Longitude (W)	Monster	Tucker	Hydro-bios	Beam Trawl	IKMT
RA01	2024-08-13	72.87296	75.67376		X	X		X
RA02	2024-08-14	77.23849	79.12221		X	X		
RA03	2024-08-15	77.29016	80.71558		X	X		X
RA04	2024-08-16	77.36346	81.07282		X	X		
RA06	2024-08-18	79.67942	73.06782	X	X			
RA07	2024-08-19	79.78566	73.55393	X	X			
RA08	2024-08-20	79.83347	74.16684	X	X		X	
RA09	2024-08-22	82.31491	60.88815			X		
RA12	2024-08-24	81.56948	67.63607		X	X		X
RA13	2024-08-25	81.2877	68.37775		X	X		
RA14	2024-08-26	81.50767	65.97359		X	X		X
RA15	2024-08-27	81.6735	64.08083		X	X		
RA16	2024-08-28	81.70686	59.21858	X	X		X	
RA17	2024-08-29	81.63156	58.91363	X	X		X	
RA20	2024-09-02	75.57048	78.86624			X		
RA21	2024-09-02	76.03148	83.12226			X		
RA24	2024-09-04	78.03047	75.60573	X	X			
Total Leg 3				6	14	11	3	4

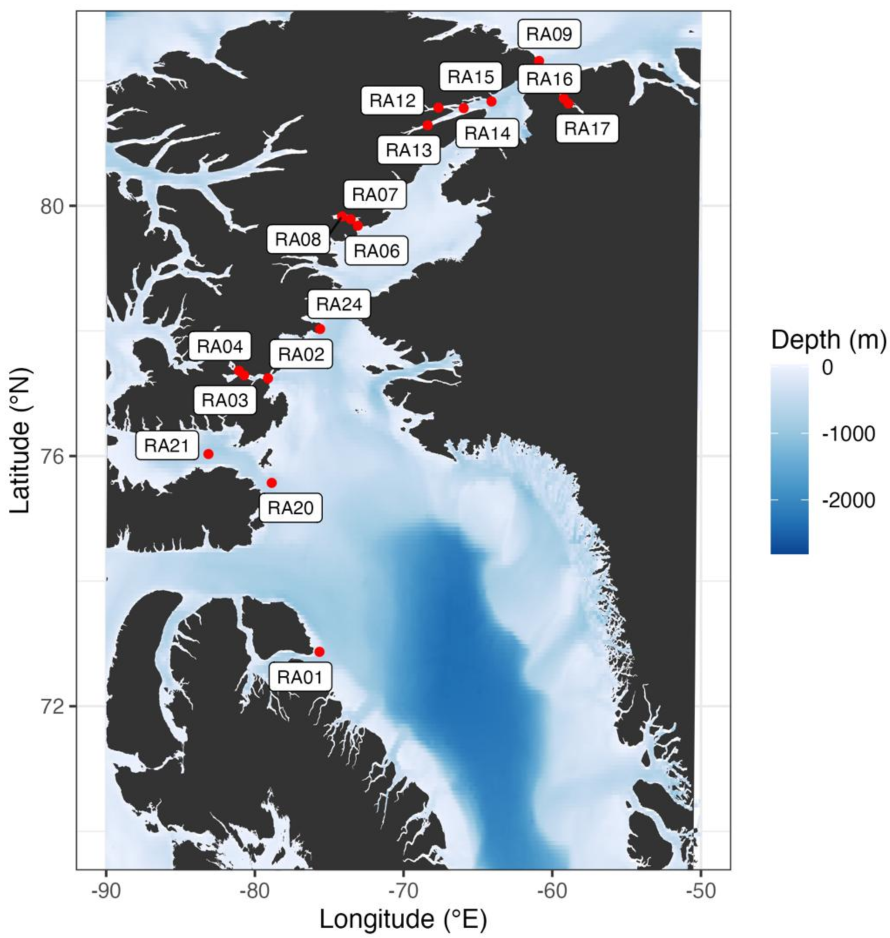


Figure 36-9: Map of the sampling sites where nets were deployed during Leg 3.

- *Adult fish (IKMT and Beam Trawl)*

There were 35 fish from 5 families caught in the IKMT (n = 25) and Beamtrawl (n = 10) nets. The most frequently caught species in the benthic trawl belonged to the Zoarcidae and Liparidae families, while the most frequently caught species in the pelagic trawls belong to the Liparidae and the Gadidae families. The noticeable abundance of Cottidae at station RA01 is due to the IKMT reaching the bottom of the sea because of a sudden change in the course of the ship and a rapid change in the angle of the cable. Abundances in both types of trawls were noticeably low throughout Leg 3, we tried to trawl as long as possible but the presence of ice often obliged us to shorter trawl duration.

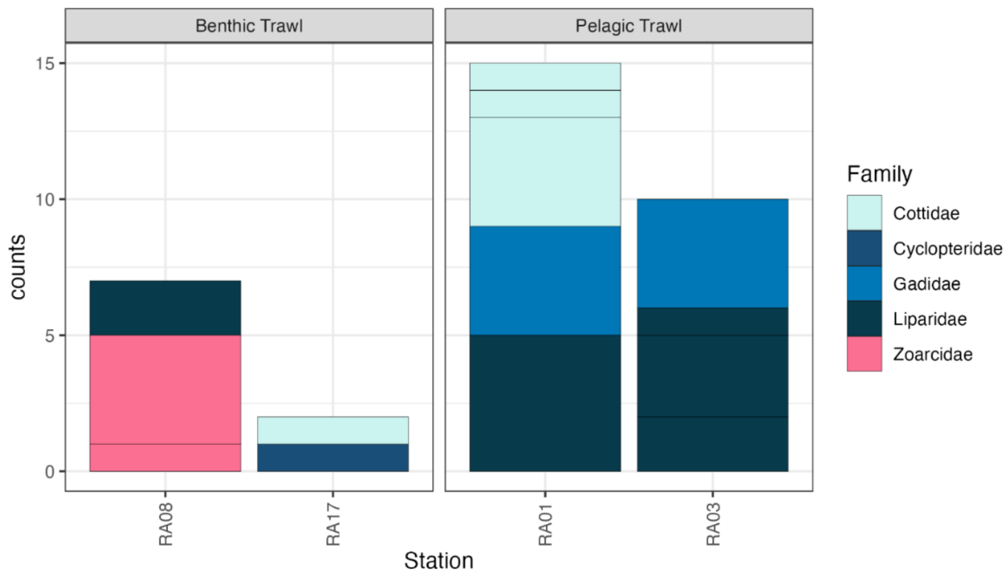


Figure 36-10: Abundance of fish families by stations for the Beam Trawl and the IKMT in Leg 3. Thin black lines divide color bars if there are several species by family. Note that the timing of trawling is not taken into account on this graph since there was almost no influence of the day-night cycle at the latitudes of our sampling.

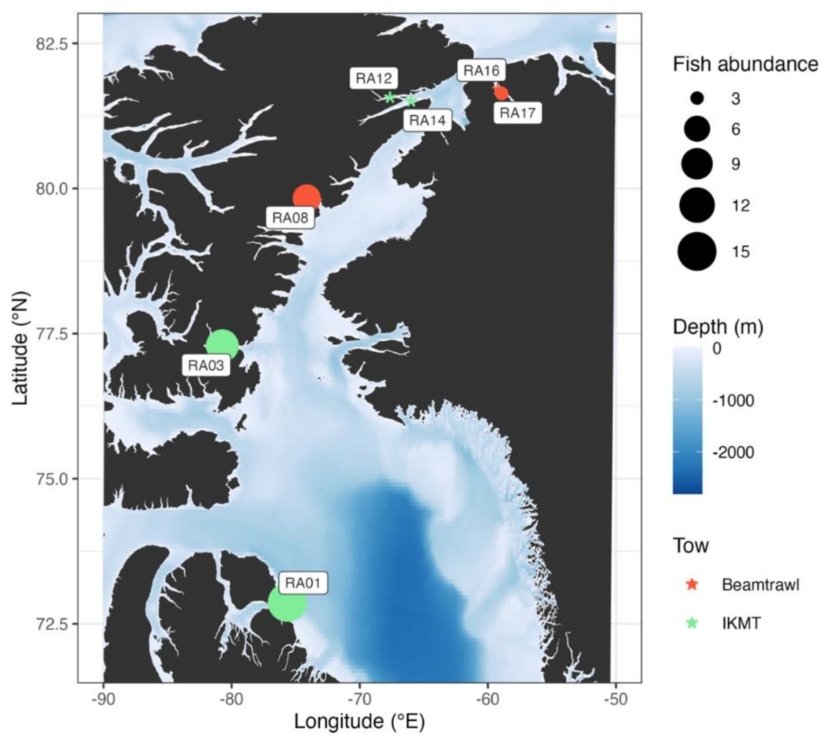


Figure 36-11: Total fish abundance by stations for the Beam Trawl and the IKMT. Stations with no fish are marked by a star (RA12, RA14 and RA16).

There is a clear latitudinal gradient in the abundance of adult fish sampled with both trawls, with the three northernmost stations having not provided any fish. This was reflected in the echograms and is not likely to be solely due to the methodological challenge of sampling fish with our trawls in icy waters (Figure 36-12). We can notice that the echogram is almost empty in Archer fjord where no fish where sampled, while it was very low in Newman fjord that provided only a few fish individuals.

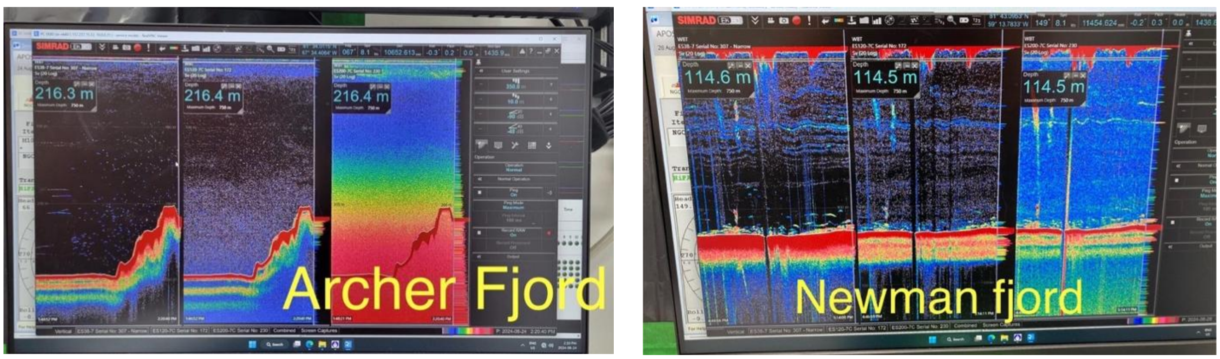


Figure 36-12: Snapshots of echograms from Archer fjord and Newman fjord, two of the fjords providing the least number of fish.

- *Larval Fish (Tucker)*

There were 381 fish larvae collected by the Tucker (and two from the IKMT at station RA03) from 3 different families that were identified, counted, and preserved. The most frequently occurring species were from the Gadidae family, with an overwhelming abundance found in the first and southernmost station off Bylot Island (RA01; Figure 36-13). The composition was more equal between Gadidae and Liparidae in the other stations. The overall abundance of larvae remained quite variable and low (Figure 36-7). As with the occurrence of adult fish, there seems to be a negative gradient from south to north, and there were interesting gradient within fjords, that vary according to fjord and needs to be linked with environmental properties (Figure 36-8).

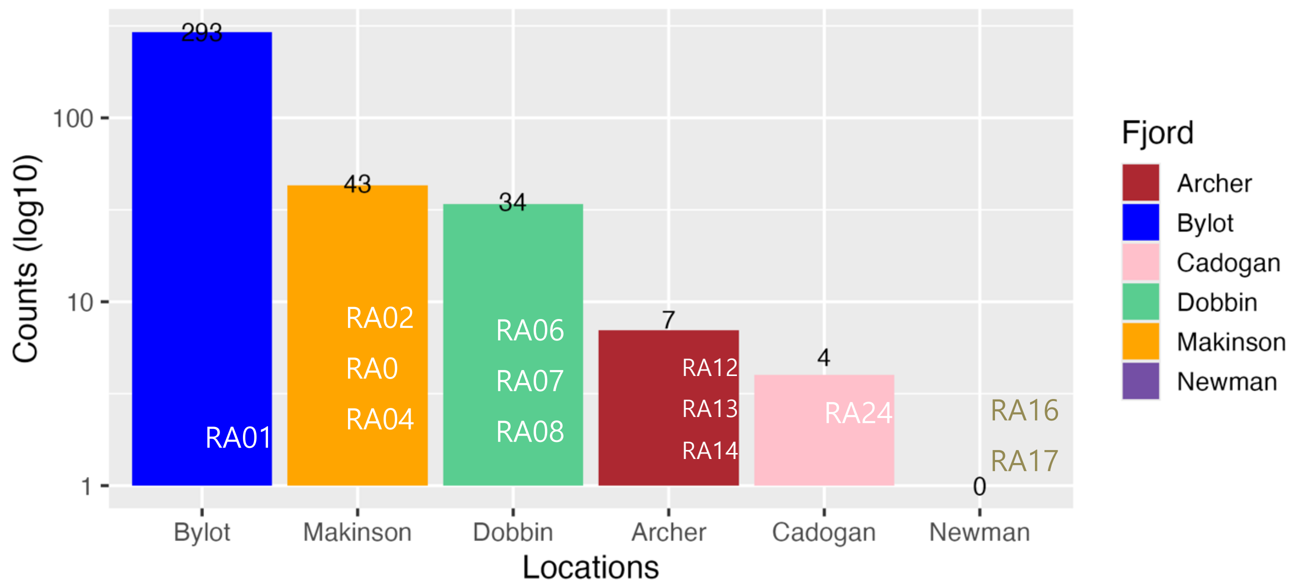


Figure 36-13: Counts of fish larvea by fjord (note that the number of stations can vary per fjord, especially only one station at the entry of Cadogan so the number is underestimated).

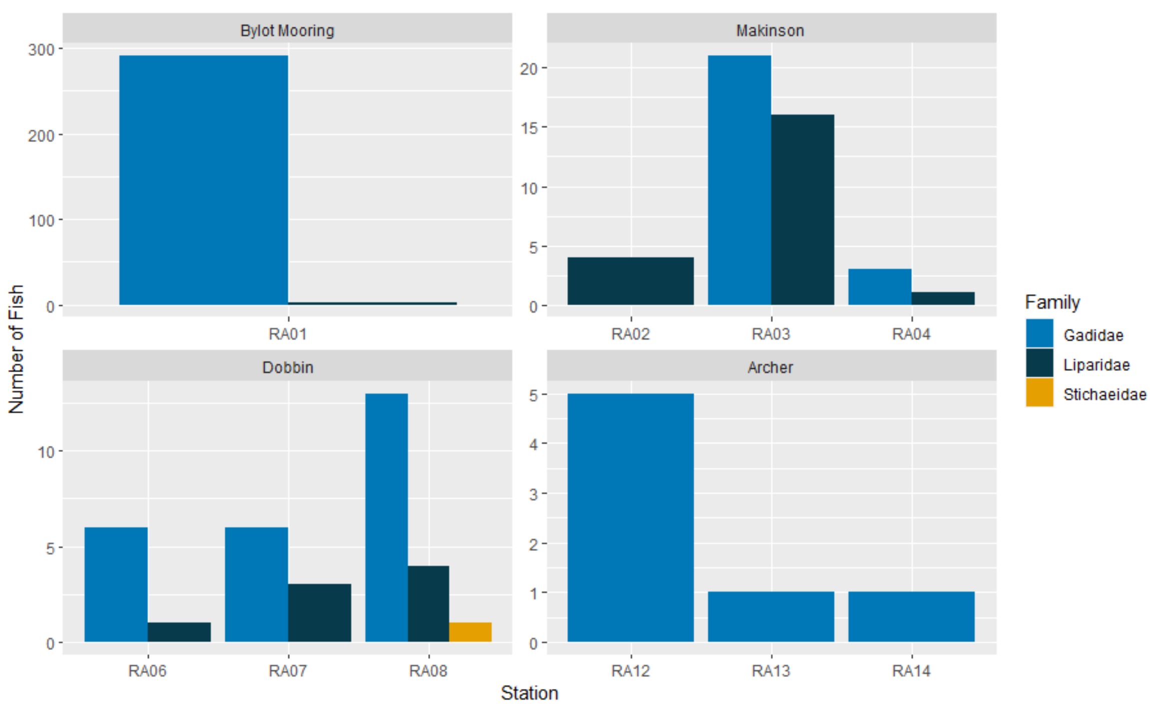


Figure 36-14: Abundance of fish larvae families by stations, sampled by the Tucker net.

The length of larval fish was usually quite variable (c.a. a factor of 3) within each fjord, except at RA01 off Bylot Island (

Figure 36-15). This could mean that in some instances we were sampling different cohorts of recruitment with different length structure as we progressed within the fjord.

Table 36-4: Average length of all individual fish larvae family (SD = standard deviation) *calculated from the 81 measured fish, the remainder were only processed as bulk:

Family	n	Mean Length	SD Length
Gadidae	347	16.52649*	5.498630*
Liparidae	29	18.75971	6.761755
Stichaeidae	1	18.75000	*NA*

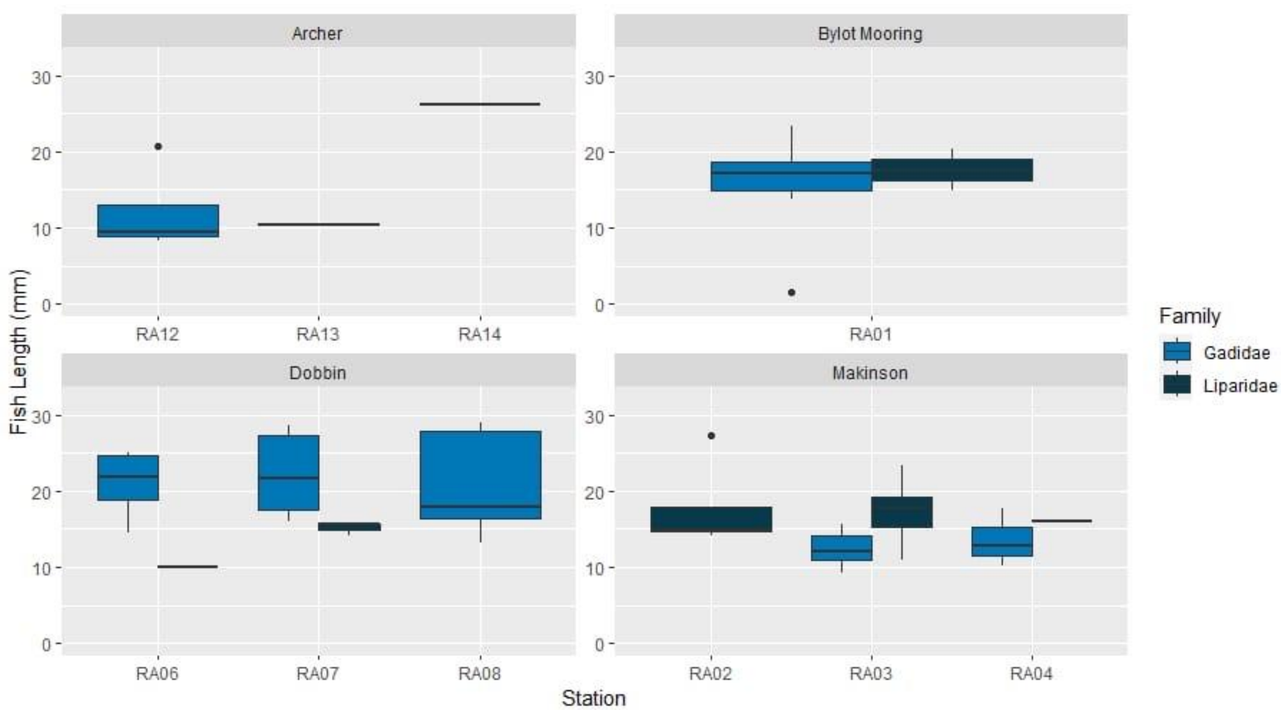


Figure 36-15: Frequency distribution of the length of individual larvae sampled during Leg 3.

- *Macrozooplankton (IKMT)*

There were 1,275 individuals of macrozooplankton identified, counted, and preserved from the IKMT net (Figure 36-16). The most abundant zooplankton organisms were Mysidae (note the log scale on Figure 36-17), followed by the jelly *Aglanta digitale* and the crustacean amphipods *Themisto sp*. Among all macrozooplankton, gelatinous phyla were clearly dominating the abundances of sampled individuals, with Cnidarians, Ctenophora, pteropods (the predator *Clione limacina*) and Chaetognatha dominating the assemblages. Note that chaetognaths were sometimes identified at the species level to *P. maxima*, so their abundance is separated (needed to be merged to compare with last legs). On the contrary, *Themisto sp*. were sorted to species in Leg 2b but not in Leg 3. In general, be careful when comparing samples from different legs.

At each station, one specimen per species of Cnidarians and Ctenophora was preserved at -80°C in a separated whirlbag for genetic analysis, while the remainder were kept together in another whirlbag and stored at -80°C for other analyses (e.g. stable isotopes) for Eugenie Jacobsen's project. In particular, we found a lot of ctenophores from the *Beroe* genera but species were difficult to identify, and genetics would be really helpful to validate the sorting.

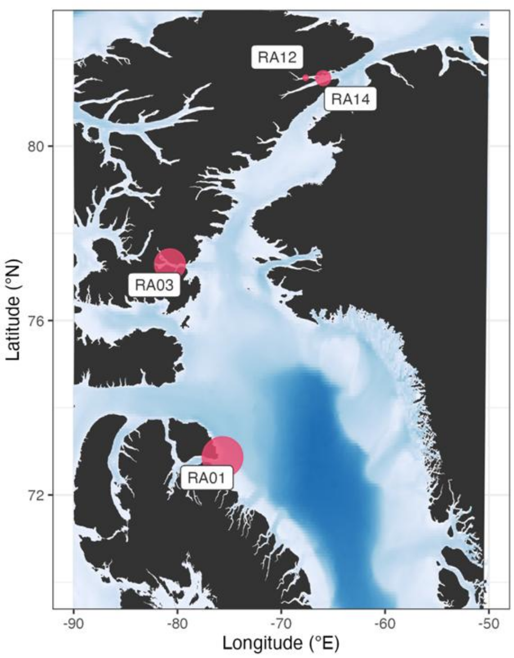


Figure 36-16: Abundance of the total macrozooplankton individuals sampled by the IKMT net during Leg 3.

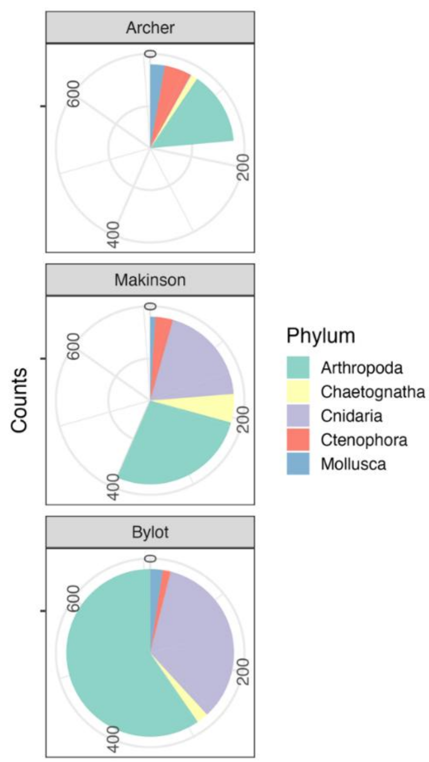


Figure 36-17: Abundance of macrozooplankton taxa colored by Phylum, sampled by the IKMT net (log-transform y-axis).

- *Mesozooplankton (Hydrobios and Monster and Tucker)*

Each of the net deployment was successful. In this section, we can only provide our first impressions since the taxonomical analysis will be conducted later in the laboratory.

First, the generally consistent latitudinal gradient of abundance noted above for each taxonomic categories seems to be reflected in the mesozooplankton abundance, i.e. it seemed more abundant in the south than in the north. Second, interesting spatial patterns were noticed both horizontally from the mouth to the head of the fjords and vertically from the surface to the bottom, in relation to the local primary productivity. Generally, it seems that mature mesozooplankton communities dominated by late development stages of the large copepod species *Calanus hyperboreus* and large individuals of associated predators (Chaetognaths, amphipods and gelatinous organisms) were present at the entrance of the fjords, while communities dominated by younger development stages and smaller individuals were found at their head (Figure 36-18). As an example, the innermost sample (RA13) is dominated by large abundances of *Calanus hyperboreus* CI to CIII copepodite stages. The development of the communities seems to be almost synchronous, following a bloom of phytoplankton. The outermost sample (RA15) is characteristic of a mature community of *C. hyperboreus* dominated by late copepodite stage and adults.

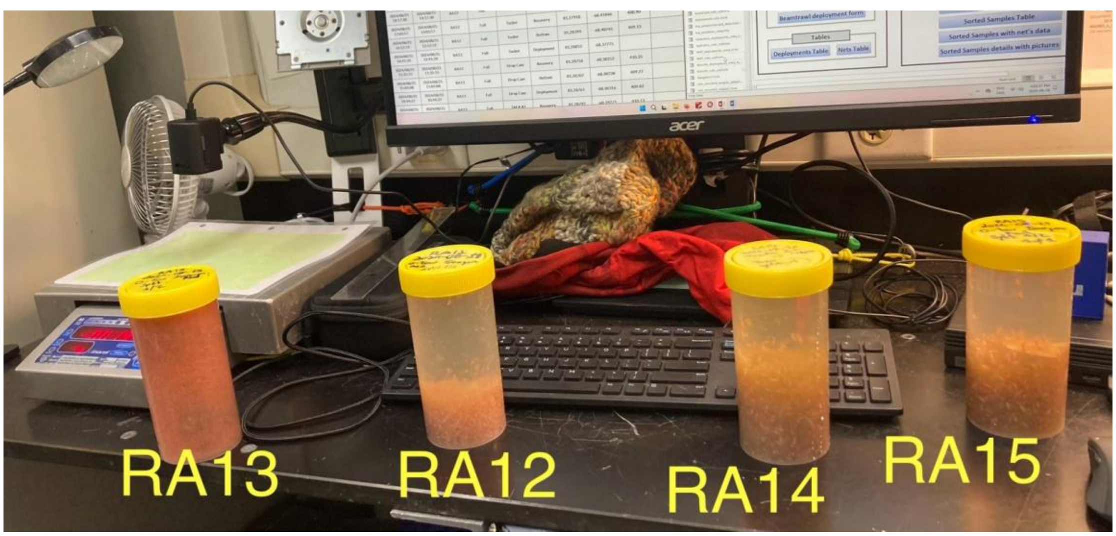


Figure 36-18: Example of the apparent differences in the mesozooplankton communities' samples along Archer fjord, from its entrance (station RA15) to its interior (station RA13). The containers are the fraction of the Tucker nets (oblique tows) kept for taxonomic analysis.

Finally, another information worth noticing is that the herbivorous pteropod Limacina helicina was often really abundant and associated with its predator Clione limacina, but only caught by the Tucker and not by the IKMT. Data from both sampling devices should be used together to help interpreting the distribution patterns of several predator microzooplankton taxa.

- *Underwater Vision Profiler*

The Underwater Vision Profiler 6 (UVP6) recorded images and particles counts at each rosette deployment (40 casts, Figure 36-19) and the data will be saved on the Ecotaxa platform in the project uvp6_sn000006hf_2024_am_leg3.

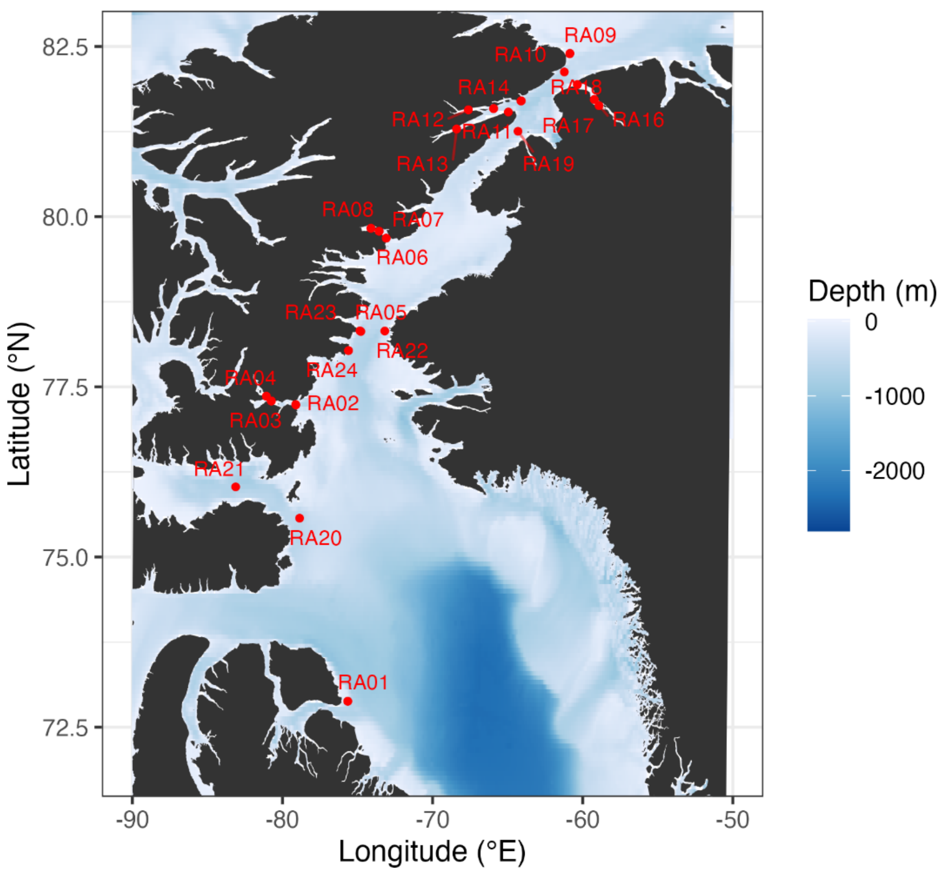


Figure 36-19: Stations with UVP profiles (1 or 2 casts by stations) during Leg3.

- *Drop Camera*

Fifteen deployments of the drop camera were completed during Leg 3, amounting to over 7.5 hours of recorded video. These preliminary results are from a quick glance at some of the videos captured. A more thorough analysis will be completed at a later point by researchers and students at the Marine Institute in St. John's Newfoundland. Any questions about the data should be directed Drs. Jonathan Fisher and Maxime Geoffroy.

We observed unique benthic habitats and faunal communities within each fjord. In all deployments of the drop camera, echinoderms, primarily ophiuroidea, and hydrozoans were the most abundant organisms observed. Crustaceans and gastropods were also commonly encountered but in fewer numbers. Makinson fjord was notable due to the presence of large octocorals in the outer station (RA02) and a very high number of ophiuroids in the inner portion, closest to the glacier (RA04) (Figure 36-14). Dobbin's fjord had a layer of silt above the sediment at all stations (RA06, RA07, RA078), with large rocks encountered in the middle station (RA07). Archer and Conybeare fjord both had fine sand sediment and were mostly occupied by echinoderms and hydrozoans (RA12, RA13, RA14, RA15). The outer station of Archer fjord (RA15) had a scattering of small rocks over the sediment and a very deep trench was encountered during deployment. RA15 was also the first instance we observed kelp on video. Lincoln sea (RA09) was unique in that the bathymetry was very variable, and sediment was covered in a layer of small rocks. The high abundance of crinoids was also a distinctive feature compared to the rest of the stations. Newman fjord was primarily covered in fine sand and silt (RA16, RA17, RA18). The crinoid abundance was high compared to the other locations (excluding RA09). Some kelp pieces were also observed, and a few live urchins with many urchin tests were noted. More detailed descriptions of each deployment can are in the below stations notes.

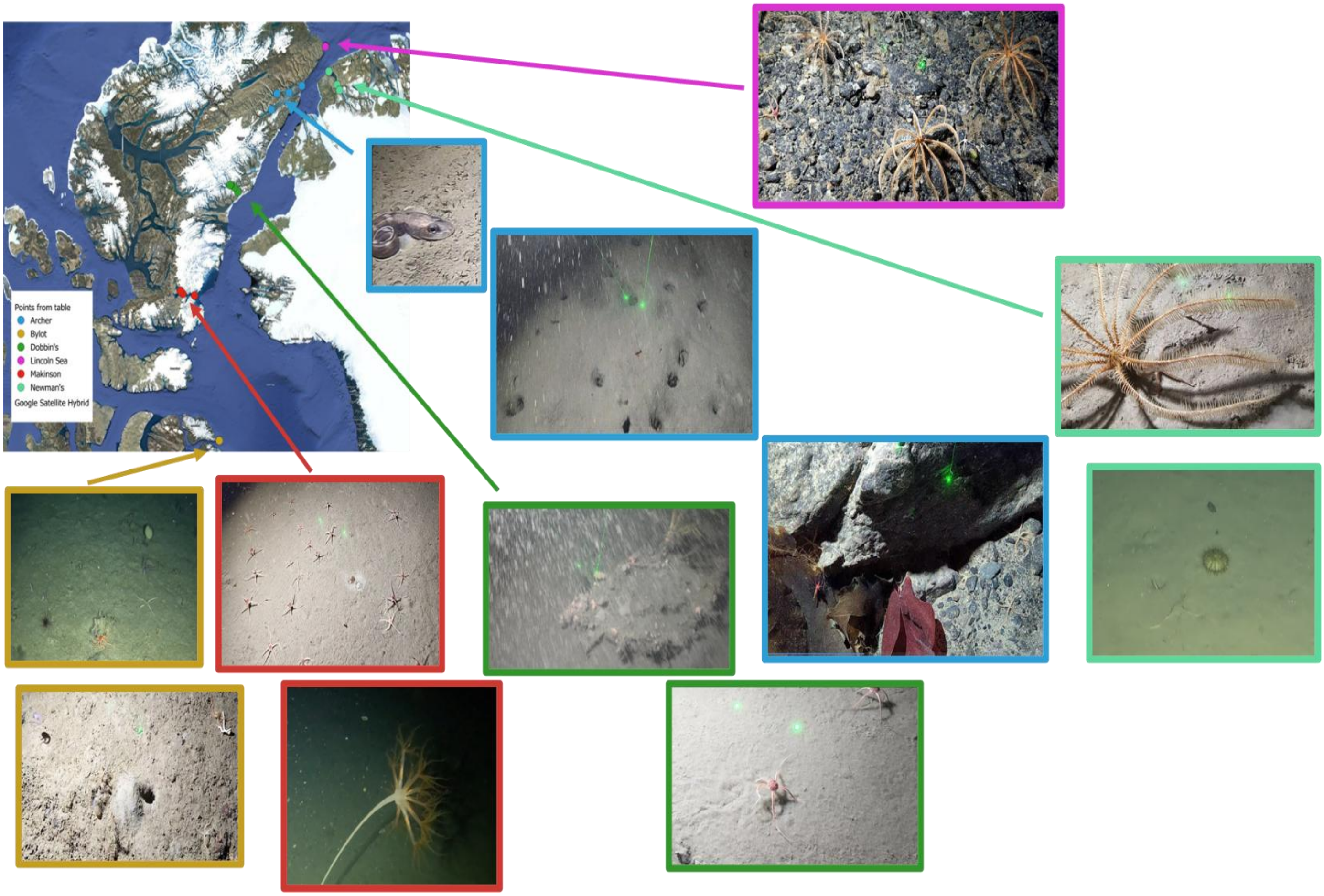


Figure 36-20: Some images from the drop camera and their relative locations.

- <u>*Stations Notes*</u>

RA01 2024-08-13 Bylot mooring station

Drop cam: shitshow. Computer is not working, station deployment went over time by more than 1 hour. Good gopro video, should increase brightness and glide closer to the bottom. Couldn't download subC camera video.

Tucker: deployment was smooth, more than 300 Boreogadus saida larvae in sample. Samples rich in zooplankton.

Hydrobios: deployment was smooth all layers rich in life.

IKMT: Hit bottom and collected many benthic species.

RA02 2024-08-14 – Entry of Makinson fjord (no ice)

Drop cam: good deployment, great videos with many high corals, one light stopped during deployment

Tucker: lot of wind, beginning of the deployment was difficult but then it was good, 4 Liparidae larvae. Some appendicularians.

Hydrobios: good deployment but forced to touch the ground really slowly to reach trigger depth because depth has changed, all layers rich except 150-250m which was also an oxygen minimum according to the rosette cast

RA03 2024-08-15 – Middle of Makinson fjord (a lot of ice blocks, plume of glacier) **Hydrobios:** good deployment **Drop cam:** really good deployment, really turbid on videos but many sea stars and some fish, also one octopus **Tucker:** good deployment, Gadidae and Liparidae larvae **IKMT:** difficult deployment because of ice, boat often changes trajectory and angle changed also, but we managed to adjust cable length an boat speed to keep a constant depth around 300m. Short trawl because needed to go up because of ice. Best we could do with the conditions.	*RA04 2024-08-16 – Emd of Makinson fjord (close to the glacier)* **Hydrobios:** good deployment. Not abundant in zooplankton. Medium and small calanus (young stages of copepods present). **Drop cam:** Unique video. Very high density of brittle stars. Some fishes observed on echogram, high avoidance of the camera. Many tube anemones. **Tucker:** Medium sized copepods, ctenophores and almost no appendicularians
RA05 2024-08-17 – Mooring retrieval station no sampling for fish/zoo team	*RA06 2024-08-18 – Entry of Dobbins fjord* **Monster:** good deployment **Drop cam:** Good deployment. Silty substrate, some hard and soft coral, many echinoderms. Crinoids observed for the first time. **Tucker:** Many pteropods and appendicularians. Few large fish larvae, mostly gadids. Typical Arctic community.
RA07 2024-08-19 – Middle of Dobbins fjord **Monster:** good deployment. **Drop cam:** Completed the night of 08-18. Extremely silty with some rocks and hard coral. Many echinoderms. **Tucker:** 50 µm net had the wrong cod end, sample discarded. Yellow net had 50 µm cod end. Many pteropods and appendicularians. Few large fish larvae, mostly gadids. Typical Arctic community. **Beam trawl:** Canceled due to deep layer of mud and silt and the presence of rocks.	*RA08 2024-08-20 –end of Dobbins fjiord* **Monster:** Good deployment. **Drop cam:** Strong current. Winch cable at weird angle, paused survey for a few minutes. Pretty good footage. Silty with anemones and echinoderms. Fish signal observed but not much seen on camera. **Tucker:** Hipap on but no signal received. Went to 100m based on cable angle. High abundance of pteropods in many different sizes. Fewest appendicularians compared to the rest of the fjord. Large fish larvae. **Beam trawl:** Very short deployment. Some fish caught. Giant sea spider. Strong acoustic signal likely not well sampled.
RA09 2024-08-20 –Lincoln Sea	*RA12 2024-08-24 –Fjord north of Archer fjord*

Hydrobios: Shallow deployment, only 5 layers sampled (to 150m). Zooplankton layers observed at 80m during deployment and a second layer at 150m after sampling was done and water became deeper. Thick dinoflagellate bloom, phaeosystis. **Drop cam:** Strong current and variable bathymetry made for a difficult deployment. Paused survey for a few minutes, dragged on the bottom for a minute or two. Pretty good footage, layer of small rocks over silt. Hundreds of crinoids everywhere. **Tucker:** Canceled due to ice, winds, and current. **Beam Trawl:** Canceled due to ice, winds, and current.	**Hydrobios:** Shallow deployment, only 6 layers sampled (to 250m). strong stratification, top layer full of phytoplankton. **Drop cam:** Easy deployment. Sand and Mud hardly any life. **Tucker:** Good deployment. Red flowmeter didn't reset and stopped tracking at 99999. No larvae in the red net, 5 larvae in yellow net. **IKMT:** Successful deployment. Depth of water at the start was about 300m and quickly rose to 190m. targeted 220m but most of the deployment was closer to 150. Tow time was short, due to ice and depth of water. Caught amphipods, many Themisto sp. And ctenophores. No fish
RA13 2024-08-25 –end of Archer fjord **Hydrobios:** Good deployment, uneventful. **Drop cam:** Easy deployment. Sand and Mud hardly any life. **Tucker:** Good deployment. No larvae in the red net, 1 larvae in yellow net. **IKMT:** Canceled because of no signal.	*RA14 2024-08-26 –entry of Archer fjord* **Hydrobios:** Good deployment, uneventful. **Drop cam:** Easy deployment. Sand and Mud hardly any life. **Tucker:** Good deployment. One larva in the yellow net, larger zooplankton compared to inside fjord. **IKMT:** Postponed due to ice. Completed out of the ice and away from station on way to RA15. No fish. Faint echogram signal at are around 350m. Caught only Ctenophores and arthropods.
RA15 2024-08-27 – out of Archer fjord, close to coast **Hydrobios:** Good deployment, uneventful. **Drop cam:** Quite difficult deployment because sea floor was variable. When we looked at videos, we saw a cliff, rocks, kelps pieces, and shrimps. It was a surprising station. **Tucker:** Good deployment. Really large and red adults C. hyperboreus females, with fat and a lot of algea in the gut content. Really interesting sample. **IKMT:** canceled because low signal and because Einat went on the barge to take underice videos with the Gopro and look if fish (cod) larvae were associated to the ice.	*RA16 2024-08-28 – Middle of Newman fjord* **Monster:** Good deployment, uneventful. **Drop cam:** Easy deployment. Sand and mud, quite poor. **Tucker:** Good deployment. Few abundances and no larvae. **Beam Trawl:** Good deployment, about 12 minutes and we had to go up because of ice. No fish, really poor. Benthic organisms given to benthos team, including one Kelp.
RA17 2024-08-29 – End of Newman fjord **Monster:** Good deployment, uneventful.	*RA18 2024-08-29 – Entry of Newman fjord*

Drop cam: Easy deployment. Sand and mud, a lot of Crinoids. **Tucker:** Good deployment. A lot of appendicularians and Aeginopsis jellies but no larvae. **Beam Trawl:** Good deployment, 15 minutes. Two fish, one squid and quite a lot of benthic organisms given to benthos team.	**Drop cam:** DropCam only because no time for more, good deployment. Some deep sea corals and some urchins. RA20 2024-09-02 – Entry of Jones Sound **Hydrobios:** Post-phytoplankton bloom conditions, high abundances, especially at depth.
RA21 2024-09-02 – Inside Jones Sound **Hydrobios:** Recent phytoplankton bloom, more young stages. Abundance peaks between 20 and 40m, then low abundances until 250m. Large copepods diapausing at depth and large chaetognaths.	

36.3.3 *Leg 4*

- *General overview*

A total of 39 net deployments from 16 stations were conducted to sample the fish, meso- and macrozooplankton communities (Monster n=14, Hydrobios n=5, Tucker n=11, IKMT n=6, Beam Trawl n=3, Figure 36-21, Table 36-5).

Due to weather and sea ice conditions, the stations initially planned in the Lincoln Sea had to be cancelled. Transects were then carried out, sometimes interspersed with sea ice stations, with the aim of sampling the Nares Strait as much as possible. A vertical plankton net (Monster or Hydrobios), an oblique plankton net (Tucker) and a fish net (IKMT or BeamTrawl) were planned at each station, but for reasons of weather, ice conditions or logistics (no scientific operations between midnight and 6 am), some nets had to be cancelled.

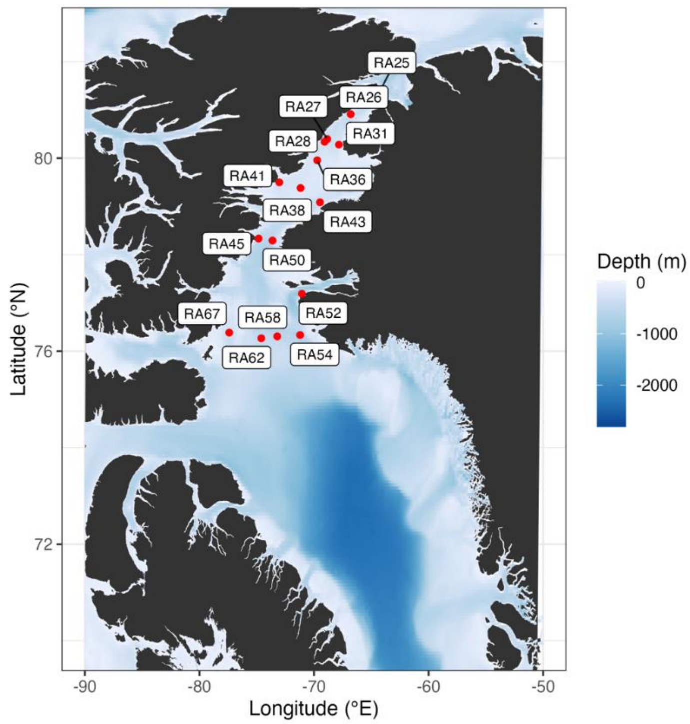


Figure 36-21: Map of the sampling sites where nets were deployed during Leg 4

Table 36-5: Sampling sites with their latitude, longitude and associated net activity for Leg 4 of the Amundsen expedition 2024 (latitude and longitude for the deployment of the first net).

Station ID	Date (UTC)	Latitude	Longitude	Monster	Tucker	Hydrobios	IKMT	Beam Trawl
RA25/RA-NS-07	2024-09-08	81.40340	-64.22015		X	X		
RA26	2024-09-09	80.90181	-9972855		X		X	
RA27	2024-09-10	80.39076	-68.82646	X	X	X		
RA28	2024-09-11	80.34976	-69.01501	X	X			X
RA31	2024-09-12	80.27790	-67.82824	X				
RA36	2024-09-13	80.02691	-69.52383	X				X
RA38	2024-09-15	79.38028	-71.16737	X	X			X
RA41	2024-09-16	79.49639	-73.03639	XX	X			
RA43	2024-09-17	79.08403	-69.47914	X				
RA45	2024-09-18	78.33307	-74.82121		X	X		
RA50	2024-09-20	78.30462	-73.58627		X	X	X	
RA52/CEOS-M1-23	2024-09-22	77.19017	-71.05847	XX				
RA54/115	2024-09-23	76.33417	-71.21051	X	X		X	
RA58/111	2024-09-24	76.30631	-73.21303	X			X	
RA62/108	2024-09-25	76.26435	-74.59557	X	X	X	X	

RA67/101	2024-09-26	76.38361	-77.41155	X	X		X	
			Total	**14**	**11**	**5**	**6**	**3**

In general, the species richness of macrozooplankton and fish (larvae and adults) observed in pelagic and benthic trawls was low, especially in comparison with the Labrador and southern Baffin Bay regions. Regarding macrozooplankton, a lot of jellyfish and arthropods were found in our trawls. A latitudinal gradient emerges from the samples collected, with lower abundances and lower biodiversity to the north compared to the south of the Nares Strait.

- *Adult fish (IKMT and Beam Trawl)*

All fishes with a standard length equal or superior to 4 cm were considered adult. There were 34 adult fish from 4 families caught in the IKMT (n = 23) and Beamtrawl (n = 11) nets. The most frequently caught species in the benthic trawl belonged to the Zoarcidae and Cottidae families, while the most frequently caught species in the pelagic trawls belong to the Liparidae (with Liparis fabricii as the most abundant species) and the Gadidae (with Boreogadus saida as the most abundant species) families (Figure 36-22). Abundances in both types of trawls were noticeably low throughout Leg 4.

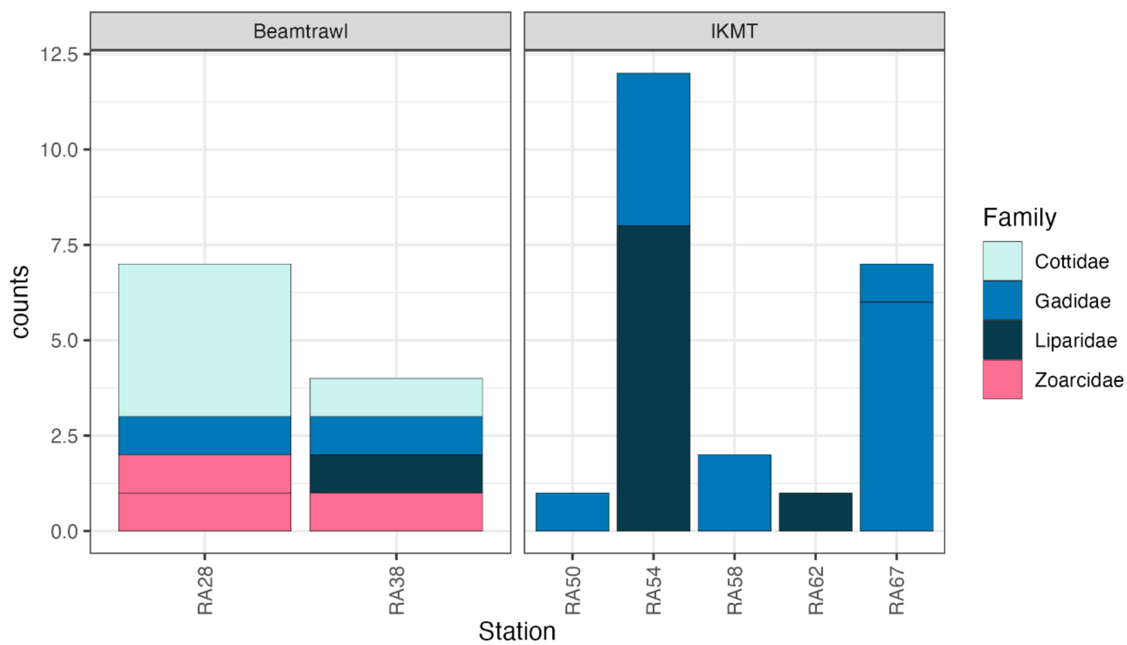


Figure 36-22: Abundance of adult fish families by stations for the Beam Trawl and the IKMT during Leg 4. Thin black lines divide colour bars if there are several species by family. Note that the timing of trawling is not considered on this graph since all operations were conducted during daylight.

Looking at pelagic catches (IKMT), we can see a latitudinal gradient with an increase in the number of catches further south, mainly in the North Water Polynya (Figure 36-23, Figure 36-24). In the case of benthic fish (Beam Trawl), adult fishes were caught at stations RA28 and RA38 (Figure 36-23) at the extremities of the Kane Basin, whereas no adult fish were caught at the station within the Basin (Figure 36-23, station RA36).

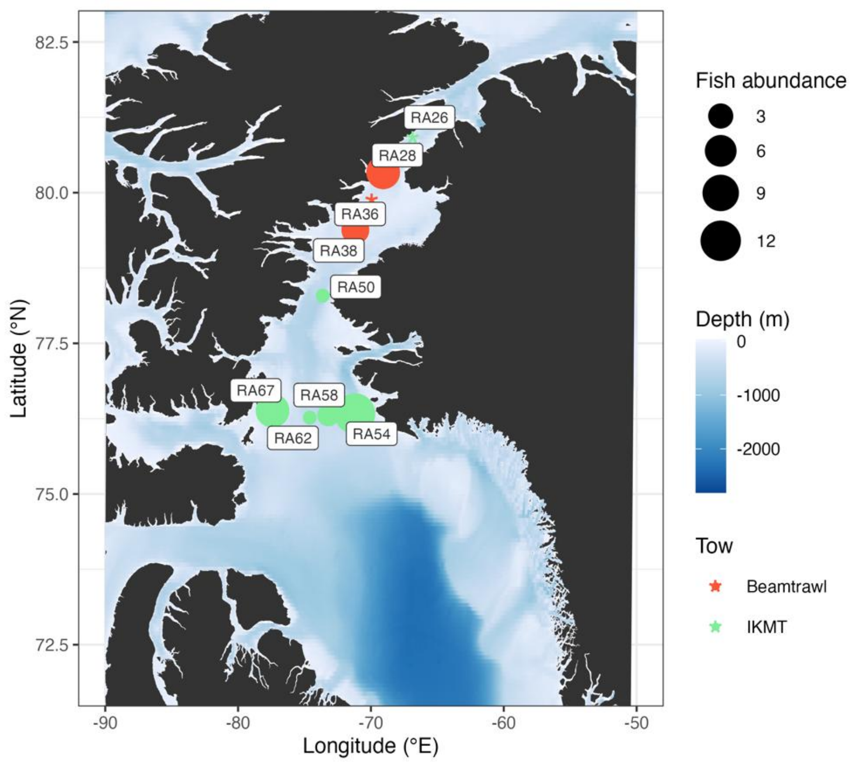


Figure 36-23: Total fish abundance by stations for the Beam Trawl and the IKMT. Stations with no fish are marked by a star (RA26 and RA36).

Figure 36-24: Comparison of catches with the IKMT at two stations: RA26 with zero fish and RA54 with 12 fish.

Overall, even when fish were caught, they were small to medium-sized (Table 36-6). Several large larval fish (around 3cm) were caught in the IKMT (see next section), but there were very few large catches.

Table 36-6: Average length of all individual fish family (SD = standard deviation) as well as the maximum and minimum length

Family	n	Mean Length ± SD (mm)	Max Length (mm)	Min Length (mm)
Cottidae	5	75.2±11.97	90	58
Gadidae	16	81.0±28.05	160	40
Liparidae	10	72.5±9.79	87	53
Zoarcidae	3	114.0±9.54	124	105

- *Larval fish*

Here we will consider larval fish as all fish specimen with a standard length below 4 cm. There were 46 fish larvae collected by all nets during Leg 4, from 4 different families that were identified, counted, measured and preserved.

As with the occurrence of adult fish, there seems to be a negative gradient from South to North (Figure 36-6). Overall, the counts and variability of fish larvae were low in the North of the Nares Strait, but increased in the North Water Polynya (Figure 36-25, Figure 36-26).

The most frequently occurring species were from the Gadidae family, almost all of them identified as Boreogadus saida (Arctic cod), and most of them found at stations RA54 and RA62 in the North Water Polynya (Figure 36-26). The second most important family of fish larvae was Liparidae (Figure 36-26). The length of larval fish was quite stable within stations, around 3 cm. (Table 36-7).

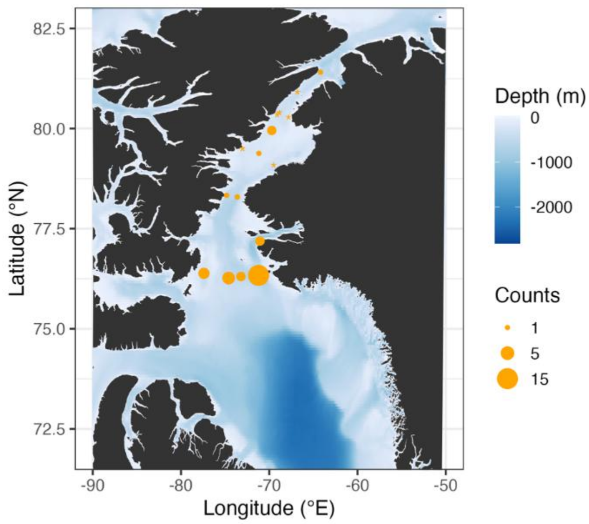


Figure 36-25: Abundance of fish larvae by stations

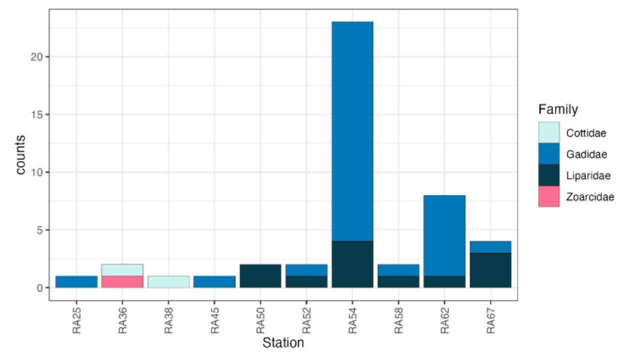


Figure 36-26: Abundance of fish larvae families by stations.

Table 36-7: Average length of all individual fish larvae family (SD = standard deviation) as well as the maximum and minimum length

Family	n	Mean Length ± SD (mm)	Max Length (mm)	Min Length (mm)
Cottidae	2	30.50±6.36	35	26
Gadidae	31	32.44±5.73	39	13
Liparidae	12	33.08±4.12	38	24
Zoarcidae	1	11.80	11.8	11.8

- *Macrozooplankton*

There were 2,087 individuals of macrozooplankton identified, counted and preserved from the different nets (Figure 36-27). The most abundant zooplankton organisms were arthropods, with particular high abundances of Themisto sp. Ctenophores and Chaetognaths were the next most abundant phyla. Note that the identification of ctenophores and cnidarians was difficult due to a lack of knowledge in the team, but the majority of samples were photographed and preserved for future genetic analysis.

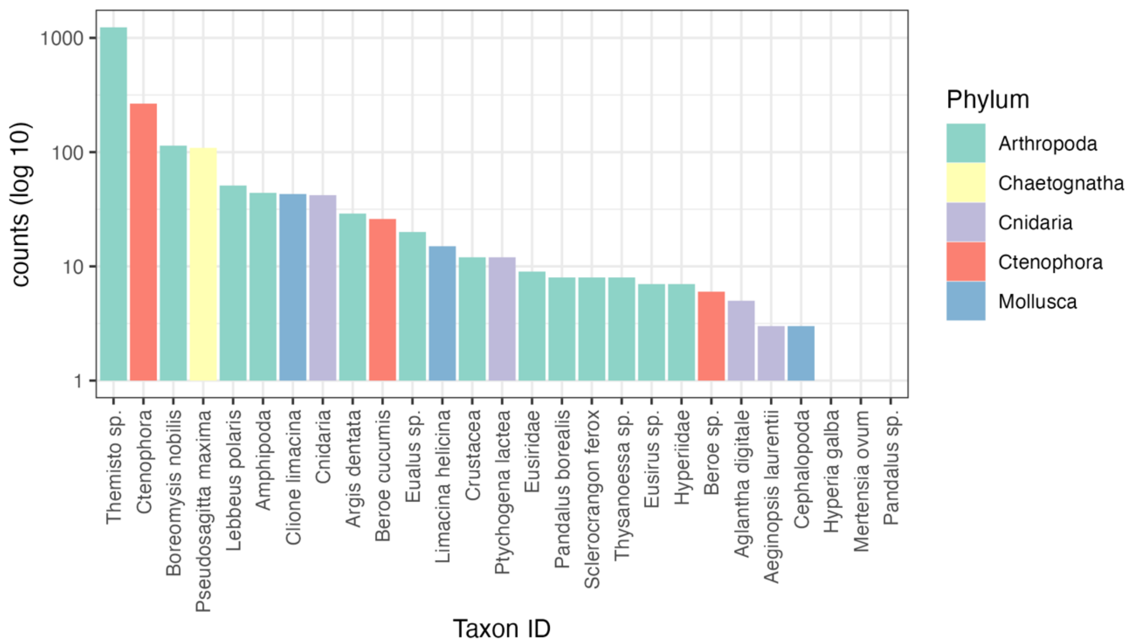


Figure 36-27: Abundance of macrozooplankton taxa colored by Phylum found in IKMT and Tucker net (y-axis log transformed).

As for the fish and fish larvae samples, a clear latitudinal gradient is present with higher abundance in the North Water Polynya compared to the other northern stations (Figure 36-28). More specifically, the catch of *Themisto* sp. in the North Warter polynya was particularly important and represents a large proportion of the samples in this area (Figure 36-29). The Ctenophora were more abundant in the Northernmost stations than in the North Water polynya (Figure 36-29).

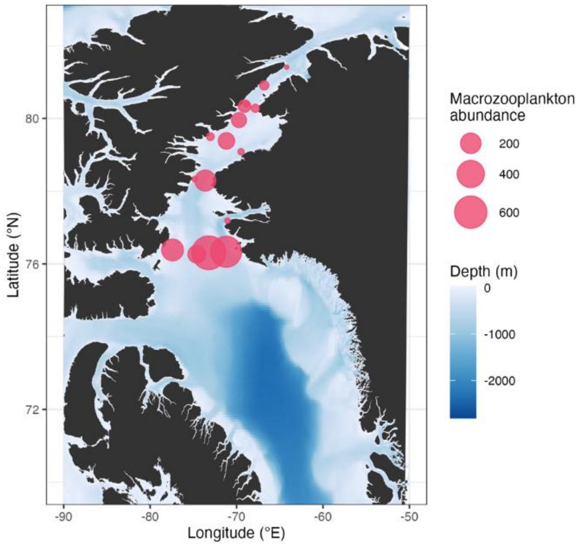


Figure 36-28: Distribution of macrozooplankton abundance during Leg 4.

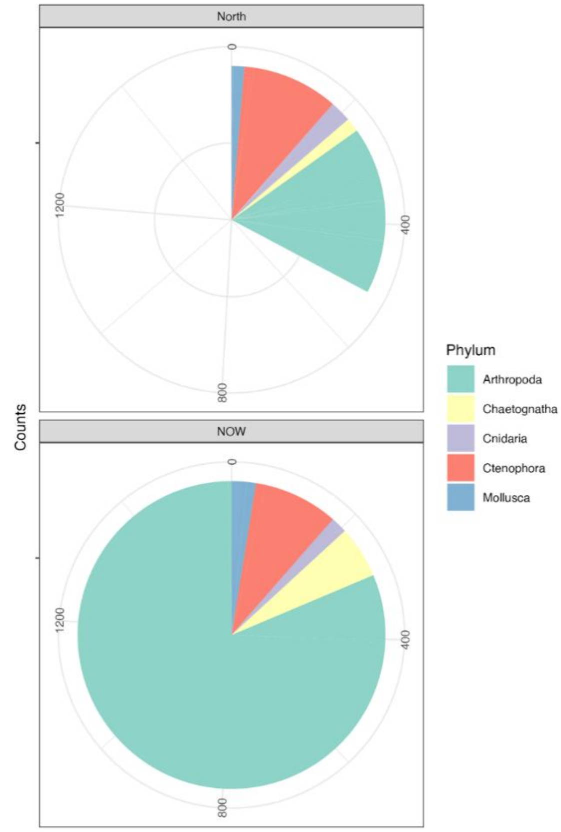


Figure 36-29: Abundances and proportions of macrozooplankton taxa colored by Phylum found in IKMT and Tucker nets in two regions of the Leg 4: the Northern stations and the NOW transect stations.

- *Mesozooplankton (Monster, Tucker and Hydrobios)*

All the net deployments were successful. In this section, we can only provide our first impressions since the taxonomical analysis will be conducted later in the laboratory. With the Hydrobios we can see an interesting vertical pattern in the NOW transect especially, in relation to the abundance of phytoplankton at the surface and diapause of copepods at depth (Figure 36-30, RA62). In the northern stations (RA50 and RA25), there seems to be a smaller number of copepods in diapause at the bottom and a lower abundance of copepods in general in those waters.

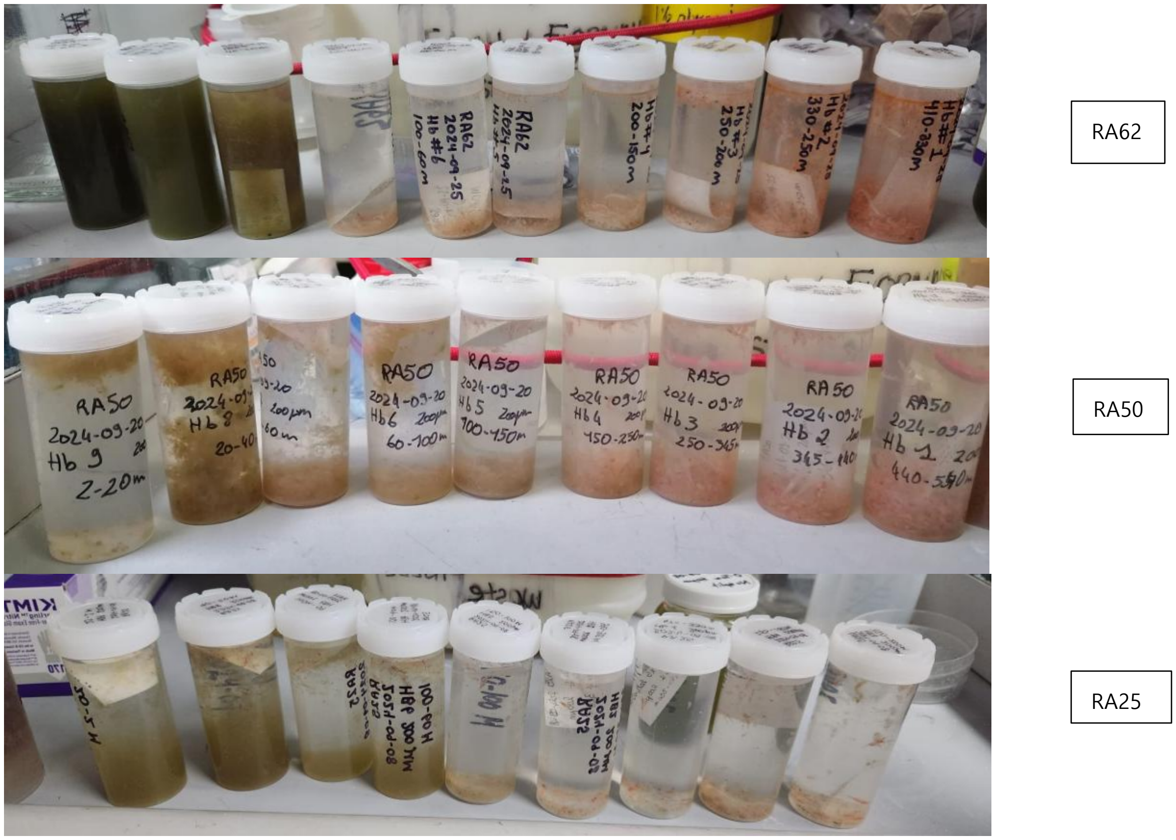


Figure 36-30: Photos of samples from the Hydrobios at station RA62 (443 m), RA50 (580 m) and RA25 (515 m) from surface to depth (left to right).

Moreover, we can say that the Monster net and the Tucker net were not sampling the same individuals in terms of mesozooplankton because visually the catch often seemed very different, with a lot more phytoplankton caught by the Monster net (Figure 36-31). Some incubations of mesozooplankton were also done with samples from additional Monster nets during this Leg at stations RA27, RA41, RA52 and RA62.

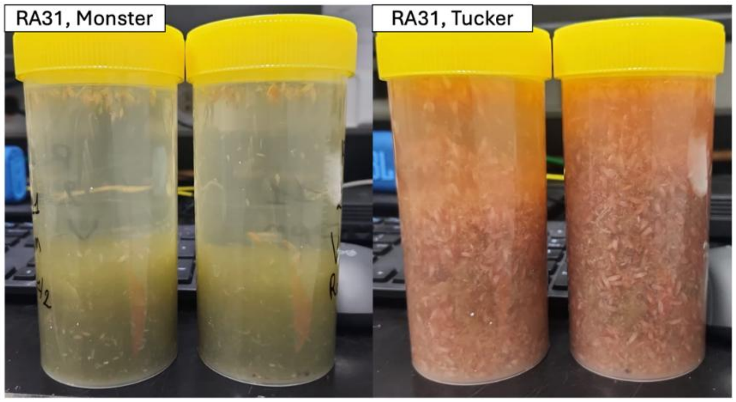


Figure 36-31: Photos of samples from the Monster and Tucker nets at station RA31

- *UVP6*

The Underwater Vision Profiler 6 (UVP6) recorded images and particle counts at each rosette deployment (64 casts) and the data will be saved on the Ecotaxa platform in the project uvp6_sn000006hf_2024_am_leg4 (Figure 36-32).

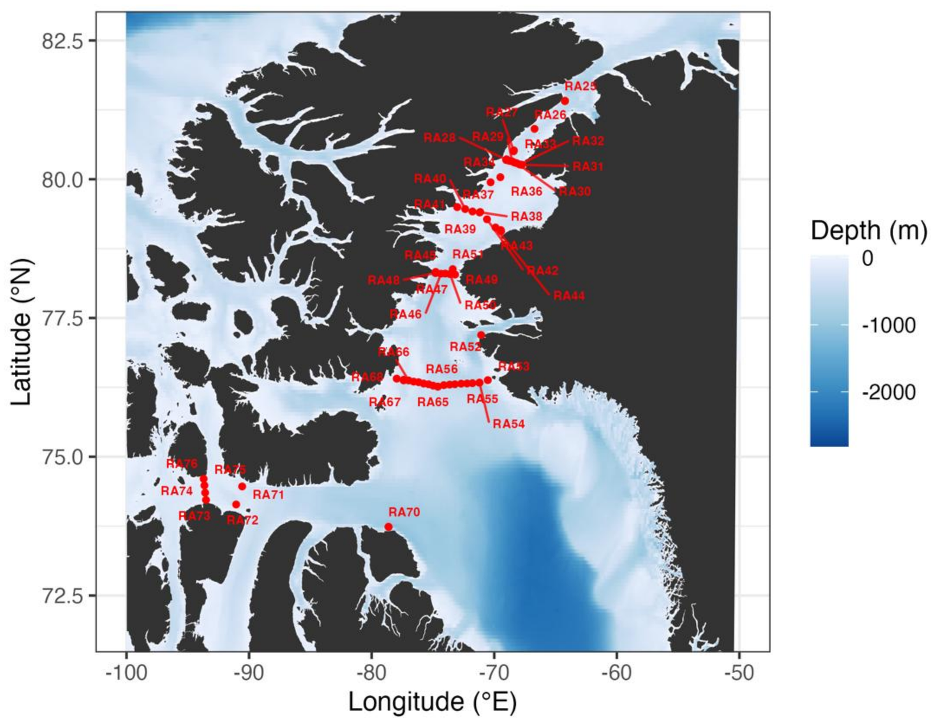


Figure 36-32: Map of UVP6 samples during leg 4.

- *Stations Notes*

RA25 2024-09-08 **Tucker:** deployment was smooth **Hydrobios:** deployment was smooth **IKMT: canceled** because of ice and wind	*RA26 2024-09-09* **Tucker:** deployment was smooth **IKMT:** deployment was smooth but nothing instead of a few Ctenophora, 2 *Themisto* and some *Clione Limacina*. **Hydrobios: canceled** because we ran out of time (no operations between midnight and 6am)
RA27 2024-09-10 **Tucker:** deployment was smooth **Hydrobios:** deployment was smooth but not a lot of biomass except at the surface with some phytoplankton. **IKMT: canceled** because of no signal on EK80 (in accordance with Fred) and there was a lot of ice **Monster:** Monster for Zoé for incubations. Only until 100m. Deployment went smoothly, but the flowmeter didn't seem to work and the 50µm net didn't filter - it was twisted.	*RA28 2024-09-11* **Tucker:** deployment was smooth – lots of phyto so the cod end were not filtering water efficiently. Had to filter a lot at the lab. **Monster:** deployment was smooth – lots of phyto so the cod end were not filtering water efficiently. Had to filter a lot at the lab. I have a doubt with the 50µm net but I think it worked. Flowmeters doesn't have a high difference number but it is maybe usual. **Beam Trawl:** smooth deployment. Some fish!! Went very well. Had difficulty in the lab for the identification, a lot to be confirmed. •
RA31 2024-09-12 **Monster:** deployment was smooth – lots of phyto so the cod end were not filtering water efficiently. Had to filter a lot at the lab. **Tucker & Beam Trawl: canceled** because of ice	*RA36 2024-09-13* **Monster:** deployment was smooth **Tucker: canceled** because of ice **Beam Trawl:** went well but we adjust the deployment to be able to do it in the ice. Deployment and recovery has been done with no speed. Got 2 fish!
RA38 2024-09-15 **Monster:** deployment was smooth **Tucker:** deployment was smooth **Beam Trawl:** deployment was smooth. Got some fish!	*RA41 2024-09-16* **Monster 1:** deployment was smooth **Monster 2:** for Zoé - deployment was smooth **Tucker:** deployment was smooth **Beam Trawl: canceled** because of ice.
RA43 2024-09-16 **Monster:** deployment was smooth **Tucker & Beam Trawl: canceled** because of ice.	*RA45 2024-09-18* **Hydrobios:** depth changing really quickly from 500m to 340m in less than 10min. Had to reprogram the hydrobios

	3 times but at the end went well. We passed by the trigger depth of 10m instead of 15m to avoid the bottom. **Tucker:** went well. **Beam Trawl/IKMT:** **canceled** because of currents and changing depth.
RA50 2024-09-20 **Hydrobios:** went well. **Tucker:** went well. Got 4 fish larvae. **IKMT:** went well. Got one fish and some jelly fish	*RA52 2024-09-22* **Monster:** did 2 monster nets, one for Léna incubation and one for Zoé. Not a lot of copepods.
RA54 2024-09-23 **Monster:** went well. Lot of microzooplankton and big copepods and phyto. Enormous chaetognaths. **Tucker:** Went well, no fish larvae. **IKMT:** went well. Got some fish and fish larvae, both bosa and liparidae.	*RA58 2024-09-24* **Monster:** went well. **IKMT:** went well. Got 2 fish and 2 fish larvae, both bosa and liparidae. Lots of Themisto.
RA62 2024-09-25 **Hydrobios:** went well. Had a nice pattern with a lot of phyto at the surface and diapausing copepods with large amounts of lipids at depth **Tucker:** went well. **IKMT:** went well.	*RA67 2024-09-26* **Monster:** went well but lot of wind so we couldn't rinse the nets. **Tucker:** went well but lot of wind so we couldn't rinse the nets. **IKMT:** went well.

36.3.4 *Leg 5*

The most frequently occurring fish taxa caught in the IKMT were glacier lanternfish (*Benthosema glaciale*) and Arctic cod (*Boreogadus saida*) with highest abundance at TCAT6-03(A3) and TCAT3-1, respectively (Figure 36-34). *Benthosema saida* had a higher abundance at stations more influenced by Atlantic water masses (e.g. TCAT3-17 compared to TCAT3-08) even at higher latitudes in waters previously presumed to be dominated by Arctic water. Snailfish (*Liparis fabricii*) was the third most abundant taxa caught at all but one station in southern Baffin Bay (i.e. TCAT6-03[A3]). *Benthosema glaciale*, *Boreogadus saida,* and *Liparis* *fabricii* were average 58.7mm (27mm-77mm), 43.5mm (31mm-111mm), 70.8mm (140mm-32mm), respectively (Figure 36-35).

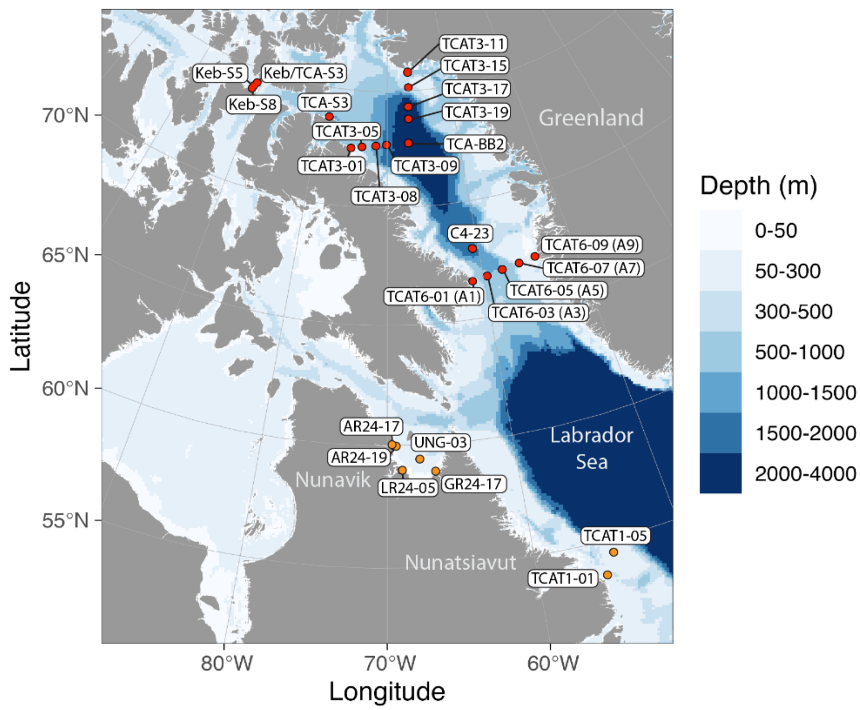


Figure 36-33: Map of the sampling sites for both Leg 5a (Red) and 5b (Orange).

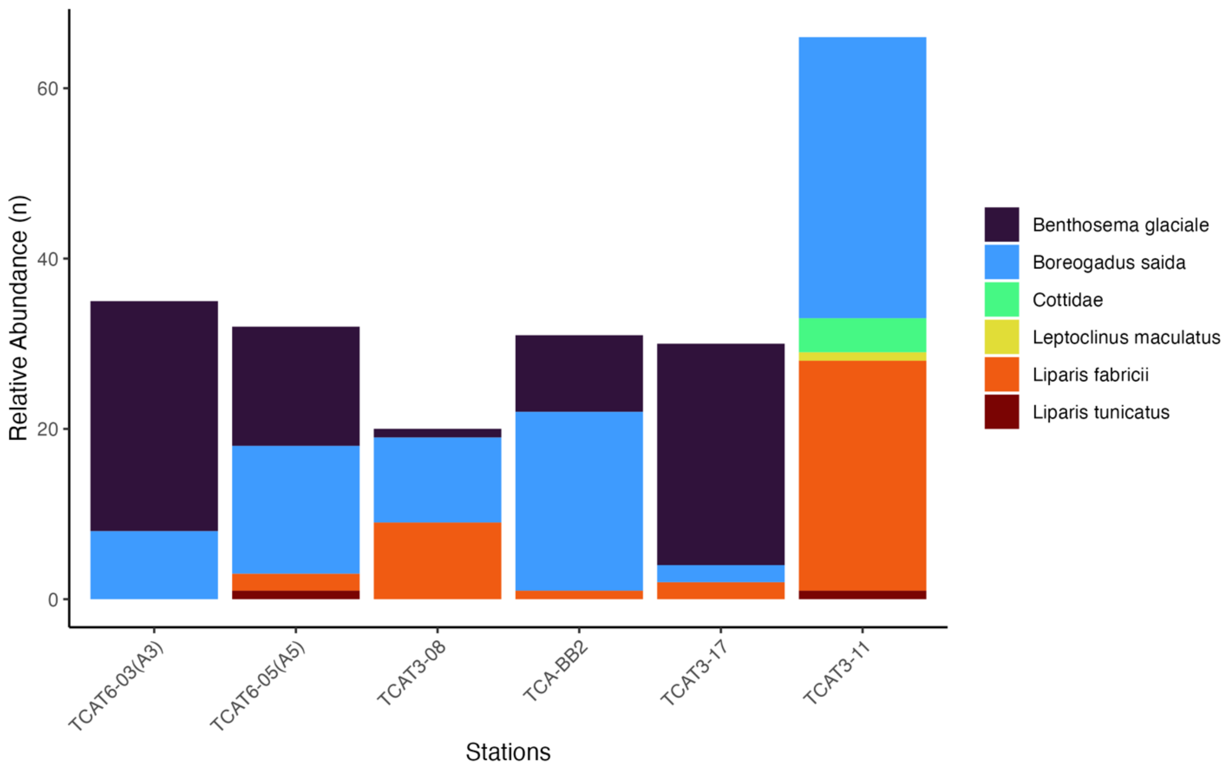


Figure 36-34: All adult fish taxa caught in the IKMT (pelagic trawl) during Leg 5a and Leg 5b.

Table 36-8: Table of the sampling sites

Station	Date (UTC)	Latitude	Longitude	IKMT	Beam trawl	Monster	Monster (Zoe)	Tucker*	Hydrobios	UVP
C4-23	2024-10-15	67.9821955	-60.60781					X	X	X
Keb-S5	2024-10-05	74.2238128	-90.9741397		X					X
Keb-S8	2024-10-04	74.4033035	-90.6391072					X	X	X
Keb/TCA-S3	2024-10-05	74.0954328	-91.0957712	X		X	X			X
TCA-BB2	2024-10-09	72.7568652	-67.0027612				X	X	X	X
TCA-S3	2024-10-06	73.7375355	-78.6555395					X	X	X
TCAT3-01	2024-10-07	72.5062062	-75.0190595		X	X				X
TCAT3-05	2024-10-08	72.5811028	-73.5012167			X		X		X
TCAT3-08	2024-10-08	72.6487582	-71.5625873	X			X	X	X	X
TCAT3-09	2024-10-09	72.6934072	-70.1113647					X		X
TCAT3-11	2024-10-12	75.830494	-66.4952847	X				X	X	X
TCAT3-15	2024-10-12	75.1559073	-66.5545482					X		X
TCAT3-17	2024-10-11	74.3201733	-66.736952	X			X	X	X	X
TCAT3-19	2024-10-11	73.7938395	-66.8307342					X		X
TCAT6-01 (A1)	2024-10-18	66.6055933	-61.1775788						X	X
TCAT6-03 (A3)	2024-10-17	66.726871	-59.6048943	X				X	X	X
TCAT6-05 (A5)	2024-10-17	66.8745768	-57.9060215	X				X	X	X
TCAT6-07 (A7)	2024-10-16	66.9844725	-56.05896				X	X	X	X
TCAT6-09 (A9)	2024-10-16	67.0932852	-54.270095		X	X		X		X
AR24-17	2024-10-21	60.01173	-69.56144					X		X
AR24-19	2024-10-21	59.98768	-69.35127					X		
LR24-05	2024-10-22	58.97615	-68.87157					X		
UNG-03	2024-10-23	59.42146	-67.47212					X		
GR24-17	2024-10-24	58.88201	-66.29337					X		
TCAT1-05	2024-10-26	54.48728	-54.75401				X			
TCAT1-01	2024-10-26	53.66391	-55.54398		X					

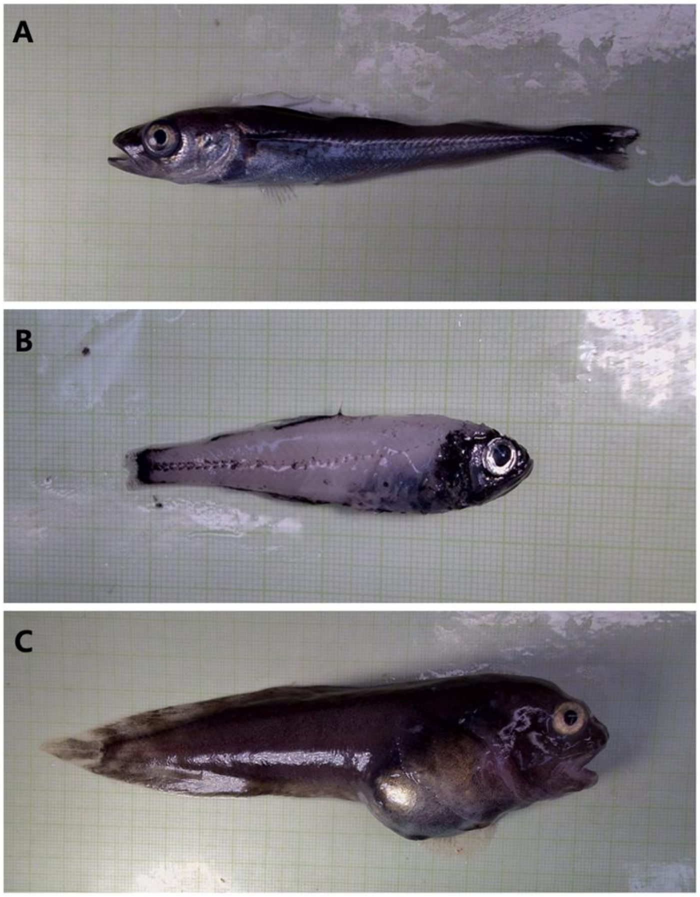


Figure 36-35: (A) Arctic cod (Boreogadus saida) from TCAT3-11, (B) glacier lanternfish (Benthosema glaciale) from TCAT6-03(A3), and Liparis sp. from TCAT3-11.

The highest number of macrozooplankton were sampled at station TCAT3-11 and was dominated by *Boreomysis* sp., Sattididae, and *Themisto* sp. (Figure 36-36). For the genus *Boreomysis*, the most frequently occurring species was *Boreomysis nobilis* and for the genus *Themisto*, the most frequently occurring species was *Themisto libellula*. In northern Baffin Bay, there was only *Themisto libellula* caught, while it was only in southern Baffin Bay (TCAT-03[A3] and TCAT6-05[A5]) that the more-Atlantic associated *Themisto abyssorum* was caught.

Among the Cnidarians, the *Beroe* genus was the most frequently caught with *Beroe abyssicola* as the most frequently caught species. At the transition zone between the Arctic and Atlantic water masses in central Baffin Bay (TCA-BB2 and TCAT3-17) ~9kg and ~6kg of *Beroe abyssicola* were caught (Figure 36-37).

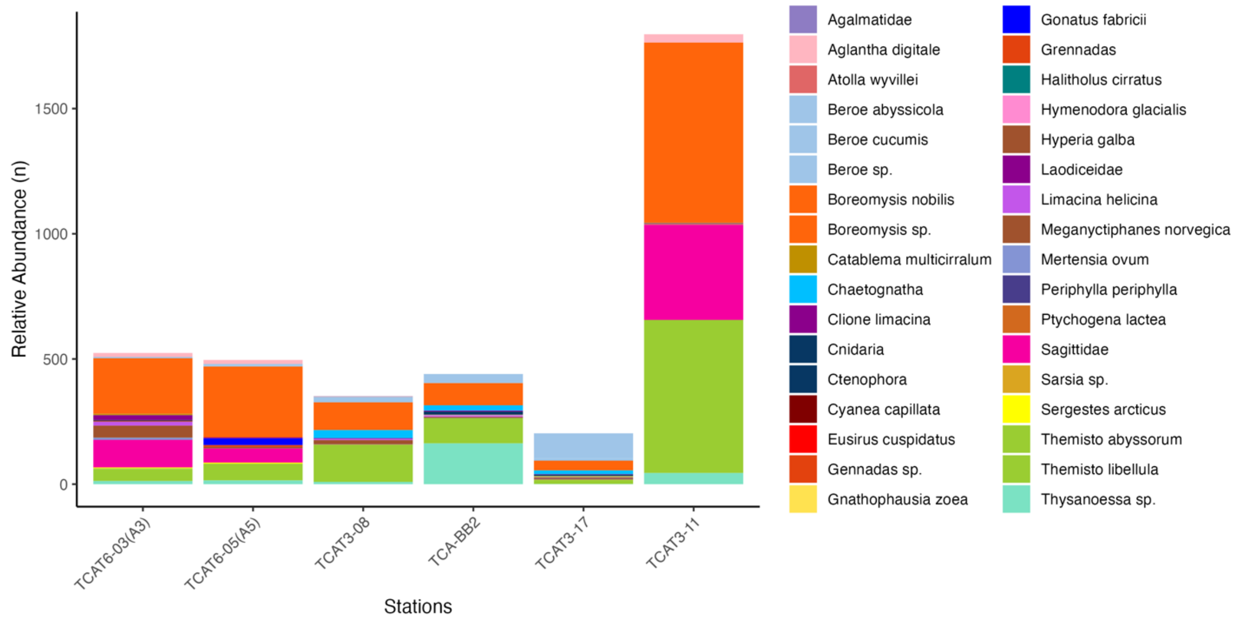


Figure 36-36: All macrozooplankton taxa caught in the IKMT (pelagic trawl) during Leg 5a and Leg 5b. Colours represent the genus or else the highest taxonomic level available

Figure 36-37: *Beroe abyssicola* sampled in the IKMT at TCA-BB2 and TCAT3-17.

Similar to the pelagic trawl, the most abundant species caught was *Boreogadus saida* with average standard length of 102.3mm (30mm-185mm) (Figure 36-38). However, no Arctic cod were caught at station TCAT6-09(A9), likely because the trophic niche overlap with *Gadus* sp. (Atlantic cod or Greenland cod). It is important to note that no fish were caught at stations TCAT1-01 and TCAT3-01. This could be because of (1) the topography of the sampling area or (2) timing of their life cycle. There was very little depth complexity on the Labrador shelf at station TCAT1-01 (e.g. slopes), which is less of an attractant for fish. Secondly, the lack of fish, which was also reflected in the Ek80 echogram, might be because at this time of the season when the fish move towards deeper depths to overwinter.

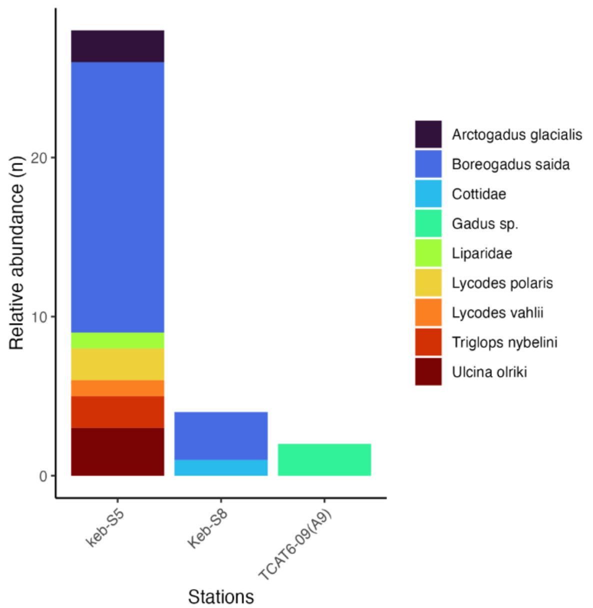


Figure 36-38: All fish taxa caught in the beam trawl (benthic trawl) during Leg 5a and Leg 5b. No fish were caught at TCAT1-01 and TCAT3-01.

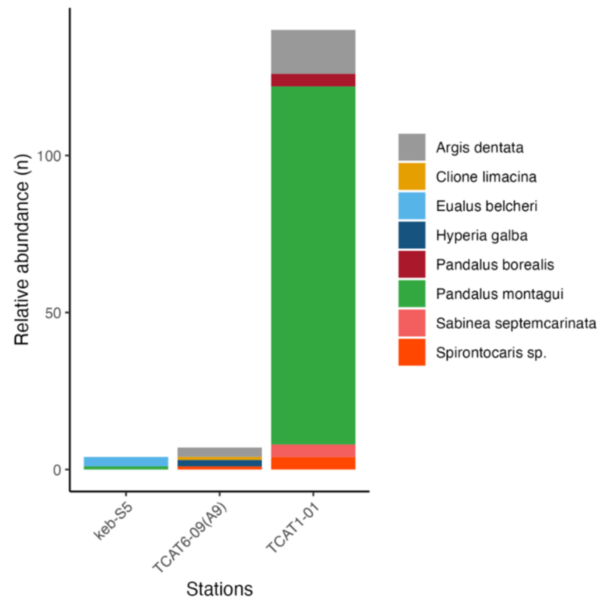


Figure 36-39: All macrozooplankton taxa caught in the beam trawl (benthic trawl) during Leg 5a and Leg 5b. No 'shrimps' were caught at Keb-S8 and TCAT3-01.

Macrozooplankton recorded in the beam trawl are highlighted in Figure 36-39. Typically, we only record the 'shrimps', but at station Keb-S5 we recorded everything. Despite this, the highest diversity of shrimps was found in southern Labrador Sea station TCAT1-01, where the most abundant taxon was *Pandalus montagui*.

The most frequently occurring larval fish caught was overwhelmingly *Boreogadus saida* with an average size of 34.7mm (23mm-54mm) followed by *Liparis* sp. with an average size of 32.0mm (25mm-47mm) (Figure 36-40, Figure 36-41). In the coastal stations in Greenland (TCAT6-09[A9]) and Ungava Bay (GR24-17), the catch was dominated by sandlance (*Ammodytes* sp.) with an average size of 43.2mm (24mm-73mm). With the exception of the sandlance from Ungava Bay that were frozen at -80C and given to Marianne Farladeau, all samples were preserved in 95% ethanol.

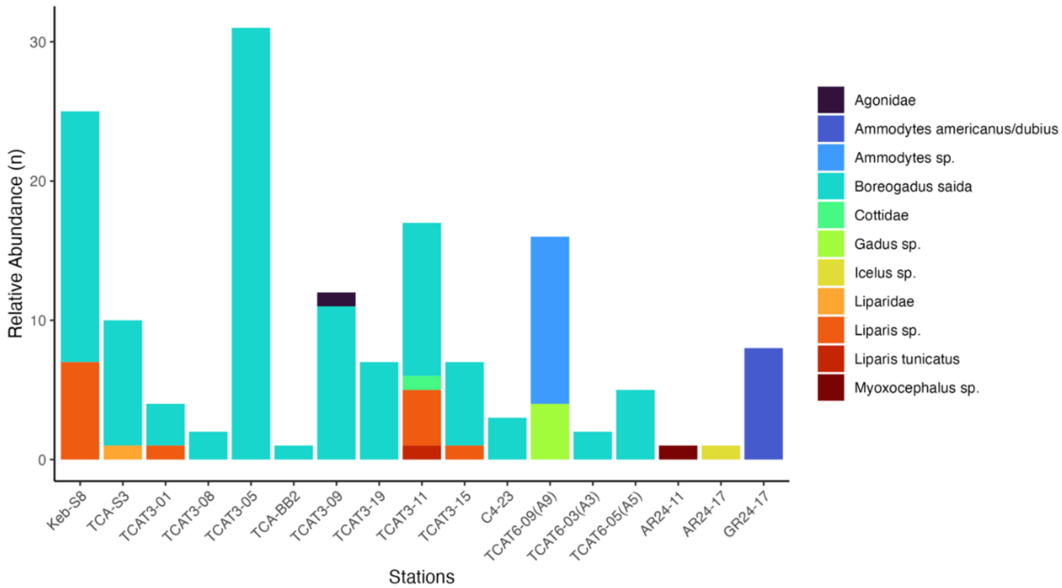


Figure 36-40: Larval fish caught in the IKMT (pelagic trawl) during Leg 5a and Leg 5b.

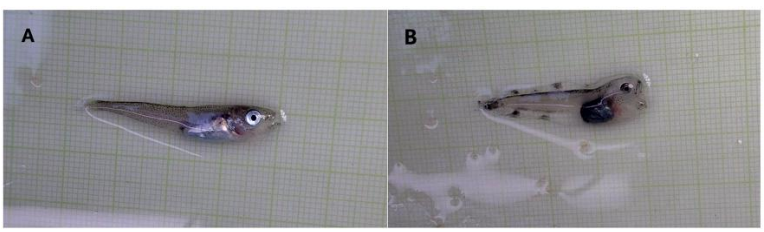


Figure 36-41: Arctic cod (Boreogadus saida) from TCAT6-05(A5) and snailfish (Liparis sp.) from TCAT3-11.

It is impossible to describe the distribution of mesozooplankton with precision or certainty, since the taxonomic analysis will be conducted later in the laboratory. However, we have observed trends in the composition of the samples, which we attempt to explain here. Samples from hydrobios nets show a highly stratified mesozooplankton composition at depth. This is particularly visible on the long transect across the Baffin Sea. Three of the 4 stations sampled (TCA-T3-17, TCA-T3-17, TCA-BB2) show a similar 5-layer profile (e.g. Figure 36-42):

- Layer 1, 0-20m deep, few organisms.
- Layer 2, 20-40m, many small organisms and a green color.
- Layer 3, 40-250m, very few organisms.

- Layer 4, variable thickness, from 500 to over 1000m wide, many larger organisms and a reddish color (many calanus sp. whose astaxanthin probably gives the layer its red color, and Chaetognatha).
- Layer 5, to the bottom, same thickness as layer 4, few organisms, mostly *Calanus sp*. with little red pigment, and systematically one or more shrimps.

Layer 2 is located at the depth where the surface chlorophyll maximum (SCM) is observed. This was particularly high at the stations along this transect, indicating an autumn phytoplankton bloom, giving the layer its green color. The numerous small organisms observed at this precise depth are probably feeding on the phytoplankton. Monster nets set in the first 100 meters of water at night showed intense bioluminescence. In the Arctic and sub-Arctic, this is often attributed to copepods of the genus *Metridia*. They probably make up a significant proportion of the small organisms in layer 2.

Layer 4 is found in waters with temperatures and salinities typical of Atlantic waters. At this time of year, copepods of the Calanus genus are in diapause, which explains why they are found in abundance close to the bottom. However, they are rarely found in layer 5, which is several hundred meters thick. One possible explanation is that they began their diapause further south, in a shallower region, and were advected by Atlantic currents. The presence of large chaetognaths in this zone is not surprising, since they feed on *Calanus* sp.

Coastal station TCAT3-08 on the same transect shows a pattern rather similar to that described above, but layer 1 and layer 5 are not strongly differentiated from neighboring layers. This may be explained by shallower bottom depths, and probably greater surface mixing.

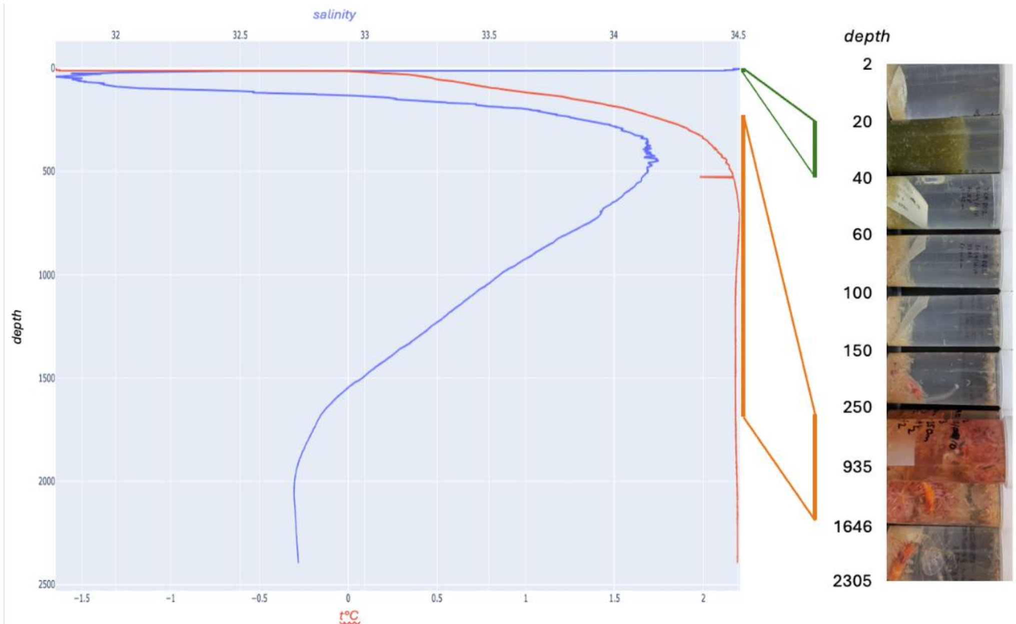


Figure 36-42: Station BB2, the salinity and temperature depth profile of the rosette in relation to the hydrobios samples at different depths. The green and red lines show the depth of the layer 2 and 4 respectively.

The Underwater Vision Profiler 6 (UVP6) recorded images and particles counts at almost each rosette deployment (74 casts, Figure 36-12) and the data will be saved on the Ecotaxa platform in the project uvp6_sn000006hf_2024_am_Leg5.

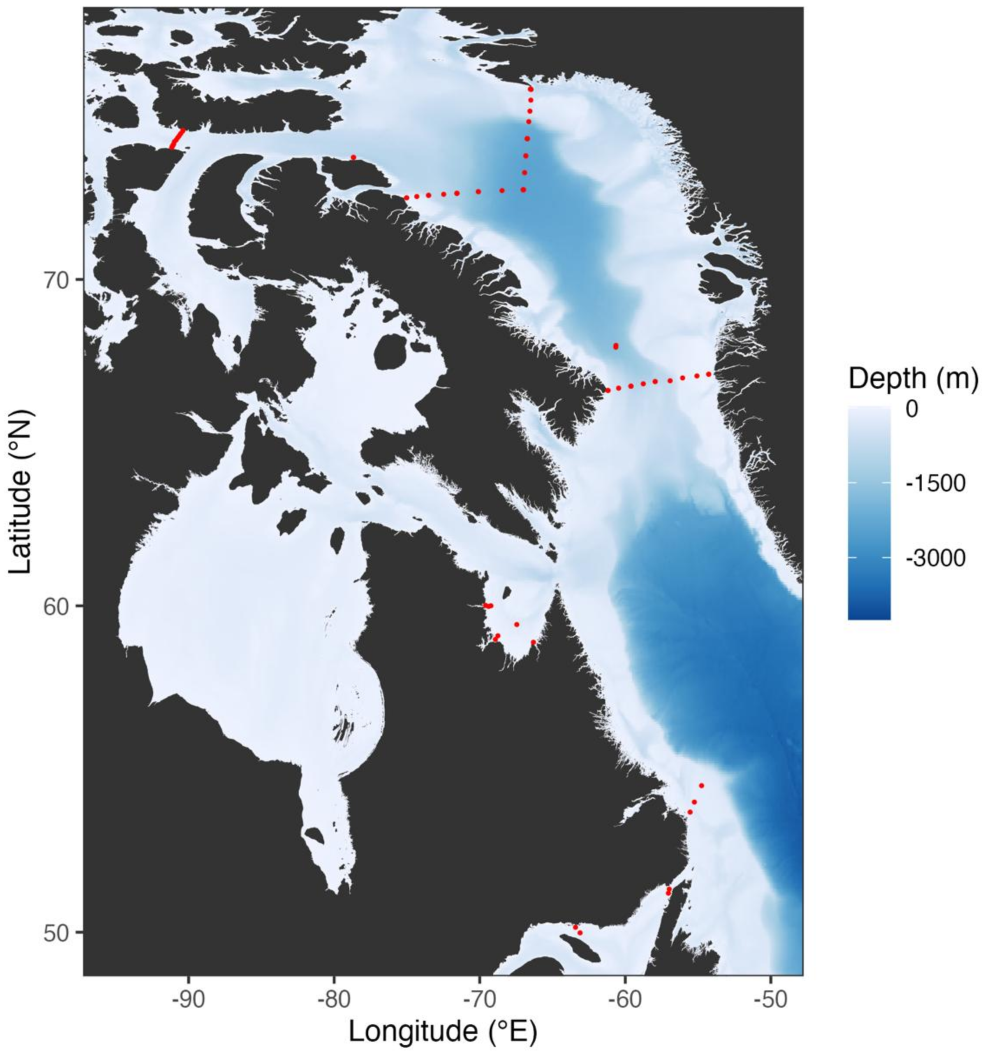


Figure 36-43: Stations with UVP profiles (1 to 3 casts by stations) during Leg5.

36.4 Recommandations

- Add a TV to the lab or set up the cameras on the computer

Have the acquisition room computer screen (EK80, Multibeam, Depths) accessible from the lab, to be able to prepare gear and data sheets prior of going on the deck. Have a TV screen with access to the deck camera, to be able to follow operations better.

- Replace/fix the Hydrobios carrousel trolley

The wheels on the wooden trolley tend to get stuck, making it harder to move the device in and out of storage, especially with the need to avoid rotations that would entangle the cables/nets.

- Add a HiPAP support to the Hydrobios

In strong currents, there has been some issues with the Hydrobios not reaching the trigger depth despite the cable length exceeding it. Using a HiPAP would fix this issue without relying on giving it more space and losing sampling depth. However, there is no safe and convenient spot to attach one on the device as the cable is entirely fed into the wench pulley during deployment. An attachment point could possibly be attached on the net triggering part of the device, maybe near where the CTD is located. Alternatively, it is possible that recalibrating the CTD could help.

- Improvements to the IKMT trolley

The new IKMT trolley is a definite improvement to previous versions. However, it is still not high or wide enough to prevent the wings from touching the ground making it significantly more difficult to move around, for the scientists and the crew. Though it is unclear how or if that could actually be fixed without making the trolley too unwieldy.

- Tap hoses in Lab 610

It is very convenient to multitask by using lab 610 for some of the processing. It would be useful if some rubber hoses could be added to the taps there. **Ashley will ask Quentin first, the taps already have the spout for it, there might be extra rubber hoses on board that could just be installed right now.

- Drop Camera

The plate used to house the SubC camera was tested for the first time during this leg, and further modifications are needed to be able to allow proper rinsing and installation of the cameras and lights. A system that would allow all electrical ports to remain covered during installations would be ideal. Better lights for the front facing GoPro camera would also benefit this setup. While the HiPap was used during the majority of the deployments, we found its use unnecessary and redundant. Overall, deployments were easy and smooth, but since the entirety of the trip was in a calm sea and weather state, it is unknows how this current setup would be fare under rougher conditions.

- Tucker Net

The tucker nets 50 μm net should have an updated connecting mechanism identical to the one on the monster net.

- Flowmeters: Tighten the flowmeter cords to make them fit better (they must have loosened up over time), as they have come back twisted several times.
- A towel rack in the Zooplankton and Fish lab as well as hooks (e.g. like small command hooks) to put the sorting utensils through.
- We lost the bar for the Hydrobios in the water, so we would need replacement one for triggering the nets.

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37 Assessing the linkages between marine food webs and Arctic Char quality in the context of climate change in Nunavik

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37.1 Introduction and Objectives

Arctic Char (*Salvelinus alpinus*, or *Iqaluppik* in Nunavik Inuktitut) is among the most consumed country foods by Nunavimmiut (Inuit of Nunavik) and Inuit across the North (e.g., Allaire et al. 2021). It supports commercial, sport, and, importantly, subsistence fisheries in Inuit Nunangat. Inuit have a millennial connection to Arctic Char as a vital source of healthy food, well-being, and a foundation to culture and identity (e.g., Harris et al. 2022). In particular, the anadromous (or searun) form of Arctic Char – which stays in freshwater systems in the winter and migrates to the ocean in the summer to feed – is of high importance within Inuit food systems. Arctic marine systems are impacted by climate change including receding sea ice, warming water temperatures, and climate-related shifts in food webs such as a borealization of the Arctic (e.g., AMAP 2021). These changes are impacting searun Arctic Char both directly, through effects on physiology or habitat use, and indirectly through its marine diet (e.g., Falardeau et al. 2022, Harris et al. 2022). Given the key role of Arctic Char for Inuit, these impacts will, in turn, have implications for food security, health, and culture. There is thus an urgent need to shed light on ongoing and upcoming impacts of climate change on Arctic Char to inform the sustainable development and management of fisheries as well as decision-making pertaining to Inuit food security and health.

In this project, we aim to understand the linkages between climate change, marine food webs, Arctic Char, and Inuit food security. Food security encompasses multiple pillars, especially

Indigenous food security frameworks expressing a holistic vision (e.g., Inuit Circumpolar Council of Alaska). In the western world, the pillars traditionally used, as initially proposed by the Food and Agriculture Organization (FAO), are access, availability, utilization, and stability. New pillars have been added in recent years, but these four foundational ones serve as a good heuristic to understand and study food security. In this specific project, we focus on utilization, or "how the body assimilates food, which is influenced by food quality and safety, peoples' overall health, as well as their skills, knowledge, and cultural preferences for how to prepare and consume foods" (Paquin and Falardeau 2024), namely the quality of Arctic Char. Arctic Char has high levels of nutrients that are important for human health, including carotenoids and polyunsaturated omega-3 fatty acids (e.g., Bolduc et al. 2024). The exceptional quality of searun Arctic Char is strongly connected to its marine diet. Indeed, like other salmonids, this species acquires carotenoids and omega-3 through the marine organisms that they feed upon, including crustaceans (e.g., de Carvalho and Caramujo, Shahidi et al. 1993). In the Arctic, zooplankton prey are particularly rich in nutrients, especially lipids (e.g., Falk-Petersen et al. 2007). It was hypothesized in previous studies that the borealization of Arctic marine food webs could alter the quality of nutrients transferred to top predators, including Arctic Char (e.g., Falardeau et al. 2022, Harris et al. 2022). Of particular importance for Char are carotenoids, especially astaxanthin that gives its red color to fish flesh; a color that is usually preferred by Inuit (Harris et al. 2022) and that provides a greater market value to fish. However, there is little research on the implications of climate-related shifts in marine food webs for Arctic Char quality. Our aim is thus to assess the diet of Arctic Char in different locations in Nunavik, and – connected to our work on the Amundsen icebreaker – to document the nutritional quality of key prey for the diet of Arctic Char in Nunavik. This critical information will allow us to evaluate the nutritional implications of diet shifts, which is currently poorly understood. Furthermore, given the little biological information available about the Ungava Bay marine environment, we aim to provide an exploratory assessment of the coastal and pelagic habitats. Indeed, very few scientific endeavors were conducted in this region to systematically sample zooplankton; this study will thus provide key information on the types of species available and habitat characterization (this includes a collaboration with Maxime Geoffroy's team).

Project objectives:

(1) Perform an exploratory characterization of the zooplankton available in the region and the coastal and pelagic habitats.

(2) Measure the stable isotope signature of key prey of Arctic Char sampled in the Ungava Bay region.

(3) Measure the nutritional quality, in terms of carotenoids and omega-3 fatty acids, of key prey of Arctic Char sampled in the Ungava Bay region.

The sampling stations were in the vicinity of the three communities visited in the Ungava Bay region (Kangirsuk, Tasiujaq, and Kangiqsualujjuaq) and representative of coastal habitats. We also sampled one station in Central Ungava and more representative of a pelagic habitat (Table 1). Note that this new project builds on our ongoing research since 2020 in close partnership with Nunavik communities and organizations, including the Anguvigaq, on the importance of Arctic Char for Nunavimmiut and the impacts of climate change on marine ecosystems and Arctic Char today, and into the future. This research brings together biophysical methods and Inuit Knowledge. It has been funded by the Genome Canada project *Fostering Indigenous Small-scale fisheries for Health, Economy, and food Security* (FISHES; 2020-25) and the Belmont Forum project *Marine Arctic Resilience, Adaptations and Transformations* (MARAT; 2020-24).

37.2 Methodology

1.2.1. Double Square Net (Tucker)

Ichthyoplankton, meso- and macro-zooplankton were sampled using a double square net (Tucker net) carrying two 1m^2 aperture nets (mesh size 500 µm) and one small net (50 µm). The Tucker was deployed obliquely at maximum sampling depths of about 100m with a ship speed of two knots. One 500 µm net and the 50 µm net were for the team of Maxime Geoffroy (see their field report) and the other net was for this project.

For this project, following sample retrieval, the content of the net was poured in a glass container on top of ice for coarse sorting. The ichthyo- and macro-zooplankton were sorted out of the bulk zooplankton and frozen at -80°C. The main species or species groups sorted were *Themisto libelulla*, fish larvae (including *Ammodytes* spp., Sand lance), and gelatinous organisms. Then, the remaining bulk zooplankton was frozen at -80°C.

Table 37-1: Table of the sampling stations where the Tucker was deployed

Date	Station ID	Station Type	Latitude	Longitude	Time (UTC)	Depth (m)	Nearby community
2024/10/21	AR24-19	Basic	59.9839670	-69.3595337	18:13:50	78.74	Kangirsuk
2024/10/21	AR24-17	Basic	60.0115348	-69.5718852	21:40:16	54.5	Kangirsuk
2024/10/22	LR24-05	Basic	58.9713603	-68.8861262	16:56:55	153.82	Tasiujaq
2024/10/22	LR24-04	Basic	59.0790058	-68.7483253	19:59:48	76.93	Tasiujaq
2024/10/23	UNG-03	Basic	59.4270483	-67.4593095	11:05:13	180.98	Central Ungava
2024/10/24	GR24-17	Basic	58.8852973	-66.3049297	14:15:17	57.48	Kangiqsualujjuaq

1.2.2. Box core

Through a collaboration with the Benthos team (leads: Philippe Archambault, Jasmin Godbold), we collected a few benthic organisms for this project. You can refer to the field report of the benthos team for details on deployment of the box core. For this project, the organisms in the epifauna were of interest, thus the first 5-10 centimeters of the upper layer. Organisms were rinsed out of the mud, and sorted by species group, then frozen at -80°C. The species group collected were Amphipods, Ophiuroidea, Polychaeta, and Bivalvia.

37.3 Preliminary Results

N/A

37.4 Recommendations

This is not so much a recommendation as it is a general reflection on operations in the Ungava Bay region. During this leg, we could not sample by barge nor zodiac due to a mix of factors, including difficult weather conditions. The strong tides in the Ungava Bay limit the time window to operate, which further challenges any operations closer to river mouths and in the rivers. In addition, the rivers in the region are complex to navigate due, for instance, to shifting currents and rock formations. The Coast Guard's expertise and knowledge of the sea, as well as safety practices, are invaluable and of extremely high quality. However, given the subtleties of local conditions and the complexity of navigation in the region, it could enhance sampling efforts in the area to partner with Inuit guides from local communities who have deep knowledge of the Ungava Bay and its rivers. Moreover, this would provide an opportunity to further align scientific research onboard the Amundsen with their observations and knowledge of the marine environment, while contributing to the local economy by providing new guiding opportunities. It would be of high interest to continue sampling efforts in Ungava Bay and Nunavik given the importance of the marine environment and wildlife to communities, the rapid pace of climate change, and the limited scientific information available on this unique marine system. We would be happy and welcome the opportunity to discuss how to sustain this work and collaborate with Inuit experts through Amundsen Science, in Nunavik and other regions as well. We are grateful for this expedition and your precious support.

37.5 References

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38 Multibeam Mapping

Principal Investigator: Amundsen Science
Cruise Participants – Leg 2a: Joshua Van Dijk and Myriam Thériault
Cruise Participants – Leg 2b: Joshua Van Dijk, Myriam Thériault and Alexis Belko
Cruise Participants – Leg 3: Daniel Amirault and Tony Furey
Cruise Participants – Leg 4: Alexis Belko
Cruise Participants – Leg 5: Arthur Wickens (Canadian Hydrographic Service)

38.1 Introduction and Objectives

38.1.1 *Leg 2a:*

Leg 2a of the 2024 Amundsen expedition began in St. John's on the 11th of July and finished in Qikiqtarjuaq on the 29th of July. The leg had no planned dedicated mapping time, but opportunistic mapping was performed during transit at speeds around 12 kn, as well as at some stations where time allowed at a reduced speed of 8 to 10 kn. Sub-bottom surveying was completed to support scientific operations if needed. A mooring positioning survey was performed at the Hopedale Saddle station to accurately determine its position after deployment. During the entire Leg 2a, the Multibeam Echo Sounder (MBES) and the sub-bottom echo sounder were active and acquired data. In total 8,767.8 km of multibeam data was collected.

38.1.2 *Leg 2b:*

Leg 2b of the 2024 Amundsen expedition began in Qikiqtarjuaq on the 29th of July and finished in Iqaluit on the 8th of August. The leg had 24 hours planned dedicated mapping time and was performed at speed around 6 kn. Sub-bottom surveying was completed to support scientific operations when needed. A mooring positioning survey was performed at C4 station to accurately determine its position after deployment. During the entire Leg 2b, the Multibeam Echo Sounder (MBES) and the sub-bottom echo sounder were always active and acquired data. In total 1479km of multibeam data was collected (without the specific mapping of the three fjords – see results). The multibeam and sub bottom was turned off at 8pm, when entering Frobisher Bay, as the waters were completely mapped, and the Amundsen science operators were disabling the TSG due to saline waters, which is used for surface beamforming.

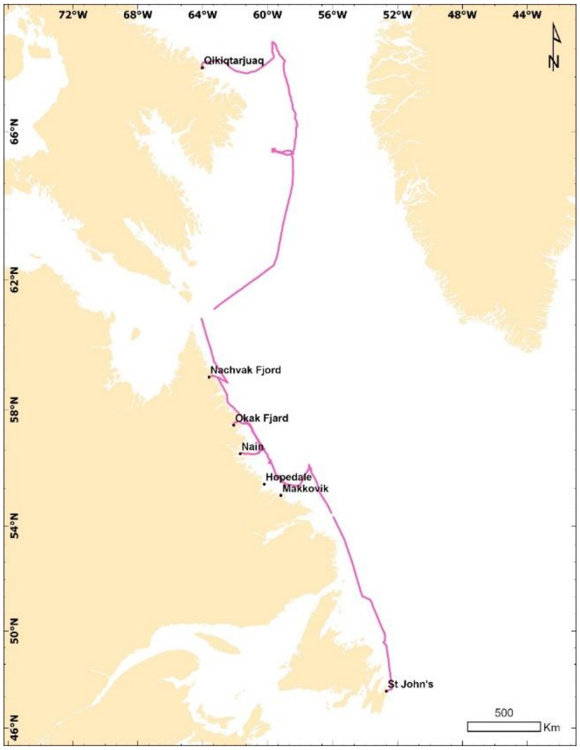


Figure 38-1: Overview of Leg 2a shiptrack. During the entire shiptrack, multibeam and sub-bottom echo sounder data was acquired.

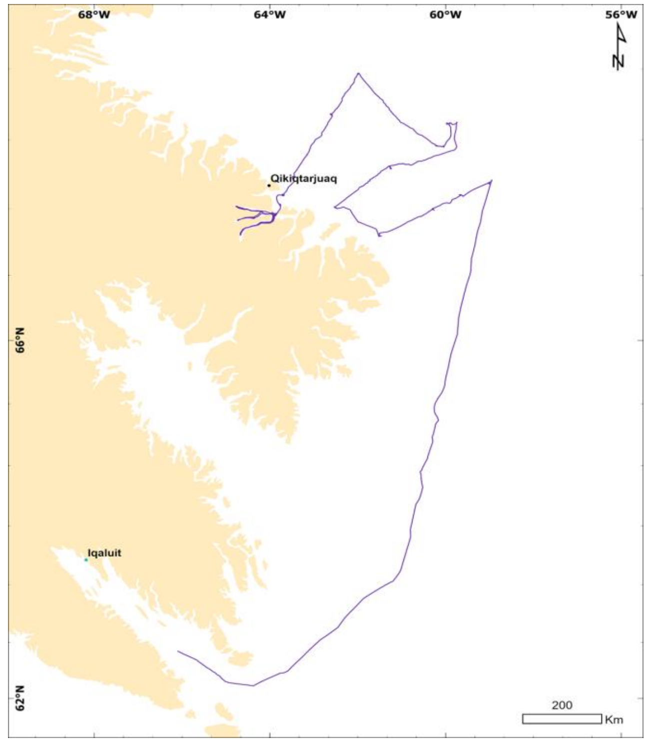


Figure 38-2: Overview of Leg 2b shiptrack. During the entire shiptrack, multibeam and sub-bottom echo sounder data was acquired.

38.1.3 *Leg 3:*

Leg 3 of the 2024 Amundsen expedition began in Iqaluit on the 8th day of August and finished in Pituffik space base on September 5th. The leg featured dedicated mapping efforts in four fjords in support of the Refuge Arctic Program, as well as opportunistic seafloor data acquisition during transits and extra time between stations. Support operations also included positioning of moorings in the water column display and evaluation of bottom substrate at various stations with the sub-bottom profiler. The Amundsen mapped a total area of 8250 km^2 while collecting sub-bottom data over an aproximate total of 3400 nautical miles.

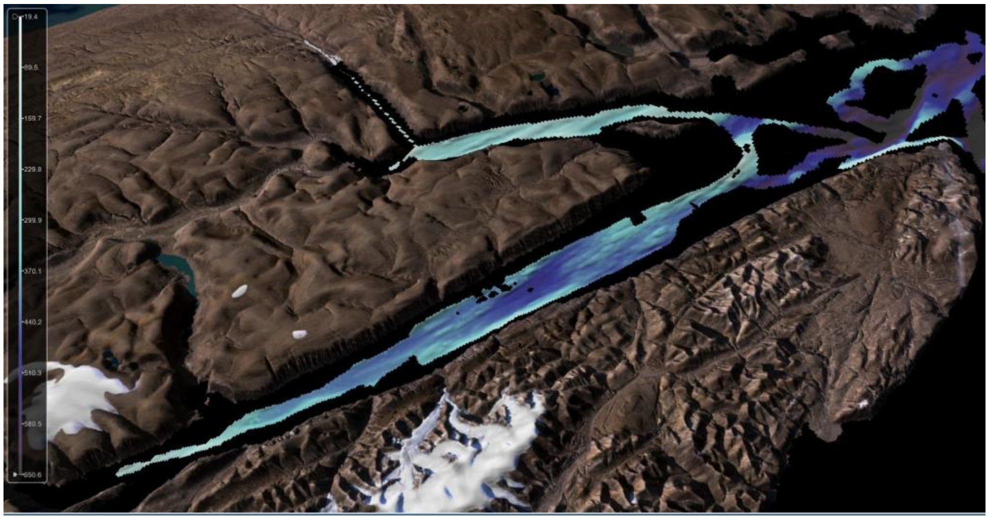


Figure 38-3: Mapped area during Leg 3 of the 2024 Amundsen expedition

38.1.4 *Leg 4*

Leg 4 of the 2024 Amundsen expedition began in Pittufik space base on the 5th day of September and finished in Resolut Bay on October 3rd. The leg featured dedicated mapping efforts on designated areas of the Refuge Arctic Program, especially on non-mapped water close to stations during the nights, as well as opportunistic seafloor data acquisition during transits. Support operations also included positioning of moorings in the water column display and evaluation of bottom substrate at various stations with the sub-bottom profiler. The Amundsen mapped a total area of 2132 nautical miles while collecting sub-bottom.

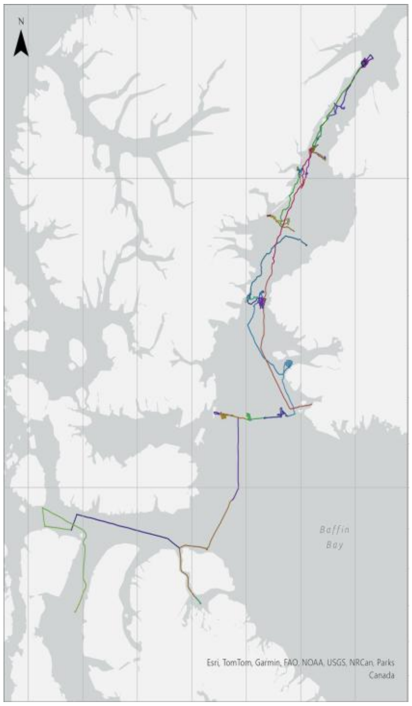


Figure 38-4: Mapped area during Leg 4 of the 2024 Amundsen Expedition

38.1.5 *Leg 5:*

Leg 5 of the 2024 Amundsen expedition occurred from 2024/10/03 to 2024/10/30. With no dedicated mapping operations planned, the operator onboard operated the scientific sonars and collected opportunistic data through the Leg. Support operations included monitoring bottom depth in support of navigation and evaluation of bottom substrate at various stations with the sub-bottom profiler. The Amundsen mapped a total area of 7590 km2 while collecting sub-bottom data over an aproximate total of 4400 nautical miles.

Figure 38-5: Leg 5 shiptrack (colour changes indicate new multibeam data section)

As a part of Amundsen Science's partnership with the Canadian Hydrographic Service, Arthur Wickens while on board helped diagnose issues and find improvements to be made in a number of seabed mapping processes onboard. Some fixes can be found in the Miscellaneous section.

38.2 Methods

38.2.1 *Kongsberg EM 304 Multibeam Sonar*

The CCGS *Amundsen* is equipped with a Kongsberg EM304 deep-water sonar, which operates using Kongsberg's proprietary software Seafloor Information System (SIS) version 5.12.2 (upgraded to 5.12.3 during Leg 3). The sonar data is corrected in-situ with an Appalanix POS-MV V5 system, providing both inertial (pitch, heave, and roll) corrections, and position information for georeferencing. The position accuracies were around 1 meter horizontally and 4 to 5 meters vertically in latitudes above 78°, with rotational accuracy from the Inertial Measurement Unit (IMU) of ~0.02 deg. Soundings were corrected using CTD profiles acquired at scientific stations to provide sound speed throughout the water column, while a direct sound speed measurement provided constant sound speeds at the sea surface for beamforming.

38.2.2 *Knudsen 3260 CHIRP Sub-bottom Profiler*

A Knudsen 3260, operating at 3.5 kHz, was used to examine sub-bottom sediment distribution and the geological makeup of the seafloor. Depending on the sediment characteristics and water depth, the Knudsen profiler can depict structures 50 m below the sea floor. Positioning data is provided by the CNAV 3050, while attitude information was provided by the Applanix POSMV's IMU. This allowed for examination of the sub-bottom information with proper georeferencing.

38.2.3 *Barge – EM2040 Multibeam Echosounder*

An EM2040 multibeam echo sounder was installed on the *Amundsen*'s barge to collect multibeam data in areas considered unfeasible for the ship. In addition to increasing survey capabilities, the EM2040 is more effective in shallow water than the Amundsen's EM304. New in 2023, the barge's multibeam pole supports much safer and faster deployment, also the ability to tilt the multibeam to 35 degrees outward. Ancillary equipment to the EM2040 include the Amundsen's previously installed POSMV V4 system with its proprietary IMU and new Trimble AP540 antennas; and a micro SV sensor. An AML-3 XSV probe acquires Sound Velocity profiles.

38.2.4 *Barge – Knudsen 12kHz Sub-bottom Profiler*

In 2024, the Knudsen 12kHz was installed on the barge to collect sub-bottom profiles in synchronization with the EM2040. The 2024 installation utilised the previous EM2040 pole in order to avoid the addition of new mounting plates

38.2.5 *Post-Processing*

All multibeam data acquired was post-processed before the completion of the cruise using CARIS HIPS & SIPS version 11 bathymetric software. This post-processing enabled rapid anomaly detection and the removal of outliers from data. Tidal information was retrieved using the Bedford Institute of Oceanography's WebTide tidal model, which vertically references the multibeam data to Mean Sea Level (MSL). Sound velocity profiles were collected from CTD rosette information and applied during acquisition. The WOA18 model was used to generate a sound velocity profile in the Sound Speed Manager application when synthetic profiles were needed.

38.3 Results

38.3.1 Leg 2a:

Leg 2a had no time dedicated solely to mapping, but several small areas were mapped opportunistically around planned stations as time allowed. Both the EM304 MBES and Knudsen 3260 CHIRP Sub-bottom profiler continuously collected data for the entire duration of Leg 2a. The primary aim of the opportunistic mapping is to expand the extents of the Canadian Hydrographic Service's (CHS) existing database of bathymetric coverage previously collected by Canadian Coast Guard vessels, among other sources. The post-processed bathymetric data acquired on Leg 2a will be shared with the CHS to allow updates to the database and nautical charts.

Opportunistic Surveys

Underwater Trenches and small Seamount near Makkovik 'Hanging Gardens'

Given that ROV and mooring operations could only be completed in the day, this allowed for mapping time overnight at key stations where ROV dives or mooring deployments were planned for the following day. Near the Makkovik Hanging Gardens, two separate opportunities were presented, both with interesting results. The first, located just southeast of the cliff face site of the dive, revealed a small seamount above the cliff, rising to just over 30m depth. The second site led to the discovery of several underwater trenches and more cliff faces. Given the proximity and similarity between these novel cliff faces and those at the 'Hanging Gardens', it is suspected that these new cliff faces may have similarly interesting and biodiverse coral habitats as the gardens.

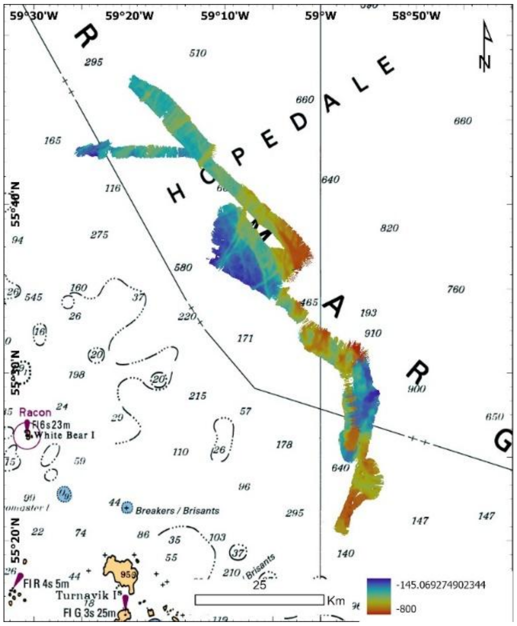


Figure 38-6: Opportunistic mapping in an area without in-situ bathymetry data.

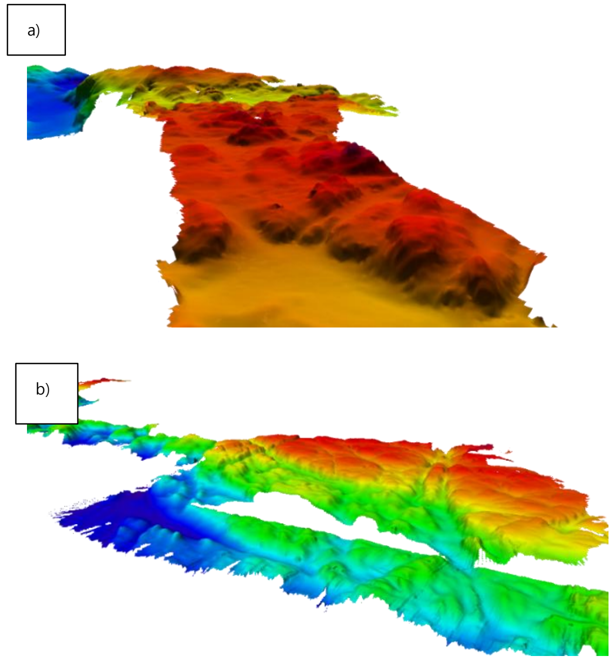


Figure 38-7: 3D rendering of opportunistic multibeam surveys near Makkovik Dive site. a) Southeast seamount on top of Makkovik Hanging Garden cliffs (3x vert. exagg.). b) Trenches and submarine cliffs northwest of the Makkovik Hanging Gardens (3x vert. exagg.)

Moorings

One mooring at Hopedale Station was deployed during Leg 2a. After deployment, it was identified in the water column data provided by the MBES. The SIS water column display allowed an accurate measurement of the depths of the buoys and therefore, confirmed a successful deployment.

a) b)

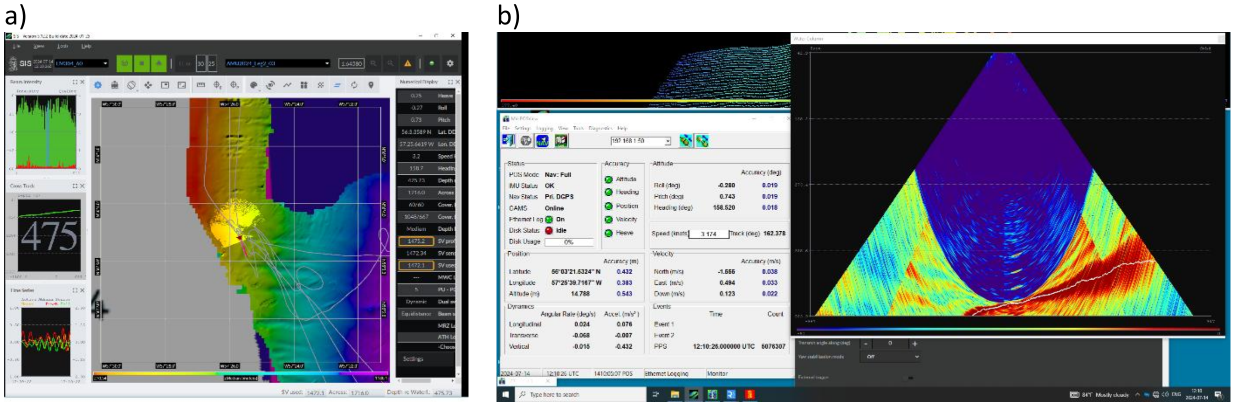


Figure 38-8: Deployed mooring at the Hopedale Saddle station. a) Mooring location and acquired MBES survey around the station. b) SIS watercolumn display of the mooring.

38.3.2 *Leg 2b:*

Leg 2b had about 24h of specific mapping allocated. Both the EM304 MBES and Knudsen 3260 CHIRP Sub-bottom profiler continuously collected data for the entire duration of Leg 2b.

Dedicated Operations

During Leg 2b, many dedicated multibeam surveys were conducted aboard the Amundsen using the EM304. The initial plan was to map two unmapped fjords (Maktak and North Pangnirtung) and extend the coverage of Coronation Fjord to understand the dynamics of recent glacier retreat, with a focus on glacial landform. For the two unmapped fjords, the coverage started with a first line in the middle around 5 knots and then to continue the coverage, the vessel stayed in the multibeam data to avoid shallow waters. A grid with a resolution of 10 m was exported from Caris, allowing the interpretation of gullies, moraines, icebergs scours and glacial lineations. Coronation Fjord was mapped in 2019 and the other objective of this mission was to expand the coverag

Maktak fjord

Maktak fjord was mapped for 8h in good and clear conditions. An area of 33km^2 has been mapped.

Coronation fjord

Coronation fjord was mapped for 4h in good and clear conditions. An area of 46km2 has been mapped with the combination of the data collected in 2019.

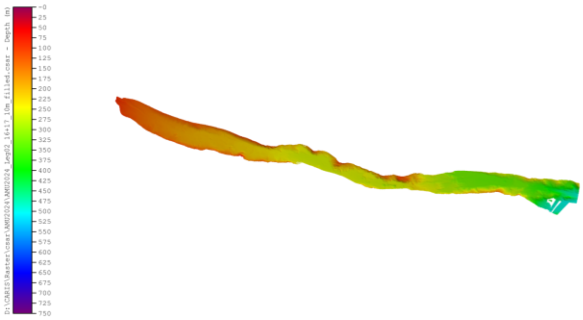


Figure 38-9: Multibeam surface of Maktak fjord(10m)

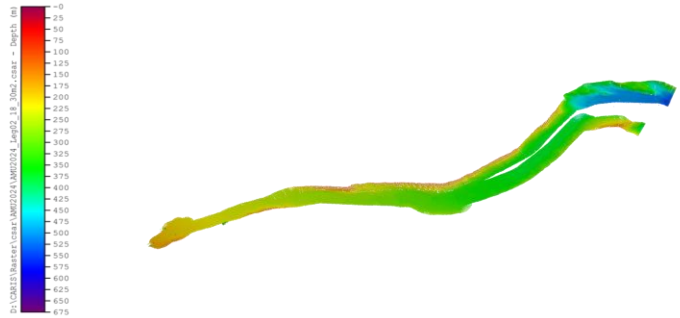


Figure 38-10: Multibeam surface of Coronation fjord (30m)

North Pangnirtung fjord

North Pangnirtung fjord was mapped for 12h in good and clear conditions. An area of 79km^2 has been mapped.

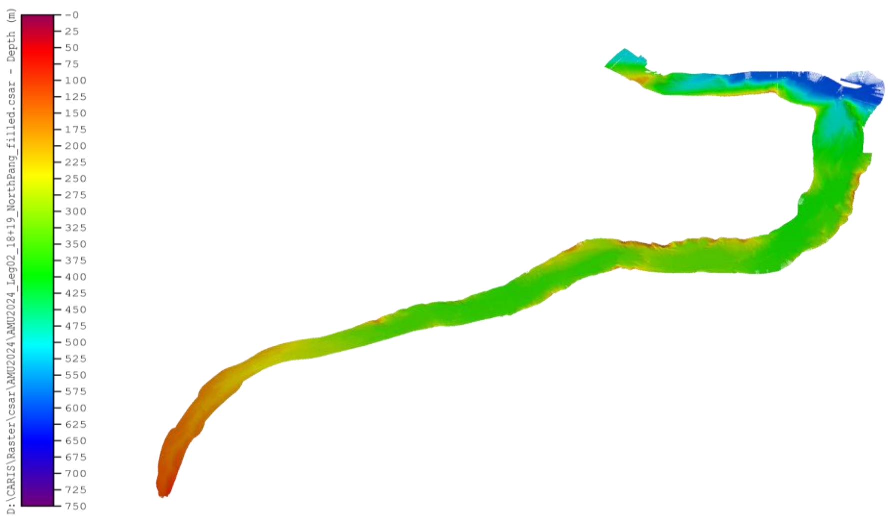


Figure 38-11: Multibeam surface of North Pangnirtung (10m)

Moorings

The mooring deployed during Leg 2b required the multibeam operators to sight it using the watercolumn visualisation feature of the EM304. Objects in the watercolumn can be seen as they reflect sound from the multibeam.

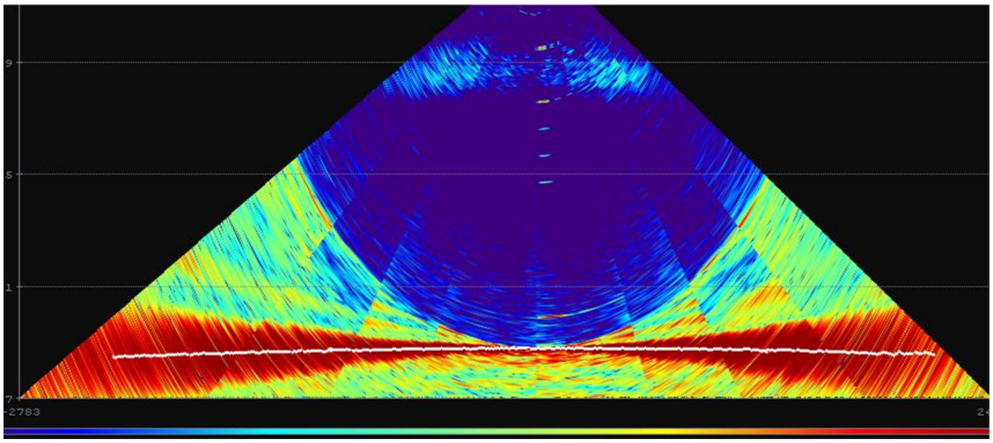


Figure 38-12: SIS Watercolumn display - Mooring C4-24

Cooring operations

Coring teams required an evaluation of sub-bottom data in order to identify the bottom type before the use of a gravity core, box core. Sub-bottom surveys were conducted arriving at each station involving coring operations. Some sites were located in a location with previously collected data allowing the team to evaluate the seafloor before arriving to stations.

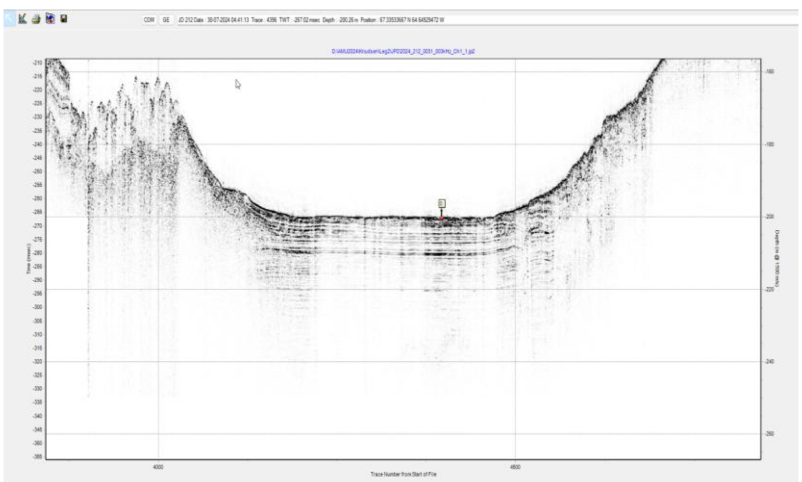


Figure 38-13: Site TCA52

38.3.3 *Leg 3:*

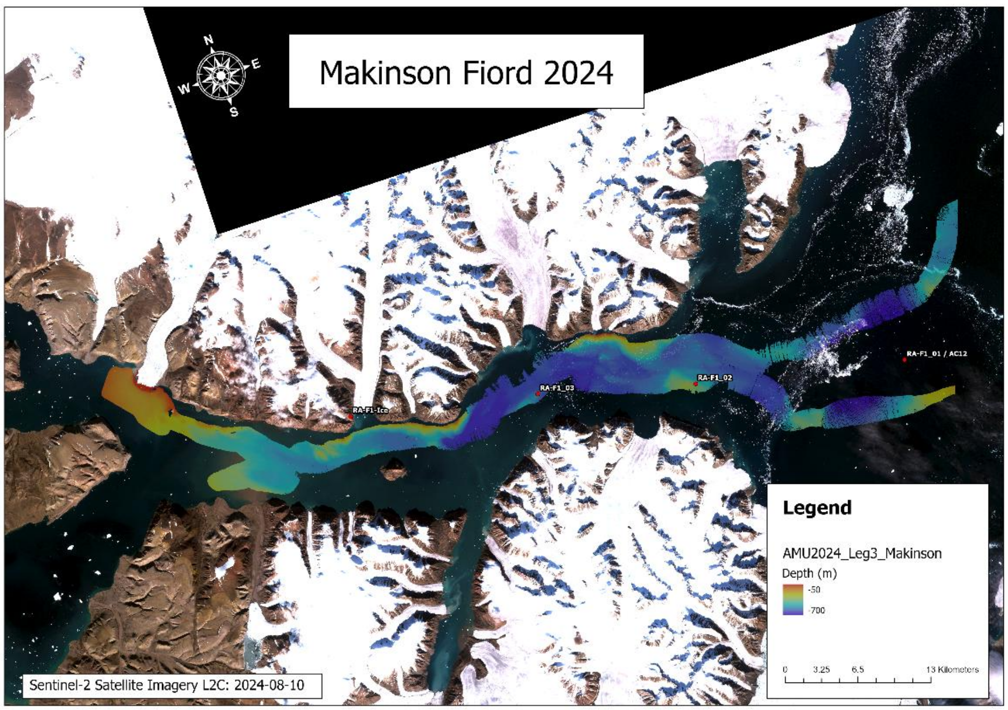
During Leg 3 dedicated mapping occurred in Makinson Fjord near Smith Bay, Dobbin Fjord near Kane Basin, Archer Fjord in the Nares Strait just above Kane Basin Sea, and Newman Bay

(Greenland) above Kane Basin. Both the EM304 MBES and Knudsen 3260 CHIRP Sub-bottom profiler continuously collected data for the entire duration of Leg 3.

Dedicated Data Acquisition

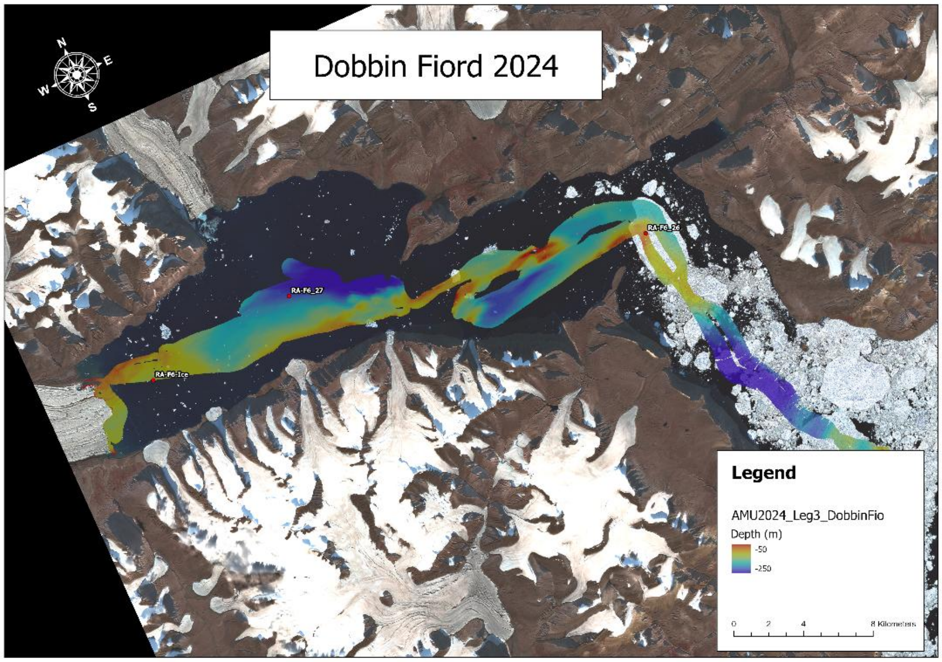
Makinson Fjord

There were 3 nights of dedicated Amundsen multibeam surveying, as well as a day of dedicated barge mapping in Makinson Fjord. Previous data in Makinson was limited to a transit of single beam soundings. New multibeam coverage totalling 281 km^2 acquired by the Amundsen is shown in the map below.



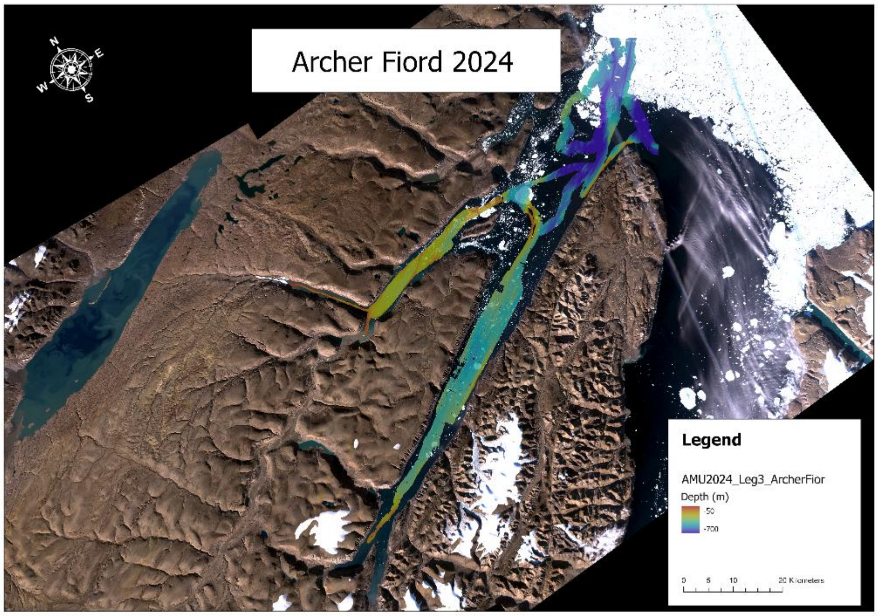
Dobbin Fjord

There were 3 nights of dedicated Amundsen multibeam surveying, as well as a day of dedicated barge mapping in Dobbin Fjord. There were no previous soundings in this fjord. New multibeam coverage totalling 112 km^2 acquired by the Amundsen is shown in the map below.



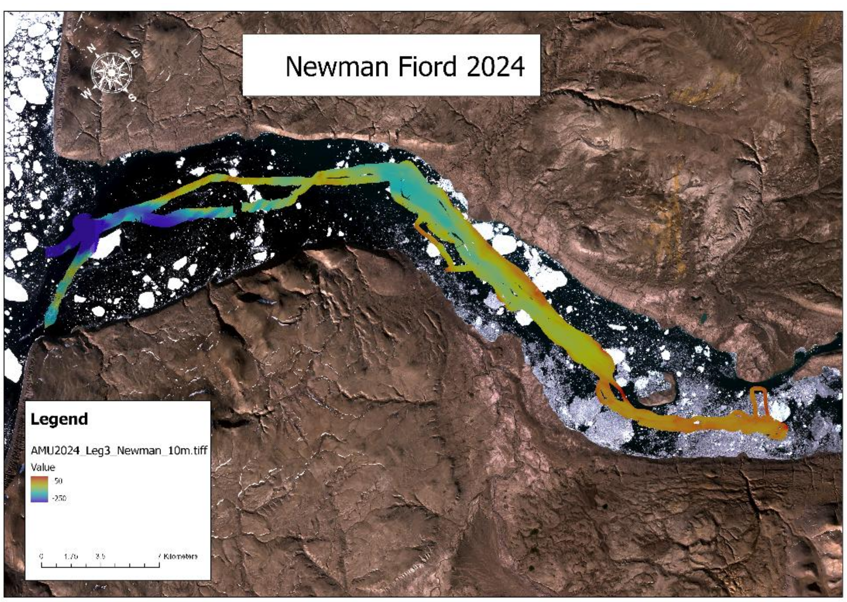
Archer Fjord

There were 4 nights of dedicated Amundsen multibeam surveying in Archer Fjord and Chandleur Fjord, as well as opportunistic mapping with the barge to collect multibeam data up to the mouth of the river north of Chandleur Fjord. This years mapping extended the coverage gathered by the Amundsen in 2023 by 631 km^2. New multibeam coverage acquired by the Amundsen is shown in the map below.



Newman Fjord

There were 2 nights of dedicated Amundsen multibeam surveying in Newman, as well as opportunistic mapping during transit. There were no previous soundings in this Greenland fjord. New multibeam coverage totalling 70.4 km^2 acquired by the Amundsen is shown in the map below.

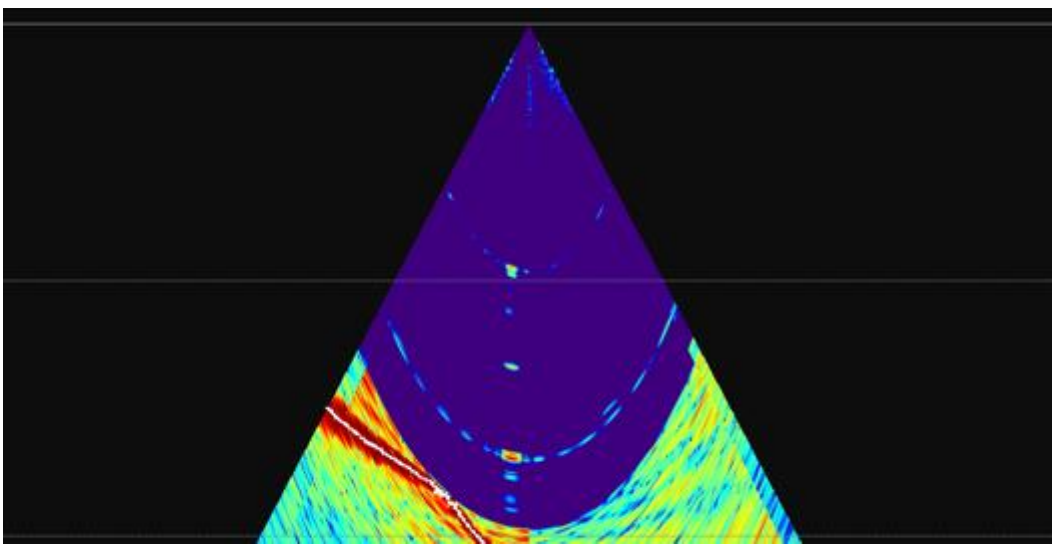


<u>*Opportunistic Data Acquisition*</u>

The primary aim of opportunistic mapping is to expand the extents of the Canadian Hydrographic Service's (CHS) existing database of bathymetric coverage previously collected by Canadian Coast Guard vessels, among other sources. The post-processed bathymetric data acquired on Leg 3 will be shared with the CHS to allow updates to the database and hopefully nautical charts.

Moorings

Each mooring recovery and deployment on Leg 3 required the multibeam operator to sight it in the watercolumn visualization feature of the EM304. This provided an accurate location of the mooring on the seafloor. There were seven mooring recoveries and two mooring deployments on Leg 3.



Coring Operations

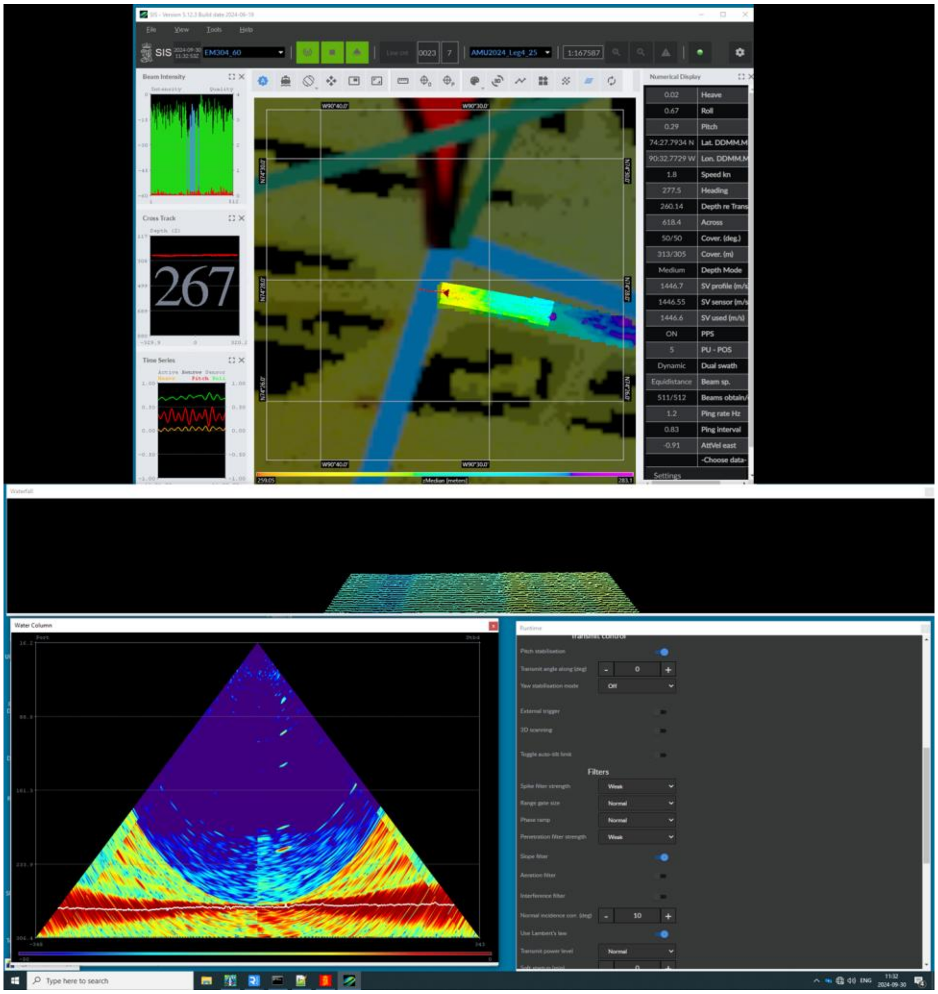
Coring teams required an evaluation of sub-bottom data in order to identify the bottom type before the use of a gravity core, box core, or van veen grab. Sub-bottom surveys were conducted arriving at each station involving coring operations. Some sites were located in a location with previously collected data allowing the team to evaluate the seafloor before arriving to stations.

38.3.4 *Leg 4*

During Leg 4, as night shifts were not covered for the operations of the various research programs, opportunistic data acquisition surveys were carried out close to the stations, with the main aim of searching for coring and box core sites as well as augmenting the Canadian Hydrographic Service's (CHS) existing database of bathymetric coverage previously collected by Canadian Coast Guard vessels, among other sources. The post-processed bathymetric data acquired on Leg 4 will be shared with the CHS to allow updates to the database and hopefully nautical charts.

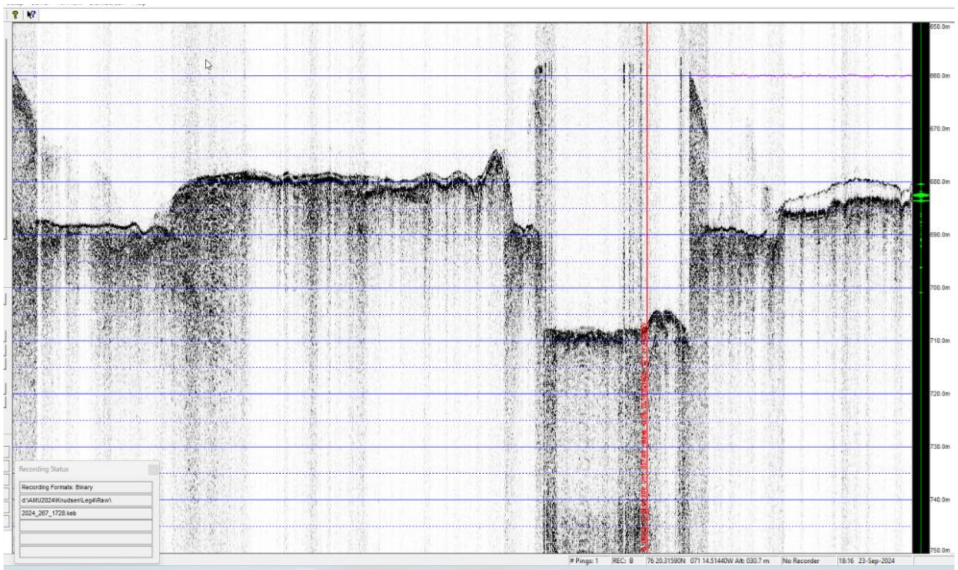
Moorings

Each mooring recovery on Leg 4 required the multibeam operator to sight it in the watercolumn visualization feature of the EM304. This provided an accurate location of the mooring on the seafloor. There were three mooring recoveries Leg 4.



<u>*Coring operations:*</u>

Coring teams required an evaluation of sub-bottom data in order to identify the bottom type before the use of a gravity core, box core. Sub-bottom surveys were conducted during the night before arriving at each station involving coring operations. Some sites were located in a location with previously collected data allowing the team to evaluate the seafloor before arriving to stations.



38.3.5 *Leg 5*

Moorings

During a mooring operation on Leg 5 (October 15th), the teams required the multibeam operator to sight the mooring in the watercolumn visualization feature of the EM304. This provided an accurate location of the mooring on the seafloor.

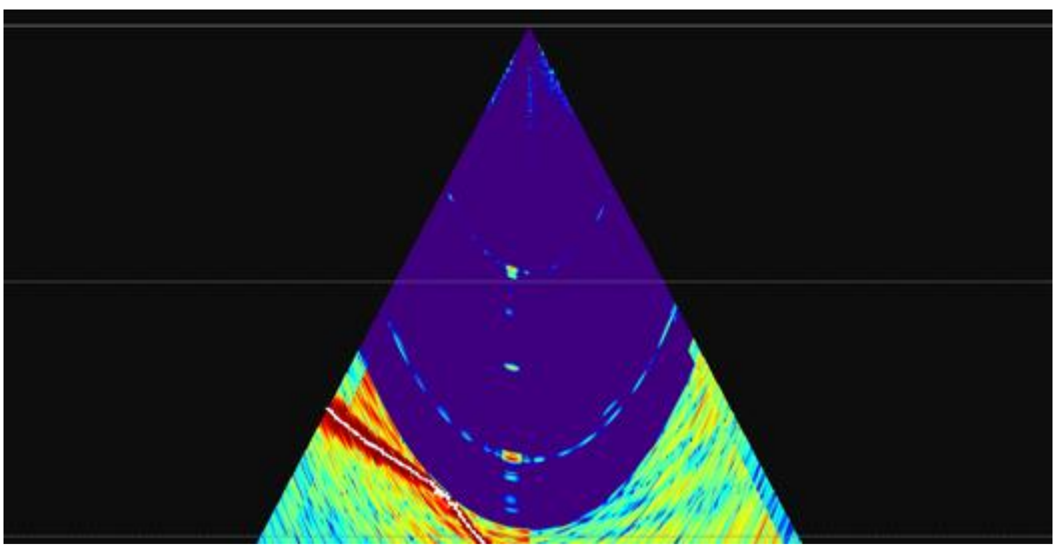


Figure 38-14: Mooring watercolumn imaging

Coring Operations

Coring teams required an evaluation of sub-bottom data in order to identify the bottom type before the use of a gravity core, box core, or van veen grab. Sub-bottom surveys were conducted arriving at each station involving coring operations. Some sites were located in a location with previously collected data allowing the team to evaluate the seafloor before arriving to stations.

Opportunistic Data Acquisition

The primary aim of opportunistic mapping is to expand the extents of the Canadian Hydrographic Service's (CHS) existing database of bathymetric coverage previously collected by Canadian Coast Guard vessels, among other sources. The post-processed bathymetric data acquired on Leg 5 will be shared with the CHS to allow updates to the database and hopefully nautical charts.

Mapping in Ungava Bay

A small zone of 340km^2 was mapped with the EM304 in Ungava Bay (59.39°N, 67.4°W) on October 23rd 2024. See below the mapped area:

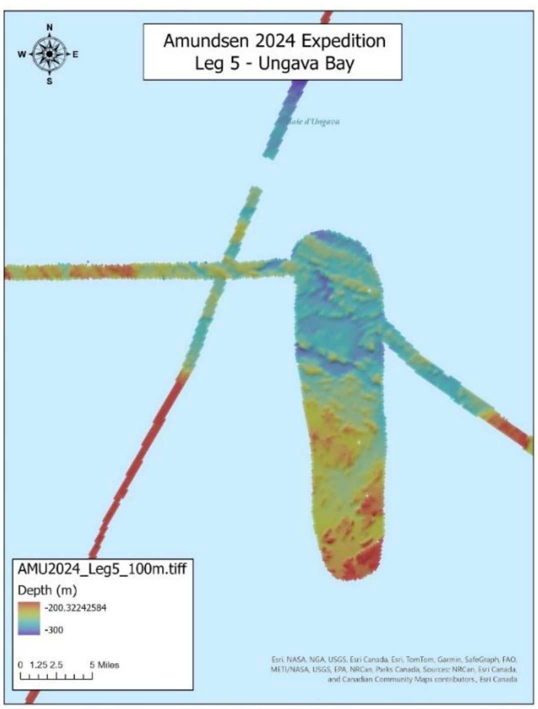
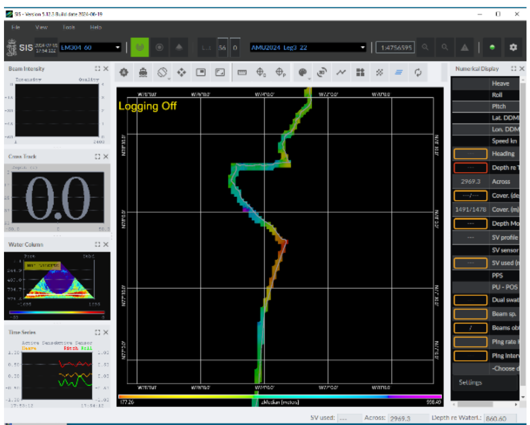


Figure 38-15: Ungava Bay Seabed Mapping (location: 59.39°N, 67.4°W, duration: 6.5hrs)

38.4 Miscellaneous

SIS Computer Issues

At various points throughout the Leg 2, Leg 3, Leg 4 and Leg 5, multiple problems with the SIS application were perceived. The application crashed many times during each leg (usually every one to two days). Kongsberg support was contacted, and replied this was an outstanding issue with the previously current version of SIS 5.12.2 but should be solved in the most recent 5.12.3. Mid-Leg the now current version of software and firmware were uploaded. The issue persisted after updating.



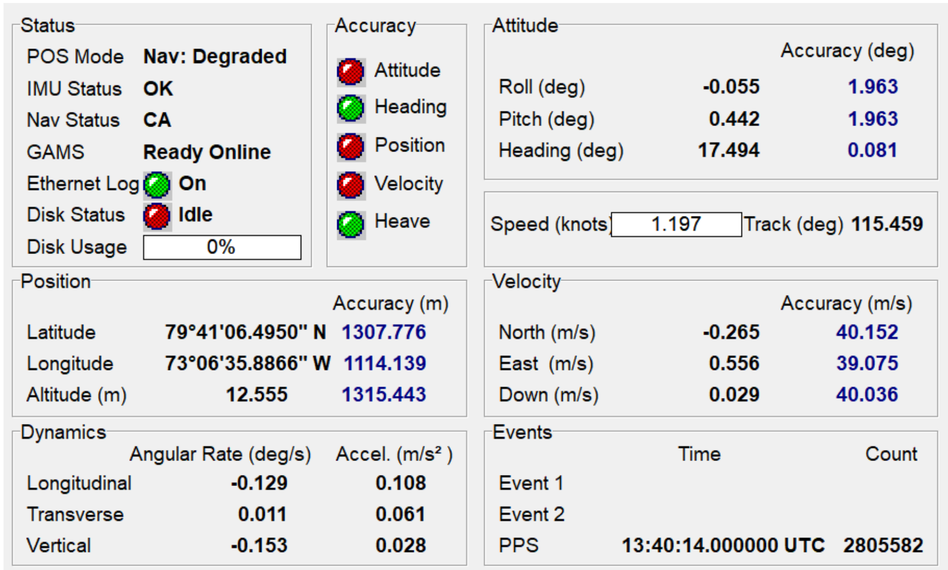
On September 3rd 2024, an additional attempt to fix the SIS issue was made. Kongsberg identified an issue within their EM software which caused bugs and crashes in SIS and the Processing Unit (PU) when receiving the POSMV Attitude Velocity Datagrams (These config files can be found though POSView - Ethernet Realtime > 102/103 Sensor Navigation Solution) for extended periods of time. A Kongsberg technician sent a small patch update to Amundsen Science to be applied to the PU Firmware. Once added the POSMV 102/103 datagram was no longer received by the Multibeam. This is a crucial datagram, the multibeam will not ping without it. The team was unable to ping the PU's Secondary network address which receives the POSMV datagram, and unable to access the application allowing factory reset or SW/FW changes to the PU. A remote session with Kongsberg was determined necessary. It was determined the patch update corrupted configuration files within the EM304 PU, leaving no other solution than specialised intervention within its internal files. Once the Kongsberg team successfully removed the patch, the patch update file was modified and correctly reapplied. Their team also gave a workflow to monitor the system for any other issues, which will be run throughout the rest of the year. A total of 16 hours of multibeam data collection was lost due to this issue, and a survey towards Cadogan fjord had to be delayed.

ComCap NMEA Logging Issues

At the start of the Leg 2, there were issues with the ComCap logging of the raw NMEA files for future use in converting to shiptrack, then to tides. ComCap would stop logging after 1 hour. It was determined to be a licensing issue. The software had been moved to a new PC from years prior, and the licensing was not properly installed. After discussion, Daniel Amirault purchased a new license and this was installed to the ARCGIS computer's ComCap installation, solving the issue.

POSMV Issues

This issue only arose once, but caused serious problems and loss of accurate data for the multibeam, so it is addressed here. For unknown reasons, the PosMV system would raise an error that the GAMS had invalid installation parameters, and then set the system to standby mode briefly. It would then re-enable itself and take ~30s to acquire lock on satellites and return to standard operation accuracies. This occurred every 2-5minutes for around 45 minutes while a software solution was attempted to be found. Finally, we went to the deck unit, manually turned it off and checked that all connections were secure before turning it back on. This solved the issue and the PosMV then functioned as expected for the remainder of Leg 2. Twice during Leg 3 and Leg 4, the POSMV returned accuracies of over 1000m, rendering position data unusable for +/- 10min. The issue was resolved after restarting data acquisition on the POSMV a couple times. It is believed that multipath is the cause, as both occurrences were as the ship was stationed in narrow fjords with elevated mountains. The issue is noted in case further problems occur in the future.



ARCGIS Pro Freezing

At various points, we created polygons in ArcGIS for export to SIS to provide specific areas of opportunistic mapping to the bridge. At times, when selecting these polygons to edit the location of vertices, ArcGIS would freeze completely, with no response or even highlighting of buttons when hovered. The task manager would have to be used to close the software before restarting it and loading the backup.

Knudsen Noise Issues

At the beginning of the Leg, there were issues with the amounts of noise being erroneously acquired in the sub-bottom data, particularly in deeper water. After discussion and testing various settings, it was determined that increasing the Tx power significantly improved bottom tracking, and removed substantial amounts of noise.

Absence of MBES Data From Past Years

The mapping team was relied on as an important resource to identify previously unmapped areas or to provide information that might be relevant when selecting opportunistic sampling sites. This service was hampered by the absence of MBES data collected from previous years. Such data is a valuable asset to many researchers and should be made available so as to optimize future sampling and prevent duplication of effort.

New CARIS Post-Processing Model

A new process model was created during the 2023-2024 off season, allowing automatic processes to be applied to multiple steps of the multibeam's raw – to – final product workflow. During Leg 3 the multibeam team tested and reconfigured the process model into working order.

Details within the Amundsen Science CARIS Process model were modified (ex: HDCS Navigation source when importing raw data to CARIS) alongside Daniel Amirault of Amundsen Science to improve model efficiency.

Unscheduled software updates

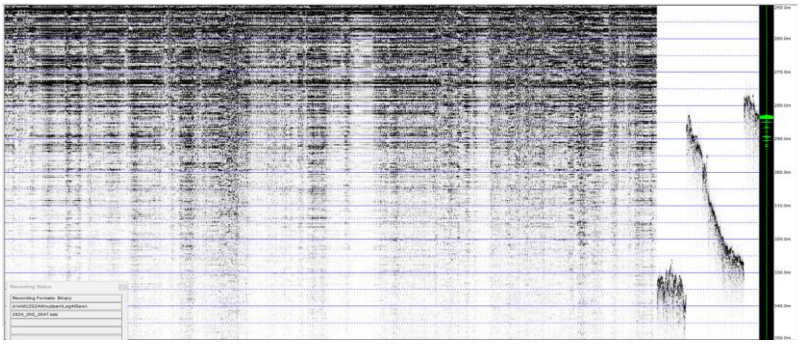
Between 7:30 UTC and 12:10 UTC on 17-09-2024 (Leg 4), most of the computers were accidentally connected to the Internet, resulting in a series of automatic computer updates and unscheduled restarts. This happened during the night, resulting in a data loss of about 6 hours.

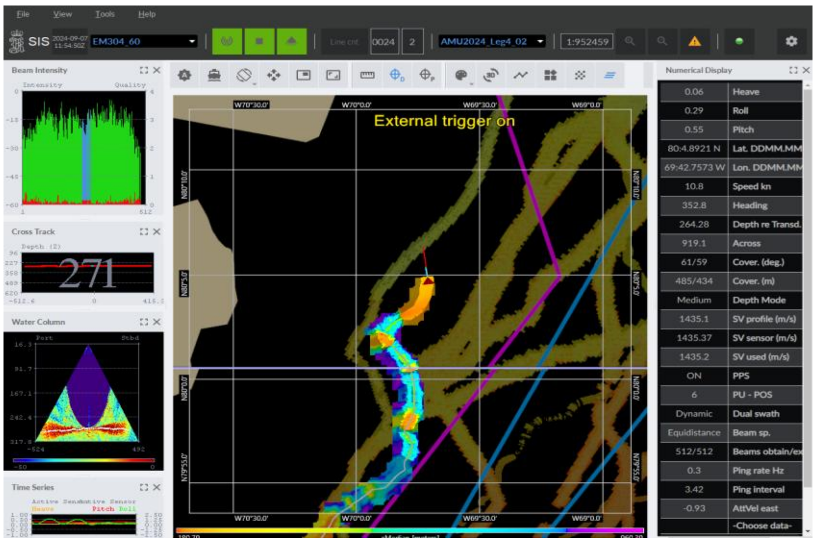
•*Sonar cut-off near Pond-Inlet*

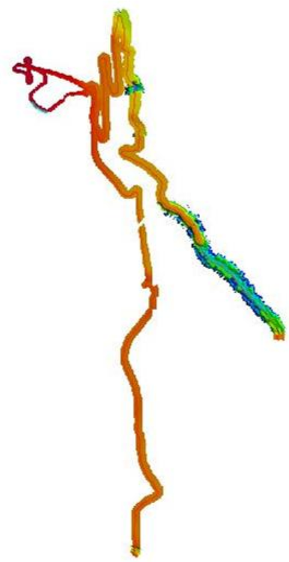
Given that data coverage was already very satisfactory and that the communities of Pond Inlet had not been contacted regarding the use of our sonnards near the village, it was decided to shut down the sonnards between September 28 12am UTC and September 29 8pm UTC (Leg 4).

Major data collection problems

Multibeam and subbottom data acquisition was problematic because only one multibeam operator was assigned for the entire Leg 4. The fact that no one was present half the time to set up and operate the acquisition software resulted in a significant loss of data, especially at night. Therefore, the following figures show data gaps or poor data collection that could have been avoided with the right number of multibeam operators assigned to this mission.







Data/Outer Beam Accuracy

Further analysis on the outer beams were made during Leg 5. In some cases, the automatically selected pinging mode was not sufficient to retrieve a proper signal. Upon manually selecting a setting a better signal could be received, allowing for less errors and loss of data at outer beams.

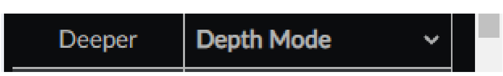


Figure 38-16: Ping mode

FIXED: Post-Processing SVP

An issue causing the inability to post process SVPs within CARIS was linked to the headers in the SVP file, as well as specific values within the vessel file.

After correcting the two elements, SVPs can be correctly added to the multibeam data if they were not added to SIS during acquisition.

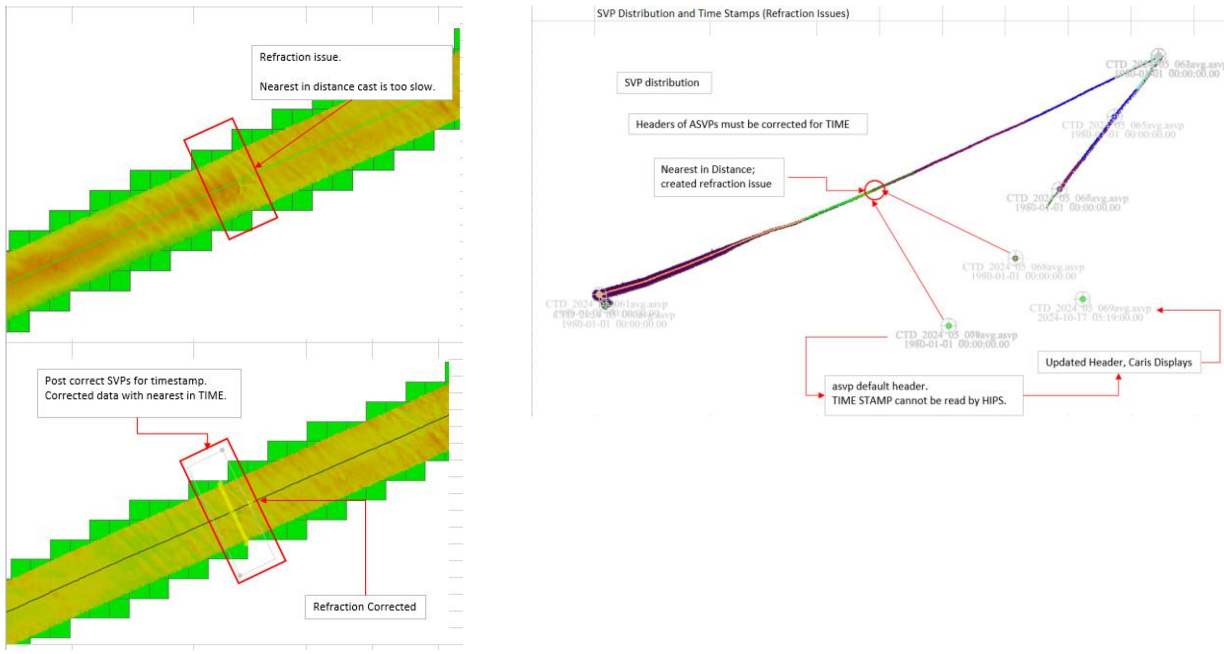


Figure 38-17: SV Corrected Refraction (Time vs. by Distance), SVP Distribution and Time Stamps

39 Sediment biogeochemistry and benthic-pelagic nutrient cycling

Principal investigators: Christopher Algar[1] (chris.algar@dal.ca), Paul Snelgrove[2], Phil Archambault[3], Haley Geizer[1], Silas Jones[2], Camille Poitrimol[3]

Cruise participants – Leg 2a: Haley Geizer[1], Silas Jones[2], Camille Poitrimol[3]

Cruise participants – Leg 2b: Haley Geizer[1], Camille Poitrimol[3]

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39.1 Introduction and Objectives

Sediment sampling was conducted using box cores to quantify sediment benthic-pelagic biogeochemical cycling. Quantifying the current rates of these biogeochemical processes is important as they may be altered by anthropogenic climate change with potential ecosystem wide effects. Coastal and shelf sediments are hotspots of biogeochemical cycling, they are responsible for up to 80% of marine carbon burial and 50% of global denitrification. Fjords are also particularly important ecosystems for biogeochemical cycling and carbon storage as they receive and retain large amounts of sediment into their basins due to their steep, unstable slopes. These regions sequester approximately 18 million tons globally every year. Another area of interest is the Makkovik Hanging Gardens as they could be sensitive to warming temperatures, they provide critical habitat for many marine species and have been observed to have greater remineralization rates (samples from 2023). Knowledge of these cycles in the Eastern Canadian Arctic and Subarctic is limited due to the challenge of collecting field measurements in such remote environments. This provides the motivation for the objectives for this research mission, which are: 1) to quantify the exchange of carbon, oxygen, and nutrients between the sediments and overlying water across a latitudinal gradient stretching from the Sub-Arctic to the Arctic, and from coastal to continental shelf and slope environments, 2) to estimate how much carbon is being stored in Northern fjords and 3) to observe the effect of the Makkovik Hanging Gardens on nutrient cycling and benthic community structure.

Objective 1 will continue work conducted on previous Amundsen expeditions in 2021, 2022 and 2023. Our most southerly site is Joey's Gully (2022) and our most northerly was Disko Fan (both 2021 and 2023). This year data collected from Makkovik and Ramah Shelf will be added.

At each site, we will quantify the total oxygen uptake (TOU), diffusive oxygen uptake (DOU), nutrient fluxes, porewater chemistry, geophysical properties, organic C content and identify microbial communities. This data will be used in Haley Geizer's PhD dissertation (Dalhousie University, supervisor: Dr. Christopher Algar).

Our second objective also will be using data from multiple cruises. In previous years we have sampled from Southwind Fjord (2021 and 2023), Hebron Fjord (2022), Nachvak Fjord (2022), Okay Bay (2023), and Saglek Fjord (2023). This year we collected samples in Okak Bay (fjard) and Nachvak Fjord. The Nachvak Fjord site was important as it was sampled in 2022 and it will be interesting to compare those results. In 2023, Okak samples were very rocky so we could not do as many replicates as we would have liked. Resampling this year will allow us to better quantify remineralization and carbon burial in this fjard. More fjords will also be sampled on Leg 2b. Sediment collected at each site will be used to observe the TOU, DOU, nutrient fluxes, porewater chemistry, geophysical properties, organic C content and identify microbial communities. Pb 210 data from in collaboration with NRCan along with flux information will allow the calculation of carbon burial in each fjord. This will then be scaled up to all Arctic and Subarctic fjords. Results from these findings will be a chapter in Haley Geizer's PhD thesis as well (Dalhousie University, supervisor: Dr. Christopher Algar).

For our last objective (3), boxcores were deployed near and away from the Makkovik Hanging Gardens at 2 different locations (M1 and M2). The depths were similar between all sites. Cores at these locations were collected for nutrient fluxes and later sectioned for macrofauna in a collaboration between Haley and Camille. Additionally, at M1, a transect of boxcores (near, far and extended) were collected in collaboration with Francesco Bisiach (University of Calgary). For the M1 extended site, cores were only collected for porewater chemistry and microsensor profiling to help determine how much of an effect the vertical wall has on the biogeochemistry. The fluxes, porewater chemistry and microbial data from all M1 sites will be used in Haley Geizer's PhD thesis (Dalhousie University, supervisor: Dr. Christopher Algar) while the fluxes and macrofauna from M1 and M2 will be a part of Camille's post-doctoral work (Université Laval, supervisor: Dr. Phil Archambault).

39.2 Methodology

39.2.1 *Core collection*

Leg 2a

In total 48 sub cores from boxcore deployments were collected from 5 different sites (Figure 39-1). 6 push cores were sub cored using core liners (35 cm x 6.7 cm). These cores contained 3 flux cores, 1 core for microsensor profiling and 2 cores for porewater chemistry. An example of a sediment core sampled and a boxcore with sediment are shown in Figure 38-2. Complete description of core locations and analysis conducted are provided in Table 39-1.

Leg 2b

In total 18 sub cores from boxcore deployments were collected from 3 different sites (Table 39-1). At each site, 6 push cores were sub cored using core liners (35 cm x 6.7 cm). These cores contained 3 flux cores, 1 core for microsensor profiling and 2 cores for porewater chemistry. It should be noted that the boxcore from Maqtaq fjord was quite sandy and the surface was disturbed. The boxcore in Coronation fjord was also disturbed as the box overflowed with sediment even with multiple deployments and 2 different locations. Samples retrieved from North Pang fjord were undisturbed with overlaying water which is ideal. Photos of these boxcores are shown in figure 2. Complete description of core locations and analysis conducted are provided in Table 39-1.

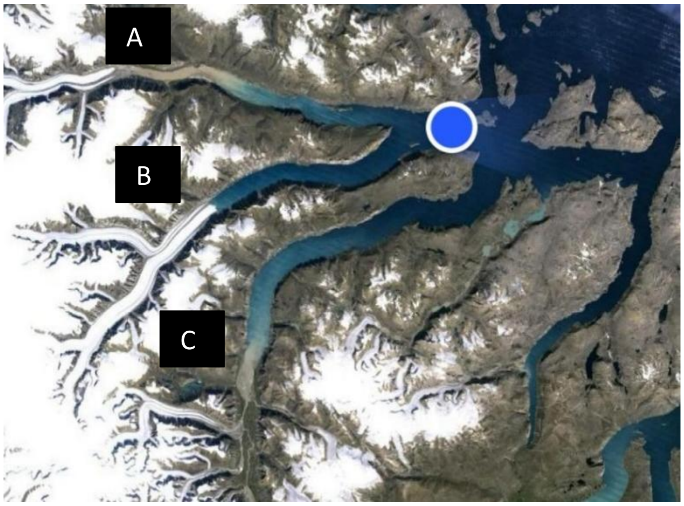

Figure 39-1: Google map of the three fjords sampled: A) Maqtaq Fjord, B) Coronation Fjord and C) North Pang Fjord during Leg 2b.

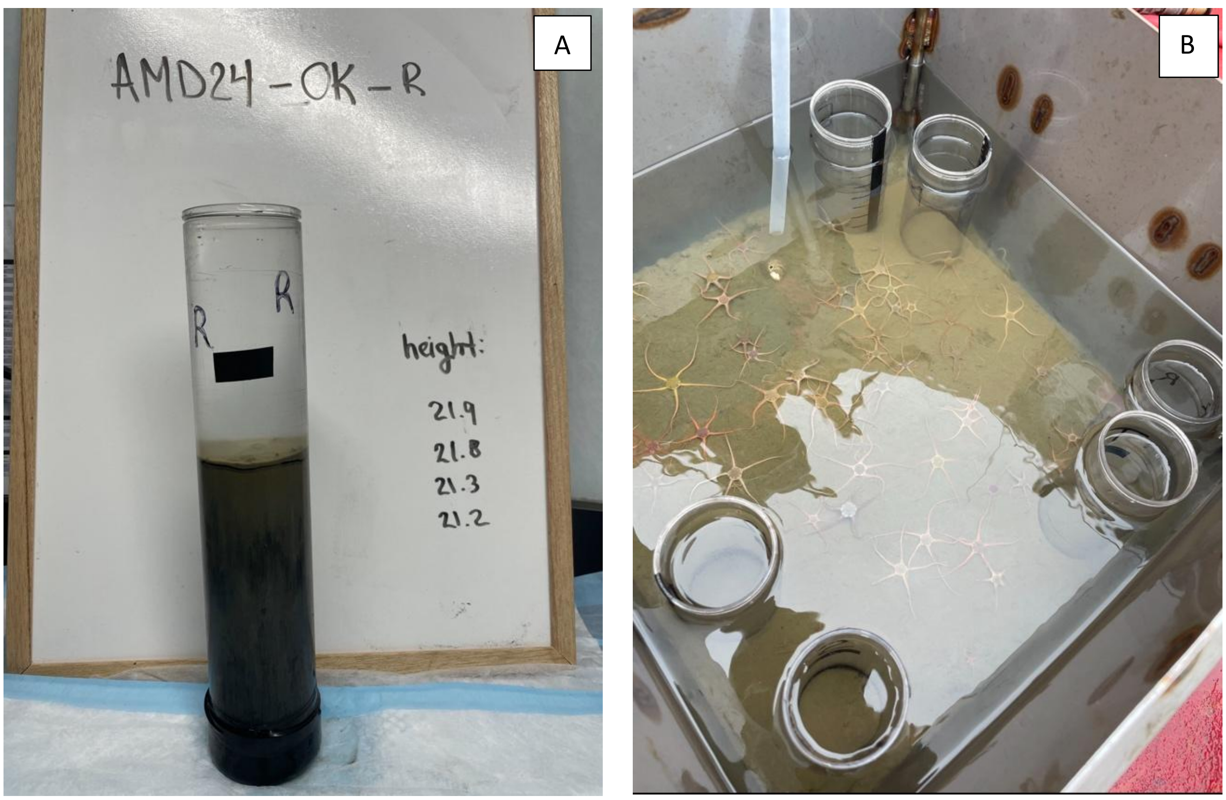

Figure 39-2: A core sampled at Okak (A) and a boxcore of sediment retrieved in Okak (B) (Leg 2a)

A) B) C)

Figure 39-3: Photos of a boxcores sampled from A) Maqtaq Fjord, B) Coronation Fjord and C) North Pang Fjord with overlaying water drained but still in core tubes (Leg 2b)

Table 39-1: Summary of all cores collected

Leg	Site	Latitude (N)	Longitude (W)	Depth (m)	# core	Flux	Pore-water	Microsensor/ CHN/ micro	Macrofauna samples
2a	MAK-M1-N	55.51494	58.93990	696	6	3	2	1	Camille (Laval)
	MAK-M1-F	55.43345	58.94017	706	6	3	2	1	Camille (Laval)
	MAK-M1-E	55.43522	58.94580	710	3	NA	2	1	NA
	MAK-M2-N	55.51376	58.93916	698	3	3	NA	NA	Camille (Laval)
	MAK-M2-F	55.51489	58.93805	697	3	3	NA	NA	Camille (Laval)
	OK	57.56950	62.04820	92	6	3	2	1	Silas (MUN)
	NV	59.08567	63.46928	210	6	3	2	1	Silas (MUN)
	RS	58.88754	62.49186	202	6	3	2	1	Silas (MUN)
2b	MQ (TCA-5.2)	67.33544	-64.6511	200.38	6	3	2	1	Camille (Laval)
	CF (TCA-5.3)	67.23000	-64.65742	223.35	6	3	2	1	Camille (Laval)
	NP (TCA-5.1)	67.09565	-64.65633	164.71	6	3	2	1	Camille (Laval)

39.2.2 *Flux incubations:*

For flux incubations sediment cores were collected in triplicate with approximately 20 cm of sediment and 15 cm of overlying water. All boxcores retained their overlaying water which was then collected with the sediment. Cores were placed in a water bath in the temperature controlled cold room. (see Figure 39-4A). The target temperature was 4°C, however temperature measurements in the water bath consistently read ~3.9°C which was a drastic improvement from last year where it was typically 5-7°C. Cores were left to sit for 12 hours. After 12 hours overlying water was exchanged with bottom water (~10m above bottom) collected from the CTD rosette. To exchange the bottom water a disk with the inner diameter of the sediment cores was cut from bubble wrap and placed on the water surface, this was to prevent resuspension of the sediment during syphoning off the overlying water and refilling the core liners- although sometimes the sediment was still mildly stirred. After this point the cores were capped to mark the beginning of the flux and stirred at ~60 rpm using motors with a magnetic coupler. Oxygen measurements were collected at 0, 2, 4, 8, 12, 16 and 24 hours using Fibox non-invasive oxygen dots (Pyroscience). Water sampling was conducted every 8 hours. Water samples were collected through sampling ports in the caps using a 60mL spring and water simultaneously replaced with a second syringe. Samples were collected in 11 mL exetainers for DIC analysis and 12 mL were collected for nutrient analysis (NO3-, NO2-, NH4+, PO43-, SiO2).

39.2.3 *Porewater chemistry:*

At all sites, cores were collected for the characterization of porewater chemistry. After collection porewater was extracted at 2 cm increments using Rhizon samplers (see Figure 39-4B). Extractions were performed in the temperature controlled cold room (~4°C), ideally immediately and always within 24 hours after core collection. After porewater collection, samples were sub-divided for analysis. Aliquots were taken for dissolved DIC, TA, dissolved nutrients (NO_{x^-}, NH_{4+}, PO_{43+}), Fe_{2+}, and H_2S. Fe_{2+} (fixed with Ferrozine reagent) and H_2S (fixed with zinc acetate reagent) subsamples were stored at ~4°C, while nutrient samples were frozen at -20°C until analysis. Samples will be analyzed post-cruise in Dr. Algar's laboratory at Dalhousie University.

39.2.4 *Microsensor Measurements:*

To determine oxygen penetration into the sediments, microsensor profiling was conducted using Clark Type electrodes (UNISENSE OX-100). Briefly, a 100 µm diameter oxygen electrode was lowered into the sediments at 100 µm increments using a programable stepper motor controlled using UNISENSE SensorTrace profiling software (Figure 39-4C). Oxygen profiling measurements were performed in the cold room (~4°C) at close to ambient in situ temperatures and the overlying water was bubbled with air to ensure 100% O_2 saturation. In each core four oxygen profiles were measured and will be combined to create an average profile and standard deviation. In years past this analysis has been difficult while the ship's thrusters are being used due to strong vibrations in the aft cold laboratories. This year to mitigate this issue these experiments were only done while transiting.

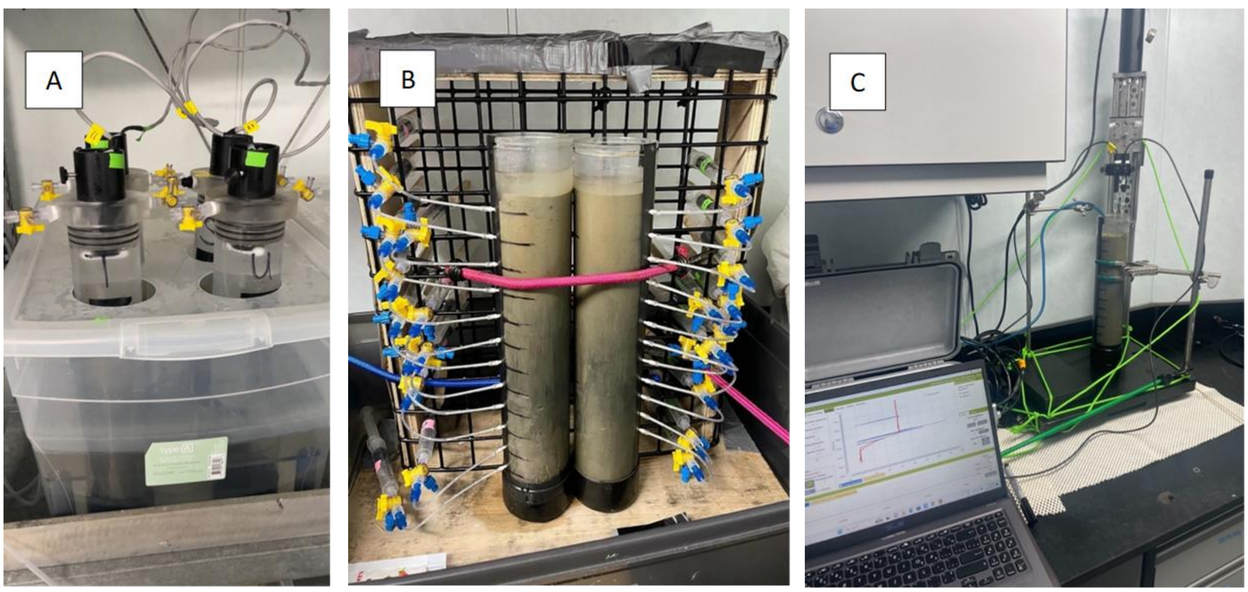

Figure 39-4: Flux incubation experiment setup demonstrating capped cores with spinning motors in a cool water bath (A). Porewater being extracted by rhizons and syringes every ~2 cm down the cores (B). Micro-profiling oxygen with our microsensor (C) with an example of the plot it generates. The horizontal spikes in oxygen on the plot occurred when the bow thruster was being used and the counters were shaking.

40 Microbial Baselines, Hydrocarbon Degradation, and Sulfate Reducing Bacteria

Project leaders: Casey Hubert[1] (chubert@ucalgary.ca)

Cruise participants – Leg 2a: Francesco Bisiach[1], Aidan Bender[1], Amelia Danzinger[1], Nidhi Patel[1], Ali Kasraian[1]

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40.1 Introduction and Objectives

Microbes play a vital role in all ecological niches on earth, driving biogeochemical cycles and occupying a large fraction of the food web (Falkowski et al., 2008; Moran 2015). It is hence very important to investigate microbial communities in the sub-Arctic marine regions to obtain a comprehensive overview of these ecosystems.

As climate change reduces the extent and duration of sea ice cover, shipping and industrial development in (sub)Arctic marine environments are expected to escalate, increasing the risk of oil and fuel spills in this extreme marine environment. Diesel re-supply to remote northern communities also poses a risk of spillage that could affect the marine environment. Microbial communities can be heavily impacted by the presence of oil, acting as indicators for post-spill changes in the environment. Moreover, microorganisms living in marine environments can act as nature's 'first responders' to oil spills possessing metabolic pathways to degrade toxic hydrocarbons into innocuous CO_2 (ZoBell 1946; Atlas 1981). Baseline data enhances the expedient understanding of the structure, diversity, and complexity of bacterial communities and their potential to respond to an oil spill (Angelova et al. 2021) or other environmental perturbations that would similarly provoke a re-organization of resident microbial communities. Therefore, understanding hydrocarbon-degrading populations within the marine microbiome is important with respect to (1) the potential that these microorganisms have to contribute to clean-up and mitigating the negative effects of oil spills, and (2) providing an environmental signature for the state of the ecosystem, i.e., the presence of or exposure to an input of hydrocarbons. This work can provide critical ecological and epigenomic insights (Beaulaurier et al. 2019) into the Arctic Ocean microbiome responses to environmental changes, contributing to our understanding of this essential ecosystem and its vulnerability to anthropogenic impacts.

The goal of Nunatsiavut Government's marine management project, Imappivut, is a community-driven marine planning in the coastal and marine zones of Nunatsiavut (Saunders and Hubert 2023). Imappivut uses a comprehensive approach to understanding the marine environment, including sequencing of marine microbiomes. A microbiome dataset for the region will allow for monitoring of changes in marine habitats undergoing chronic or acute disruptions, such as those resulting from climate change or oil spills (Saunders and Hubert 2023).

Our sampling and research objectives along the Nunatsiavut coast and beyond are:

a) to collect sediment samples to establish microbiological baselines to inform the Nunatsiavut Imappivut ocean management plan;

b) to filter seawater for the collection of (1) bacterial DNA, (2) picoeukaryote DNA and (3) viral DNA to obtain a complete overview of the microbial trophic levels in marine waters;

c) to establish microcosm experiments exposing sediment microbial communities to crude oil to simulate an oil spill and closely monitor their molecular and ecological responses during the initial stages of contamination, both in the presence and absence of nutrient enrichment;

d) to measure the activity of in situ sulfate reducing bacteria in the upper layers of sediment, both in the presence and absence of oil contamination.

e) Investigate the effects of high faunal biodiversity areas on the activity of microbial communities by measuring their sulfate reducing activity relative to distance from one of the "Makkovik Hanging Gardens" coral walls.

40.2 Methodology

40.2.1 *Water Sampling*

The CCGS *Amundsen* was equipped with a CTD-Rosette fitted with twenty-four 12 L Niskin bottles. Sensors on the CTD captured profiles of chlorophyll fluorescence, dissolved oxygen concentrations, water temperature, and salinity. Samples from the water column were taken at several depths from 13 sampling stations using the CTD-Rosette (Table 40-1). At each station, surface and bottom water were sampled, as well as an intermediate depth halfway to the seafloor. Additionally, a surface pump was deployed to collect true surface water in addition to the surface water from the Rosette, which corresponds to about 2 m below the sea surface. All samples were obtained in triplicate; i.e., three Niskin bottles from the rosette for each sampling depth, and the surface pump was used to fill three separate carboys.

Table 40-1: Water sampling locations during the 2024 expediton

Station	Date	Latitude (N)	Longitude (W)	Station depth (m)	Cast	Depths sampled (m)	Analyses
Hopedale Saddle	Jul 13	56.054	57.411	661	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						300	
						661	
Makkovik Hanging Gardens (M1-Near)	Jul 15	55.433	58.936	707	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						300	
						688	
Hopedale Shelf	Jul 17	55.432	58.945	226	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						100	
						190	

Sentinel	Jul 18	56.318	59.838	554	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						275	
						569	
Sentinel North	Jul 19	60.472	61.251	486	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						250	
						499	
Okak Bay	Jul 20	57.569	62.050	91	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						40	
						80	
Nachvak Fjord	Jul 22	59.085	63.468	208	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting and viral genomics
					CTD-Rosette	Rosette surface	
						100	
						191	
Ramah Shelf	Jul 22	58.887	62.491	205	Surface pump	True surface	Microbial DNA, Cell counting
					CTD-Rosette	Rosette surface	
						40	
						199	
Kangalaksiorvik Shelf	Jul 23	59.534	63.286	164	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						80	
						179	
Killinik 2	Jul 24	60.848	64.063	390	Surface pump	True surface	Microbial (including

					CTD-Rosette	Rosette surface	eukaryotic) DNA, Cell counting and viral genomic
						200	
						407	
DS_500_B2	Jul 26	65.535	59.607	500	Surface pump	True surface	Microbial DNA, Cell counting
					CTD-Rosette	Rosette surface	
						250	
						490	
DS_500_B1	Jul 26	65.446	58.444	500	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						250	
						486	
BB1_A	Jul 27			630	Surface pump	True surface	Microbial (including eukaryotic) DNA, Cell counting
					CTD-Rosette	Rosette surface	
						300	
						590	

40.2.2 *Sediment Sampling*

Surface sediment was collected at 18 different stations with three replicates per station using the box cores aboard the Amundsen (Table 40-2). Once the box core came back on deck, the overlying water was siphoned off and the surface sediment temperature was recorded. For each box core, ~2 mL of surface sediment (0-3 cmbsf) was collected using sterilized spatulas in two sets of triplicates into 2 mL cryovials and frozen at -80 °C. The first set is meant for metagenomic analyses, while the second set is meant for epigenetic sequencing using Nanopore technology. From some cores, an additional set of triplicate cryovials were collected for onboard sequencing analysis. ~15 mL 'bulk' surface sediment (0-3 cmbsf) was also collected into 50 mL conical tubes for microcosm incubations. From some sites, sub-cores were taken for radiotracer analysis. Two sets of duplicate plexiglass coring tubes (31 cm long, 29 mm diameter) with 27 holes sealed with silicone along one side were used to subsample from box cores while preserving stratigraphy. Where multiple box cores were scheduled for a site, only one of the box cores was sampled. Makkovik Hanging Gardens was an exception to the rule, where samples were collected from all three box cores within the “M1” transect.

Table 40-2: Sediment sampling locations

Station	**Date**	**Depth (cm)**	**Latitude (N)**	**Longitude (W)**	**Station depth (m)**	**Analyses**
Hopedale Saddle	Jul 13/24	0-3	56.066	57.460	273.86	Microbial DNA, Cell counting
Makkovik Hanging Gardens M1-Far	Jul 15/24	0-3	59.077	63.528	204.12	Microbial DNA, Cell counting, oil microcosm incubations
		0-25				Sulfate reduction cores
Makkovik Hanging Gardens M1-Near	Jul 16/24	0-3	58.149	62.777	254.17	Microbial DNA, Cell counting
		0-25				Sulfate reduction cores
Makkovik Hanging Gardens M1E	Jul 17/22	0-3	58.150	62.776	254.07	Microbial DNA, Cell counting, oil microcosm incubations
		0-25				Sulfate reduction cores
Hopedale Shelf	Jul 17/24	0-3	58.149	62.777	254.28	Microbial DNA, Cell counting
Sentinel	Jul 18/24	0-3	58.119	-63.001	130.45	Microbial DNA, Cell counting, oil microcosm incubations
		0-25				Sulfate reduction cores
Sentinel North	Jul 19/24	0-3	60.47196	-61.25127	479.11	Microbial DNA, Cell counting
Okak Bay	Jul 20/24	0-3	57.56955	-62.05035	92.11	Microbial DNA, Cell counting
Nachvak Fjord	Jul 22/24	0-3	59.08528	-63.4687	209.74	Microbial DNA, Cell counting, oil microcosm incubations

Ramah Shelf	Jul 22/24	0-3	58.88754	-62.49101	201.82	Microbial DNA, Cell counting
Kangalaksiorvik Shelf	Jul 23/24	0-3	59.5344	-63.28672	180.25	Microbial DNA, Cell counting
DS_500_B2	Jul 26/24	0-3	65.53555	-59.60715	488.37	Microbial DNA, Cell counting
DS_500_B1	Jul 26/24	0-3	65.44669	-58.4444	498.25	Microbial DNA, Cell counting
DS_600_A1	Jul 26/24	0-3	66.20043	-58.20814	624.52	Microbial DNA, Cell counting
BB1_A	Jul 27/24	0-3	67.76814	-59.04109	579.74	Microbial DNA, Cell counting

40.2.3 *Water filtering for prokaryotic DNA and cell counting*

A volume of 2 L of water collected in triplicate for each sampled depth (bottom, middle and surface) from the rosette and surface pump was aseptically vacuum filtered on two manifolds over 0.2 um filters (47 mm, Pall) using 250 mL disposable filter cups. The filters were then folded, stored in individual Whirl-Pak bags, and frozen at -80°C for future downstream analysis.

40.2.4 *Water filtering for eukaryotic DNA and cell counting*

The protocol utilized a bottle-top filter unit connected to a vacuum pump. A volume of 2 L of sea water collected in triplicate for each depth from the rosette and surface pump was filtered through a 47 mm 20 μm nylon membrane pre-filter and filtered once more through a 3.0 μm mixed cellulose ester (MCE) filter. Filter fractionation isolated nanoplankton microbial communities, primarily composed of protists (Caron et al., 2012), while excluding many prokaryotes and zooplankton. Captured biomass was preserved on the MCE filters using 500 μL of DNA/RNA Shield, preserving the nucleic acids. Filter discs were then stored at 4°C until high molecular weight (HMW) extraction and the subsequent generation of long-reads via Oxford Nanopore sequencing. Ultimately, hybrid assembly will be used to construct a targeted eukaryotic marker gene region (Goankar & Campbell, 2024). The curated genome assemblies will contribute to the growing database of protistan reference genomes available to researchers and add detail to the understanding of (sub)Arctic microbial diversity.

40.2.5 *Water filtering for viral analysis and microbial trophic levels*

Microbial trophic levels were separated from 20 L samples of CTD-Rosette bottom and surface water at Nachvak Fjord and Killinik. A Geopump Peristaltic Pump was used to filter each 20 L water sample through a series of filter units containing a 20 μm, 47 mm, nylon membrane filter, a 3 μm, 47 mm, polycarbonate and a 0.22 μm Sterivex filter unit. Each filter was stored at -80 ·C after the addition of 2.5 mL DNA/RNA Shield. Nucleic acids from these filters will be extracted and sequenced to determine the diversity of picoeukaryotes and prokaryotes present. The filtrate was saved and 2 mL of 10 g/L iron chloride was added to each 20 L sample. The iron chloride was used to flocculate the viruses to prevent them from passing though the filter (Poulos et al., 2018). After 1 hour of incubation at room temperature, the water was filtered using the same Geopump Peristaltic Pump through a 0.1 μm, 142 mm, polycarbonate membrane filter on top of a 0.8 μm, 142 mm, Supor support filter. The 0.1 μm polycarbonate membrane filter was stored at 4°C and the 0.8 μm Supor support filter was disposed. The nucleic acids will be extracted and sequenced to determine the viral diversity.

40.2.6 *Radiotracer experiments for sulfate reducing bacteria*

Aliquots of 150 kBq of 20 uL 35S-SO4 were injected through the holes of plexiglass cores tubes (31 cm long, 29 mm diameter) at 2 cm intervals. For half of the cores, each injection was followed by a 20 uL 0.1% crude oil injection through the same hole. The cores were incubated at 3°C temperature for 12 hours, after which the cores were sectioned into 2 cm sections and stored at -20°C in 20% zinc acetate (Jørgensen & Fenchel 1974). The sediment sections will be analyzed at the University of Calgary for the calculation of in situ sulfate reduction rates through cold chromium distillation ((Jørgensen & Fenchel 1974). These rates will be paired with geological and geochemical analyses performed on these sites by other groups present on the vessel.

40.2.7 *Oil microcosm sediment incubations*

For some sites, up to eight treatment groups were set up, comparing different concentrations of crude oil and different nutrient-amended media. From the box cores in Sentinel and Nachvak Fjord, 14 samples of ~10mL/15g surface sediment were obtained and placed in glass serum bottles to make triplicates of four treatments and two controls. An additional sediment-free control was prepared. The first two treatment groups contained 0.1 % crude oil and either only ambient seawater or ambient seawater amended with ammonium chloride and potassium phosphate. The third and fourth treatment group contained 0.01 % of crude oil with either ambient seawater or ambient seawater amended with Ammonium Chloride and Potassium Phosphate. Seven more microcosms were set up for the Sentinel site that included the same treatment groups as described above along with the addition of 320 kBq of 35S radiotracer solution to each bottle. An additional crude oil free control was prepared. Triplicate microcosms were only established for the treatment group with 0.1 % crude oil and ambient seawater amended with ammonium chloride and potassium phosphate and the 35S radiotracer solution. The concentrations of the Ammonium Chloride and Potassium Phosphate in each microcosm were 4.67 mM and 1.46 mM respectively. All microcosms were incubated at 4°C. Subsamples of slurry were taken on day 5, and day 10. Gas subsamples of ~10 mL were taken at day 10 to measure the oxygen depletion induced by bacteria in the microcosms. Downstream analyses include gas chromatography for gas composition assessments, cold-chromium distillations for the calculation of sulfate reduction rate in the radiotracer-spiked incubations (Jørgensen & Fenchel 1974), and DNA extractions for the evaluation of community composition and shifts.

40.3 Recommendations

Regularly equipping the box cores with a HiPAP beacon is beneficial as it allows us to more accurately determine the origin of the sediment samples. This practice should continue in the coming years

40.4 References

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41 Benthic Refuges: Developing monitoring strategies for marine refuges protecting sensitive benthic areas in the Eastern Canadian Arctic

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41.1 Introduction and Objectives

Marine Refuges are another Effective Area Based Conservation Measure (OECM) implemented under Canada's *Fisheries Act* that provide a complementary conservation tool to *Oceans Act* Marine Protected Areas for meeting Canada's marine conservation goals. In the Eastern Canadian Arctic, three Marine Refuges (the Disko Fan, Davis Strait, and Hatton Basin Conservation Areas), have been established to protect sensitive benthic areas hosting habitat-forming cold-water corals (e.g., sea pens, small and large gorgonians) and sponges. Associated benthic infauna in these areas also perform important ecosystem functions (e.g., carbon and nutrient cycling). Due to their remote location (100s km offshore), large area (7,485 – 42,459 km^2), wide bathymetric range (100s m to > 1000 m), and fragile nature of these slow-growing biogenic habitats, there is a need to develop efficient, cost-effective, and non-invasive techniques and identify relevant indicators for monitoring the ecological integrity of these areas. The Department of Fisheries and Oceans is responsible for leading the development of comprehensive monitoring plans for these areas in collaboration with rights-holders and stake-holders in the region. Monitoring frameworks should address the diversity, abundance, and distribution of corals, sponges, and other associated benthic fauna while also characterizing the habitat features and other environmental parameters relevant to their continued persistence.

During Leg 2a of the 2024 Amundsen Expedition, we carried out a number of survey operations at several benthic-focussed stations in Davis Strait and Disko Fan to characterize benthic habitats within or adjacent to the Marine Refuges in the Eastern Canadian Arctic. Our objectives for this cruise were to:

1) Collect data on the distribution, abundance, and diversity of corals, sponges and other benthic fauna in the Eastern Canadian Arctic for purposes of monitoring Marine Refuges.
2) Expand benthic imagery collections (Drop camera, ROV) to survey coral and sponge habitats, add to regional imagery guides for image and video annotation, and build training datasets for building 3D reconstructions of benthic habitats using photogrammetry techniques, characterize their structural complexity (cm scale), and developing machine learning classification workflows for benthic habitats and key taxa.
3) Collect eDNA water samples for a less invasive evaluation of benthic biodiversity and comparison with imagery collection methodologies.
4) Expand sampling effort in Hatton Basin and Davis Strait to characterize diversity of benthic infauna, sediment properties, and food supply (quantity, quality, and source).
5) Measure the carbonate saturation state and other carbonate chemistry parameters relevant for the growth and persistence of corals and other calcifying benthic organisms.

41.2 Methodology

On Leg 2a, seven benthic stations were sampled in Davis Strait and Baffin Bay with a narrower set of survey operations focused on the benthos. These stations were located within or adjacent to the Davis Strait and Disko Fan Conservation Areas: Davis Strait 2024, DS-500-B1, DS-500-B2, DS-600-A1, BB1-A-600, Disko-BC (In and Out). It was hoped that additional benthic stations could be sampled in the Davis Strait, the Disko Fan bamboo coral forest, and the northwest arm of Hatton Basin Conservation Area. However, time, weather, or sea ice constraints limited the number of stations that could be accomplished this year.

At each station, seafloor imagery was collected using either ROV ASTRID (Davis Strait 2024, BB1-A-600; Figure 41-1) or the drop camera system (DS-500-B1, DS-500-B2, DS-600-A1, Disko-BC-In, Disko-BC-Out; Figure 41-1B). Details on methods and preliminary results of ROV and drop camera operations can be found in other sections of this report (sections 42 et 43). ROV operations included dedicated video transects that will be used to develop 3-D photogrammetry models of the coral and sponge habitat at those sites and describe their structural complexity. Imagery and video will also be used to characterize the abundance and diversity of corals and sponges at these sites and build training datasets for developing machine learning classification and object recognition workflows to streamline analysis of benthic habitats and key taxa in the future.

Water sampling was conducted at 5 of the benthic stations using the CTD-Rosette (Davis Strait 2024, DS-500-B1, DS-500-B2, DS-600-A1, and BB1-A-600; Figure 41-1C). Water sampling included triplicate bottom samples for evaluation of benthic biodiversity using eDNA (described in detail in section 26) as well as profiles at standard sampling depths throughout the water column to characterize the carbonate chemistry, saturation state, and saturation horizon (described in detail in section 7). Environmental DNA provides a less invasive alternative for monitoring benthic biodiversity, while the carbonate chemistry data will be relevant for monitoring impacts of ocean acidification on biocalcifiers such as cold-water corals.

To characterize diversity of benthic infauna, sediment properties, and food supply (quantity, quality, and source), we conducted 3 boxcores (Figure 41-1D) in Davis Strait. Planned boxcore operations at additional sites in Davis Strait and Hatton Basin were unfortunately cancelled due to time and weather constraints and will be re-visited in another year. A fourth boxcore was collected by DFO Arctic Team at Killinek to provide benthic diversity data relevant for the proposed Torngat Area of Interest. On recovery of the boxcore, overlying water (if present) was carefully drained while minimizing disturbance to the surface layer. The boxcore surface was then photographed before removing larger epifauna, which were subsequently placed in larger Whirlpak bags and frozen for later identification (-20 °C). Half the 50 cm by 50 cm core was reserved for collection of surface sediment samples. To measure grain size distribution, a syringe core (60 mL) was used to collect sediment from the top 5 cm. To evaluate food quantity, quality, and potential sources available to the benthos, 60 mL syringe cores were also used to collect sediment samples from the top 1 cm of sediment for later analysis of organic matter content, total organic carbon, and stable isotopes. Grain size, organic matter, and stable isotope samples were placed in small Whirlpak bags and frozen (-20 °C). Triplicate samples from the top 1 cm were also collected using smaller 10 mL syringe cores, placed in Whirlpak bags, wrapped in tinfoil, and frozen at -80 °C for analysis of concentration of chlorophyll and other phaeopigments. The remaining half of the core was reserved for measuring infauna abundance and diversity. Sediments were collected to a depth of 20 cm (or to the depth of hard-packed clay if shallower) and placed in plastic buckets. The depth of sediment collected and estimated volume were recorded. Subsequently, bulk sediments were sieved on board and the sieved residue preserved and stored in 1 L Nalgene bottles with a 10% seawater-formalin solution buffered with Sodium Tetraborate. Due to the coarse grain size of the Davis Strait sediments, samples were fractionated on 2 mm, 1 mm, and 500 μm sieves. The sample from Killinek consisted of larger pieces of gravel and cobbles. Therefore, syringe cores could not be collected, and the entire sample was sieved over a large mesh size (2 mm). Cobble and gravel pieces were then individually photographed. All pieces and retained biota were placed in a large bag and frozen (-20 °C).

41.3 Preliminary results

The substrate and biota observed at the Killinek boxcore site was similar to the brief glimpses of the bottom obtained at the drop camera location ~2.5 nm to the north. The substrate was dominated by cobbles and large gravel pieces (Figure 41-2A). The types of fauna (encrusting or low profile) and their distribution (on both top and bottom of cobbles) were indicative of a high-energy hydrodynamic environment (Figure 41-3). Located near the outflow of Hudson Strait, the Killinek area experiences very high tidally-influenced currents. The fauna comprised agglutinated and non-agglutinated worms, encrusting bryozoans, hydroids, brittle stars, chitons, encrusting and small club-shaped sponges (Figure 41-3).

The substrate at the three Davis Strait benthic stations was composed mainly of muddy sand with aggregations of large tubular foraminifera at the surface (Figure 41-2A-C). Gravel and occasional cobbles were also present below the surface. Therefore, it was challenging to recover a fully intact sediment grab, leading to slumping cores at DS-500-B1 and DS-500-B2 (Figure 41-2B-C). Surface samples cannot therefore be considered undisturbed at these sites.

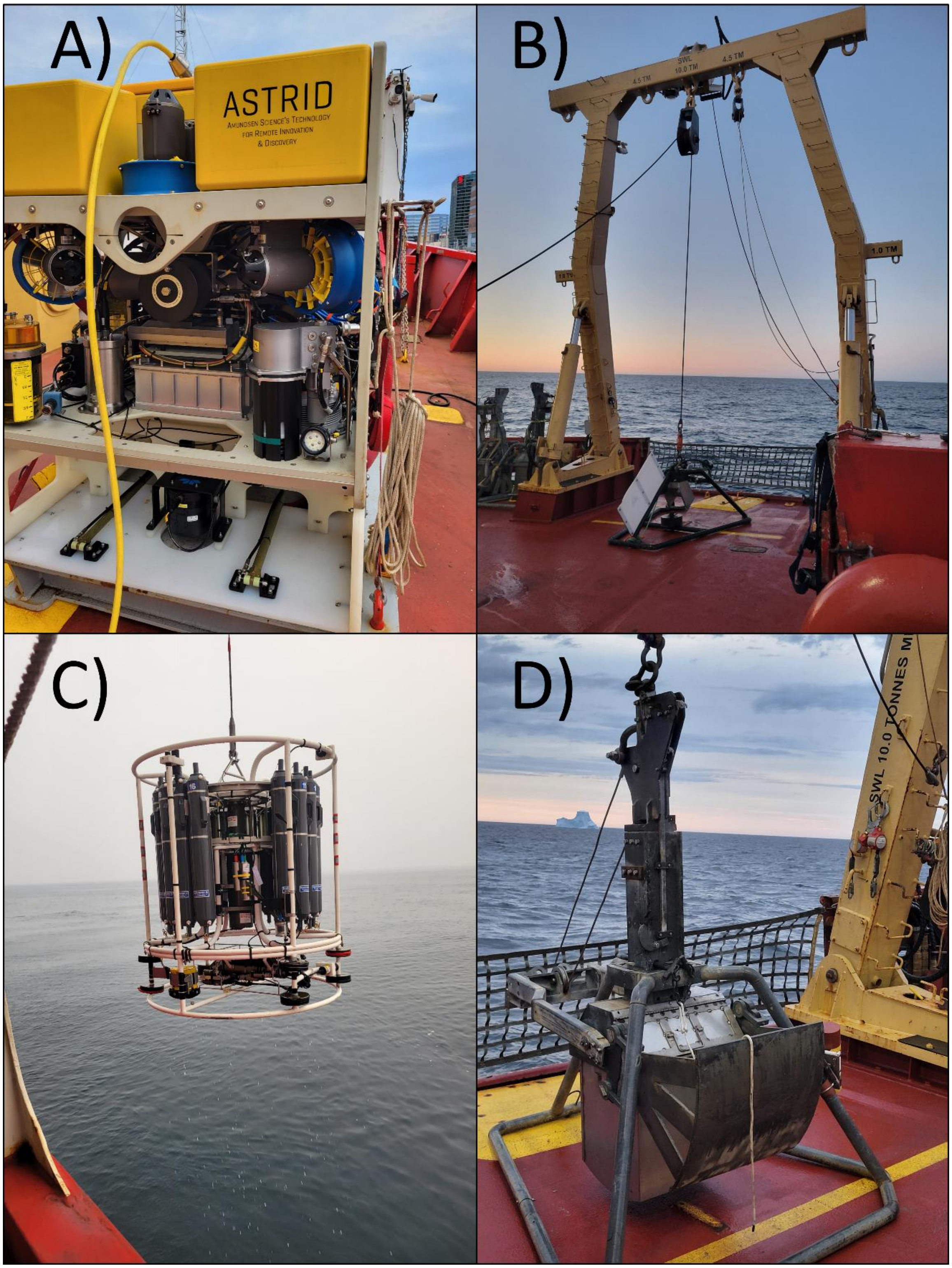
A)
B)
C)
D)
ASTRID
AMUNDSEN SCIENCE'S TECHNOLOGY
FOR REMOTE INNOVATION
& DISCOVERY
SWL
10.0 TM
4.5 TM
4.5 TM
1.0 TM

Figure 41-1: Primary operations conducted at benthic stations in Davis Strait and Baffin Bay on Leg 2a: A) ROV, B) Drop camera, C) CTD-Rosette, D) Boxcore.

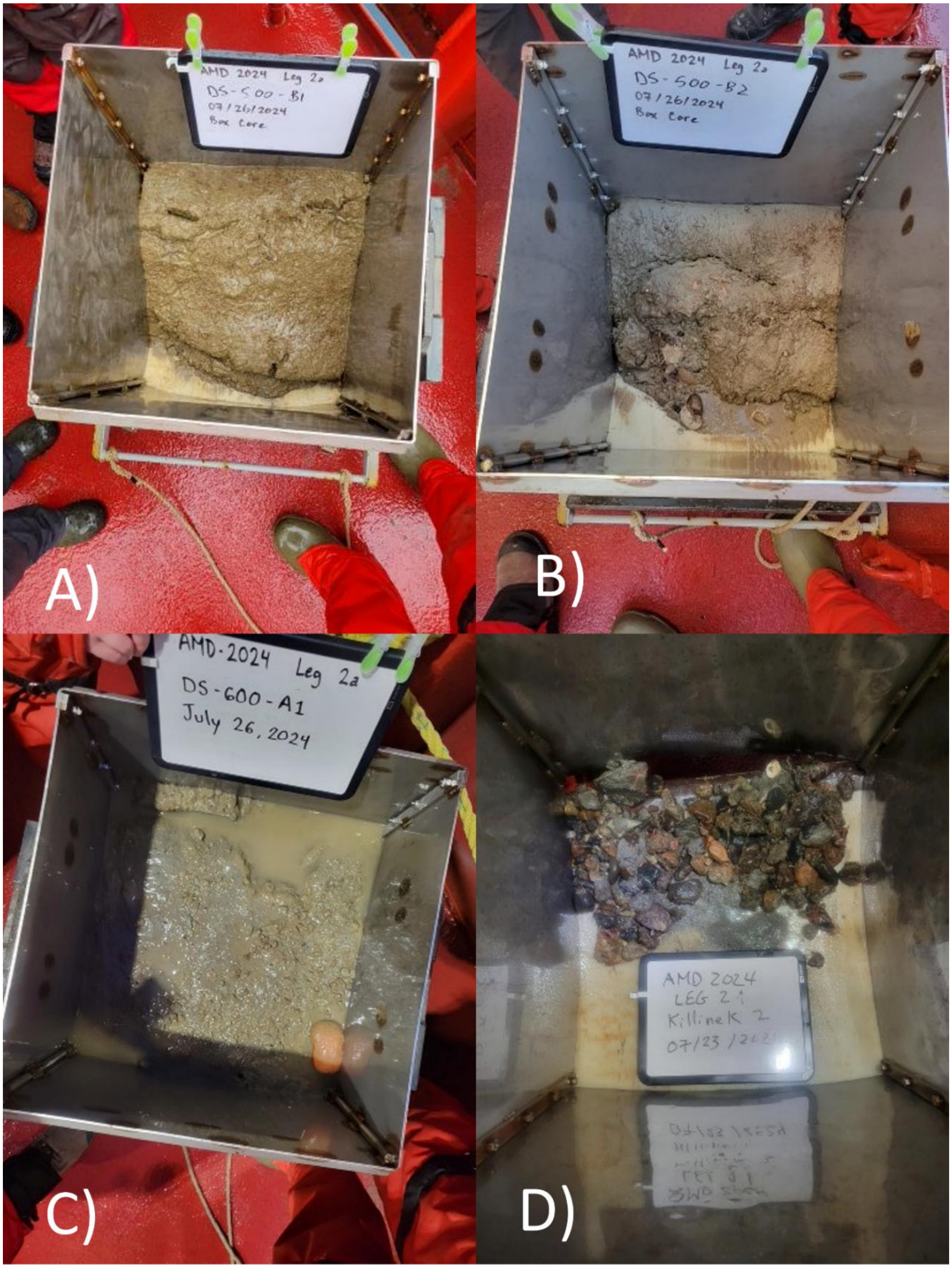
A)
AMD 2024 Leg 2a
DS-500-B1
07/26/2024
Box Core
B)
AMD 2024 Leg 2a
DS-500-B2
07/26/2024
Box Core
C)
AMD-2024 Leg 2a
DS-600-A1
July 26, 2024
D)
AMD 2024
Killinek 2

Figure 41-2: Surface photographs of the boxcores collected by DFO-Arctic team during Leg 2a for benthic stations at A) DS-500-B1, B) DS-500-B2, C) DS-600-A1, D) Killinek 2.

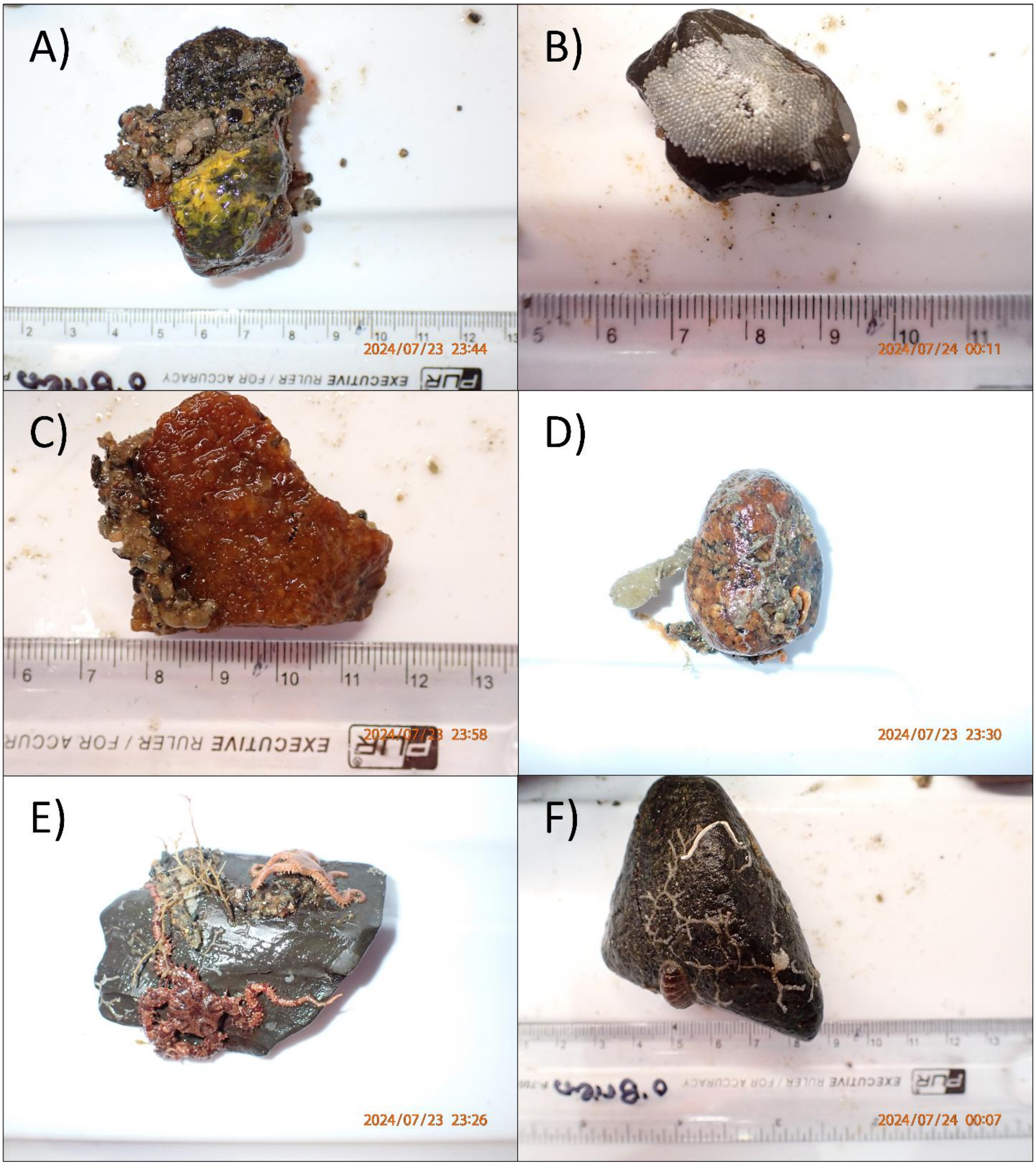

Figure 41-3: Representative examples of benthic biota observed from Killinek 2 boxcore sample. A) Agglutinated worms at encrusting sponge, B) Encrusting bryozoan, C) Agglutinated worm, D) Encrusting bryozoans, bladder-like club-shaped sponge, hydroids, agglutinated bryozoans

41.4 Recommendations

- There is quite a bit of corrosion in the clean seawater line in the Benthic Lab. This may be an issue that it is not possible to address without a major retrofit of the plumbing, but should be noted.
- The rotating spray arm on the Benthic Solutions auto-siever did not consistently move with the applied water pressure as it should and may require repair or trouble-shooting.
- The addition of an attachment point for securing a HiPaP beacon to the boxcore frame was a welcome addition this year, making deployment easier compared with attaching the beacon to the winch line. Something similar may be considered for the drop camera in the future.
- The door to the Benthic Lab must be propped up to use the seawater hose while sieving sediments. At present, this is can only be accomplished with the improvised use of tie-down straps or bungees. It would be safer if a dedicated latch or hook could be installed to prevent the door from swinging in heavier seas.

42 Deep-water benthic habitat Remotely Operated Vehicle (ROV) surveys

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42.1 Introduction and Objectives

Remotely Operated Vehicle (ROV) operations in 2024 aimed to complement the suite of operations planned as part of the Imappivut marine planning program (Coalescing Research in the Labrador Sea and Nunatsiavut Coast to Support the Imappivut Marine Planning Initiative) led by the Nunatsiavut Government. The ROV ASTRID (Amundsen Science) is equipped with two 7-function manipulator arms, and a suit of accessories for sampling imagery, benthic fauna, water, and sediment samples. This year our general objective was to video-survey and sample at six main locations in coastal Labrador, northern Labrador Sea, and Baffin Bay (Figure 42-1): Makkovik Bank, The Sentinel, Killinek, HT-Arm-1200 (Hatton Basin), Davis Strait, and Disko Fan. Several different programs benefited from ROV collected data and are described in other chapters of this cruise report (e.g., Sections 39 and 40). During the ROV dives we acquired HD and 4K video data on the occurrence, distribution and abundance of bottom types, corals, sponges, other invertebrates and fish. We also collected biological samples of various benthic invertebrates using the ROV manipulator arm, scoop, and suction sampler, collected high resolution underwater images, and made observations on fauna behavior.

42.2 Methodology

A total of 4 ROV dives took place at 4 sites (Table 42-1, Figure 42-1). Overall, the ROV (Figure 42-2) performed well and HD and 4K imagery (videos, photos), as well as 67 biological and seawater samples were collected (Table 42-2). Biological samples were shared by DFO-NL (B. Neves), DFO-Arctic (J. O'Brien), and MUN (E. Edinger) and photographed, subsampled for DNA analysis (preserved in 100% ethanol or RNAlater), preserved in 10% formalin or 70% ethanol, and/or frozen at -20°C and -80°C depending on objectives.

Table 42-1: ROV dive operation durations during Leg 2a of the 2024 Amundsen expedition

Dive	Location	Station	Date	Ops duration[1]	Bottom time	Status[2]	Originally planned
51	Makkovik	M1	7/15/2024	7:05:05	5:29:13	A	Yes
NA	Makkovik	M2	C	C	C	C	Yes
NA	Makkovik	M3	C	C	C	C	Yes
52	The Sentinel	The Sentinel	7/18/2024	4:23:31	2:51:32	A	Yes
NA	Killinek	Killinek	C	C	C	C	Yes
NA	Hatton Basin	HT-Arm-1200	C	C	C	C	Yes
NA	Davis Strait	Davis Strait 2021	C	C	C	C	Yes
53	Davis Strait Conservation Area	Davis Strait 2024	7/25/2024	5:03:53	3:13:53	A	Alt[3]
NA	Disko Fan Conservation Area	Disko Fan	C	C	C	C	Yes
54	Disko Fan Conservation Area	BB1-A-600	7/27/2024	7:46:32	6:16:52	A	No

[1]Deck to deck; [2]Status A = accomplished, C = canceled; [3]An alternative dive location identified during expedition planning.

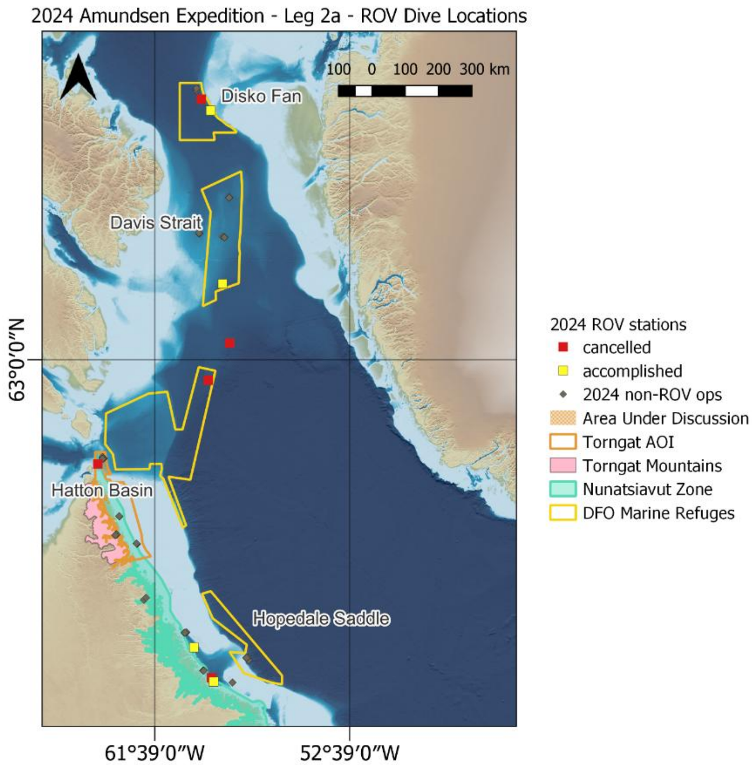

Figure 42-1: General stations surveyed during the 2024 Amundsen expedition.

Figure 42-2: ROV ASTRID deployed during Leg 2a of the 2024 CCGS Amundsen expedition.

Table 42-2: List of ROV samples collected during Leg 2a of the 2024 Amundsen expedition.

Time	Number	Identifier	Method	Description	Latitude (N)	Longitude (W)	Depth (m)
7/15, 13:08	R51-1	coral	arm	*Primnoa*	55° 26.0274′	58° 56.0646′	439
7/15, 13:12	R51-2	sponge	arm	*Plicatellopsis*	55° 26.0274′	58° 56.0646′	438.9
7/15, 13:16	R51-3	coral	arm	*Duva*	55° 26.0304′	58° 56.0616′	437.5
7/15, 13:50	R51-4	coral	arm	*Primnoa*	55° 26.0436′	58° 56.091′	529.7
7/15, 13:53	R51-5	sponge	arm	*Plicatellopsis*	55° 26.0436′	58° 56.0922′	529.3
7/15, 14:06	R51-6	coral	arm	*Paragorgia*	55° 26.0454′	58° 56.0964′	553.7
7/15, 14:13	R51-7	Coral- sponge	arm	*Primnoa and Plicatellopsis*	55° 26.0472′	58° 56.0952′	552.6
7/15, 14:20	R51-8	sea star	arm	*Novodinia*	55° 26.049′	58° 56.0952′	558.5
7/15, 14:48	R51-9	sponge	arm	*Plicatellopsis*	55° 26.0472′	58° 56.1006′	587
7/15, 14:51	R51-10	coral	arm	*Primnoa*	55° 26.0478′	58° 56.1006′	586.7
7/15, 15:16	R51-11	coral	arm	*Primnoa*	55° 26.0448′	58° 56.1108′	623.9
7/15,15:27	R51-12	sponge	arm	*Cladorhiza*	55° 26.046′	58° 56.1162′	635.1
7/15,15:30	R51-13	sponge	arm	*Plicatellopsis*	55° 26.0466′	58° 56.1162′	635.2
7/15, 15:34	R51-14	coral	arm	*Duva*	55° 26.0448′	58° 56.1144′	633.2
7/15, 15:36	R51-15	sponge	arm	*Polymastia*	55° 26.0454′	58° 56.115′	633.3
7/15, 16:02	R51-16	worm	suction	worm	55° 26.0406′	58° 56.1204′	672.1
7/15, 16:04	R51-17	sea star	arm	*Hippasteria*	55° 26.04′	58° 56.1186′	671.9
7/15, 16:13	R51-18	sea star	arm	*Tremaster mirabilis*	55° 26.0406′	58° 56.1192′	671.3
7/15, 16:25	R51-19	sea star	arm	*Tremaster mirabilis?*	55° 26.0436′	58° 56.1168′	651.5
7/15, 16:37	R51-20	sea anemone	arm	sea anemone	55° 26.0448′	58° 56.1072′	621.4
7/15, 16:39	R51-21	sea star	arm	*Tremaster mirabilis?*	55° 26.046′	58° 56.1066′	621.8
7/15, 16:42	R51-22	sponge	arm	*Plicatellopsis*	55° 26.0466′	58° 56.1078′	621.8
7/15, 16:48	R51-23	sea star	arm	*Tremaster mirabalis?*	55° 26.0436′	58° 56.1024′	600
7/15, 16:56	R51-24	sea anemone	arm	sea anemone	55° 26.0442′	58° 56.0892′	576.3
7/15, 16:59	R51-25	coral	arm	Dead *primnoa* and live sea anemone	55° 26.0436′	58° 56.0886′	575.8
7/15, 17:10	R51-26	sea anemone	arm	sea anemone	55° 26.043′	58° 56.0868′	562
7/15, 17:13	R51-27	coral	arm	soft coral	55° 26.0424′	58° 56.0874′	561.9
7/15, 17:19	R51-28	sea water	niskin	550 m	55° 26.0424′	58° 56.0886′	549.7
7/15, 17:19	R51-28	sea water	niskin	550 m	55° 26.0424′	58° 56.0892′	550
7/15, 17:21	R51-30	sea star	arm	*Tremaster mirabilis*?	55° 26.0412′	58° 56.0874′	547.4
7/15, 17:35	R51-31	hydroid	arm	hydroid? tube worm?	55° 26.0406′	58° 56.0754′	501.3
7/15, 17:43	R51-32	sea star	arm	*Hippasteria*	55° 26.0406′	58° 56.0772′	488.4
7/15, 17:52	R51-33	sea star	arm	*Tremaster mirabilis?*	55° 26.0376′	58° 56.0694′	463.8
7/18, 23:34	R52-2	kelp	arm	detritus	56° 19.1928′	59° 50.2218′	573.2

Time	Number	Identifier	Method	Description	Latitude (N)	Longitude (W)	Depth (m)
7/25, 13:46	R53-1	sea star	arm	*Novodinia*	64° 32.8206′	58° 31.2612′	702.3
7/25, 14:06	R53-2	coral	arm	*Stauropathes*?	64° 32.8236′	58° 31.2816′	700.4
7/25, 14:19	R53-3	coral	arm	*Flabellum*	64° 32.8284′	58° 31.3002′	700.4
7/25, 14:24	R53-4	brittle star	arm	*Ophiomusa*?	64° 32.8296′	58° 31.3044′	701.6
7/25, 14:35	R53-5	coral	arm	*Acanella*	64° 32.8374′	58° 31.3398′	699.8
7/25, 14:41	R53-6	coral	arm	*Acanella* with sponge	64° 32.8416′	58° 31.3476′	699.6
7/25, 15:19	R53-7	coral	arm	*Umbellula*	64° 32.8482′	58° 31.3656′	698.7
7/25, 15:22	R53-8	sea water	niskin	691 m	64° 32.8404′	58° 31.3734′	691.1
7/25, 15:22	R53-8	sea water	niskin	691 m	64° 32.8404′	58° 31.3734′	691.1
7/27, 17:06	R54-1	sea water	niskin	644.2 m	67° 46.323′	59° 4.125′	644.2
7/27, 17:07	R54-1	sea water	niskin	644.2 m	67° 46.323′	59° 4.1244′	644.2
7/27, 17:10	R54-3	sea star	arm	*Novodinia*	67° 46.323′	59° 4.1238′	644.2
7/27, 17:15	R54-4	coral	arm	dead *Acanella* skeleton	67° 46.3242′	59° 4.125′	644
7/27, 17:22	R54-5	coral	scoop	dead *Flabellum*	67° 46.3248′	59° 4.1238′	644.2
7/27, 17:26	R54-6	coral	scoop	dead *Acanella* skeleton	67° 46.3242′	59° 4.125′	644.1
7/27, 17:37	R54-7	coral	arm	Acanthogorgiidae?	67° 46.3278′	59° 4.1262′	643.4
7/27, 17:52	R54-8	sea anemone	arm	purple, unknown species	67° 46.3224′	59° 4.1454′	644.4
7/27, 17:56	R54-9	sponge	arm	glass sponge (frilly, gray); *Asconema*?	67° 46.323′	59° 4.1466′	644.6
7/27, 18:03	R54-10	sponge	arm	arborescent sponge; *Lissodendoryx*?	67° 46.3224′	59° 4.1442′	644.3
7/27, 18:05	R54-11	sponge	arm	globular glass sponge; unknown species	67° 46.323′	59° 4.1448′	644.3
7/27, 18:10	R54-12	sponge	arm	white chimney sponge on brown sponge	67° 46.3224′	59° 4.1454′	644.4
7/27, 19:40	R54-13	coral	suction	*Heteropolypus*?	67° 46.5354′	59° 3.1782′	590.4
7/27, 19:51	R54-14	bryozoan	arm	bryozoan or possible stylasterid coral	67° 46.542′	59° 3.1596′	587.5
7/27, 20:04	R54-15	bivalve	arm	Bright red mantle; *Acesta*?	67° 46.5318′	59° 3.1206′	584.6
7/27, 20:22	R54-16	coral	arm	*Paragorgia*	67° 46.485′	59° 3.0174′	583.1
7/27, 20:32	R54-17	urchin	arm	urchin with kelp detritus	67° 46.4754′	59° 2.9934′	582.2
7/27, 20:38	R54-18	coral	arm	black coral; *Bathypathes*?	67° 46.4754′	59° 2.9874′	581.8
7/27, 20:59	R54-19	coral	arm	Acanthogorgiidae?	67° 46.4286′	59° 2.9106′	582.3
7/27, 21:41	R54-20	sponge	arm	white fan-shaped sponge	67° 46.3134′	59° 2.7912′	583.9
7/27, 21:51	R54-21	coral	arm	*Paragorgia*	67° 46.3056′	59° 2.7858′	586

42.3 Preliminary Results

42.3.1 *Dive 51. Makkovik Trough (July 15th, 2024)*

This dive is associated with the rosette cast 007. The dive was planned to start at 6 am Québec time, but ROV launch was at 7:20 am. ROV altitude did not work for part of this dive. Six Star-Oddi loggers were deployed during this dive (Table 42-3).

This site was video-surveyed in 2023 during dive ASTRID C0038 and description of the fauna can be found in the 2023 report (2023 Expedition | Amundsen Science). The dive lasted seven hours (5:30 hours on the seafloor). It started at 430 m depth, at the position originally identified to represent the end of the dive (Table 42-3). We have changed the start position to deploy three 3D printed corals on top of the wall (i.e., deploying them as the first dive activity). The three corals were deployed near and on a boulder identified in 2023 with a large *Primnoa resedaeformis* colony on it (Figure 42-4). In addition, the first logger (white, S13134) was deployed on this *P. resedaeformis* at 438 m. Finally, three samples were collected here: *P. resedaeformis*, *Duva florida*, and a sponge, likely *Plicatellopsis bowerbankii* (Figure 42-4).

Once these deployments were completed, we proceeded transiting to the original start position. But because the ROV could stay close to the wall (as opposed to flying off-bottom), we proceeded with logger deployment and sampling downslope. At 530 m we stopped to deploy the second logger (green, S13132) on another *P. resedaeformis* colony (on the wall) (Figure 42-4), and a fragment of this colony was also sampled. We continued descent and deployed additional loggers on corals along the wall at 553 m (on a colony of *Paragorgia arborea*), 587 m, and at 624 m (Table 42-3). Once we reached the bottom of the wall (at 672 m), we deployed the last logger directly on soft sediment (black, S13135). A worm was collected here using the ROV suction sampler (new tool in 2024; Figure 42-4), as this unidentified worm is often observed in underwater images in this region.

Since there was still time during the dive, we started ascent again to collect additional specimens along the wall. A total of 33 samples were collected during this dive, including 31 invertebrates and two Niskin bottles (Table 42-2). After being brought back on deck, samples were photographed and preserved frozen (-20°C, -80°C) and/or in 100% ethanol for stable isotopes, lipids/fatty acids, and DNA barcode analyses, respectively.

Table 42-3: List of Star-Oddi loggers deployed during dive 51 (Makkovik) and dive 52 (The Sentinel).

Site	Logger ID	Color	Host	Location	Latitude (N)	Longitude (W)	Depth (m)
Makkovik	S13129	red	*Primnoa* coral	Wall	55.43406	58.9352	623.8
	S13131	yellow	*Primnoa* coral	Top of wall	55.43412	58.935	587.3
	S13132	green	*Primnoa* coral	Wall	55.43406	58.9349	529.2
	S13134	white	*Primnoa* coral	Wall	55.43378	58.9344	438.4
	S13135	black	seafloor	Base of wall	55.43398	58.9353	671.6
	S13136	red-black	*Paragorgia* coral	Wall	55.43409	58.9349	553.2
Sentinel	S13133	blue	seafloor	Top of wall	56.31997	59.8384	558.2
	S13137	green	*Primnoa* coral	Top of wall	56.32076	59.8385	529.5
	S13138	pink	*Primnoa* coral	Wall	56.31996	59.8384	560.2

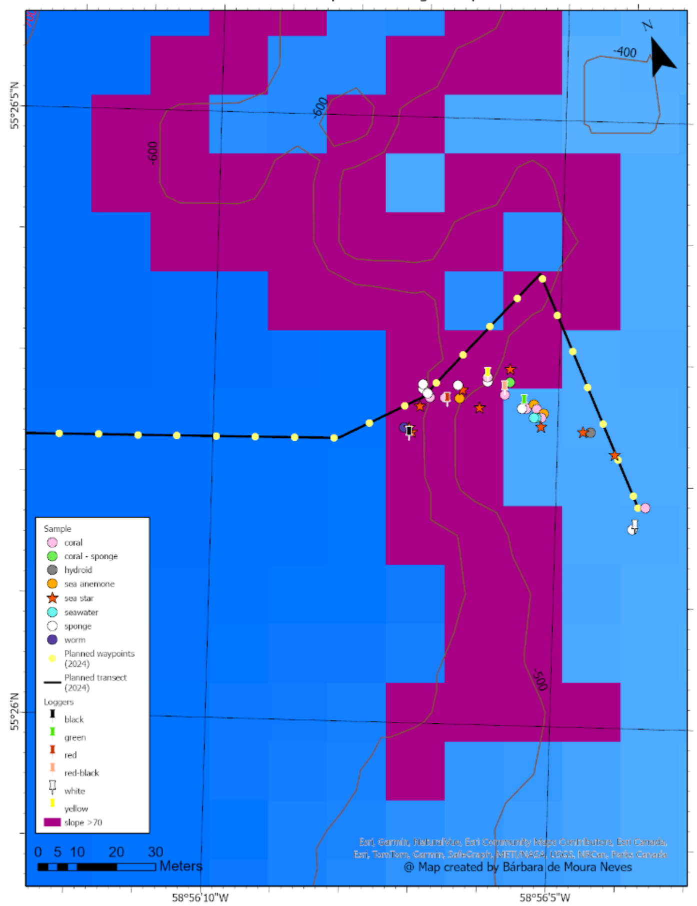

Figure 42-3: Path of accomplished ROV dive 51 at Makkovik Trough in relation to planned transect line, samples and loggers deployed during the dive.

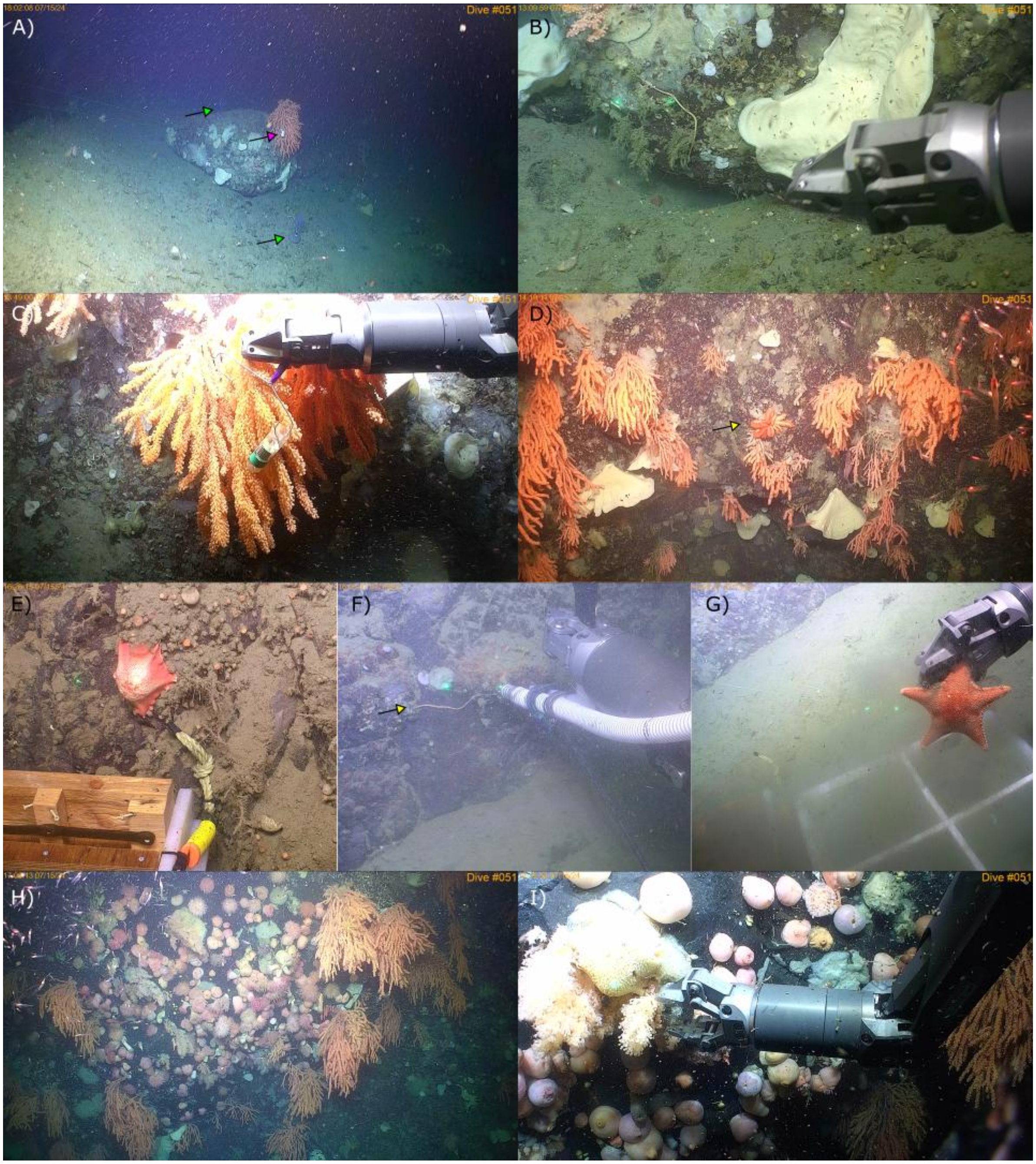

Figure 42-4: Seafloor images obtained during ASTRID dive 51 off Makkovik. A) boulder with Primnoa resedaeformis where first logger was deployed and location of three 3D-printed corals, B) sponge being sampled near same P. resedaeformis colony, C) logger being deployed on P. resedaeformis on wall, D) overview of wall with abundant P. resedaeformis and sponges (likely Plicatellopsis bowerbankii) and sea star sampled (likely Novodinia americana, arrow), E) sea star Tremaster mirabilis being sampled, F) worm (see arrow) being sampled using the suction sampler, G) sea star Hippasteria

sp. being sampled at base of wall, H) mix of corals and sea anemones, G) soft coral being sampled. Distance between green laser points is 10 cm.

42.3.2 *Dive 52. The Sentinel (July 18th, 2024)*

This dive had a duration of 2:50 hours on the bottom, but ~4:25 deck to deck. Dive started near waypoint 11 of the original dive plan, at 532 m (Figure 42-5). The ROV landed in front of a boulder with a large *Paragorgia arborea* colony (Figure 42-6), and because the ROV had lost navigation during descent, we waited ~7 minutes on the seafloor before transiting to the planned start position (waypoint 11 of original plan). Once we arrived at waypoint 11 we assessed the area for the presence of the large gorgonians *P. resedaeformis* and *P. arborea*, but since these were not seen we moved to the drop camera waypoint 3 surveyed earlier that day (not ROV waypoint 3). Although the specific position of the corals seen during the drop camera deployment was not known, waypoint 3 seemed like a site with potential because it was where the drop camera was recovered with a piece of *P. resedaeformis* on it (see Section 8). During this transit a variety of sponges (including large individuals), soft corals, sea anemones, sponges (some relatively large), and dense zoanthids were observed, but no large corals (Figure 42-6). When the first *Primnoa* was located on a boulder on a flat area, we deployed one of the Star Oddi loggers directly on it (Table 42-3, Figure 42-6). Because no high coral abundances were seen at this location neither, we decided to transit to the high slope area identified in the original dive plan.

Upon arrival we identified a cliff with high densities of *P. resedaeformis* (Figure 42-6) in addition to large colonies of *P. arborea* (>1 m wide). We spent the dive exploring the wall laterally and took the opportunity to zoom in on colonies to observe them in detail (Figure 42-6). Another logger was deployed on a *Primnoa* colony along the wall (560 m), and the last logger was deployed on the top of the bank at 558 m (Figure 42-3).

Redfish (*Sebastes* sp.) were often seen in the vicinities of corals and often in very close proximity to them (Figure 42-6). One unidentified invertebrate was observed and a small fragment was collected using the ROV arm and suction sampler for DNA analysis. Although during the dive we believed it to be a crinoid, post-dive research indicates the possibility of the organism being a colonial hydroid, which will be confirmed upon examination in the lab and result of DNA analysis. Kelp detritus was noted during the dive, and one fragment was also collected (J. O'Brien).

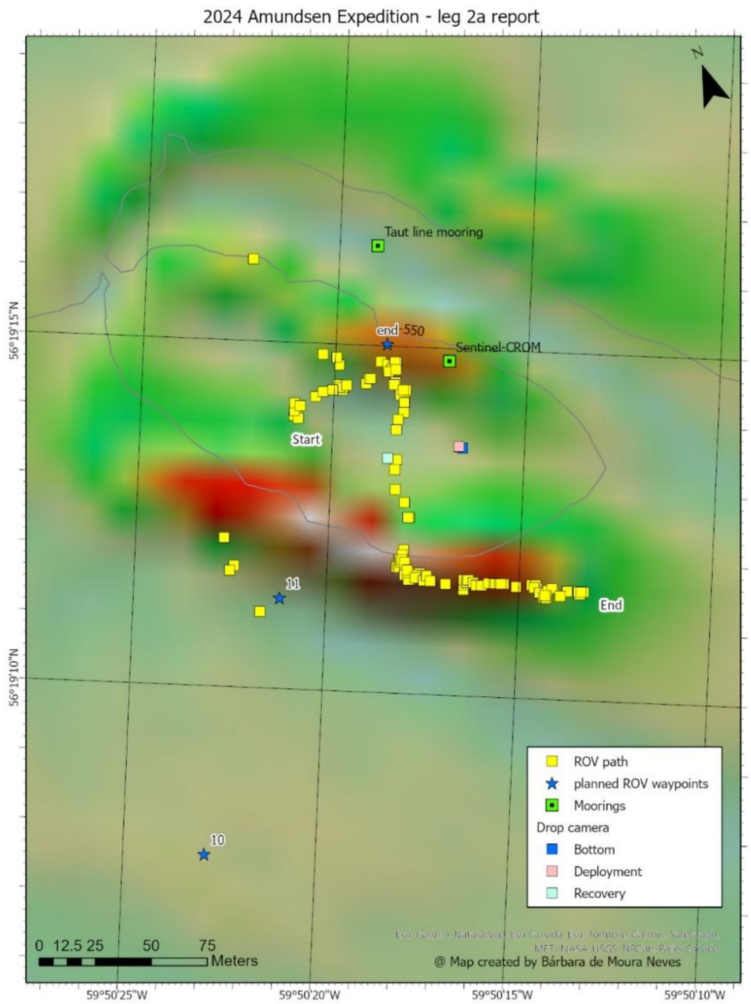

Figure 42-5: Map showing ROV track at the Sentinel in relation to drop camera deployment and moorings

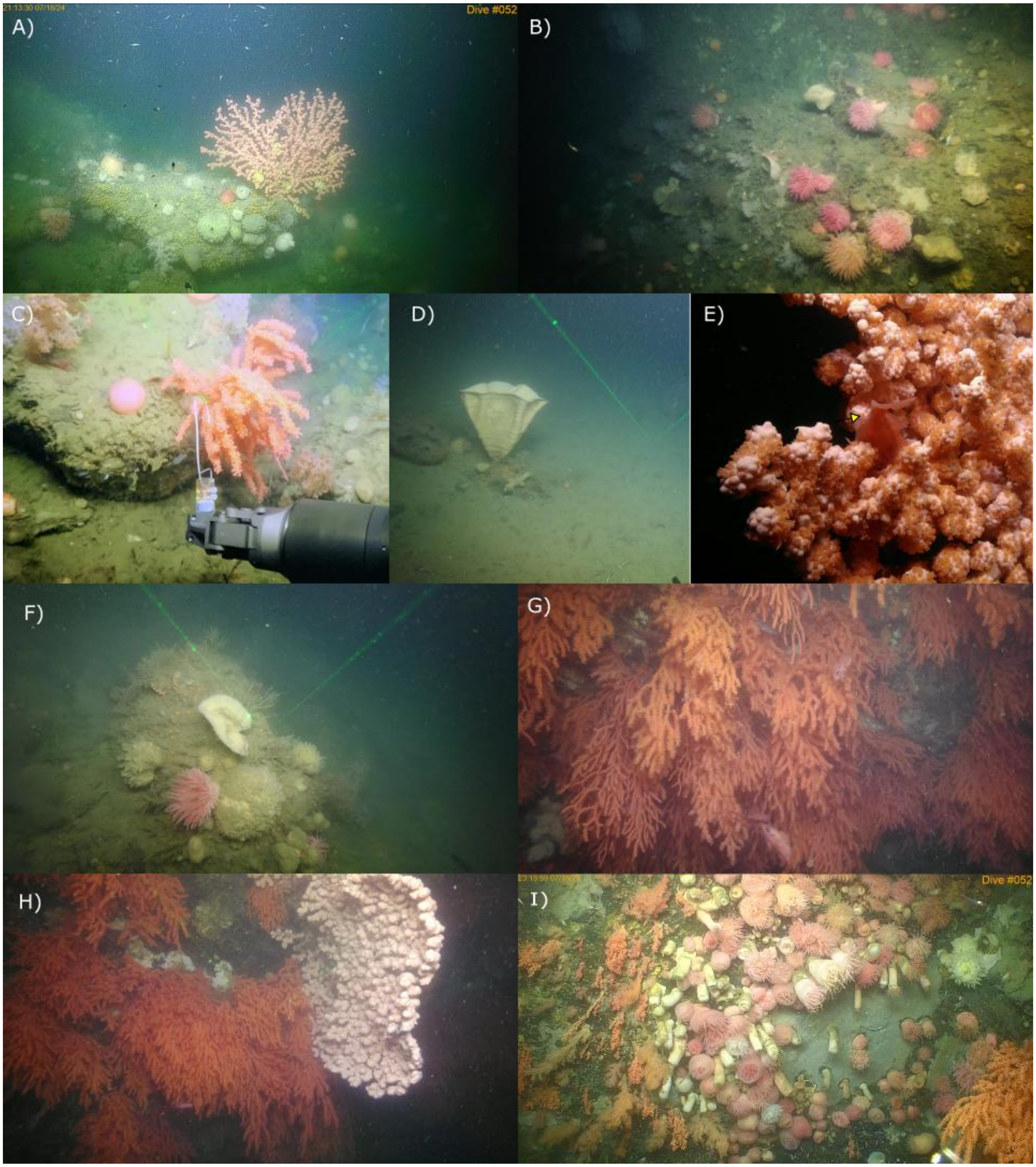

Figure 42-6: Seafloor images at The Sentinel. A) Large Paragorgia arborea colony observed upon arrival on the bottom, B) diversity of benthic fauna, C) Star Oddi logger deployed on Primnoa resedaeformis colony, D) Large sponge, E) close-up of P. arborea and Redfish (*Sebastes* sp., see arrow) on it, F) other benthic fauna including sponges and sea anemones, G) wall of P. resedaeformis, H) wall of P. resedaeformis and large P. arborea, I) cluster of sea anemones and soft corals on wall.

42.3.3 *Dive 53. Davis Strait 2024 (July 25th, 2024)*

The purpose of this dive was to characterize the benthic megafauna diversity, abundance, and habitat structure in the southern portion of the 44,000 km^2 Davis Strait Marine Refuge, in conjunction with other benthic stations (CTD-R, drop camera, box core) completed in 2023 and 2024. This site was in close proximity (~ 7 nm) to a site (DS3) surveyed previously with the drop camera in 2023 during Leg 1 and targeted an area of significant aggregation of small gorgonian corals and sponges as identified from previous research trawl surveys and benthic imagery.

This dive is associated with CTD-Rosette cast 020. No box core or drop camera were completed at this station in 2024. The ROV dive had a total bottom time of 3 hours 13 minutes and just over 5 hours deck to deck. The dive consisted of 4 segments (Figure 42-7). Two segments were dedicated to conducting high-resolution video transects for constructing 3-D models of biologically-derived physical structure using photogrammetry techniques. The photogrammetry occurred at opposite ends of the dive (Figure 42-7). The first set began at a depth of 703 m and consisted of 12 transects, 25 m in length spaced 5 m apart, and running parallel to one another proceeding to the WSW (Figure 42-7). For transects, the ROV flew at an altitude of ~ 1 m with a camera tilt of 27 degrees. Some adjustments were made in the course of completing the first set of transects to improve video quality. Starting at the eight transect, the ROV navigated in the reverse direction when moving along down-current transects to prevent sediment disturbed from the thrusters limiting visibility and occluding the field of view. It was also suggested to turn off ROV scaling lasers while on transect to eliminate their potential interference with photogrammetry software. In the centre portion of the dive, the ROV moved along one continuous transect through the site to the NW (Figure 42-7), gathering video data, and occasionally pausing to collect samples. The last samples were collected at the end of the dive, after truncating the second photogrammetry survey at the end of the fourth transect. These operations were truncated after the Bridge informed us that the wind was increasing above 25 kt, and the sea state was rising, raising concerns about safe recovery of the ROV. The bottom was relatively flat, with only 10-m difference in depth between the maximum (703 m) and minimum depths (693 m) of the dive. The bottom type in the Davis Strait 24 site was dominated by muddy sand, with occasional cobbles and rare boulders. The sand often had small mounds and pits in it, with burrows commonly occurring in some of the pits. The organisms responsible for making the burrows were not seen. Biological observations from the ROV transect (Figure 42-8) were consistent with what was seen in the drop camera footage from 2023. Fishes were relatively uncommon, and included Atlantic cod, blue hake, grenadier, a few other gadids, and the occasional skate or sculpin. Surprisingly, no Greenland Halibut were observed. Several squid (probably *Rossia* spp.) were also observed during the dive.

The coral fauna was dominated by patches of the small gorgonian coral *Acanella arbuscula*, with other patches of a variety of sea pens, of which the most common were *Balticina* sp. (*B. finmarchica*?) and *Anthoptilum* sp. (probably *A. grandiflorum*). The solitary scleractinian coral *Flabellum* (probably *F. alabastrum;* Figure 42-8B) was also commonly observed, in patches. Several colonies of the black coral *Stauropathes arctica* were observed, including one collected as a voucher specimen (Figure 42-8D). The tall sea pen *Umbellula* sp. (possibly *U. encrinus*) was rare. No large gorgonian corals were observed. The sponge fauna was dominated by the glass sponge *Asconema* spp. (assumed *A. foliata*; Figure 42-8C), which generally occurred growing on large cobbles and small boulders. Other sponges included polymastid sponges, carnivorous sponges (*Cladorhiza* and *Chondrocladia*), and various encrusting and vase-shaped sponges. Sponges were sometimes observed growing on small gorgonian corals but were never observed growing directly on the sandy bottom. Surprisingly, no *Geodia* sponges were observed. Other invertebrates observed included a Brisingidae sea star (likely *Novodinia* sp., collected as a voucher specimen) (Figure 42-8A). This sample may allow us to confirm a purported range extension for this species. Anemones (family Hormathiidae) were common. Holothurians were rare, as were asteroids, but a variety of ophiuroids were common, often observed at the base of colonies of *Acanella*. The most common ophiuroid was assumed to be of the genus *Ophiomusa*; one example was collected as a voucher specimen. Another sea star (*Hippasteria* sp.) was observed on the (mostly) dead rachis of a sea pen, within 1 m of the top of the *Umbellula* coral that was collected (but lost). It is not known if the sea pen rachis was from the same species or same individual as the detached top of the *Umbellula* colony, we assume that the observation represents predation by the sea star on the sea pen (Figure 42-8E).

Collections included two colonies of *Acanella arbuscula*, of which one was primarily collected for the sponge living epizootically on top of the coral. We also collected one whole *Flabellum* *alabastrum* coral, one colony of the black coral *Stauropathes arctica*, and an attempted collection of the top of an *Umbellula* sea pen. Unfortunately, this sea pen sample was lost, either during collection or during transport to the surface. One of two Niskin bottles was collected; the second Niskin bottle did not fire when triggered.

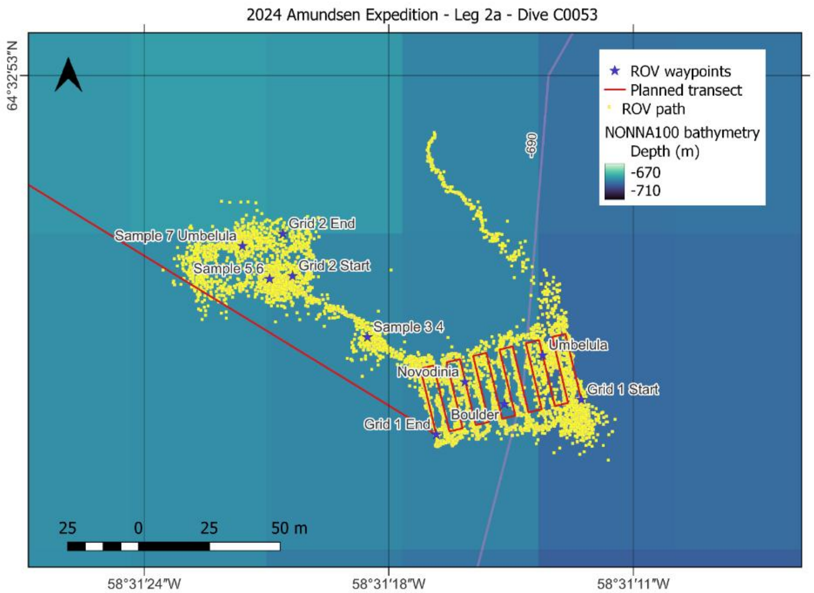

Figure 42-7: ROV track and waypoints along with planned transect during Dive C0053 at Davis Strait

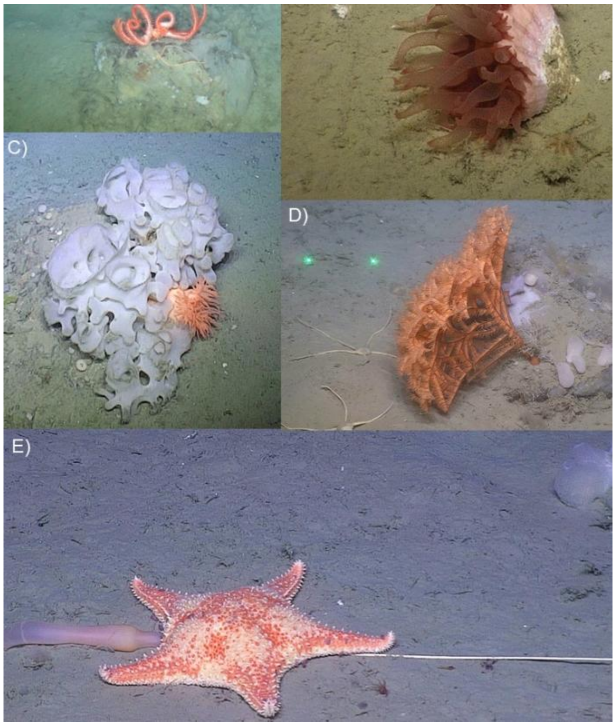

Figure 42-8: Seafloor images of Davis Strait 2024, dive C0053. A) Brisingidae sea star (likely Novodinia sp., B) Flabellum sp., C) Asconema sp. and an anemone, D) Stauropathes arctica and brittle stars (likely Ophiomusa sp.), E) potential predatory interaction between sea star (*Hippasteria* sp.) and large sea pen (*Umbellula* sp.).

42.3.4 *Dive 54. Disko Fan Marine Refuge, BB1-A-600 (July 27, 2024)*

The site explored during this dive is situated at the mouth of the Disko Trough and was at a depth range of 574 m to 644 m, in the shallower end and eastern boundary of the second of four benthic monitoring zones initially established and surveyed by the Department of Fisheries and Oceans in 2012 inside the Disko Fan Marine Refuge (Figure 42-9). This was an alternate site to the priority Disko Fan bamboo coral forest site, which was determined to be inaccessible due to proximity to sea ice and presence of icebergs, along with next most preferred alternate site, BB1-B-600. BB1-A-600 was previously surveyed by drop camera in 2023 and 2012. This dive is associated with CTD-rosette cast 024. Total bottom time was 6 hours and 17 min and 7 hours and 46 min deck to deck. The purpose of the dive was to better characterize the distribution, diversity, and abundance of sea pens, small gorgonian corals, sponges, and other benthic invertebrates, collect voucher specimens for taxonomy, evaluate the biological habitat structure, and expand imagery surveys downslope. The plan for this dive was to launch at about 630 m depth, perform a series of short photogrammetry transects, and proceed down the gentle slope to the SW, stopping for samples along the way, for the remainder of the dive. By the time we navigated to the start of the first photogrammetry transect, depth was 642 m and remained relatively consisted for the duration for the duration of the photogrammetry survey. For this survey, we opted for closer spacing (2.5 m) between adjacent transects (Figure 42-9) compared with dive C0053 to facilitate better overlap between frames. We completed 14 transects in total in just over 1 hour before proceeding with sample collection. Presence of two icebergs required the ship to evade the icebergs by travelling to the NE, roughly upslope, for more than an hour, and then along contour to the SE for roughly 500 m. This did not affect the dive duration, but did limit the duration of the transect downslope and took the ROV shallower than the originally targeted depth (Figure 42-9). The slope here is very gentle, less than a 2.5 % slope (about 1.5˚ on average), although we did see steeper areas at small scales. The bottom was dominated by muddy sand, with abundant sea pens and small gorgonians (*Acanella arbuscula*) (Figure 42-10A, G-H). However, large portions of the bottom (maybe up to 1/3) comprised patches of gravel, cobbles, and boulders. In many areas, the boulders were rounded, as in a fluvial or gravelly beach setting, but elsewhere the rocks were angular to highly angular. A visual memory suggests that areas of rounded and angular boulders tended to be separated. The rocky bottoms were generally steeper than the sandy areas, but the angle and orientation of those slopes was not clear. Most slopes appeared to be well below the angle of repose, as no grain flows were observed. Semi-consolidated horizons of sediment were observed rarely. Two of the coral collections were made on rocks. The rounded small igneous cobble on which a black coral was collected had clearly crossing glacial striations, indicating transport by a glacier at some point, although it could have still arrived by ice-rafted debris. The medium limestone or dolomite cobble on which a small gorgonian coral was collected was highly angular, and showed evidence of recent staining, corrosion, and bioerosion above the sediment-water interface. This is interpreted as more likely arriving as a dropstone (ice-rafted debris, IRD) out of the Canadian Arctic Archipelago.

Muddy sand bottom patches were dominated by sea pens, especially *Ptilella grandis* (Figure 42-10A), but also common *Anthoptilum grandiflorum* and less common *Balticina finmarchica*, and by abundant small gorgonians, *Acanella arbuscula*. Nephtheid soft corals (*Duva* sp.) were less common, and usually found on isolated rocks. Rare species in muddy bottom areas included the tall gorgonian *Radicipes* sp., and some sponges, which mostly appeared to be growing on small rocks within the muddy sand patches. *Flabellum* cup corals were uncommon, but not rare. Standing dead and fallen but intact colonies of the small gorgonian coral *Acanella* were uncommon, but not rare. Two were collected; one using the manipulator arm, and one using the scoop. Rocky bottom areas included a diverse assemblage of sponges, including *Asconema s*pp. and other large glass sponges (Figure 42-10D & I), blue encrusting sponges (*Hymedesmia*), arborescent sponges (probably *Lissodendoryx sp*.), and various polymastid, fan- and vase-shaped sponges. One large astrophorid sponge was collected (*Stelletta sp.?).* Also in rocky areas were rare black corals, two small examples of the large gorgonian species *Paragorgia arborea* (Figure 42-10C), and small specimens of other gorgonian species that we could not confidently identify, but likely belong to the family Acanthogorgiidae (Figure 42-10F). We observed what appeared to be two species of black coral, *Stauropathes arctica* (collected in dive C0053), and *Bathypathes patula* (collected in dive C0054). These were distinguished mostly by their branching pattern. Even amongst the rock areas, small patches with sediment hosted sea pens and *Acanella*. In more cobble-dominated areas, small mushroom corals (possibly *Heteropolypus* sp.) were uncommon, but not rare. Some live coral samples were placed in an aquarium with bottom water collected from the site where the corals were growing, in the hope that they would exsert their tentacles, but this technique was effective only for the black coral, which we were able to photograph well inside the aquarium. Other invertebrates observed throughout the dive included sea anemones (Figure 42-10A), large urchins and whelks, ribbon worms, nudibranchs, an unidentified bivalve (possible *Acesta* sp.; Figure 42-10B), encrusting and erect Bryozoa (Figure 42-10E), and several genera of sea stars (e.g., *Hippasteria*, *Tremaster*, *Ceramaster*, *Pseudoarchaster*, *Henricia*, *Solaster*). Other collections included another sample of the brisingid sea star *Novodinia* sp. (Figure 42-7I*)*, which likely surpasses the potential range extension for this taxon observed at the Davis Strait Dive (C0053). Several species of crab were observed, usually in areas of mixed mud and cobbles/boulders. Fish were abundant, including Atlantic cod or Greenland cod (*G. ogac;* Figure 42-10H), redfish (*Sebastes sp*.), snailfish, pout, grenadier, sculpins, and turbot. The cod appeared to be attracted to the lights of the ROV, but most of the other fish species did not show any major reaction to the presence of the ROV.

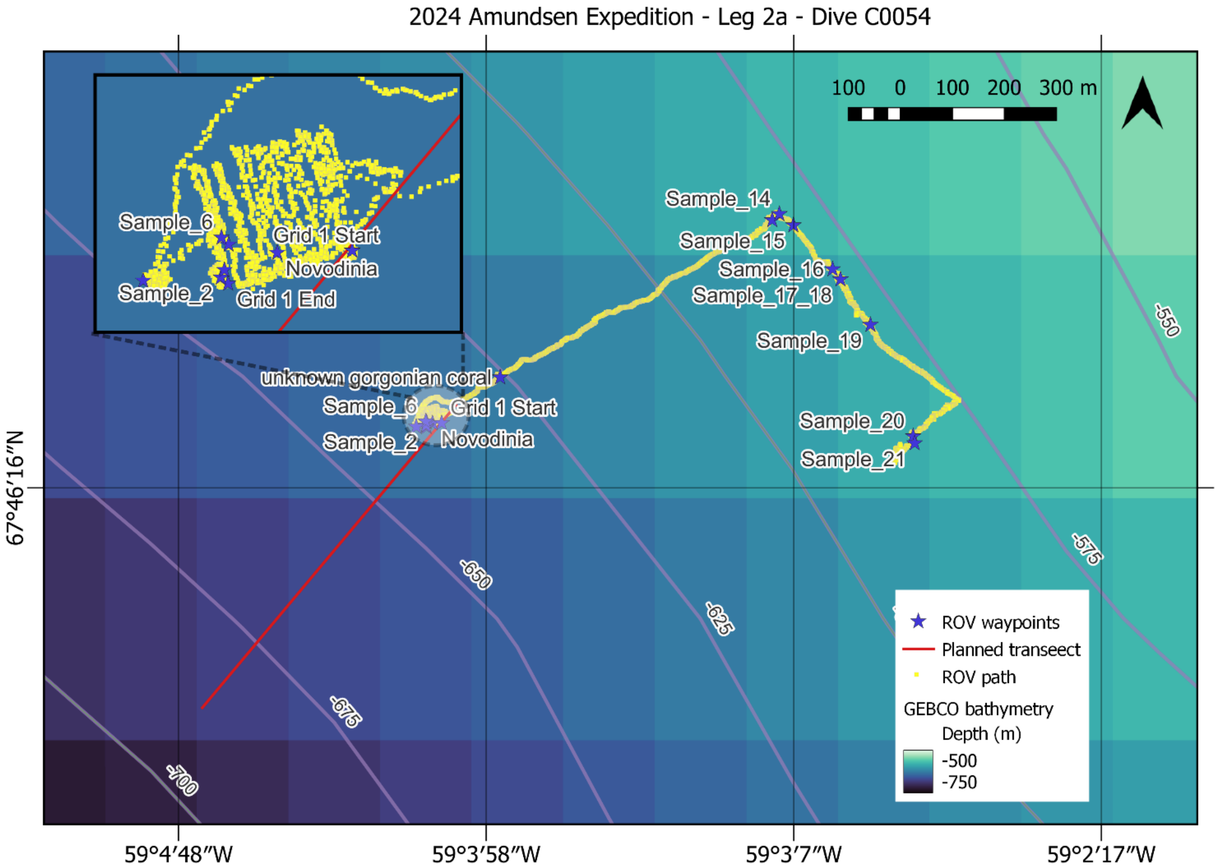

Figure 42-9: ROV track and waypoints along with planned transect during Dive C0054 at site BB1A-600 in the Disko Fan Conservation Area Marine Refuge

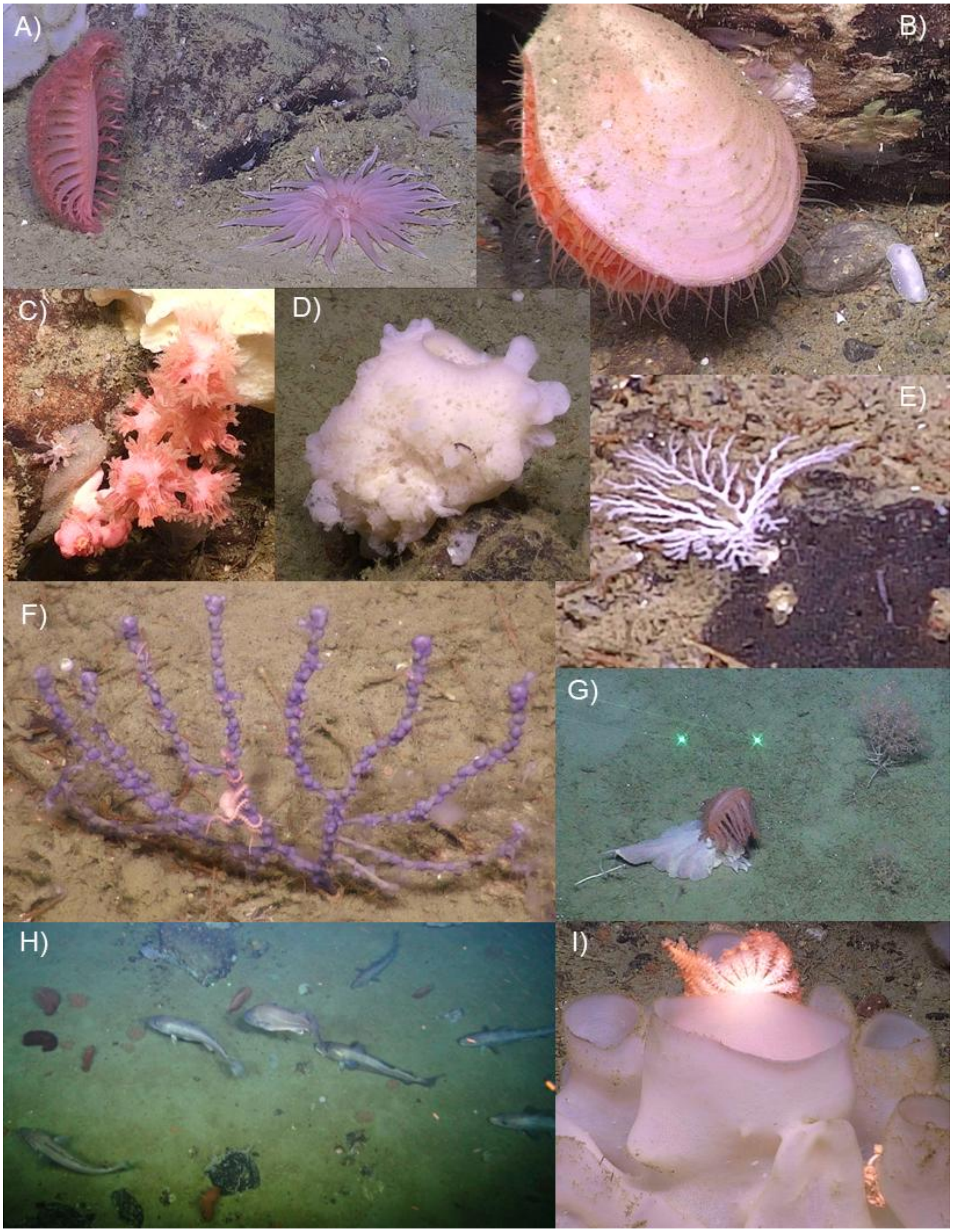

Figure 42-10: Seafloor images from dive C0054 in Disko Fan Marine Refuge, site BB1-A-600. A) Sea pen (*Ptilella grandis*) and anemone, B) Bivalve (possibly *Acesta* sp.) and nudibranch, C) *Paragorgia* sp., D) Sponge, E) Bryozoan, F) unidentified gorgonian coral (family Acanthogorgiidae)., G) Anemone, sea pen, and small gorgonian coral Acanella arbuscula, H) Cod above a representative megabenthic epifaunal

community, I) Brisingidae sea star, (likely Novodinia sp.), and basket star on a glass sponge (Asconema sp.)

42.4 Recommendations

This year was our first experience with the new dynamic positioning (DP) system. Anecdotally, it seemed to make a significant improvement in the ability to hold station without making large correctional movements of the ship. This extra degree of precision proved useful when sampling and deploying loggers along vertical walls at Makkovik and The Sentinel and while conducting closely-spaced photogrammetry transects at Davis Strait and BB1-A-600. This improvement well outweighs the extra time required to calibrate the DP prior to each dive.

The new suction sampler was another useful add to the ROV toolbox this year, which facilitated collection of some smaller and more delicate specimens quite effectively (e.g., worms, hydroids, small corals).

On a couple of occasions, one of the niskins either did not fully close or failed to fire altogether. This issue should be investigated at the end of the season to ensure proper functioning for next year. Collecting true bottom water is especially useful for storing and observing collected specimens prior to processing. There were some issues with the PC HiPaP software this year; namely certain beacons disappearing inexplicably from the list of available beacons in the program. Luckily, the Amundsen Science staff were able to troubleshoot the issue without significant impacts on operations time. However, on one occasion this issue was discovered only after ASTRID had been deployed to begin the time-sensitive dive at The Sentinel. Considering the sometimes-narrow window for ROV operations given inclement weather and operational limits of ASTRID and the essential requirement for subsea positioning, we recommend de-bugging this software issue over the winter to avoid potential loss of operations time. A number of ROV dives were cancelled this year due to either inclement weather, strong currents, or sea ice (M2, M3, Killinek, HT-Arm-1200, Davis Strait 2021, Disko Fan). We recommend a new contingency section be added to the annual dive plans to identify alternative sites and/or operations that may achieve the same or similar research objectives.

For a second year, heavy sea ice at or in close proximity to the site precluded a planned ROV dive at the Disko Fan bamboo coral forest site. In the future, we recommend planning dive attempts in Baffin Baffin for later in the season. If marginal ice conditions cannot be avoided altogether in this area, this may require a more fulsome discussion between the ROV staff, Amundsen Science, and Canadian Coast Guard as to tolerable limits considering the new capabilities of the DP system while ensuring safety of crew and minimizing risks to equipment.

43 Benthic Surveys of the Labrador Sea, Davis Strait, and Baffin Bay Using Drop Camera

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43.1 Introduction

Drop cameras are a relatively low-cost effective monitoring technique that assist in characterizing benthic fauna and habitat, particularly when sampling is not required. The drop camera was used in Leg 2a of 2024 to: 1) conduct further exploration of the Makkovik Hanging Gardens and the Sentinel prior to ROV dives; and 2) to extend the surveys of Nunatsiavut Area of Interest, with targeted surveys ranging from Okak to Killinek. Drop camera data was also collected north of Killinek to aid DFO Arctic in their surveys of arctic benthic environments, particularly within Marine Refuges protecting dense aggregations of cold-water corals and sponges.

43.2 Methods

The deep-sea camera system consisted of two GoPro Hero 11 cameras with battery extenders housed in a custom Anglerfish Deepsea housing, two custom Anglerfish 30W LED lights and one BigBlue 2000 lumen light in underwater GroupB housings, and two sets of custom Anglerfish paired lasers separated by 10 cm used to interpret sizes of organisms captured by the cameras. This equipment was fixed to a custom-made frame (Figure 43-1), equipped with removable steel plates for additional weight. The frame was attached to a winch cable system and lowered from the vessel at 80 m/min. When the drop camera was within ~50 m from the last reported depth, it was lowered at 20 m/min until it touched bottom. The deckhand operating the winch used the difference in tension force measured by the tensiometer on the winch to determine when the frame touched the bottom. If the tensiometer failed to indicate differences in tension as the frame was lowered to the seafloor, the High Precision Acoustic Positioning (HiPAP) system was used. The HiPAP beacon is a small, removable device that is attached to the winch cable just above the camera frame, that provides information on the subsea position of the equipment to the surface. Once on the seafloor, a "yo-yo" method was employed whereby the camera would be raised ~1-2 m off the bottom (as measured by the length of winch cable retracted), "flown" for 30 seconds above the seafloor while maintaining a 0.5 knot drift speed, and dropped on the bottom again. This procedure was repeated for 30 minutes.

A record was kept of the time of the camera deployment, coordinated when the frame was on bottom, and the time that the camera was lifted back on deck. Once the camera was back on deck, the camera apparatus was rinsed with fresh water, removed from the camera frame, and taken to the foredeck lab to have the video footage downloaded and saved to an external hard drive. The housings were checked for leaks or defects, o-rings were replaced when required and/or lubricated using silicon grease. Batteries for the cameras, lights and lasers were changed after each deployment. Drop camera footage was also used to inform the suitability of bottom habitats for other sampling devices (e.g. boxcore, beam trawl, and ROV). A total of 14 drop camera deployments were conducted during Leg 2a of the 2024 Amundsen Expedition (Figure 43-2, Figure 43-3,Table 43-1). All transects except Killinek and the Sentinel were successful in providing data that will assist in characterizing benthic communities. At the Killinek station, high bottom currents only allowed for 5 bottom touches and at the Sentinel, the frame got stuck on a wall for most of the transect. Because the drop camera operation is a "blind" deployment, this issue was not discovered until after camera recovery and data download. We did, however, gain information on a location of Primnoa cold water corals at the Sentinel which was used to direct the ROV dive that was successful in finding an extensive coral (Primnoa and Paragorgia) garden (see Section 42). Short glimpses of Primnoa were visible in a few key frames while the camera bounced up and down along the wall, and a colony of Primnoa was dislodged and recovered on the camera frame itself. A summary of the results is provided in Table 43-2 with accompanying still images retrieved from video footage.

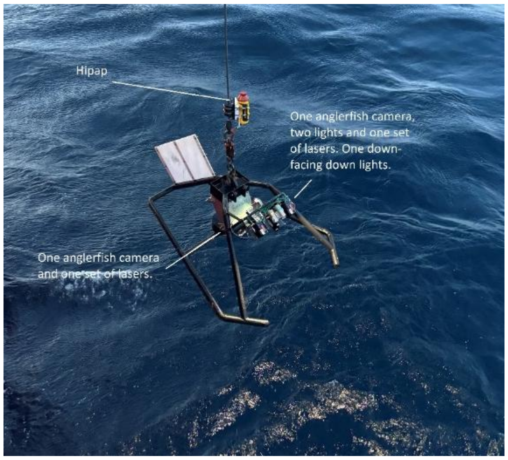


Figure 43-1: The drop camera system attached to a custom-made frame utilized in Leg 2a of the 2024 Amundsen Expedition.

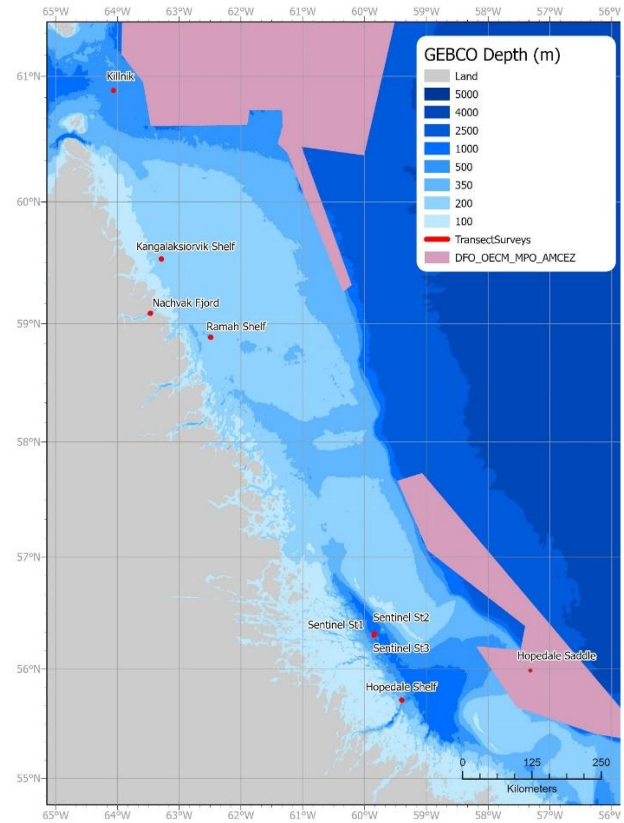


Figure 43-2: Locations of drop camera transects on the Labrador Shelf during Leg 2a of the Amundsen 2024 Expedition. Pink polygons denote the boundaries of DFO Marine Refuges.

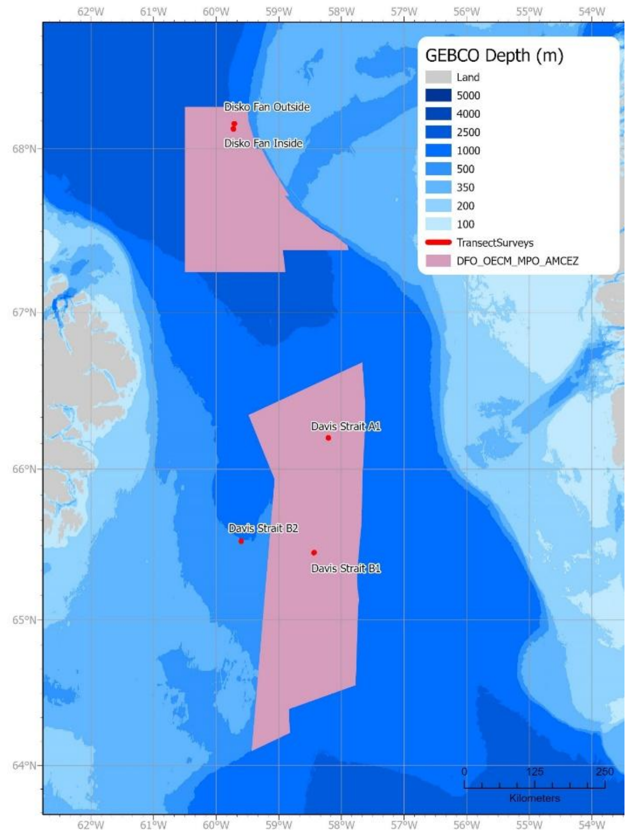


Figure 43-3: Locations of drop camera transects in Davis Strait and Baffin Bay during Leg 2a of the Amundsen 2024 Expedition. Pink polygons denote the boundaries of DFO Marine Refuges.

Table 43-1: Metadata for drop camera stations of Leg 2a, 2024

STATION ID	LATITUDE BOTTOM START (N)	LONGITUDE BOTTOM START (W)	LATITUDE BOTTOM END (N)	LONGITUDE BOTTOM END (W)	DATE	START TIME (UTC)	END TIME (UTC)	MEAN BOTTOM DEPTH (M)
HOPEDALE SADDLE	55.9868732	57.3143185	55.9818620	57.3098815	14 Jul	01:20:58	02:24:18	1189
HOPEDALE SHELF	55.7170295	59.3930358	55.7198748	59.4006893	17 Jul	13:35:23	14:18:07	247
SENTINEL STN1	56.3198597	59.8388513	56.3171825	59.8429628	18 Jul	10:45:27	11:38:02	561
SENTINEL STN2	56.3080387	59.8460068	56.3038597	59.8500450	18 Jul	12:34:06	13:17:53	512
SENTINEL STN3	56.3204368	59.8379465	56.3203842	59.8384838	18 Jul	17:26:05	18:21:38	531
NACHVAK FJORD	59.0857460	63.4688883	59.0870127	63.4608608	22 Jul	15:01:34	15:41:29	210
RAMAH SHELF	58.8863795	62.4934342	58.8866460	62.4843607	23 Jul	03:29:11	04:06:52	203
KANGALAKSIORVIK SHELF	59.5343990	63.2867250	59.5359757	63.2924308	23 Jul	13:04:35	13:43:02	183
KILLINEK STN1	60.8896875	64.0638393	60.8899428	64.0560270	24 Jul	07:47:45	08:00:53	377
DS_500_B2	65.5257450	59.6006468	65.5305837	59.5975891	26 Jul	06:04:23	06:47:28	490
DS_500_B1	65.4534355	58.4337865	65.4506172	58.4419665	26 Jul	14:00:56	14:47:46	500
DS_600_A1	66.2019355	58.2081915	66.2062445	58.2097868	27 Jul	01:42:00	02:20:08	625
DISKO_BC_OUT	68.1507753	59.7057448	68.1511851	59.7195468	28 Jul	04:52:58	05:47:06	860
DISKO_BC_IN	68.1176308	59.7227681	68.1237198	59.7283455	28 Jul	06:48:43	07:44:28	1010

43.3 Preliminary results

The new drop camera set up performed well and a variety of fish and invertebrate taxa were observed including Vulnerable Marine Ecosystem taxa such as large gorgonian corals, sea pens and cerianthids. A preliminary analysis of taxa detected are presented in Table 43-2.

Table 43-2: General description of drop camera transects by bottom type, video quality, biological productivity, and a broad overview of biodiversity and community composition from preliminary observation of drop camera footage for Leg 2a of the 2024 Amundsen Expedition.

STATION ID	SUBSTRATE	VIDEO QUALITY	BIOLOGICAL PRODUCTIVITY	BIODIVERSITY OVERVIEW
HOPEDALE SADDLE	Silt	DownCam: Poor ForwardCam: good, cable touching bottom causing plumes of silt	Medium	Brittle star, sponge, sea pens (*Anthoptilum*), urchins, crinoid, octopus, sea star, anemone, mushroom coral, bamboo coral (*Acanella*), black coral, cup coral, octocoral (*Radicipes*), soft coral, myctophid, blue hake, eel, kelp detritus
HOPEDALE SHELF	Silt, rocky with boulders	DownCam: good ForwardCam: good to poor; lots of plankton and flying too high at times	High	Basket star (*Gorgonocephalus*), anemone, soft coral (*Duva, Gersemia*?), shrimp (Pandalidae), sponge, whelk, sea squirt (?), juvenile fish (?), sea urchin, sea cucumber (*Psolus*?)crinoid, *Flabellum*, arrow worm, skate, snake blenny
SENTINEL STN1	Silt	DownCam: poor ForwardCam: poor; a lot of trouble maintaining 1m from the bottom, too much cable out and hiPAP in the view	Unknown due to limited footage	Sea star, anemone, cerianthid, tube worm (Sabellidae?), soft coral, sponge, grenadier, shrimp, crinoid
SENTINEL STN2	Silt	DownCam: good to poor ForwardCam: poor, video glitching	Low	Crinoid, anemone, tube worm (Sabellidae?), snake blenny, eel pout, redfish, sea star, mud star, turbot, shrimp, skate, flounder, sculpin , kelp detritus
SENTINEL STN3	Silt	DownCam: poor ForwardCam: poor	Unknown due to limited footage	Soft coral, *Asconema*, sponge (*Plicatellopsis?*), redfish, *Primnoa*, grenadier
NACHVAK FJORD	Mud	DownCam: good to poor; due to down light brightness ForwardCam: good	Low	Anemone fields, isopods (*Saduria*), sponges, arrowworms, brittle stars, kelp detritus, shrimp

RAMAH SHELF	Mud	DownCam: good ForwardCam: good	Low	Brittle stars, shrimp (*Pandalidae*), whelk, hermit crab, crinoid, kelp detritus, anemone, tube worm, sculpin, snake blenny, arrowworms, octopus
KANGALAK SIORVIK SHELF	Mud with some boulders	DownCam: good to poor ForwardCam: good to poor; a lot of sediment and plankton	Low	Brittle stars, crinoids, sea stars, whelk, hermit crab, hydroid, tube worm, arrowworms, sponges, soft coral
KILLINEK	cobble	DownCam: good to poor due to fast current. ForwardCam: good to poor due to fast current	Low	Whelk, bryozoans, anemones, sea stars, brittle stars, hydroid, agglutinated worms, chitons
DS_500_B2	Silt, pebbels, cobble	DownCam: good ForwardCam: good	High	Anemones, *Asconema*, shrimp, myctophid, sunstars, grenadier, sea stars, encrusting sponges, redfish, whelk, solitary and colonial tunicates, soft coral, cusk (?), sea cucumbers, sea urchin, crinoid, foraminerfera, sponges, *Chondrocladia*, *Asbestopluma*?. tube worms (Serpulidae), eel pout, turbot
DS_500_B1	Silt	DownCam: good ForwardCam: good	High	Soft corals, sponges (*Craniella*), sea stars, sunstars, grenadier, *Asconema*, sea pens (*Anthoptilum*), *Acanella*, anemones, redfish
DS_600_A1	Silt	DownCam: good to poor due to silt plumes. ForwardCam: good to poor due to silt plumes	Medium	Anemones, soft coral, sea stars, *Craniella*, *Asconema*, *Asbestopluma?*, sea pen (*Umbellula*), myctophid, snake blenny (?), eel (?), whelk, *Acanella*, foraminifera
DISKO_BC_ OUT	Silt, boulders	DownCam: good ForwardCam: good	Medium	Black coral, encrusting sponges, turbot, solitary and colonial tunicates, tube worms (Serpulidae), hydroids, brachiopods, foraminifera, soft corals, anemone, sea stars, *Asconema*, whelks, octopus, sea pen (*Anthoptilum*)
DISKO_BC_I N	Silt, boulders	DownCam: good ForwardCam: good	Medium	Anemones, soft coral, arrowworm, sea stars, octopus, , grenadier, snake blenny, bryozoans, whelks, sun star, skate, encrusting sponges, fan-shaped sponges, solitary tunicates, foraminerfera, tube worms

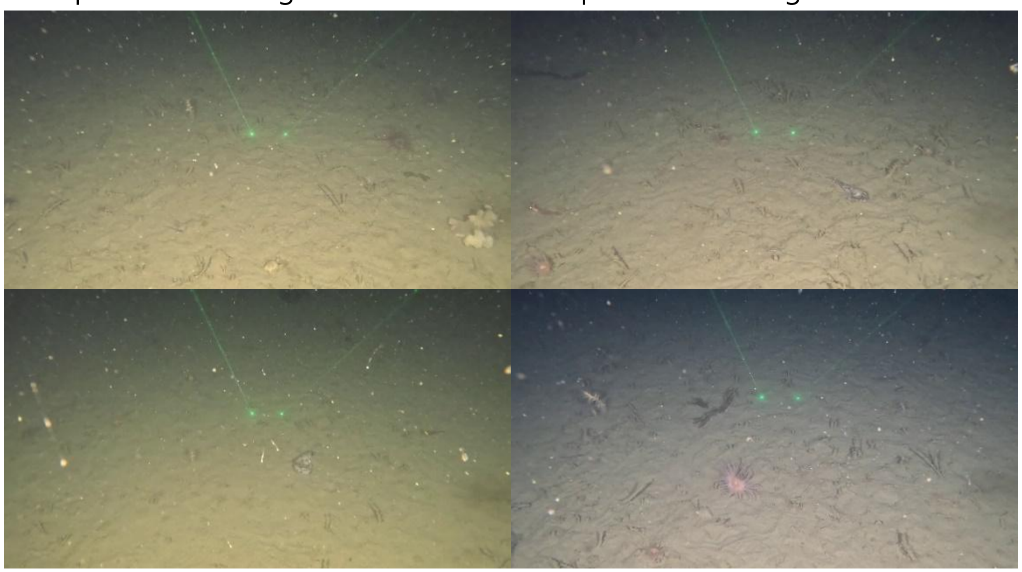
Drop camera images from Leg 2a

Examples of still images retrieved from drop camera footage at Hopedale Saddle.

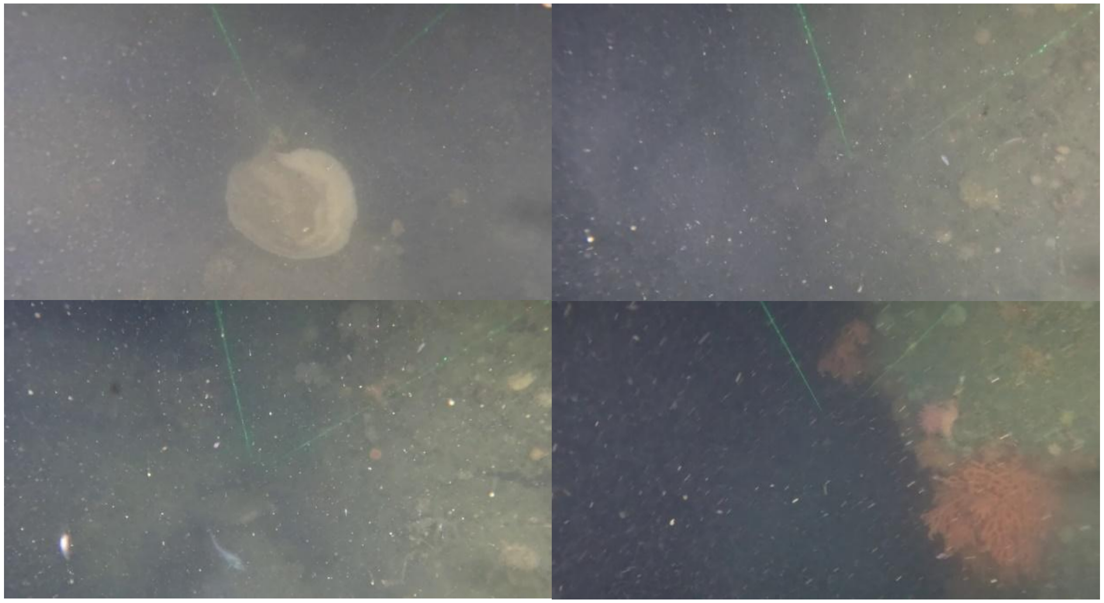
Examples of still images retrieved from drop camera footage at Hopedale Shelf.

Examples of still images retrieved from drop camera footage at the Sentinel Station 1.

Examples of still images retrieved from drop camera footage at the Sentinel Station 2.



Examples of still images retrieved from drop camera footage at the Sentinel Station 3.

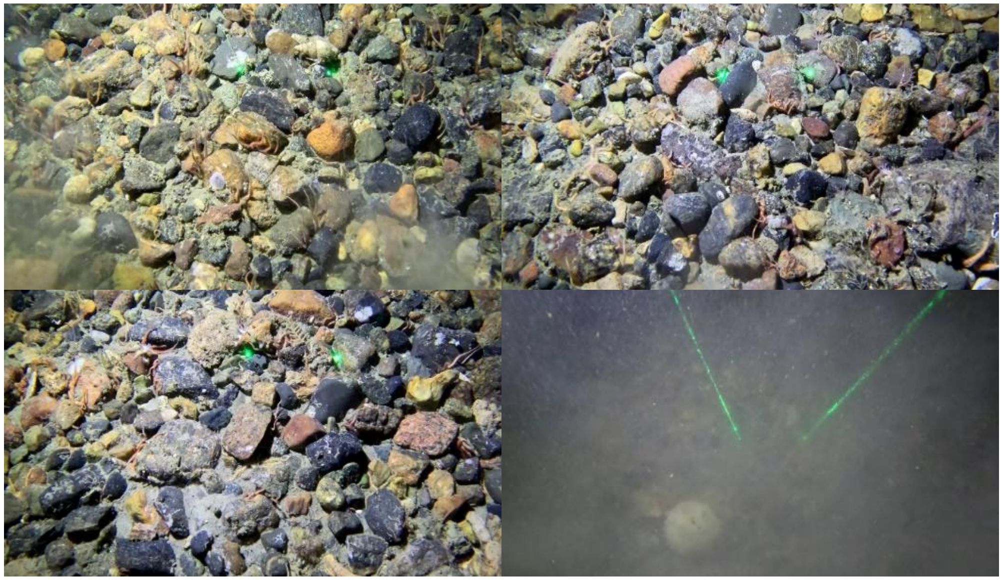


Examples of still images retrieved from drop camera footage at Nachvak Fjord

Examples of still images retrieved from drop camera footage at Ramah Shelf.

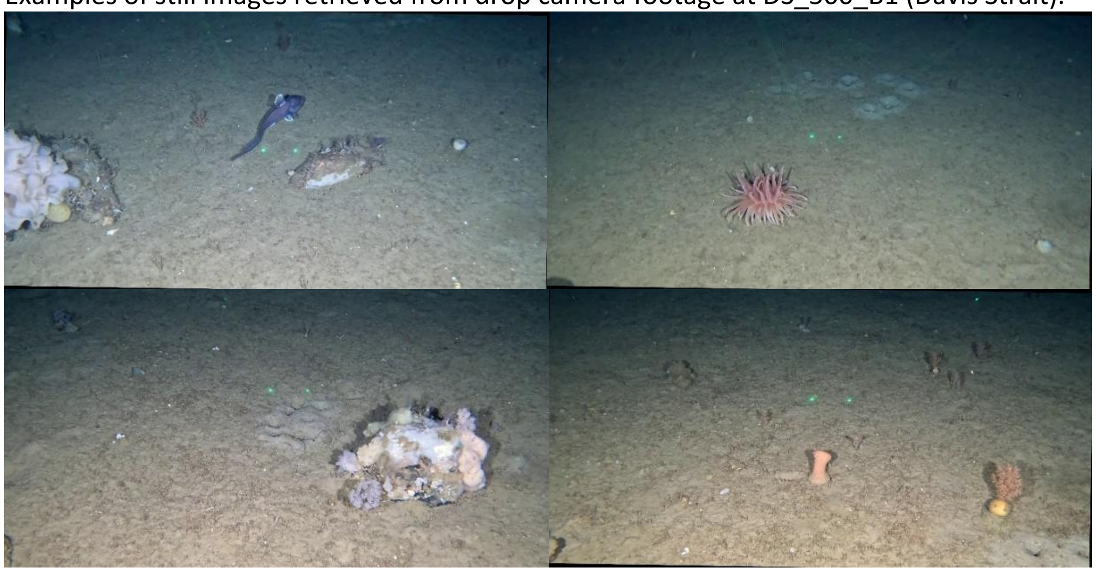
Examples of still images retrieved from drop camera footage at Kangalaksiorvik Shelf.

Examples of still images retrieved from drop camera footage at Killinek.

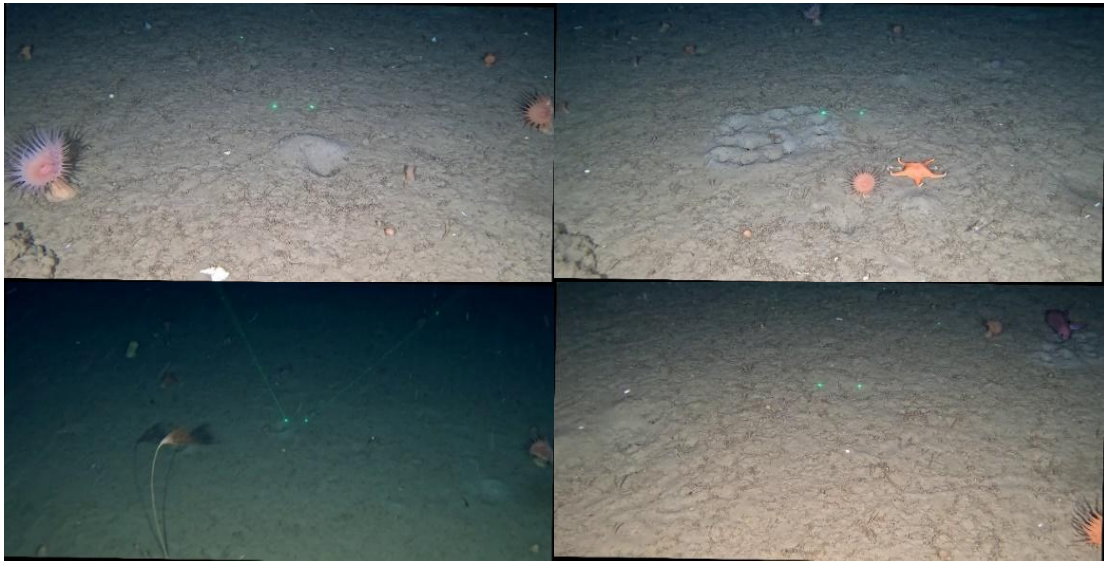


Examples of still images retrieved from drop camera footage at DS_500_B2 (Davis Strait).

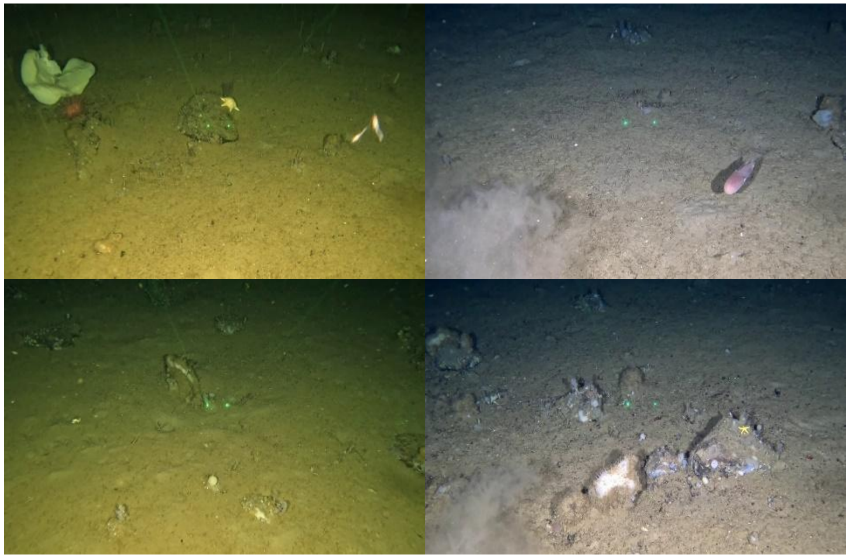
Examples of still images retrieved from drop camera footage at DS_500_B1 (Davis Strait).



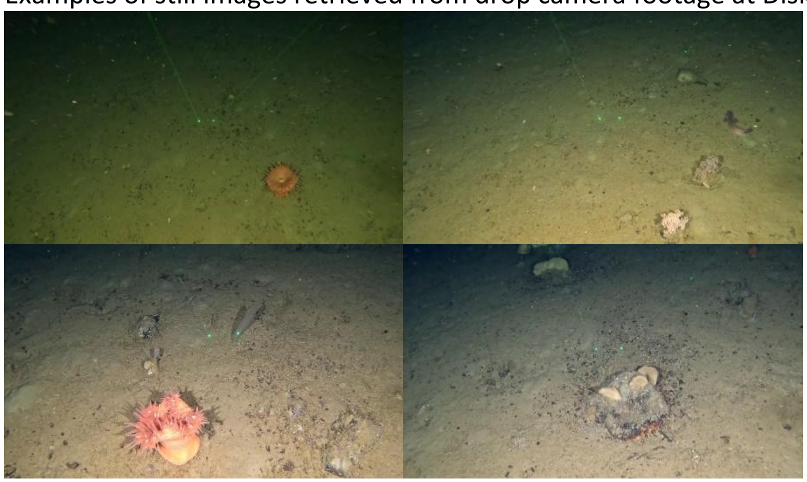
Examples of still images retrieved from drop camera footage at DS_600_A1 (Davis Strait).



Examples of still images retrieved from drop camera footage at Disko_BC_Out (Disko Fan).



Examples of still images retrieved from drop camera footage at Disko_BC_In (Disko Fan).



43.4 Recommendations

1) Always use Big Blue Dive Lights in the GroupB light housings. The dive lights can be set to the second or third lowest setting to avoid overheating while providing adequate lighting. The GroupB light housing should only have one thin o-ring at each opening (i.e., one near the lens, one at the main opening where the light is inserted, and one at the back end). Ensure grooves are clean and greased prior to each deployment.

2) Use compressed air to remove humidity from the cable inputs. Grease with dielectric grease

prior to each deployment.

4) Successful deployment relies on the proper functioning of the tensiometer. If in doubt, attach the HiPap to the camera frame or attach extra weight to the frame, especially in depths greater than 1000 m.

5) Ensure winch operator does not feed too much excess cable or it may get wrapped around the Anglerfish camera mount.

6) When possible, conduct the transect from shallow to deep to avoid tipping over the frame or dragging along the sea floor.

7) Use a GPS booster, especially when conducting transects in more northern sites, to ensure adequate logging of location data.

44 Reducing uncertainties on carbon cycling, Northwest Atlantic – Land to Sea

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44.1 Introduction and Objectuves

The ocean's carbon cycle plays a critical role in mitigating atmospheric CO_2. However, there are many uncertainties with respect to the amount of carbon uptake and sequestration that takes place at different latitudes and also at various interfaces of the air-ocean, water column and seabed, and between the land and the sea. In this project, we are exploring how terrestrially derived matter is transported to oceans and sequestered, through the water column and into the sediments. Specifically, this project examines the mechanisms of matter transport and the effect of freshwater fluxes on carbon burial and sequestration on the shelf and into deeper water environments. Our objectives are to quantify the amount of matter from different terrestrial and aquatic sources being transported and stored in sediments from various coastal environments into deeper shelf environments.

44.2 Methods

A) B) C)

Figure 44-1: Sampling methods used for sediment coring on Leb 2B. A) box-coring in Coronation Fjord, B) push cores inserted into box core, C) gravity core lowered into the sea for coring

Sediments were sampled in Maktak, Coronation, and North Pangnirtung fjords of Auyuittuq National Park, at the junction of all three fjords, and along a transect extending NE into Baffin Bay. A box core was taken at each site and once brought onboard, was sampled with 9.8 cm (inside) diameter push cores (Figure 44-1A-B). Box core (or push core) lengths were recorded, and the cores were trimmed, capped, taped, and labelled for storage at 4°C. Surface samples were taken from the box cores for lipids and sedimentary environmental DNA research (Dumoulin). The sample sites within the fjords (TCA 5.1, 5.2, 5.3) were also sampled through gravity coring, allowing for longer core lengths at each site. Once onboard the gravity core was split into 151 cm length sections or less. The length of each core segment was measured, the cores were trimmed where necessary, capped, taped, and labelled for storage at 4°C.

44.3 Preliminary Results

In total, there were 15 push cores collected from box cores at 7 locations and 5 gravity cores at 3 locations (Figure 44-2,

Table 44-1, Table 44-2). The lengths of the push cores collected from the box cores range between 27.7 and 54 cm and the total lengths of the gravity cores collected range between 227-548 cm. Coring was attempted near the future site of the Qikiqtarjuaq port but was unsuccessful, likely due to high sand content, or possibly sediment cover thickness. There were two push cores obtained from TCA 5.2 in the Maktak Fjord, both of which appeared to contain sand at the base and water laden silt at the top. Only one gravity core was successful at TCA 5.2. The other two attempts were empty when the gravity corer was retrieved. The successful core unfortunately contains a sock (!) in the top core barrel. This was used when the core catcher seemed to be damaged, however, the sock came apart during the coring and is now contained within the core in at least two intervals that are visible on the outside of the core. This will likely compromise the usefulness of this gravity core. Three push cores were collected in the Coronation Fjord (TCA 5.3) after moving to a second coring site when the first site selected in this fjord resulted in overflowing box cores with no preservation of the sediment-water interface. Two gravity cores were also successfully retrieved at the second site in Coronation Fjord. There were 3 push cores and 2 gravity cores collected at site TCA 5.1 in the North Pangnirtung Fjord. Several additional push cores were collected from box cores that were planned as part of the TCA sampling and as part of Kebabb program. Box cores noted in Table 1 along the Kebabb transect that were not successful typically encountered dropstones that prevented closure of the box at depth, or a high sand content.

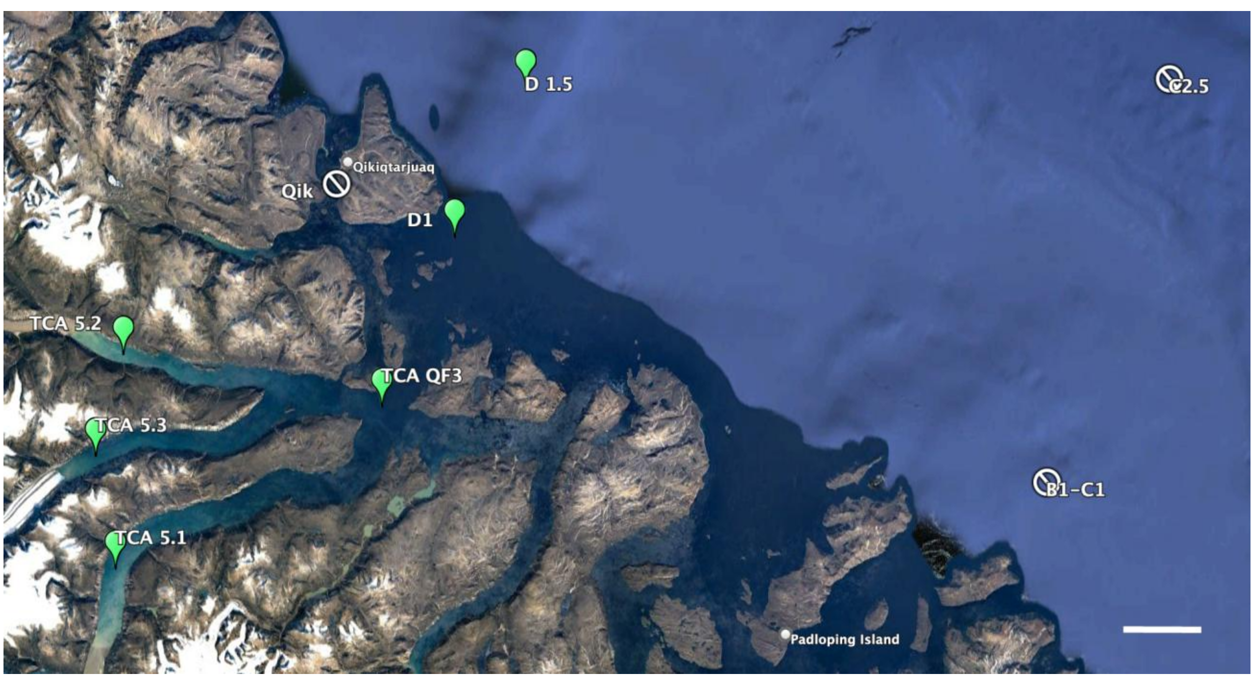

Figure 44-2: Core sampling sites on Leg 2b. Green denotes a site where cores were collected

Table 44-1: Push cores taken from box cores on Leb 2B of the 2024 Amundsen expedition.

Site Number	Date	Bottom Latitude	Bottom Longitude	Depth (m)	Sample Number	Length (cm)
Qik Port	2024-07-29	67.53093	-64.04017	38.57	AMD2402-24BC	-
Qik Port	2024-07-29	67.53117	-64.03942	34.85	AMD2402-25BC	-
TCA 5.2	2024-07-30	67.33544	-64.65109	200.38	AMD2402-26BC	27.5
TCA 5.2	2024-07-30	67.33525	-64.65019	200.38	AMD2402-27BC	31
TCA 5.3	2024-07-31	67.22113	-64.72246	192.26	AMD2402-28BC	-
TCA 5.3	2024-07-31	67.22106	-64.72154	192.97	AMD2402-29BC	-
TCA 5.3	2024-07-31	67.22987	-64.65798	222.94	AMD2402-30BC-01	52
TCA 5.3	2024-07-31	67.22987	-64.65798	222.94	AMD2402-30BC-02	47
TCA 5.3	2024-07-31	67.22987	-64.65798	222.94	AMD2402-30BC-03	54
TCA 5.3	2024-07-31	67.23000	-64.65742	223.35	AMD2403-31BC	-
TCA QF3	2024-07-31	67.28344	-63.89772	600.96	AMD2402-32BC-01	39.5
TCA QF3	2024-07-31	67.28344	-63.89772	600.96	AMD2402-32BC-02	40.5
TCA QF3	2024-07-31	67.28344	-63.89772	600.96	AMD2402-32BC-03	40.5
TCA 5.1	2024-08-01	67.09620	-64.65658	164.90	AMD2402-33BC-01	40
TCA 5.1	2024-08-01	67.09620	-64.65658	164.90	AMD2402-33BC-02	43
TCA 5.1	2024-08-01	67.09620	-64.65658	164.90	AMD2402-33BC-03	42
TCA 5.1	2024-08-01	67.09572	-64.65630	164.62	AMD2402-34BC	-
D1	2024-08-01	67.47314	-63.69393	668.35	AMD2402-35BC-01	34.5
D1	2024-08-01	67.47314	-63.69393	668.35	AMD2402-35BC-02	32.5
D1.5	2024-08-01	67.64045	-63.49163	573.99	AMD2402-36BC-01	41
D3	2024-08-02	68.24571	-62.59642	1536.57	AMD2402-37BC	39
C2.5	2024-08-04	67.64668	-61.60406	1303.20	AMD2402-38BC	-
B1-C1	2024-08-05	67.19975	-61.98244	274.03	AMD2402-39BC	-

Table 44-2: Gravity cores taken on Leg 2b of the 2024 Amundsen expdition

TCA No.	Date	Latitude (N)	Longitude (W)	Depth (m)	AMD No.	GSC No.	Length (cm)
TCA 5.2	07-30	67.33507	64.64974	200.63	AMD2402-01-GC	-	-
TCA 5.2	07-30	67.33470	64.64709	201.79	AMD2402-02-GC cutter (base)	2024804-0020-GC cutter (base)	11.5
TCA 5.2	07-30	67.33470	64.64709	201.79	AMD2402-02-GC AB	2024804-0020-GC AB	151.0
TCA 5.2	07-30	67.33470	64.64709	201.79	AMD2402-02-GC BC	2024804-0020-GC BC	76.0
TCA 5.2	07-30	67.33506	64.64881	200.66	AMD2402-03-GC	-	-
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-04-GC nosecone	2024804-0023-GC nosecone	4.0

TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-04-GC cutter (base)	2024804-0023-GC cutter	25.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-04-GC AB	2024804-0023-GC AB	152.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-04-GC BC	2024804-0023-GC BC	142.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-04-GC CD	2024804-0023-GC CD	147.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-04-GC DE	2024804-0023-GC DE	78.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-04-GC cutter (base)	2024804-0024-GC cutter	26.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-05-GC AB	2024804-0024-GC AB	152.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-05-GC BC	2024804-0024-GC BC	146.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-05-GC CC'	2024804-0024-GC CC'	10.0
TCA 5.3	07-31	67.23008	64.65528	224.26	AMD2402-05-GC C'D	2024804-0024-GC C'D	80.0
TCA 5.1	08-01	67.09619	64.65716	164.31	AMD2402-06-GC AB	2024804-0027-GC AB	150.5
TCA 5.1	08-01	67.09619	64.65716	164.31	AMD2402-06-GC BC	2024804-0027-GC BC	126.5
TCA 5.1	08-01	67.09619	64.65716	164.31	AMD2402-06-GC CD	2024804-0027-GC CD	150.0
TCA 5.1	08-01	67.09619	64.65716	164.31	AMD2402-06-GC DE	2024804-0027-GC DE	30.0
TCA 5.1	08-01	67.09598	64.65642	165.41	AMD2402-07GC AB	2024804-0028-GC-AB	151.0
TCA 5.1	08-01	67.09598	64.65642	165.41	AMD2402-07GC BC	2024804-0028-GC-BC	136.5
TCA 5.1	08-01	67.09598	64.65642	165.41	AMD2402-07GC CD	2024804-0028-GC-CD	150.0
TCA 5.1	08-01	67.09598	64.65642	165.41	AMD2402-07GC DE	2024804-0028-GC-DE	42.0

44.4 Recommendations

We found that the organization was generally good for the coring operations, however, there were some aspects that surprised us and that we feel should be improved. First and foremost, it is imperative that the trawl net be done AFTER all coring operations, as this disturbs the seafloor and will have an impact on the integrity of the sediment sequence. At designated coring sites, we suggest that the coring operations be executed before the nets in order to guarantee the quality of the samples. Also, it is frequent that corers have to be deployed many times before being successful. We felt rushed, especially in the first fjord, to get moving despite not having been able to retrieve a satisfactory core. This improved at the subsequent sites. We suggest that more time be factored into the planning of coring operations in case a second site has to be investigated in the event that the first targeted site reveals itself to be inappropriate.

45 Benthic biodiversity, biological productivity and biogeochemistry

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45.1 Introduction and Objectives

In benthic ecosystems, the availability and quantity of food, as well as the type of substrate, influence the distribution, abundance, and richness of benthic organisms. Generally, rocky bottoms host a diverse assemblage of organisms (Posey and Ambrose, 1994), whereas soft bottoms are more homogeneous, with the presence of organisms depending on factors like grain size and food availability. These different substrate types create heterogeneity, potentially leading to high concentrations of organisms and the presence of specific species. Changes in the export of organic matter due to global environmental shifts will impact food webs and benthic ecosystems, where 98% of ocean biodiversity is found. The seabed, as the largest habitat on the planet, is crucial, with benthic organisms playing an essential role in global carbon budgets. However, the role of the benthic component in the global carbon pump is often underestimated or even neglected.

The primary objective of our 2024 expedition is to study benthic activities, particularly the carbon remineralization by benthic fauna in Arctic fjords. Fjords are known as crucial ecosystems in regulating the carbon cycle, as they bury the largest amount of organic carbon per unit area in the world (Smith et al., 2015).

Our main objective for Leg2a of the 2024 Amundsen expedition was to study the impact of vertical walls populated by corals and sponges on the biodiversity and functioning of the surrounding benthic ecosystems in a crucial ecological region of the Labrador Sea near Makkovik, as it is home to populations of indicator species of a vulnerable marine ecosystem. We aim at comparing the taxonomic and functional diversity of macrofauna and meiofauna in sediments and benthic fluxes near and far from the walls.

Our main objective for the Leg 2b of the 2024 Amundsen expedition was to assess the biodiversity structure of benthic ecosystems of three fjord of Baffin Island. We aim at comparing the taxonomic and functional diversity of macrofauna and meiofauna in sediments between of the three Fjords.

The primary objective of the Leg 3, 4 and 5 of the 2024 expedition is to study benthic activities, particularly the carbon remineralization by benthic fauna in Arctic fjords. Fjords are known as crucial ecosystems in regulating the carbon cycle, as they bury the largest amount of organic carbon per unit area in the world (Smith et al., 2015). Our goal is to quantify the benthic activity (total oxygen uptake, bioturbation, and bioirrigation) in two different fjord types, terrestrial and marine glacier fjords, at varying distances from the head of the fjords. The sampling locations were chosen based on preliminary data obtained during Guillaume Blais's master's research, which identified biodiversity hotspots at the head and mouth of the fjords, depending on their origin.

Another objective of this mission for our laboratory was to collect sediment samples and individuals of various benthic invertebrate species for collaboration on microplastics research and food web studies.

45.2 Methodology

45.2.1 *Leg 2a*

Samples for this project and for collaborators were collected from 11 boxcores (Table 45-1) deployed during the Leg 2a. At Makkovik station (Mak-2024-M1 and M2) 4 box cores (Table 45-1) were deployed to quantitatively sample diversity, abundance and biomass of endobenthic fauna and to obtain sediment cores for sediment analyses and incubations. From 4 box cores (Table 45-1), sediments of usually a surface area of 0.125 m^2 and 10-15 cm in depth were collected and passed through a 0.5 mm mesh sieve and preserved in a 4 % formaldehyde solution for further identification in the laboratory. Sub-cores of sediments were collected for sediment pigment content, organic carbon content, and sediment grain size; for sediment pigments, and organic carbon content, the top 1 cm was collected, although for sediment grain size, the top 5 cm was collected. Around 45 ml of surface sediment was also collected to assess meiofaunal diversity. Samples for sediment pigment were frozen at -80°C, and organic carbon samples, sediment grain size samples, and samples for meiofaunal diversity were frozen at -20°C. All samples will be transported off the ship for analyses in the lab at the Université Laval. Bottom water was collected from the rosette deployed at the same coordinates as the boxcore to allow incubation experiments (see Section 39).

Sampling for collaborators:

- *Rémi Amiraux*

At 4 stations sub-cores of sediment were collected from the boxcore and the top 1 cm was collected and frozen at -20°C for stable isotope & HBI analysis. At 3 of them (Table 45-2), few individuals of the dominant species collected with the Beam Trawl were identified to the lowest taxonomic level possible and frozen at -20°C for stable isotope & HBI analysis. See Section 36 for more details on Beam Trawl deployment.

- *Jennifer Provencher*

At 5 stations (Table 45-1), 3 x 45 ml of surface sediments were collected in the Boxcore for Jennifer Provencher to study vessel-based microplastics.

Table 45-1 : Number of samples collected from the boxcore during Leg 2a of the 2024 CCGS Amundsen expedition for our team and for collaborators.

													Collaboration	
Station ID	**Boxcore ID**	**Date (UTC)**	**Time bottom (UTC)**	**Latitude**	**Longitude**	**Depth (m)**	**Infauna Boidivesity**	**Sediment Grain size**	**Sediment Organic content**	**Sediment Pigments**	**Sediment Meiofauna**	**Pushcores**	**Sediment – R. Amiraux**	**Sediment - J. Provencher**
Hopedale Saddle	AMD2402-01BC	07/13	03:05:55	55.98777	57.31559	1188	0	0	0	0	0	0	0	3 + 1**
Mak-2024-M2	AMD2402-02BC	07/15	03:06:35	55.51489	58.93805	697	1	1	1	3	1	3	0	0
Mak-2024-M2	AMD2402-03BC	07/15	04:56:00	55.51494	58.93990	696	1	1	1	3	1	3	0	0
Mak-2024-M1	AMD2402-04BC	07/16	00:21:37	55.43345	58.94016	706	1	1	1	3	1	3	0	0
Mak-2024-M1	AMD2402-06BC	07/16	04:03:37	55.43333	58.93796	695	1	1	1	3	1	3	0	0
Mak-2024-M1	AMD2402-07BC	07/16	04:46:16	55.43365	58.93723	682	0	0	0	0	0	0	0	3
Hopedale shelf	AMD2402-09BC	07/17	14:45:53	55.71751	59.39458	209	0	0	0	0	0	0	1	0
Okak Bay	AMD2402-16BC	07/20	17:20:08	57.56951	62.04820	92	0	0	0	0	0	0	1	3
Nachvak Fjord	AMD2402-17BC	07/22	16:13:40	59.08568	63.46928	210	0	0	0	0	0	0	1	0
Kangalaksiorvik shelf	AMD2402-19BC	07/23	14:02:52	59.53405	63.28574	181	0	0	0	0	0	0	1	3
DS-500-B1	AMD2402-22BC	07/26	15:19:54	65.45171	58.43429	499	0	0	0	0	0	0	0	3 + 1*

*3 surface sediment samples and 1 empty vial for control

Table 45-2: Beam trawl stations where benthic invertebrates were collected for collaboration with Rémi Amiraux during Leg 2a of the 2024 CCGS Amundsen expedition (see more details on Beam trawl deployments in Section 36).

Station ID	Date Time (UTC)	Latitude	Longitude	Event	Depth (m)
Hopedale Shelf	07/17 18:14:52	55.72610	-59.37177	Deployment	305
	07/17 18:35:02	55.72167	-59.39164	Bottom	275
	07/17 18:51:14	55.71764	-59.40926	Recovery	259
Nachvak Fjord	07/22 22:01:44	59.08597	-63.48368	Deployment	210
	07/22 22:12:22	59.08239	-63.47606	Bottom	212
	07/22 22:27:04	59.08515	-63.45769	Recovery	211
Kangalaksiorvik Shelf	07/23 17:02:11	59.52845	-63.27911	Deployment	174
	07/23 17:10:25	59.53161	-63.27691	Bottom	173
	07/23 17:27:06	59.53150	-63.29627	Recovery	176

45.2.2 *Leg 2b*

Samples for our team and collaborators were collected from eight boxcores (Table 45-3) deployed during the leg 2b. In fjords station three boxcores (Table 45-3) were deployed to quantitatively sample diversity, abundance and biomass of endobenthic fauna and to obtain sediment cores for sediment analyses and incubations. Sediments of usually a surface area of 0.125 m^2 and 10-15 cm in depth were collected and passed through a 0.5 mm mesh sieve and preserved in a 4 % formaldehyde solution for further identification in the laboratory. Sub-cores of sediments were collected for sediment pigment content, organic carbon content, and sediment grain size; for sediment pigments, and organic carbon content, the top 1 cm was collected, although for sediment grain size, the top 5 cm was collected. Samples for sediment pigment were frozen at -80°C, and organic carbon samples, and sediment grain size samples were frozen at -20°C. All samples will be transported off the ship for analyses in the lab at the Université Laval. Bottom water was collected from the rosette deployed at the same coordinates as the boxcore to allow incubations experiment (collaboration with Haley Geizer).

Sampling for collaborators:

Rémi Amiraux

At five stations sub-cores of sediment were collected from boxcore and the top 1cm was collected and frozen at -20°C for stable isotope & HBI analysis. At four stations (Table 45-4), few individuals of the dominant species collected with the Beam Trawl were identified to the lowest taxonomic level possible and frozen at -20°C for stable isotope & HBI analysis. See report from Geoffroy's team for more details on Beam Trawl deployments.

Jennifer Provencher

At five stations (Table 45-3), 3 x 45 ml of surface sediments were collected in the Boxcore for Jennifer Provencher to study vessel-based microplastics.

Table 45-3: Number of samples collected from the boxcore during Leg 2b of the 2024 CCGS Amundsen expedition for our team and for collaborators.

													Collaboration	
Station ID	Boxcore ID	Date (UTC)	Time bottom (UTC)	Latitude (N)	Longitude (W)	Depth (m)	Infauna Boidivesity	Sediment Grain size	Sediment Organic content	Sediment Pigments	Sediment Meiofauna	Pushcores Incubations	Sediment – R. Amiraux Isotopes & HBI	Sediment - J. Provencher
TCA 5.2	AMD2402-26BC	07/30	13 :17 :14	67.3354393	64.6510943	200	0	0	0	0	0	0	1	3
TCA 5.2	AMD2402-27BC	07/30	13 :48 :49	67.3352475	64.6501912	200	1	1	1	3	1	3	0	0
TCA 5.3	AMD2402-31BC	07/31	13 :30 :33	67.23000	64.64742	223	1	1	1	3	1	3	1	0
TCA 5.1	AMD2402-33BC	08/01	09 :50 :53	67.09611	64.65642	146	0	0	0	0	0	0	0	3
TCA 5.1	AMD2402-34BC	08/01	10 :12 :28	67.09572	64.65630	165	1	1	1	3	1	3	1	0
D1	AMD2402-35BC	08/02	01 :06 :26	67.47314	63.69393	668	0	0	0	0	0	0	0	3
B1-C1	AMD2402-39BC	08/05	09 :47 :59	67.19975	61.98244	275	0	0	0	0	0	0	1	3
B2.5	AMD2402-40BC	08/05	18 :47 :49	67.25654	60.57405	885	0	0	0	0	0	0	1	3

Table 45-4: Beam trawl stations where benthic invertebrates were collected for collaboration with Rémi Amiraux during Leg 2B of the 2024 CCGS Amundsen expedition (see Geoffroy's team report for more details on Beam trawl deployments).

Station ID	Date Time (UTC)	Latitude (N)	Longitude (W)	Event	Depth (m)
TCA-QFA1	07/31; 09 :40 :45	67.21500	64.73093	Deployment	171
	07/31; 09 :51 :55	67.21882	64.71784	Bottom	190
	07/31; 10 :04 :33	67.21542	64.70667	Recovery	204
TCA 5.1	08/01; 13 :28 :32	67.21500	64.73093	Deployment	156
	08/01; 13 :38 :38	67.21882	64.71784	Bottom	175
	08/01; 13: 50: 39	67.10844	64.64001	Recovery	183
C1	08/05; 07: 35 :53	67.33524	62.48270	Deployment	125
	08/05; 07: 43: 03	67.33386	62.47004	Bottom	147
	08/05; 08: 06: 26	67.33630	62.42723	Recovery	161
B1	08/05; 14 :53 :53	67.06516	61.51102	Deployment	122
	08/05; 15 :01 :17	67.06893	61.50978	Bottom	122
	08/05; 15: 23: 57	67.08475	61.50215	Recovery	142

45.2.3 *Leg 3, 4 and 5a:*

- *Boxcore*

The boxcore was deployed to quantitatively sample the diversity, abundance, and biomass of endobenthic fauna, as well as to obtain sediment cores for further sediment analyses and incubations. Sediment samples covering a surface area of approximately 0.125 m² and 10-15 cm in depth were collected, passed through a 0.5 mm mesh sieve, and preserved in a 4% formaldehyde solution for later identification in the laboratory (Table 45-5, Table 45-6, Table 45-7). Sub-cores of sediments were also collected for analyses of sediment pigment content, organic carbon content, and sediment grain size. For sediment pigments and organic carbon content, the top 1 cm of sediment was collected, while for sediment grain size, the top 5 cm was taken. Samples for sediment pigment analysis were frozen at -80°C, while organic carbon and sediment grain size samples were frozen at -20°C. All samples will be transported off the ship for analysis in the lab at Laval University.

- *Agassiz*

During Leg 4, at 3 stations, an Agassiz trawl (1.5 m width × 0.7 m height, cod end of 0.5 cm mesh size) was towed on the seabed at a speed of 1.5-2 knots for 3 minutes to survey epibenthic species diversity, abundance, and biomass (Table 45-8). Catches were passed through a 2 mm mesh sieve. Specimens were identified to the lowest taxonomic level, then counted and weighted. The unidentified specimens were preserved in a 4% seawater-formalin solution for further identification in laboratory. Specimens were preserved for collaborators along with specimens opportunistically taken from Beam Trawls deployed by a separate team (Table 45-9). All samples will be transported off the ship for analysis in home labs. No Agassiz were performed during Leg 5a (Table 45-10).

- *Incubation*

At each station in the fjords during Leg 3 and each full station in Leg 4 and 5a, box cores were deployed to study ecosystem functions through incubation experiments (Table 45-5 and Table 45-6, Table 45-7). At these stations, sub-cores of sediment from the box cores were collected for incubation. Bottom water was collected from the rosette at these stations to facilitate the incubations.

Incubations were conducted in a dark, temperature-controlled room (approximately 4°C) to allow for 20% oxygen consumption. The top of the sediment cores was carefully covered with bottom water collected from the same station using the rosette. One control core was filled with rosette water. The cores were then gently stirred with a small stirring motor.

Oxygen levels were measured every 30 seconds using an Oxy4 sensor from Presens, which utilizes optical measurement technology. At approximately 100%, 92%, 87%, and 80% oxygen saturation, water samples were taken from the cores to measure nutrients and dissolved inorganic carbon (DIC). At the end of the incubations (around 80% oxygen saturation), luminophores were added to three of the cores for a period of six days. The remaining two cores were sieved through a 500 µm mesh to examine the biodiversity within the incubation. All samples were then preserved in 4% buffered formaldehyde for further analysis at Laval University. During the final two days of luminophore addition, a solution of 1M sodium bromide was added to the cores, with measurements taken every two hours for the first eight hours and then every eight hours. To conclude the incubation with luminophores, the sub-cores were sliced at specific depths (5, 10, 15, 20, 30, 40, 50, 60, 80, 100, 120, and 140 mm).

- *Nutrients and DIC sampling*

To sample nutrients (nitrite, nitrate, phosphate, and silicate), 15 mL polypropylene conical tubes were used, filled with water from the cores using a 60 mL plastic syringe fitted with a 25 mm GF/G glass fiber filter in a filter holder. The samples were then frozen at -20°C for further analysis.

For DIC sampling, 30 mL glass vials were used and completely filled with water from the cores to prevent the presence of air. Under an appropriate fume hood, 200 μL of 1M HgCl2 was carefully added with a micropipette, ensuring no air bubbles were introduced. The samples were then stored at approximately 4°C in the container outside for further analysis.

Table 45-5: Sampled variables during Leg 3 (Amundsen 2024) using the box core

Time (UTC)	Station ID	Latitude (N)	Longitude (W)	Depth (m)	Diversity	Grain size	Organic content	Pigment	Push cores	Porosity
08/13	RA01	72,8574368	75,5130567	663,04	1	1	1	3	X	X
08/15	RA02	77,2589122	79,1662128	573,1	1	1	1	3	5	1
08/16	RA03	77,2919235	80,7597678	436,95	1	1	1	3	5	1
08/16	RA04	77,3814943	81,0757577	182,34	1	1	1	3	5	1
08/18	RA06	79,6834667	73,0865678	246,91	1	1	1	3	5	1
08/19	RA07	79,7854023	73,5654480	230,25	1	1	1	3	5	1
08/20	RA08	79,8294345	74,1006418	256,75	1	1	1	3	5	1
08/24	RA12	81,5705637	67,6529697	285,65	1	1	1	3	X	X
08/24	RA12geo	81,5665653	67,7275045	302,89	1	1	1	3	5	1
08/25	RA13	81,2881568	68,5047670	429,03	1	1	1	3	5	1
08/26	RA14	81,5839427	65,9476127	540,72	1	1	1	3	5	1
08/27	RA15	81,6701240	64,0715292	612,98	1	1	1	3	5	1
08/28	RA16	81,7281848	59,2347392	121,95	1	1	1	3	5	1
08/29	RA17	81,6281042	58,9099013	96,44	1	1	1	3	5	1
08/30	RA18	81,9390358	60,3783032	297,55	1	1	1	3	3	1

Table 45-6: Sampled variables from the box core (BC) of van Veen (VV) during Leg 4 of the 2024 CCGS Amundsen expedition

Date (UTC)	Station ID	Latitude (N)	Longitude (W)	Depth (m)	Sampling method	Infauna Biodiversity	Sediment Grain size	Sediment Organic content	Sediment Pigment	Incubation push cores	Microplastics (J. Provencher)	OM content/source/quality (POMP)	HBI, Alkenone, lipids (R. Amiraux)	Kelp carbon surface sediments and pushcores (BlueArc)
09/08	RA25	81.4035728	64.2644277	521	BC	1	1	1	3	3	0	0	0	0
09/10	RA27	80.3856245	68.9589390	335	BC	1	1	1	3	0	0	0	0	0
09/11	RA28	80.3463117	69.0158588	338	VV	1	0	0	0	0	0	0	0	0
09/11	RA28	80.3455327	69.0162673	338	BC	0	1	1	3	0	0	0	0	0
09/12	RA31	80.2534358	67.7663403	152	BC	Fond rocailleux, BC vide								
09/13	RA36	79.8728717	69.9379235	219	BC	1	1	1	3	3	4	0	1	1
09/15	RA38	79,4406053	71.0673915	223	BC	1	1	1	3	3	0	1	1	1
09/16	RA41	79.5072303	72.8218123	233	BC	1	1	1	3	0	0	0	0	0
09/17	RA43	79.0820450	69.4531885	216	BC	1	1	1	3	0	0	0	0	0
09/18	RA45	78.3078068	74.9048710	545	BC	1	1	1	3	0	0	0	0	0
09/20	RA50	78.2997517	74.0025780	610	BC	1	1	1	3	3	0	1	1	1
09/23	RA54	76.3400282	71.2691593	660	BC	1	1	1	3	3	3	0	1	1
09/24	RA58	76.3066323	73.2102925	592	BCGeo	0	1	1	3	3	0	0	0	0
09/25	RA62	76.2676548	74.7436175	458	BC	1	1	1	3	3	3	0	1	1
09/26	RA67	76.3706022	77.4225603	390	BC	1	1	1	3	3	0	1	1	1

Table 45-7: Sampled variables from the box core (BC) of van Veen (VV) during Leg 5 of the 2024 CCGS *Amundsen* expedition

Date (UTC)	Station ID	Latitude (bottom)	Longitude (bottom)	Depth (m) (bottom)	Sampling method	Infauna Biodiversity	Sediment Grain size	Sediment Organic content	Sediment Pigment	Incubation push	Microplastics (J. Provencher)	OM content/source/quali	HBI, Alkenone, lipids	Kelp carbon surface sediments and pushcores (BlueArc)	Sediment cores for Hillary (TCA)
10/04	KEB-S8	74.40973	-90.86578	170.42	BC	1	1	1	3	0	3	0	1	0	0
10/6	WOLF-1 (TCA-S3 substitute)	73.81676	-81.11438	649.46	BC	Tombé sur une grosse roche, BC endommagé									
10/7	TCAT3-01	72.50252	-75.02464	73.50	BC	1	1	1	3	3	0	1	1	1	0
10/8	TCAT3-08	72.63691	-71.57420	1131.39	BC	1	1	1	3	3	0	1	1	1	0

10/10	TCAT3-BB2	72.74662	-67.00709	2343.22	BC	1	1	1	3	3	0	1	1	1	0
10/12	TCAT3-17	74.32249	-66.71780	2187.20	BC	1	1	1	3	3	4	0	1	0	0
10/13	TCAT3-11	75.82018	-66.48500	594.72	BC	Boxcore tout lessivé									
10/16	TCAT6-09	67.09310	-54.26877	76.30	BC	Sol très sableux, tout lessivé									
10/17	TCAT6-05	66.87105	-57.95962	819.30	BC	1	1	1	3	3	0	0	1	0	1
10/18	TCAT6-03	66.73041	-59.61108	868.17	BC	1	1	1	3	3	0	0	1	0	1

Table 45-8: Agassiz trawl stations during Leg 4 of the 2024 CCGS *Amundsen* expedition

Station ID	Date	Start			End		
		Latitude (N)	Longitude (W)	Depth (m)	Latitude (N)	Longitude (W)	Depth (m)
RA50	09/20	78.2903505	73.5710630	648	78.2653127	73.5399827	705
RA54	09/23	76.3359775	71.2437735	664	76.3447055	71.3093172	657
RA62	09/25	76.2758008	74.6275560	445	76.2803013	74.6773350	446

Table 45-9: Samples collected from the Agassiz trawl (AG) or Beam trawl (BT) during Leg 4 of the 2024 CCGS Amundsen expedition, for our team and for collaborators

Station ID	Sampling method	Epifauna Biodiversity	Lipids (R. Amiraux)
RA28	BT	NA	X
RA36	BT	NA	X
RA38	BT	NA	X
RA50	AG	X	X
RA54	AG	X	X
RA62	AG	X	X

Table 45-10: Samples collected from the Agassiz trawl (AG) or Beam trawl (BT) during Leg 5a of the 2024 CCGS *Amundsen* expedition, for our team and for collaborators.

Station ID	Sampling method	Epifauna Biodiversity	Lipids (R. Amiraux)
KEB-S5	BT	NA	X

45.3 Preliminary results

Our preliminary results in fjords during Leg 3 indicate that Makinson Fjord, the southernmost site, exhibited the highest total oxygen uptake. This gradient in oxygen uptake suggests that benthic activity, and thus the potential for carbon remineralization, seems higher in southern fjords compared to northern fjords. This might be influenced by several factors, including differences in organic matter availability, substrate type, and local environmental conditions such as temperature and water column stratification, which can affect benthic communities and their metabolic processes (Figure 45-1).

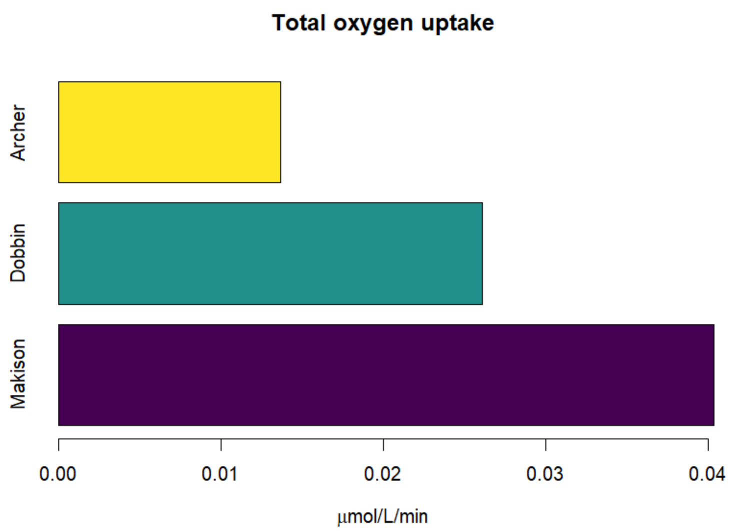

Figure 45-1: Total Oxygen Uptake in Arctic Fjords Along a Latitudinal Gradient

At this point, we do not know exactly if spatial and temporal variability of benthic diversity is governed by sediment type, food availability or other environmental variables. Samples collected require further analysis. For detailed results, identification of organisms and sediment analyses will be carried on in home labs.

45.4 Acknowledgement

We would like to thank the chief scientists, Amundsen Science and the CCGS *Amundsen* crew for their professional, experienced and competent help with deploying gear. Our work would not be possible without them!

45.5 References

Posey, M. H., & Ambrose, W. G. (1994). Effects of proximity to an offshore hard-bottom reef on infaunal abundances. Marine Biology, 118, 745-753.

Smith, R., Bianchi, T., Allison, M., Savage, C. & Galy, V. (2015) High rates of organic carbon burial in fjord sediments globally. Nature Geosci 8, 450–453. https://doi.org/10.1038/ngeo2421

46 Bioturbation and ecosystem functioning in Ungava Bay

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Cruise participants – Leg 5b : Philippe Archambault[1], Judith Gagnon[1], Jasmin Godbold[2], Isabelle Cooper[2]

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46.1 Introduction and Objectives

Rates of warming in the high northern latitudes are amongst the highest globally. One of the most dramatic manifestations are reductions in sea ice extent and thickness. Changes in climate change induced environmental conditions exert cascading effects on Arctic Ocean carbon and nutrient dynamics, causing important feedback on the local benthic ecosystems, regional processes and the global climate system. Changes to certain key components of Arctic ecosystems, such as benthic faunal assemblages or the extent of carbon and nutrient burial frequently not acknowledged in discussions of the changing Arctic. The Arctic Ocean seafloor hosts a diverse and productive benthic ecosystem that is a crucial component of an intimately coupled benthic-pelagic system. The relative importance of benthic organisms in modulating sequestration, transformation and storage of bio- essential nutrients and carbon across the Arctic Ocean is still poorly constrained.

The functional role of epi- and infauna is critical to understanding biogeochemical cycling at the sediment water interface, and the potential for organic matter to be recycled, or stored, in ocean floor sediments. The behaviour of sediment invertebrate species in terms of how they mix sediments (bioturbation) and move water through their burrows (bioirrigation) enhance the movement of oxygenated seawater into the sediment, driving a feed-back loop for nutrient cycling, and exerting a strong influence on the rate and degree of organic matter degradation and very little is known about the biodiversity and bioturbation of benthic invertebrates in Ungava Bay.

To gain a better understanding of these processes we collected intact benthic communities to investigate how changes in environmental context (depth, sediment grain size, organic matter content) across Ungava Bay affects benthic biodiversity and bioturbation.

46.2 Methodology

46.2.1 *Boxcore*

Following the same methodology as the Leg 3 sampling, we deployed the boxcore to quantitatively sample the diversity, abundance, and biomass of epi-and infaunal organisms, as well as to obtain sediment cores for further sediment analyses and incubations. We took a total of 6 Boxcores and two Van Veen grabs across 6 stations in Ungava Bay. Where possible we collected sediment samples covering a surface area of approximately 0.125 m² and 10-15 cm in depth were collected, passed through a 0.5 mm mesh sieve, and preserved in a 4% formaldehyde solution for later identification in the laboratory, but see Table 1 for deviations. Sub-cores of sediments were also collected for analyses of sediment pigment content, organic carbon content, and sediment grain size. For sediment pigments and organic carbon content, the top 1 cm of sediment was collected, while for sediment grain size, the top 5 cm was taken. Samples for sediment pigment analysis were frozen at -80°C, while organic carbon and sediment grain size samples were frozen at -20°C. All samples will be transported off the ship for analysis in the lab at Laval University.

46.2.2 *Incubations*

At each station at which we were able to recover a boxcore, we took one 12 x 12 x 10cm sub-core per box core (at station UNG_03 we took two sub-cores per boxcore) to collect intact communities for incubation (Table 46-1). Each core was returned to the temperature control room and left to settle for 5 hours, before we conducted a water change with fresh seawater and added 50g luminophores to the sediment surface (see section *Bioturbation* for details). All cores were continuously aerated and left in the dark at approximately 4°C for 5 days (Figure 46-1).

At the end of the incubations and after quantification of bioturbation, all cores were sieved through a 500 µm mesh for quantifying biodiversity within each core. All samples were preserved in 4% buffered formaldehyde for later analysis at Laval University.

Figure 46-1: Set-up of the experimental aquaria containing intact infaunal benthic communities from three stations in Ungava Bay, Canada. All aquaria were continually aerated and maintained for 5 days at 4°C in the dark. Green layer on the sediment surface is dyed sand used for the quantification of sediment reworking (bioturbation) by the infaunal community.

46.2.3 *Ammonium and nutrient sampling*

Ammonium. We collected duplicate 5mL of seawater from the center of each core. Each sample was filtered through a 25mm Ø, 0.7μm GF/G filter into glass vials and stored in a fridge at 4°C. The concentration of ammonium concentration in each sample was determined within hours of taking the samples by Jonathan Gagnon following standard procedures.

Nutrients. We collected 15mL of seawater from the centre of each core. Each sample was filtered through a 25mm Ø, 0.7μm GF/G filter into polypropylene tubes and stored in the fridge at 4°C. Concentrations of nitrite, nitrate, phosphate, and silicate were determined within 2 hours of taking the samples by Jonathan Gagnon following standard procedures.

46.2.4 *Quantifying Bioturbation*

After 5 days incubation we took a picture of all four sides of each core housed using a Canon 400D (f5.6, ISO 200, exposure 0.3 seconds) within a UV illuminated imaging box (f-SPI, Schiffers et al. 2011). For each core we will quantify the redistribution of luminophores by making stitched composite images (See example Figure 46-2) to determine the sediment surface boundary roughness (SBR), as well as the mean (f–SPILmean, time-dependent indication of short term faunal mixing) and maximum (f–SPILmax, maximum vertical extent of faunal mixing) using extracted profile data using a custom-made semi-automated macro that runs in ImageJ

(v. 1.47 s), a java-based public domain program developed at the US National Institutes of Health (http://rsb.info.nih.gov/ij/index.html). Image analysis will be conducted at a later stage at the University of Southampton.

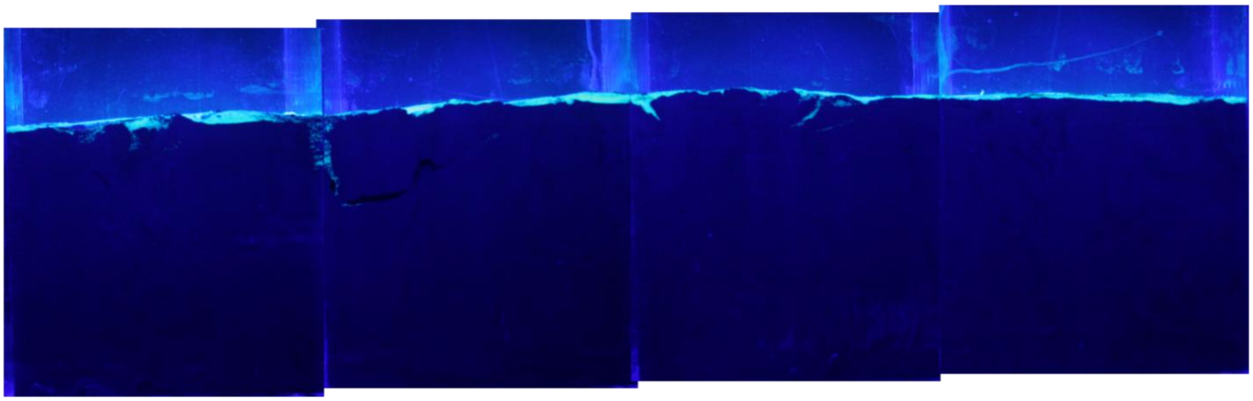

Figure 46-2: Example composite image from Station GR24_17.2 for the quantification of bioturbation. Note: this image has not yet been cleaned for image analysis and is purely for illustrative purposes.

Table 46-1: Sampled variables during leg 5b (Amundsen 2024) using the box core or van veen grab.

Time (UTC)	Station ID	Latitude	Longitude	Depth (m)	Diversity	Grain size	Organic content	Pigment	Microplastics	POMP OM	Incubation	Comment
21.10.2024	AR24_20 A and B	60.0028982	-69.2284557	79.1	B only					B only		Scallops, rocks, some biodiversity retained in 2nd box core
21.10.2024	AR24_19.1	59.9854612	-69.3887503	92.79	1	1	1	3	3	1		Grab, 60% full
	AR24_19.2	59.9854612	-69.3887503	92.79	1*	1	1	3		1	1	Boxcore *Biodiversity retained from experiment
22.10.2024	LR24_05	58.9690862	-68.9086410	132.4								Grab, gravel, no sample
22.10.2024	LR24_04	59.0814187	-68.7497380	93.47	4	1	1	3	3	1		Grab enough sediment for samples
23.10.2024	UNG24_03.1	59.4255038	-67.4544410	Not recorded in event log	2*	1	1	3	3	1	2	Boxcore, *diversity from 2 incubation cores (UNG24_03.1a UNG24_03.1b). Also took BlueArc core and falcon tube
23.10.2024	UNG24_03.2	59.4255787	-67.4565325	182.93	2*	1	1		3	1	2	Boxcore, *diversity from 2 incubation cores (UNG24_03.2a UNG24_03.2b).
24.10.2024	GR24_17.1	58.8836102	-66.3083250	Not recorded in event log	1*	1	1	3	3	1	1	Boxcore, *diversity from 1 incubation core. Also took BlueArc core and falcon tube
24.10.2024	GR24_17.2	Not recorded in event log	Not recorded in event log	Not recorded in event log	1*						1	Boxcore, *diversity from 1 incubation core.

46.3 Preliminary Results

Visual inspection of the fSPI images suggest that there are slight differences in bioturbation activity between the different locations, which relates to very different species composition as observed during sieving which are likely related to the observed differences in sediment type. Observations during sampling and sieving suggest that the cores collected outside the Arnaud River (Station AR24_19) and the George River (GR24_17.1 and GR24_17.2) have a larger grain size in comparison to those collected in the center of Ungava Bay (UNG_03.1 and UNG_03.2) where the sediment was extremely fine clay and very compact with comparatively less sediment mixing. However, the samples (sediment analyses and species identification) and images collected require analysis at the University of Laval and Southampton University.

46.4 References

Schiffers K, Teal LR, Travis JMJ, SolanM. 2011 An open source simulation model for soil and sediment bioturbation. PLoS ONE 6, e28028. (doi:10.1371/journal.pone.0028028)

47 Seafloor mapping and investigation of geohazards

Project leaders: Alexandre Normandeau[1] & Audrey Limoges[2]

Cruise participants – Leg 2a: Robbie Bennett[1], Jeremy Bentley[1], Laura Broom[1], Scott Hayward[1] and Brayden Harker[2]

Cruise participants – Leg 2b: Robbie Bennett[1], Jermey Bentley[1], Laura Broom[1], Scott Hayward[1] and Brayden Harker[2]

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[2]Department of Earth Sciences, University of New Brunswick, Fredericton, NB.

47.1 Introduction

Leg 2a:

The 2024 research program on the CCGS Amundsen aimed at providing research within the Labrador Sea in support of Nunatsiavut's Imappivut Marine Planning Initiative and the Torngat Area of Interest Feasibility Assessment. For NRCan this work was supported by the Marine Geoscience for Marine Spatial Planning (MGMSP) program which conducts research on the marine geology of Canada's continental shelves. On the Canadian East Coast, the program focuses mainly on the Scotian Shelf and the Newfoundland and Labrador Shelf. On the Labrador Shelf, research is being conducted to support both the Nunatsiavut Government's and Fisheries and Oceans Canada's decision-making on the use of the seabed.

Leg 2b:

The efforts focused on three fjords: Maktak, Coronation, and North Pangnirtung Fjord. For NRCan these efforts support the Public Safety Geoscience Program and complements work on marine geohazards in fjords across Baffin Island (Sedore et al. 2024; Bennet et al. 2022; Broom et al. 2017). Previous work has been conducted in Coronation Fjord (Rodríguez-Cuicas et al. 2024) were there has been evidence of large-scale delta front collapse, turbidity currents and glacial outburst floods, all of which represent geohazards. Mapping these fjords along with the collection of cores, will allow us to more precisely identify the source of the different geohazards in this region.

47.2 Objectives:

47.2.1 *NRCan's Objectives*

Leg 2a:

1) Characterize and constrain the timing and morphology of submarine landslide deposits in Northern Labrador fiords utilizing gravity cores and deployments of the GAVIA autonomous underwater vehicle (AUV).

2) Understand the fine scale variability in Labrador current processes at the seabed utilizing box cores.

3) Utilize gravity core deployments at the base of the Makkovik Hanging Gardens site in effort to determine how long corals have been established in this locality and whether cores can be used to assess long term fluctuations in their abundance.

Leg 2b

1) Provide the sedimentological context for cores collected from Maktak, Coronation and North Pangnirtung Fjords.
2) Investigate the sedimentary processes including geohazards within these fjords utilizing the newly acquired sediment cores, multibeam bathymetry, and sub-bottom profiler data.

47.2.2 *UNB's Objectives*

1) Develop a modern database on the distribution and abundance of microfossil, geochemical, biomarker and molecular proxies and their relationship to ocean conditions.
2) Investigate the presence of resting stages of harmful algal species in surface sediment.
3) Germinate resting cysts of dinoflagellates for taxonomic purposes (culture experiments).

Five participants from Natural Resources Canada (NRCan) and two from the University of New Brunswick participated in the 2024 expedition. The field team included Robbie Bennett, Jeremy Bentley, Scott Hayward, Laura Broom and Brayden Harker, while Alexandre Normandeau and Audrey Limoges provided onshore scientific support (Table 47-1).

Table 47-1: Geological Survey of Canada participants onboard the 2020804 CCGS Amundsen Expedition

First name	Last name	Organization	Role
Alexandre	Normandeau	Geological Survey of Canada	Research Scientist
Audrey	Limoges	University of New Brunswick	Professor
Robbie	Bennett	Geological Survey of Canada	Physical Scientist
Jeremy	Bentley	Geological Survey of Canada	Technologist
Laura	Broom	Geological Survey of Canada	Physical Scientist
Scott	Hayward	Geological Survey of Canada	Technologist
Brayden	Harker	University of New Brunswick	Masters Student

Figure 47-1: NRCan participants for the 2024 Leg 2a Amundsen Expedition. From left to right: Laura Broom, Jeremy Bentley, Robbie Bennett, and Scott Hayward.

47.3 Methodology

NRCan and UNB participated on Leg 2a of the 2024 Amundsen Science Expedition onboard the CCGS Amundsen. This was a multidisciplinary cruise that began on July 11, 2024 and ended on July 29, 2024.

UNB and NRCans stations (Figure 47-2) included:

1) Five gravity core deployments
2) Twenty-three box core deployments from which NRCan sub-sampled from 10 sites (Table 47-2) and UNB from 14 sites (Table 47-3).
3) Two Autonomous Underwater Vehicle (AUV) deployments

Leg 2b of the 2024 Amundsen Science Expedition onboard the CCGS *Amundsen* was a multidisciplinary cruise that began on July 29, 2024 and ended on August 8, 2024. A total of 17 box cores were deployed during the leg 2b for DFO's KEBABB and TCA Programs. Seven gravity cores were deployed for TCA and NRCan. NRCan's stations in support of TCA (Figure 47-3, Figure 47-4) included:

1) Seven gravity core deployments
2) Four push cores from box core deployments

UNB's stations included the collection of samples from 7 box cores (Figure 47-3).

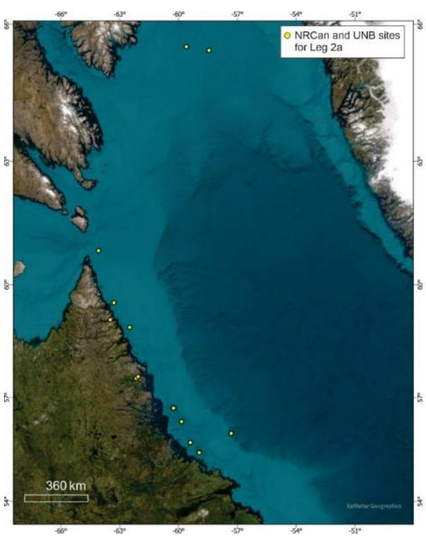


Figure 47-2: NRCan and UNB's station locations during Leg 2a of the 2024 Amundsen Science expedition. World imagery basemap from: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

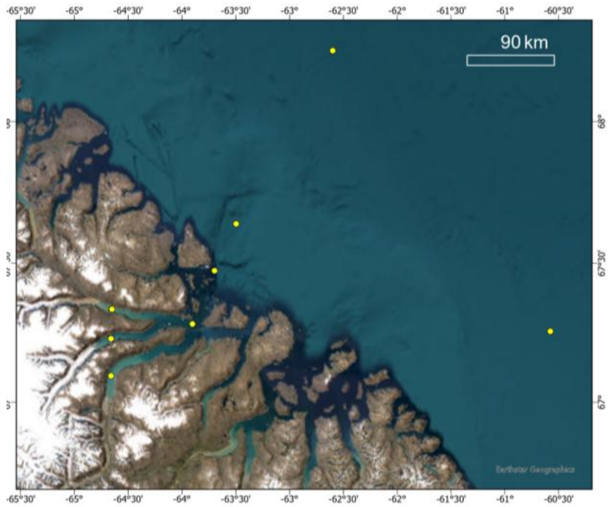


Figure 47-3: NRCan and UNB's station locations during leg 2b of the 2024 Amundsen Science expedition. World imagery basemap from: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Figure 47-4: NRCan's station locations in support of TCA. World imagery basemap from: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Table 47-2: NRCan's stations for Legs 2a and 2b of the 2024 Amundsen Science expedition.

Time (UTC)	Amundsen Station ID	NRCan Station ID	Latitude (N)	Longitude (W)	Activity	Depth (m)
07/15 20:24:21	MAK-2024-M1	2024804 0001	55.4339035	58.9355845	Gravity Core	598.83
07/15 22:02:40	MAK-2024-M1	2024804 0002	55.43363883	58.9411905	Gravity Core	707.45
07/16 01:06:32	MAK-2024-M1	2024804 0003	55.43343433	58.93949017	Box Core	702.63
07/16 04:46:16	MAK-2024-M1	2024804 0004	55.43364917	58.93722983	Box Core	681.59
07/19 04:14:44	Sentinel	2024804 0005	56.31960583	59.83990667	Box Core	541.76
07/19 19:22:59	Sentinel North - Moat	2024804 0006	56.69211783	60.28453533	Box Core	479.11
07/19 20:05:04	Sentinel North -Drift 2	2024804 0007	56.69306517	60.26792517	Box Core	492.06
07/19 21:23:33	Sentinel North - Drift 1	2024804 0008	56.7002045	60.21379117	Box Core	759.78
07/19 22:06:38	Sentinel North - Sidewall 1	2024804 0009	56.705843	60.18386117	Box Core	299.44
07/19 23:25:47	Sentinel North - Sidewall 2	2024804 0010	56.6941565	60.258533	Box Core	498.69
07/20 15:37:31	Okak Landslide	2024804 0011	57.5140465	62.1571965	AUV	69.52
07/20 17:20:08	Okak Bay	2024804 0012	57.56950783	62.0481965	Box Core	92.11
07/20 19:57:17	Okak Landslide	2024804 0013	57.517467	62.147476	Gravity Core	69.79
07/22 14:00:32	Nachvak Fjord	2024804 0014	59.10355317	63.41338267	AUV	182.89
07/22 16:13:40	Nachvak Fjord	2024804 0015	59.0856785	63.46927517	Box Core	209.74
07/22 18:24:00	Nachvak1	2024804 0016	59.11134433	63.42610467	Gravity Core	164.69
07/22 19:26:40	Nackvak2	2024804 0017	59.098615	63.40674533	Gravity Core	11.17
07/30 13:17:14	TCA-5.2	2024804 0018	67.3354	64.6511	Box Core	200.38
07/30 14:43:11	TCA-5.2	2024804 0019	67.3351	64.6497	Gravity Core	200.63
07/30 15:33:29	TCA-5.2	2024804 0020	67.3347	64.6471	Gravity Core	201.79

07/30 16:57:30	TCA-5.2	2024804 0021	67.3351	64.6488	Gravity Core	200.66
07/31 13:30:33	TCA-5.3	2024804 0022	67.2300	64.6574	Box Core	223.35
07/31 14:31:35	TCA-5.3	2024804 0023	67.2301	64.6553	Gravity Core	224.26
07/31 15:36:53	TCA-5.3	2024804 0024	67.2304	64.6561	Gravity Core	224.16
08/01 00:31:43	TCA-QF3	2024804 0025	67.2834	63.8977	Box Core	600.96
08/01 10:12:28	TCA-5.1	2024804 0026	67.0957	64.6563	Box Core	164.62
08/01 11:14:16	TCA-5.1	2024804 0027	67.0962	64.6572	Gravity Core	164.31
08/01 12:57:24	TCA-5.1	2024804 0028	67.0960	64.6564	Gravity Core	165.41

Table 47-3: UNB's box core stations for Legs 2a and 2b of the 2024 Amundsen Science Expedition.

Station ID	Boxcore ID	Date/Time (UTC)	Latitude	Longitude	Depth (m)	Samples types	Notes/Comment
Hopedale Saddle	AMD2402-01BC	2024/07/14 03:05:55	55.9877737	-57.3155940	1188.16	All proxies, Germinations	Shovel got jammed on large rock. However, there was ~30cm of water on the surface of boxcore and surface appeared undisturbed
MAK-2024-M1 (Far)	AMD2402-05BC	2024/07/16 01:06:32	55.4334343	-58.9394902	702.63	All proxies, Germinations	Surface slightly disturbed while moving boxcore. Lots of tube worms sticking out at surface. Started to rain lightly during sampling
MAK-2024-M2 (Near)	AMD2402-07BC	2024/07/16 04:46:16	55.4336492	-58.9372298	681.59	All proxies, Germinations	Light rain during sampling
Hopedale Shelf	AMD2402-09BC	2024/07/17 15:07:34	55.7175802	-59.3943612	212.21	All proxies, Germinations	First deployment failed. Second deployment was successful, ~30cm of surface water. Lots of brittle stars recovered on surface, as well as a few corals and a sea urchin
Sentinel	AMD2402-10BC	2024/07/19 04:14:44	56.3196058	-59.8399067	541.76	All proxies, Germinations	Surface slightly disturbed from swinging of box core during recovery.
Sentinel North - Drift 2	AMD2402-11BC	2024/07/19 19:22:59	56.6921178	-60.2845353	479.11	All proxies, Germinations	Sample was originally labeled with wrong station ID.
Sentinel North - Drift 1	AMD2402-12BC	2024/07/19 20:05:04	56.6930652	-60.2679252	492.06	All proxies, Germinations	Sample was originally labeled with wrong station ID. Box got shook a lot during recovery
Sentinel North - Sidewall1	AMD2402-13BC	2024/07/19 21:23:33	56.7002045	-60.2137912	432*	All proxies, Germinations	Sample was originally labeled with wrong station ID
Sentinel North - Sidewall 2	AMD2402-14BC	2024/07/19 22:06:38	56.7058430	-60.1838612	299.44	All proxies, Germinations	Only recovered ~30cm of sediment. Surface water drained out of the bottom of the box core.
Sentinel North - Moat	AMD2402-15BC	2024/07/19 23:25:47	56.6941565	-60.2585330	498.69	All proxies, Germinations	
Okak Bay	AMD2402-16BC	2024/07/20 17:20:08	57.5695078	-62.0481965	92.11	DNA, All proxies, Germinations	Surface was covered in brittle stars. Had to move them out of the way with tweezers to sample. Push cores that required surface water were instered prior to draining the water comepletly and sampling for DNA metabarcoding.
Nachvak Fjord	AMD2402-17BC	2024/07/22 16:13:40	59.0856785	-63.4692752	209.74	DNA, All proxies, Germinations	Push cores that required surface water were instered prior to draining the water comepletly and sampling for DNA metabarcoding.
Ramah Shelf	AMD2402-18BC	2024/07/23 04:28:33	58.8875467	-62.4918582	201.82	All proxies, Germinations	A few brittle stars on surface, and a shrimp
Kangalasiorvik Shelf	AMD2402-19BC	2024/07/23 14:02:52	59.5340510	-63.2857367	180.25	NONE	Rock bent the box core. Very little sediment was recovered. Surface was disturbed
Killinik 2	AMD2402-20BC	2024/07/24 02:43:23	60.8488678	-64.0635018	405.64	NONE	First deployment did not trigger the spade. Second deployment got caught on rocks. Only a few small pebbles/rocks recovered
DS_500_B2	AMD2402-21BC	2024/07/26 07:17:14	65.5229597	-59.5976768	487.26	NONE	Recovered little mud. All the water rusged out the bottom of the box core. Surface was disturbed
DS_500_B1	AMD2402-22BC	2024/07/26 15:19:54	65.4517100	-58.4344738	498.25	NONE	Recovered little mud. All the water rusged out the bottom of the box core. Surface was disturbed
DS_600_A1	AMD2402-23BC	2024/07/27 03:00:04	66.2004267	-58.2081370	624.52	All proxies, Germinations	Box was lifted slightly by crane when seperating the corer from the box. However surface appeard undisturbed.
					*Bathymetry depth		

Station ID	Boxcore ID	Date/Time (UTC)	Latitude	Longitude	Depth (m)	Samples types	Notes/Comment
Qik Harbour	AMD2402-24BC	2024/07/29 20:49:35	67.5309317	-64.0401685	38.57	NONE	Very little sediment recovered. Very sandy sediment. Surface disturbed
Qik Harbour	AMD2402-25BC	2024/07/29 21:25:24	67.5311688	-64.0394227	38.57	NONE	Very little sediment recovered. Very sandy sediment. Surface disturbed
TCA5.2	AMD2402-26BC	2024/07/30 13:17:14	67.3354393	-64.6510943	200.38	NONE	Very soupy and sandy sediment. Muddy water rushed out of bottom of box. Surface disturebed
TCA5.2	AMD2402-27BC	2024/07/30 13:38:49	67.3352475	-64.6501912	200.38	All proxies, Germinations	Very soupy and sandy sediment. Muddy water rushed out of bottom of box. Surface disturebed
TCA5.3	AMD2402-28BC	2024/07/31 11:02:19	67.2211298	-64.7224560	192.26	NONE	Box core overshot, no surface
TCA5.3	AMD2402-29BC	2024/07/31 11:27:45	67.2210555	-64.7215418	192.97	NONE	Deployed at slower speed. Box core overshot, no surface
TCA5.3*	AMD2402-30BC	2024/07/31 13:05:34	67.2298687	-64.6579768	222.94	NONE	* Alternate location. Box core overshot, no surface sediment
TCA5.3*	AMD2402-31BC	2024/07/31 13:30:33	67.2300035	-64.6574168	223.35	NONE	* Alternate location. Box core overshot, no surface sediment
TCA-QF3	AMD2402-32BC	2024/08/01 00:31:43	67.2834443	-63.8977192	600.96	DNA, All proxies, Germinations	Push cores that required surface water were instered prior to draining the water comepletly and sampling for DNA metabarcoding.
TCA5.1	AMD2402-33BC	2024/08/01 09:50:53	67.0961147	-64.6564180	164.46	All proxies, Germinations	
TCA5.1	AMD2402-34BC	2024/08/01 10:12:28	67.0957248	-64.6562962	164.62	NONE	
D1	AMD2402-35BC	2024/08/02 01:06:26	67.4731432	-63.6939283	668.35	DNA, All proxies, Germinations	Two large sea anemones on surface of box core. Push cores that required surface water were instered prior to draining the water comepletly and sampling for DNA metabarcoding.
D1.5	AMD2402-36BC	2024/08/02 03:05:29	67.6404467	-63.4916307	573.99	All proxies, Germinations	1 large sea anemone on surface
D3	AMD2402-37BC	2024/08/02 20:27:13	68.2457058	-62.5964162	1536.57	All proxies, Germinations	
C2.5	AMD2402-38BC	2024/08/04 23:30:35	67.6466815	-61.6040597	1303.2	NONE	Shovel got caught on large rocks and did not close
B1-C1	AMD2402-39BC	2024/08/05 09:47:59	67.1997517	-61.9824372	274.03	NONE	Surface disturbed. Very sandy
B2.5	AMD2402-40BC	2024/08/05 18:47:49	67.2565365	-60.5740455	885.25	All proxies, Germinations	Water drained out of bottom of box slowly. Surface was cracked but appeared generally undisturbed

47.3.1 *Coring:*

Giant Gravity Core

The gravity core was deployed five times for Leg 2a. The gravity core consisted of the piston coring system deployed as a gravity corer. This set up was used because it performs well in soft sediments (mud) and requires less time to. The set up involved installing the 9m-long corer without the trigger weight core and trip arm and the piston. The giant gravity corer system includes three 3 m long barrels attached by couplings and a 2000 lb core head (Figure 47-5). Inside of the barrels was nine meters of core liner and a butterfly valve was fitted to the top of the liner in place of the piston.

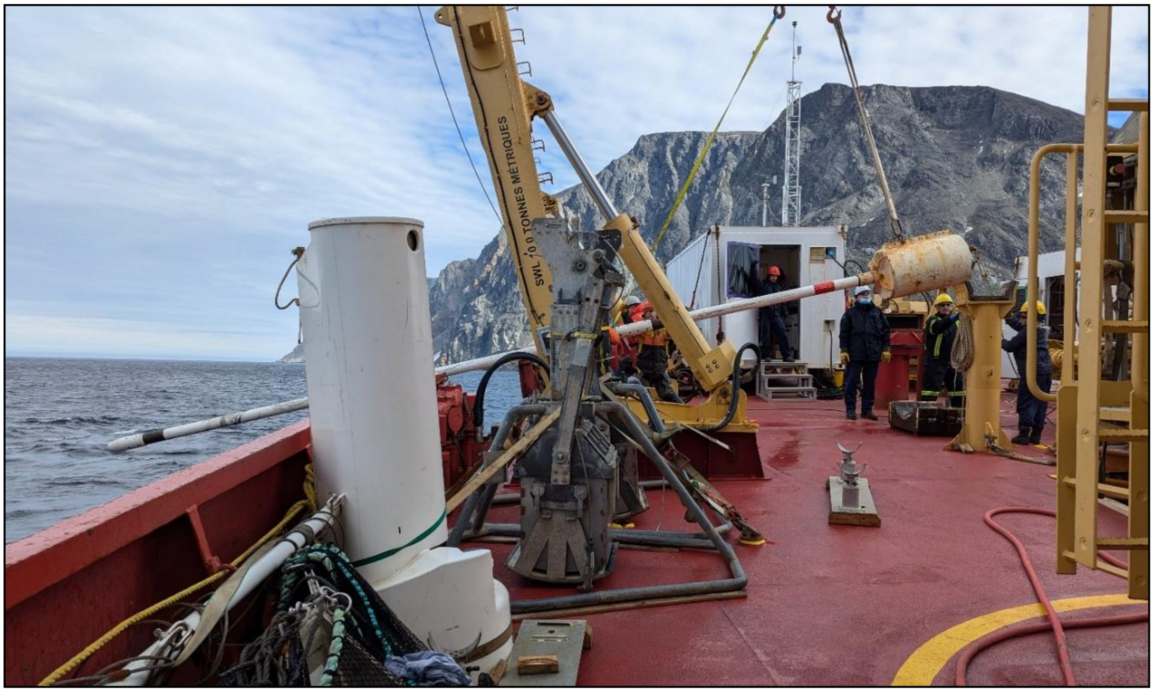


Figure 47-5: Gravity coring system ready for deployment onboard the *CCGS Amundsen*

When the gravity core is retrieved, the plastic liners are taken apart, beginning with the base. Each liner is three meters long and as they are recovered on deck, they are cut into 1.5 m sections, fitted with end caps and taken into the lab for documentation and preliminary processing. On board processing of the cores consisted of taking shear strength measurements at the top and bottom of the cores and a constant volume subsample from the top and/or bottom of core sections where the material was suitable. Shear strength measurements were taken using a torvane that was inserted into the sediment at the bottom/top of the core liner and turned at a constant rate until the sediment failed. This measurement is used to help calibrate the shear strength measurements that will be taken along the length of the core at the NRCan laboratory. Constant volume samples were collected using a cylinder of known volume which will be analysed for bulk density at NRCan. This measurement will help calibrate the bulk density measurements taken along the length of the core at NRCan. Suitable sediment for these procedures is undisturbed mud. Sand, soupy mud, or core disturbance will make the measurements unsuitable. The cores were then resealed with tape, the ends were covered with wax and the cores were stored upright in a refrigerated container. These cores will be taken back to NRCan for further processing.

Box Core

The box corer (Figure 47-7) was deployed and subsampled ten times by NRCan (Figure 47-7; Table 47-2). For NRCan's stations, the box core was subsampled by inserting a liner into the sediment (Figure 47-7). Once the push core was inserted, the excess sediment was removed from the box corer with shovels, and the core was capped with endcaps, taped, sealed with wax and stored upright in the refrigerated container.

Figure 47-6: Deployment of the box core system.

Figure 47-7: Example of push core subsampling from NRCan box core station 0010.

For UNB subsampling, when the sediment volume was sufficient (which was the case for most deployments) the sediment/water interface (0-1cm) from each box-core location was subsampled into two whirl-pak bags; one for microfossil, geochemical, biomarker and molecular proxies, and the other for germination experiments. A surface sample for DNA metabarcoding was collected at two sites (Okak Bay and Nachvak Fjord). DNA metabarcoding samples were collected into sterile 50mL centrifuge tube using sterile sampling equipment by a scientist wearing a protection sleeve apron, gloves and mask, and frozen at -80°C immediately after collection. Note: Push cores that required surface water were inserted prior to draining the box core and DNA sampling. Pictures were taken of the surface of the box core to show sediment characteristics at each site (0).

Box Core identification and sample labelling (UNB)

The sediment core samples were labelled using the following numbering system:

AMD2402-01BC

AMD = Amundsen

24 = Year 2024

02 = Leg # 2

01 = core number (sequential series; i.e. 1, 2, 3,…., x)
BC = Corer type (e.g., BC = box core)
Additionally, all samples were also labeled with the site/station name.

Sediment samples for microfossil, geochemical, biomarker and molecular proxies where immediately frozen and stored at -80°C. Samples for DNA metabarcoding were also immediately frozen and stored at -80°C. Sediment samples for germination experiments were immediately placed in the dark (wrapped in a black garbage bag) and stored in the fridge (4°C). The series of frozen DNA metabarcoding samples will be transported back to UNB at the end of Leg 2b by Brayden Harker. All other sediment samples collected during Leg 2 will be frozen/refrigerated and stored aboard the CCGS Amundsen during legs 3, 4, and 5 to be removed at demobilization during end of October in Québec City. Surface sediment will then be shipped, stored, and analyzed in detail at UNB.

Autonomous Underwater Vehicle (AUV)

The AUV used during this cruise was a Gavia, manufactured by Teledyne Marine. It is approximately 12.5′ in length and weighs 325 lbs (Figure 47-8). The main sensors on the AUV are: 1) an EdgeTech bathymetric sonar that collects side scan sonar and multibeam-like bathymetry at ~15 cm resolution; and 2) a sub-bottom profiler which operated between 12 – 23 kHz that is capable of imaging the upper 10 to 15 m of sediment. The Gavia AUV is a fully autonomous vehicle that does not receive corrections from the operator while on a mission. The AUV is programmed with a mission plan using a laptop computer (or tablet) that is connected through its own wifi network. The AUV is deployed from the foredeck of the Amundsen using the starboard crane (Figure 47-10) and then towed to the mission site using a fast rescue craft (FRC). When at the appropriate release point, the AUV is untied from the FRC (Figure 47-9) and activated using a ruggedized tablet connected via the AUV's wifi network.

Figure 47-8: Photo of the Gavia AUV on deck

Figure 47-9: Photo of the deployment of the Gavia AUV during Leg 2a.

Two AUV missions were conducted during Leg 2a of the 2024 Amundsen expedition. These missions were conducted at Okak Bay (Figure 47-10) and Nachvak Fiord (Figure 47-11). The AUV collected excellent data during both missions.

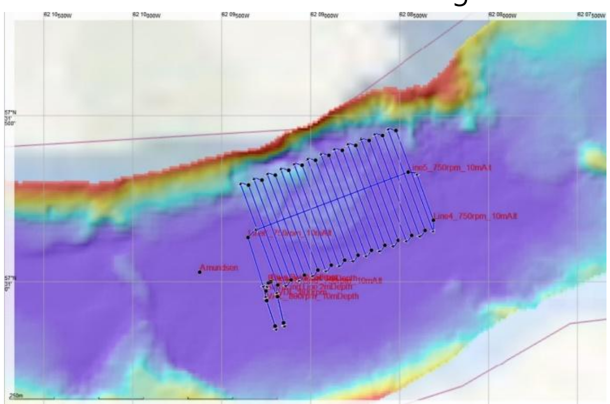


Figure 47-10: Planned AUV mission in Okak Bay, Labrador

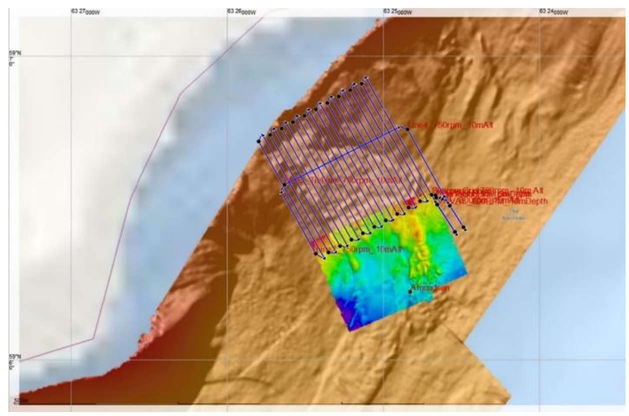


Figure 47-11: Planned AUV mission in Nachvak Fjord, Labrador.

47.1 Preliminary Results

47.1.1 *Leg 2a*

UNB Box Core Stations:

A total of 23 box cores were deployed during Leg 2a. This resulted in in the collection samples from 14 different sites. In total 14 samples for microfossil, geochemical, biomarker and molecular proxies, 14 samples for germination experiments, and 2 samples for DNA metabarcoding were collected (Table 47-4). Sediment samples will be studied for their mineralogical, geochemical (elemental and isotopic), microfossil (benthic and planktonic foraminifera), palynological (dinoflagellate cysts), magnetic, and siliciclastic grain-size signatures. Such studies will provide foundational information to improving our understanding on the past and present seafloor sediment composition and, dinoflagellate communities living in Canadian sub-Arctic. Finally, from a student and HQP-training perspective, the expedition was a unique opportunity for Brayden Harker (UNB) to receive hands-on training in sampling aboard a marine vessel.

NRCan Stations:

A total of five gravity cores (Table 47-4), two AUV dives (Table 47-5), and ten box cores (Table 47-6) were collected during Leg 2a of the 2024 Amundsen Science expedition.

Table 47-4: NRCan's gravity core stations during Leg 2a of the 2024 Amundsen Science expedition.

Station ID	NRCan station ID	Latitude (N)	Longitude (W)	Depth (m)	Core Length (cm)
MAK-2024-M1	2024804 0001	55.4339035	58.9355845	598.83	534.5
MAK-2024-M1	2024804 0002	55.43363883	58.9411905	707.45	637
Okak Landslide	2024804 0013	57.517467	62.147476	69.79	206
Nachvak1	2024804 0016	59.11134433	63.42610467	164.69	316.5
Nackvak2	2024804 0017	59.098615	63.40674533	11.17	417.5

Table 47-5: NRCan's AUV stations during Leg 2a of the 2024 Amundsen Science expedition.

Station ID	NRCan station ID	Latitude (N)	Longitude (W)
Okak Landslide	2024804 0011	57.5140465	62.1571965
Nachvak Fjord	2024804 0014	59.10355317	63.41338267

Table 47-6: NRCan's box core stations during Leg 2a of the 2024 Amundsen Science expedition

Station ID	NRCan station ID	Latitude (N)	Longitude (W)	Depth (m)	Push Core	Core Length (cm)
MAK-2024-M1	2024804 0003	55.4334	58.9394	702.63	A	36
MAK-2024-M1	2024804 0004	55.4336	58.9372	681.59	A	41.5
Sentinel	2024804 0005	56.3196	59.8399	541.76	A	37
Sentinel North-Moat	2024804 0006	56.6921	60.2845	479.11	A	36
					B	36
Sentinel North -Drift 2	2024804 0007	56.6930	60.2679	492.06	A	36.5
					B	36.5
Sentinel North-Drift 1	2024804 0008	56.7002	60.2137	759.78	A	38.5

					B	36.5
Sentinel North-Sidewall 1	2024804 0009	56.7058	60.1838	299.44	A	18.5
					B	18
Sentinel North-Sidewall 2	2024804 0010	56.6941	60.2585	498.69	A	36.5
					B	36
Okak Bay	2024804 0012	57.5695	62.0481	92.11	A	27.5
Nachvak Fjord	2024804 0015	59.0856	63.4692	209.74	A	40

Makkovik Hanging Gardens

Two gravity cores and two box cores were collected by NRCan at Makkovik Hanging Gardens (Figure 47-10). An objective of these cores was to determine if any coral remnants or chemical signatures have been preserved in the sediment and if so, to determine the age of the sediments that the corals are constrained within. Gravity core site 2024804 0001 was taken close to the rock wall to target potential coral remnants falling from the wall. Gravity core site 2024804 0002 was collected further from the wall as a “background” site.

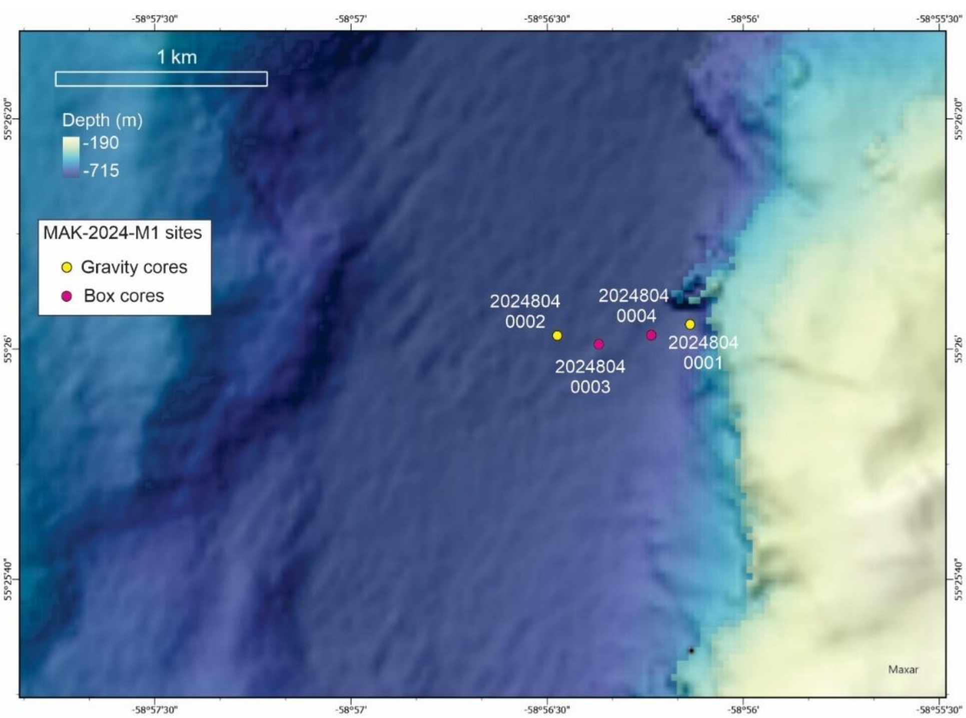


Figure 47-12 Location of gravity core and box core sites archived by NRCan at Makkovik Hanging Gardens.

The Sentinel & Sentinel North

At the Sentinel, one box core was collected and a Push core was archived for collaborations with DFO (Figure 47-13). Five box cores were successfully retrieved from the Sentinel North Site (Figure 47-13). This station was selected to improve our understanding of the fine scale variability in Labrador current processes at the seabed. The box cores were collected along a transect from the center of the drift deposit, and then upslope towards the sidewall of the channel. Due to schedule changes the mooring could not be deployed and more multibeam was not collected in the area. Arrangements were made to deploy this mooring from an alternate vessel out of Nain.

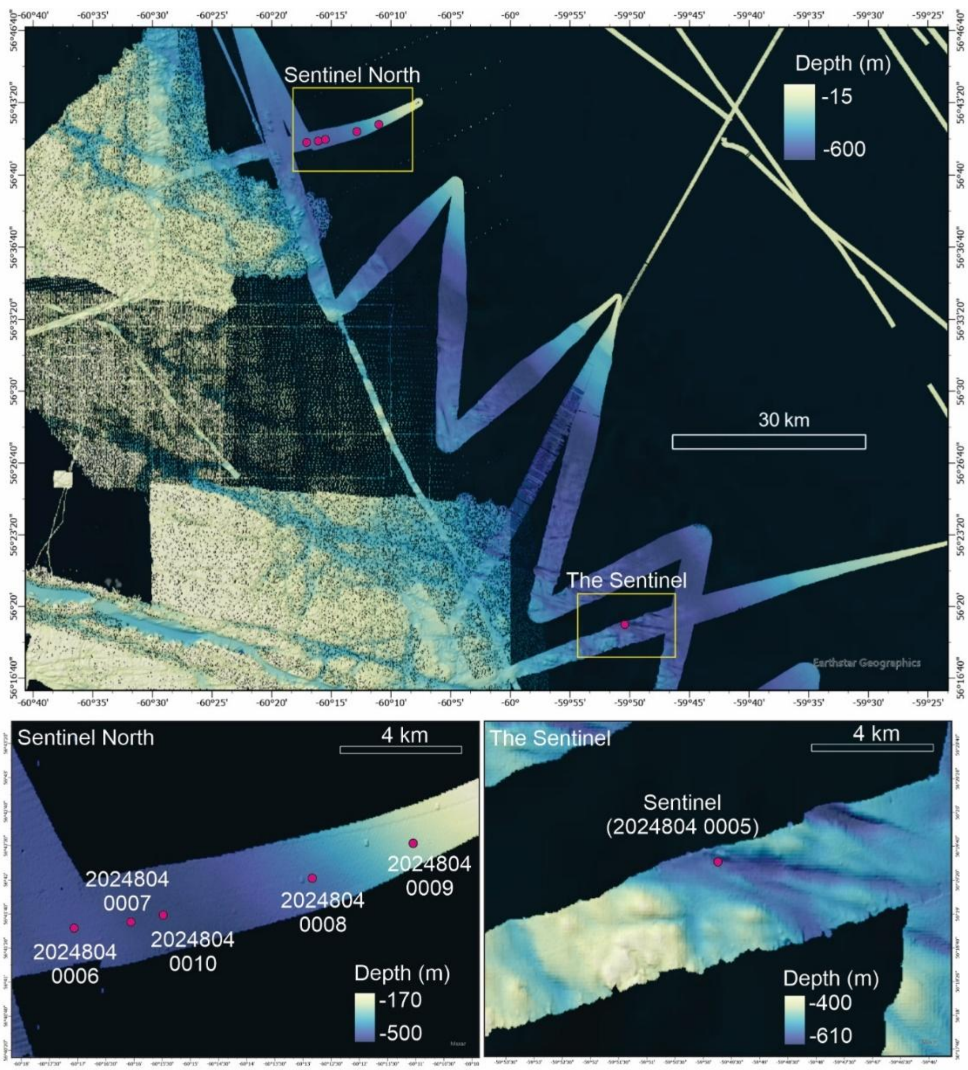


Figure 47-13: Box core locations at the Sentinel and Sentinel North collected and archived by NRCan on Leg 2a of the 2024 Amundsen Science expedition.

<u>*Labrador Fiords, Nunatsiavut*</u>

Okak Bay

One gravity core was successfully collected from the edge of a submarine landslide in Okak Bay. Station Okak Landslide (2024804 0013) recovered 2 m of sediment (Figure 47-14). This core will be taken back to NRCan for further core processing and analysis and will be used to determine the timing of this submarine landslide.

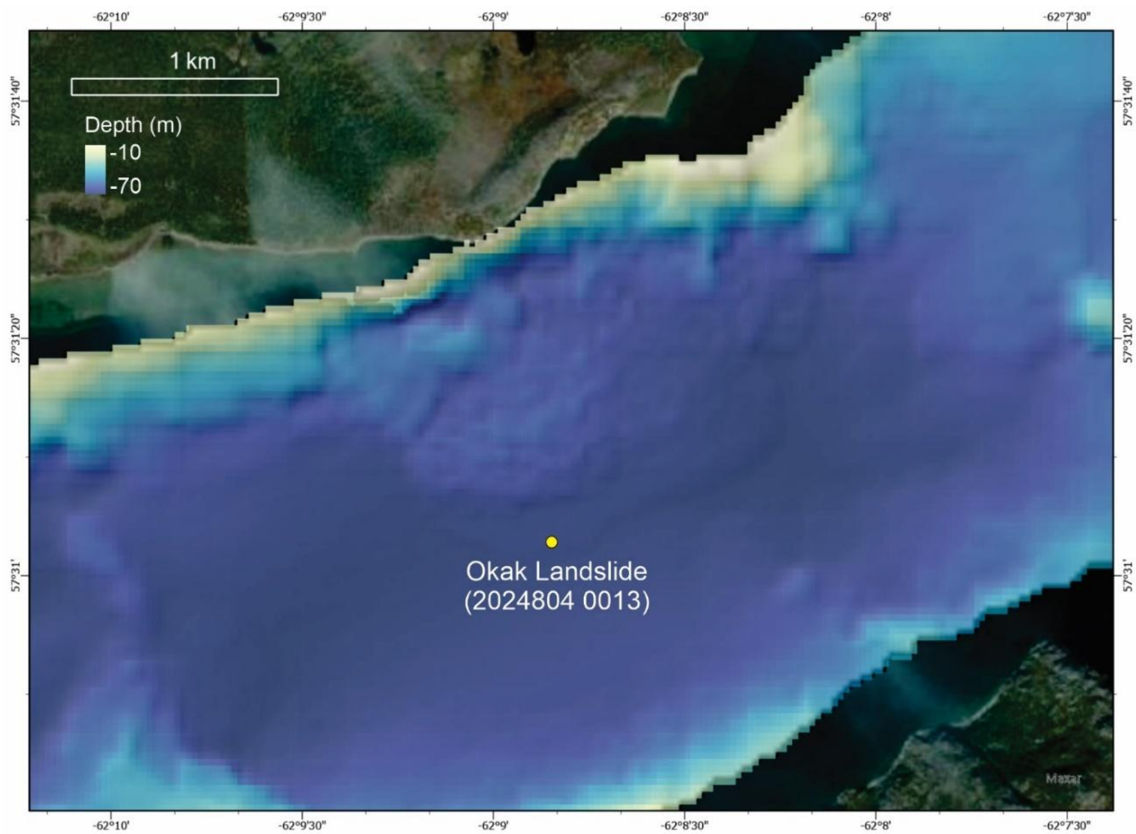


Figure 47-14: Gravity core station from Okak Bay, Labrador.

An AUV dive was performed in Okak Bay on July 20. This location was selected using existing multibeam data collected by the *CCGS Amundsen* which showed the presence of a sediment failure. The purpose of this AUV dive was to get higher resolution data to better image the morphology of this failure. This dive occurred in water depths between 52 and 72 meters and the mission was three hours and 15 minutes. The AUV completed the full mission and successfully imaged the sediment failure (Figure 47-15), providing a more detailed image than was previously available with the *CCGS Amundsen* multibeam. These data will be combined with gravity core data to better understand the age, extent, and frequency of sediment failures in Okak Bay. Sub-bottom profiler data was also collected by the AUV, however the sediments in Okak Bay are sandy, as shown from gravity cores collected in the area, and do not permit much penetration of acoustic energy (Figure 47-16).

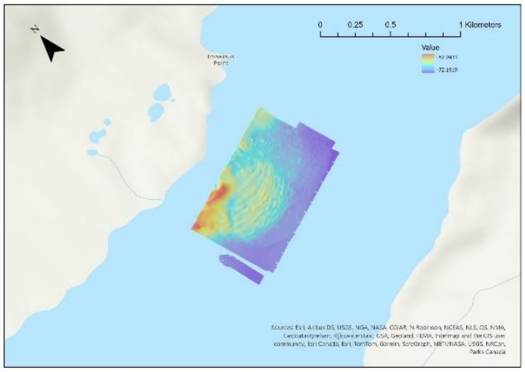


Figure 47-15: AUV bathymetric sonar data collected in Okak Bay

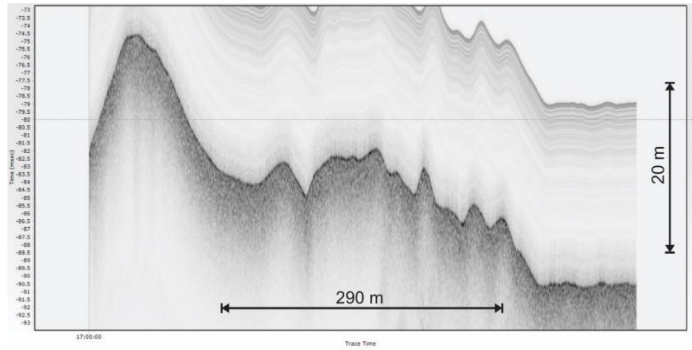


Figure 47-16: AUV sub-bottom profiler data from Okak Bay.

Nachvak Fjord

Two successful gravity cores were retrieved from submarine landslides in Nachvak Fjord (Figure 47-13). Site Nachvak 1 (NRCan station number 2024804 0016) targeted the glide plane of the large submarine landslide complex and recovered over 3 m of sediment. Site Nachvak 2 (NRCan station number 2024804 0017) targeted a smaller submarine landslide across the fjord from the first site and recovered over 4 m of sediment. These cores will be taken back to NRCan for further core processing and analysis and will be used to determine the timing of these submarine landslides. An AUV dive was preformed in Nachvak Fiord. This location was investigated previously in 2022 by NRCan using the AUV. The goal of the AUV dive during this leg was to expand the AUV data coverage over the failure as in Figure 47-18. This dive occurred in water depths between 130 and 180 meters and the mission duration was 3 hours and 17 minutes. The AUV completed the full mission (Figure 47-18) which greatly increased the coverage of AUV data at this location. These data will be used by NRCan to better understand sediment failure processes in Labrador fjords. The sub-bottom profiler data collected in Nachvak Fiord was excellent and amongst the best data ever collected by this AUV. The Gavia was able to image the upper ~30 m of sediment in this area (Figure 47-17), showing what are likely buried sediment failures.

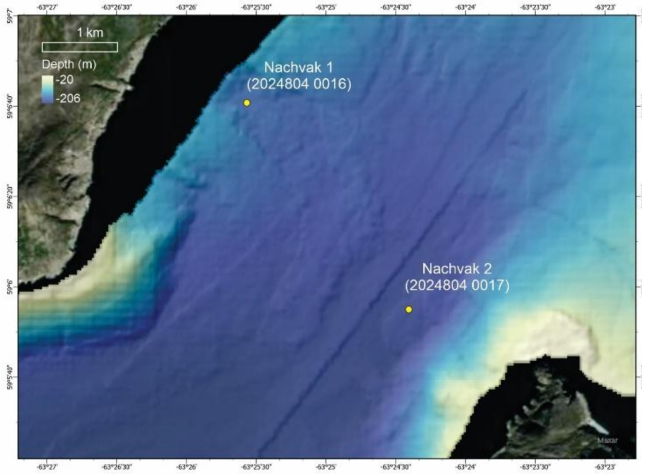


Figure 47-17: Gravity core stations Nachvak 1 and Nachvak 2 for Nachvak Fjord, Labrador.

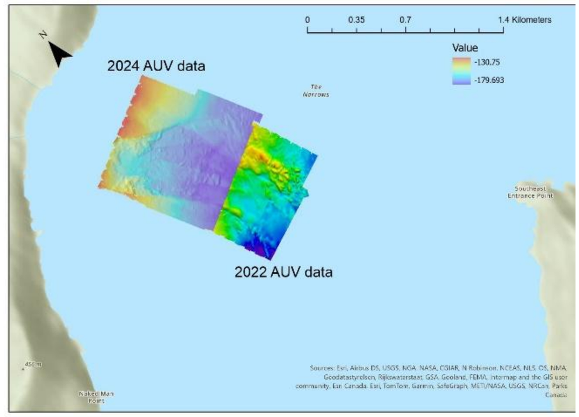


Figure 47-18: AUV bathymetric sonar data collected in Nachvak Fiord in 2022 and 2024

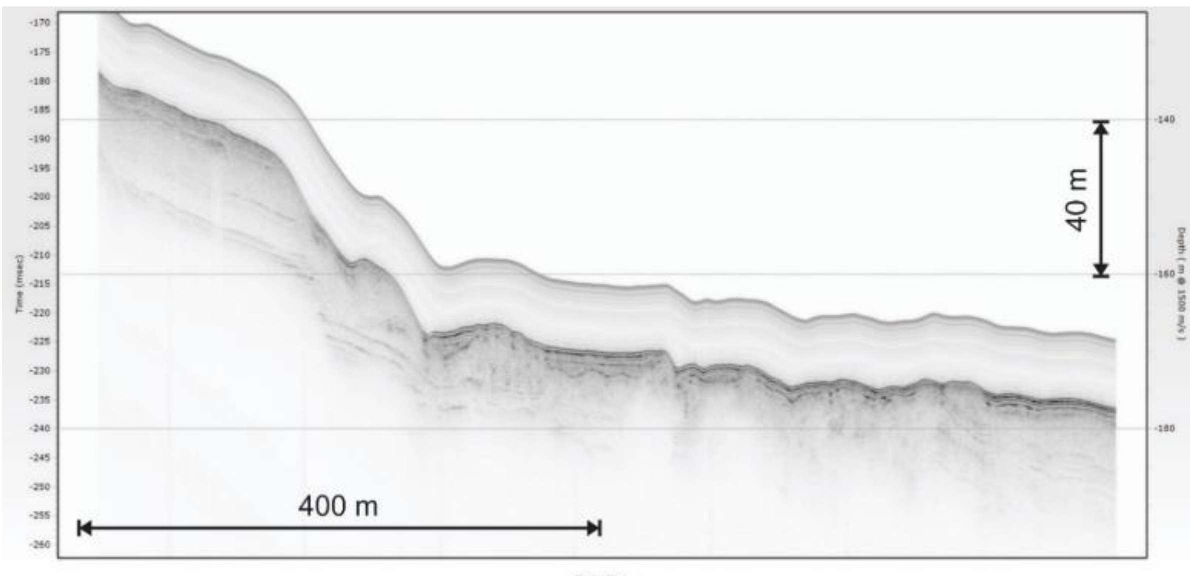


Figure 47-19: AUV sub-bottom profiler data from Nachvak Fiord.

Pictures of the box corers

AMD2402-01BC, STN: Hopedale Saddle

AMD2402-05BC, STN: MAK-2024-M1(FAR)


AMD2402-07BC, STN: MAK-2024(Near)

AMD2402-09BC, STN: Hopedale Shelf


AMD2402-10BC, STN: Sentinel


AMD2402-11BC, STN: Sentinel North – Drift 2 (NOTE: Site name in photo is incorrect)

AMD2402-12BC, STN: Sentinel North – Drift 1 (NOTE: Site name in photo is incorrect)

AMD2402-13BC, STN: Sentinel North – Sidewall 1 (NOTE: Site name in photo is incorrect)

AMD2402-14BC, STN: Sentinel North – Sidewall 2

AMD2402-15BC, STN: Sentinel North – Moat

AMD2402-16BC, STN: Okak Bay

AMD2402-17BC, STN: Nachvak Fjord

AMD2402-18BC, STN: Ramah Shelf

AMD2402-19BC, STN: Kangalasiorvik Shelf

AMD2402-20BC, STN: Killinik 2

AMD2402-21BC, STN: DS_500_B2

AMD2402-22BC, STN: DS_500_B1

AMD2402-23BC, STN: DS_600_A1

47.1.1 *Leg 2b*

In Maktak, Coronation and North Pangnirtung fjords stations were selected based on sub-bottom profiler data close to the head of each of these Fjords (Figure 47-3). A box core and two gravity core deployments were planned at each site. The box core was utilized to recover the seabed-water interface while the gravity core was deployed to recover the long-term sedimentological history of the fjords. For NRCan participants, there were seven gravity core deployments with five of them recovering material (Table 47-2). The two gravity core stations that did not recover material were from Maktak Fjord. The sediment in the box core and one successful gravity core was sandy, which likely did not allow the gravity core to penetrate the seabed during the 1st and 3rd deployments.

For the box core deployments, NRCan recovered one push from each of the three fjords and a site at the mouth of the fjords (Figure 47-3; Table 47-2). It was observed that each of the three fjords recovered different material in the box cores. Maktak Fjord recovered sandy material, Coronation Fjord recovered an overflowing box core predominately consisting of soupy mud, while North Pangnirtung Fjord recovered cohesive mud. The different seabed compositions likely reflect the different settings and sediment inputs into each of these fjords. These cores will be further analysed back at Laval University and the Geological Survey of Canada - Atlantic.

For UNB the box cores were subsampled from seven different sites (Table 47-3). In total 7 samples for microfossil, geochemical, biomarker and molecular proxies, 7 samples for germination experiments, and 2 samples for DNA metabarcoding were collected.

Sediment samples will be studied for their mineralogical, geochemical (elemental and isotopic), microfossil (benthic and planktonic foraminifera), palynological (dinoflagellate cysts), magnetic, and siliciclastic grain-size signatures. Such studies will provide foundational information to improving our understanding on the past and present seafloor sediment composition and, dinoflagellate communities living in Canadian sub-Arctic.

Finally, from a student and HQP-training perspective, the expedition was a unique opportunity for Brayden Harker (UNB) to receive hands-on training sampling aboard a marine vessel.

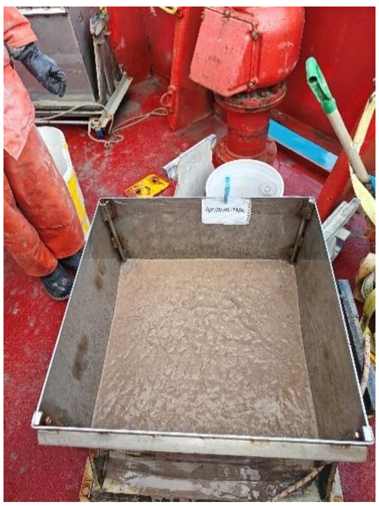
Pictures of the box corers

Top view	Push Core	Side View


AMD2402-24BC, STN: Qik Harbour


AMD2402-25BC, STN: Qik Harbour


AMD2402-26BC, STN: TCA 5.2


AMD2402-27BC, STN: TCA 5.2


AMD2402-28BC, STN: TCA 5.3


AMD2402-29BC, STN: TCA 5.3


AMD2402-30BC, STN: TCA 5.3*


AMD2402-31BC, STN: TCA 5.3*


AMD2402-32BC, STN: TCA-QF3

AMD2402-33BC, STN: TCA 5.1

AMD2402-34BC, STN: TCA 5.1

AMD2402-35BC, STN: D1

AMD2402-36BC, STN: D1.5

AMD2402-37BC, STN: D3

AMD2402-38BC, STN: C2.5

AMD2402-39BC, STN: B1-C1

AMD2402-40BC, STN: B2.5

47.2 References

Bennett, R., Normandeau, A., and Campbell, D.C., 2022. Distribution of slope failures in eastern Baffin Island fiords, Nunavut; Geological Survey of Canada, Open File 8861, 1 .zip file. https://doi.org/10.4095/329603

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Rodríguez-Cuicas, M. E., Montero-Serrano, J. C., St-Onge, G., & Normandeau, A. (2023). A 600-year marine record associated with the dynamics of the eastern Penny Ice Cap (Baffin Island, Nunavut, Canada). Journal of Quaternary Science, 38(7), 1062-1081.

Sedore, P., Normandeau, A., & Maselli, V. (2024). Environmental controls on the generation of submarine landslides in Arctic fjords: Insight from Pangnirtung Fjord, Baffin Island, Nunavut. Marine Geology, 472, 107290.

47.3 Recommendations

Amundsen Science Box core A was used for all box cores on Leg 2a. It performed very well during the cruise with no issues. Three boxes were damaged by rocks on the seafloor but they were repaired by the engineers onboard the Amundsen. Likewise, the Amundsen Science gravity core worked flawlessly during the cruise. Only regular maintenance is required on these systems.

Due to the interest of many teams on board in collection of surface sediment, we recommend a universal naming system for all box cores that can be used interchangeably by all teams that process sediment samples, such as the one outlined in this report. A universal naming system organized and managed by Amundsen Science would not only help keep data organized (i.e. help keep track of box cores in the event log, especially when there are multiple box cores at one site or failed deployments), but also facilitate comparing results between labs and research projects in the future.

48 Refuge-Arctic: Paleoceanography work package

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48.1 Introduction and Objectives

Glaciers play a dominant role in shaping the landscape of numerous fjords in both Canada and Greenland and are key to complex relationships between fjords, oceans and their ecosystems. The objective of this leg is to provide comprehensive benchmark data on 1) the recent distribution and composition of sedimentary and biogenic proxies from seafloor samples, and 2) the long-term climate-induced changes in marine productivity, sea ice, precipitation and ice sheet/cap dynamics in fjords of the Nares Strait area, where a major gap in paleo-ecological and -environmental data currently exists.

The specific objectives of this work package include:

1. Characterizing the history of decay of ice sheets and marine-terminating glaciers;

2. Characterizing the past evolution of the surface and bottom hydrology, and the ocean's impact on sea ice and the marine-terminating glaciers;

3. Assessing the implication of these physical and geomorphological changes on the distribution, composition and abundance of the protists that form the basis of the marine food web, as well as on terrestrial environments (vegetation in particular);

4. Improve the reconstruction of the rapid and recent variations of the Earth's magnetic field, which will also help reconstruct the chronostratigraphy of sediment;

5. Extending back in time the water isotope and $\delta^{13}C$-DIC instrumental data based on the fossil foraminiferal calcite $\delta^{18}O$ and $\delta^{13}C$ records. This will be feasible if some of the collected sediment cores exhibit sedimentation rates higher or equal to 0.3 cm/year, comprise a well-preserved sediment-water interface, and contain calcareous foraminifera. The dependence of calcite $\delta^{18}O$ on water temperature and $\delta^{18}O$ is well understood (Kim and O'Neil, 1997; Marchitto et al., 2014), so it is possible to deduce water $\delta^{18}O$ from calcite $\delta^{18}O$ measurements once water temperature is estimated. Also, the $\delta^{13}C$ of the epibenthic foraminifer (i.e. living at the sediment-bottom water interface) of the genus *Cibicidoides* has been shown to record the bottom-water $\delta^{13}C$-DIC with negligible isotopic fractionation (Duplessy et al., 1984; Schmittner et al., 2017);

6. Explore the potential of sedimentary ancient DNA as a new tool to unravel ecosystem changes through time in the Nares Strait/Lincoln Sea region. This includes refining and developing micro-algal proxies for Arctic sea-ice changes and improving genetic reference datasets for key species;

7. Germinate protist resting stages buried in the sediment for taxonomic purposes;

8. *Investigate the benthic foraminifera to* 1) study the geographical and vertical distribution of living benthic foraminifera in the surface sediments of North Canadian Archipelago and Greenland fjords in order to better constraint the impact of glaciers (land terminated, marine terminated) and associated sediment discharge for those micro-organisms and 2) Compare living and dead faunas in the top 30 cm of the sediment to assess the taphonomic processes that determine the fossil records in those environments in order to 3) better reconstruct environmental changes for those environments, very sensitive to climate change, for the past centuries and millennia.

48.2 Methodology

48.2.1 *Operations conducted during the Leg / Methodology*

The multibeam echosounder (Konsberg EM3024) and 3.5-kHz chirp sub-bottom profiler (Knudsen 3260) were used to ensure that the seabed was suitable for deployment of the corers, as well as to identify the thickest apparent deglacial/Holocene sequences with the absence of mass movements and/or sediment perturbations.

48.2.2 *Kongsberg EM302 Multibeam Sonar*

The Amundsen is equipped with an EM302 multibeam sonar operated with the Seafloor Information System (SIS). This system allows the mapping of the seabed at a maximum depth of ~7000 m. A transducer (TX) emits an acoustic wave that is reflected from the seabed and picked up by a receiver (RX). The EM302 echosounder emits both continuous wave (CW) and Frequency Modulated (FM) pulses at a frequency of ~30kHz. It has 864 pings per swath (dual swath) and allows coverage of 5.5 times water depth. During this expedition, the EM302 data reached a maximum depth of ~2400 m while maintaining good sounding density. Attitude is given by an Applanix POS-MV receiving RTCM corrections from a CNAV 3050 GPS receiver. Position accuracies were approximately < 0.7m in planimetry and < 1m in altimetry. Multibeam bathymetry imagery was useful in choosing coring site locations.

48.2.3 *Knudsen 3260 CHIRP sub-bottom profiler*

This sub-bottom profiler allows the acquisition of high-resolution subsurface data (sediment stratigraphy). The echo sounder transmits FM acoustic waves (3.5 kHz) with transducers that serve as both transmitters (TX) and receiver (RX). During the cruise, the data from the Knudsen 3260 echosounder were acquired at a frequency of 3.5kHz, 8kHz bandwidth, and a pulse duration of 16 ms. The acquisition and visualization of the profiles were done with the version 4.03 of the 2016 EchoControlClient software. However, the raw KEB data were converted to SegY following a routine conversion. The SegY data were then converted into JP2 format using SegyJp2 software. The sub-bottom profiles were useful in choosing coring site locations and validating the composition of the seafloor upon arrival to certain sites with scarce data (Appendix A). It should be noted that the sub-bottom was turned off in Jones Sound for reducing impact on mammals and for consideration of Ausuittuq (Grise Fiord) community.

48.2.4 *Coring*

Van Veen Sampling from the Barge

A small Van Veen grab was used to sample surface sediment from the barge close to Palisade Glacier in Makinson Inlet (meltwater plume and glacier front) (Table 47-3, Figure 47-5) The Van Veen grab was hand-deployed using a pulley system off the side of the barge to depths between 32 and 53 m. The sediments retrieved from this site were put in Whirl-Paks© and once back on the Amundsen, stored in a refrigerated container (4°C). The coastal sediment sampling was for the PhD thesis of Kerstin Brembach.

Box Core

The box core (BC) collects up to 0.125 m3 of soft sediments at the seafloor and is suitable for any water depths (limited by winch cable length; Figure 48-1). It is used for minimum disturbance of the sediment/water interface. The BC was lowered at an average speed of 60 m/min (1 m/s). When the sampler was approximately at 100 m above the seabed, wire payout was slowed to approximately 20-25 m/min (0.33 to 0.42 m/s). On contact with the seafloor, an extra 3 m was given to allow box penetration, and the winch was stopped. A few seconds thereafter, the corer was uplifted back at a slow rate, at approximately 10 m/min (0.17 m/s). It is at this time that the spade is deployed into the mud and the apparatus is pulled out. Next, the wire speed was increased to 60 m/min (1 m/s). During the expedition, the box corer was deployed and successfully sampled 15 times (Figure 48-1, Table 48-4).

Figure 48-1: Deployment of the box corer (photo: Elodie Bracquart)

When the sediment volume was sufficient (which was the case for most deployments), 4-5 push cores (PVC tubes of 10 cm diameter and ~60 cm length) were taken from each box core using a vacuum pump to reduce compaction. The sediment/water interface from each box-core location was subsampled for sedaDNA, biogenic proxies (microfossils, Carbon and Nitrogen analyses, Biogenic silica, biomarkers, etc.), sedimentary proxies (grain size, mineralogy, etc.) and germinations (Table 48-1). Occasionally, a push core was taken for pore waters (Eva Ferreira, Leg 3; Bruno Lansard, Leg 4) and some surface sample were taken for microplastics (Théo Segur). Additionally, pictures were taken of the top and side view of the box core to show sediment characteristics at each site (Appendix 48.5).

Table 48-1: List of surface subsamples collected, and storage based on types of analyses

Leg		Type analysis & person in charge subsampling	Specifications	Storage
3	BC-BIO*	*seda*DNA (JB)	First subsampling: use sterilized or single-use spoons Surface (0-1cm): all After box removed: Bottom (3cm above bottom): Gonzalez	-80°C
3	BC-BIO*	Hg, CH_4, archaea, bacteria (JB&DC)	Surface (0-1cm) After box removed: Bottom (3cm above bottom)	-80°C, anaerobic, in the dark
3	BC-GEO	All other biogenic proxies (JB)	Large volume	-80°C
3	BC-GEO	Cultures/germination (JB)		4°C in the dark
3	BC-GEO	Sedimentary proxies (JB, EB)	Large volume	4°C
3	BC-GEO	Microplastics (TS)		
4	BC-BIO*	sedaDNA (JB)	First subsampling: use sterilized or single-use spoons	
4	BC-BIO*	Hg, CH_4, archaea, bacteria (JB&DC)	Surface (0-1cm) After box removed: Bottom (3cm above bottom)	-80°C, anaerobic, in the dark
4	BC-BIO	Cultures/germination (JB)		4°C in the dark
4	All other biogenic proxies (JB)	Large volume	-80°C	All other biogenic proxies (JB)

4	Sedimentary proxies (JB, EB)	Large volume	4°C	Sedimentary proxies (JB, EB)
4	Microplastics (TS)			Microplastics (TS)

Table 48-2: List of proxies and researchers in charge of analyses on surface samples

List of proxies	**Researchers**
sedaDNA	Ribeiro & Limoges (target: protists, HABs species, sea-ice species; * will share extracts with Azaroff and Lopes Dos Santos) Azaroff & Poulain & Cossa (target: bacteria and archaea) Lopes Dos Santos (target: Labyrinthylomycetes) Dumoulin & Kush (target: haptophytes) Gonzalez (target: metagenomic)
Hg	Azaroff, Poulain & Cossa
HBIs	Amiraux
Alkenones	Amiraux (Archer–Connybeare–Lady Franklin Bay system), Kush
Grain size	Normandeau, Montero-Serrano
Dinocysts, Diatoms	Limoges, Ribeiro, Pearce
Pollen	Desprat
Foraminifers (Living and Fossil)	Bonnin, Mojtahid, Nardelli, Seidenkrantz,
TOC, TN, $d^{13}C$, $d^{15}N$	Limoges
Biogenic silica	Limoges
Mineralogy	Montero-Serrano
Microplastics	Segur
Pigments	Bonnin

Gravity Core

The gravity core (GC; Figure 48-2) has a maximum recovery length of ~2.80 m (in a 3.05 m aluminum barrel) using a stainless-steel cutting head and penetrating the sediment under a

136 kg weight. A core catcher keeps the sediment in the corer when the latter is pulled upward. Winch speeds (lowering) ranged from 60 to 80 m/min (1-1.33 m/s) depending on estimated substrate properties and speed is kept until seafloor is reached. An additional 3m was given to let the corer penetrate the sediment. The GC was then retrieved at 10m/min to extract it from the sediments and afterward at 60m/min. During the expedition, the GC was deployed six times (Figure 48-2, Table 48-5). Note that BC collected in conjunction with a GC allows recovery of the undisturbed sediment-water interface, which is usually perturbed when the GC enters the sediments. Ideally, push cores from box-cores can be correlated visually, chronostratigraphically, or geochemically with gravity cores from the same site

Figure 48-2: Deployment of the gravity core (photo: Elodie Bracquart)

Giant gravity corer

The giant gravity corer (GGC) is composed of three 3 m long metal barrels fixed together with couplings and attached to an 817 kg weight (Figure 48-3). Three 3m plastic liners are taped together and inserted in the barrels. A plastic butterfly valve (Figure 48-4) is fixed to the top liner to allow water to flow out during the descent and to prevent it from flowing in when ascending. The GGC allows a recovery of 9m long cores. A total of 8 giant gravity cores were deployed during the Leg 3. The GGC was deployed once with three barrels and deployed seven times with two barrels (Table 48-2; Figure 48-3Figure 48-5). A box core with at least two push cores were taken at each GGC coring sites in order to collect an intact sediment surface. The GGC was deployed at a speed of 70 m/min until reaching the sediment (if the cable stays straight during the descent). If conditions cause the cable to be angled, a pause is necessary at 50-100m from the bottom to allow the cable to go straight. Once the giant gravity core has penetrated the seafloor, an additional 9 m of cable is released. The GGC is retrieved at 10m/min until it is free from the sediments, then at 60 m/min until recovery.

Figure 48-3: Assembly of the giant gravity core three barrels (left) and deployment of the giant gravity core two barrels (right) (Elodie Bracquart)

Figure 48-4: Butterfly valve (picture Jean-Carlos Montero-Serrano)

Core identification and labelling

The sediment core samples were labelled using the following numbering system:
RA2403-BC-RA01-01-A-X-GEO
RA = Refuge Arctic
24 = Year 2024
03 = Leg # 3
BC = Corer type (e.g., BC = box core, GC= gravity core, GGC = giant gravity core)
RA01 = station number
01 = core number (sequential series; i.e. 1, 2, 3,...., x)
A = Push core identifier
AB = Core section (applicable for GC and GGC)
X = Experiment (since multiple experiments will be done on the same core, a "X" is used)
GEO/BIO = box core mainly used for the GEO teams or the BIO team
The 1 m subsections of the GC were labelled as per Fig. 5 with A being the base and section AB being the lowest section, followed by BC, CD etc. sequentially. When multiple push cores were taken from a box core, they were labelled by the addition of a sequential alphabetical identifier, e.g. 03BC-A, 03BC-B, 03BC-C, etc.
Core samples will be retained in refrigerated storage (4°C) on the CCGS Amundsen until demobilization in November, in Québec City.

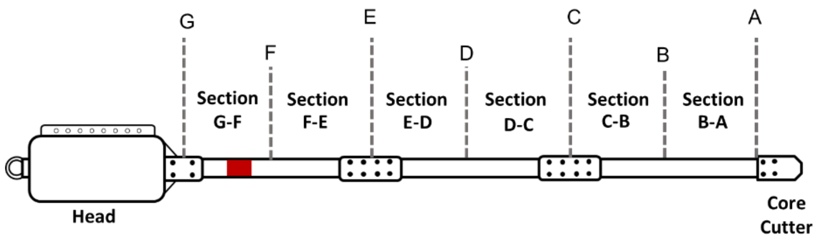

Figure 48-5: Labelling system for sections of gravity cores.

48.3 Preliminary Results

16 stations were sampled during the cruise for a total of 194 physical samples derived from the box cores and 42.57 m total core length from the gravity cores

- 16 box cores GEO;
- 6 gravity cores;
- 8 giant gravity cores;
- 2 Van Veen grabs from barge at RA04 (Makinson Inlet);
- ~6200 km of multibeam bathymetry data

Overall, the mission was successful with the collection of multiple sediment (BC, GC, GGC, VV), and water samples close to glaciers and in the fjords (Table 48-1, Table 48-2, Table 48-3). Despite an ambitious cruise plan containing several contingencies, all priority coring areas have been completed. Only few coring operations got canceled due to the absence of sediment on seafloor. All of sediment samples collected in this expedition will be stored and analyzed in detail in the different laboratories at ISMER-UQAR, ULaval, UNB, Natural Resources Canada in Halifax, Geological Survey of Denmark and Greenland, Aarhus University, Université de Bordeaux, Sorbonne Université/CNRS/IRD/MNHN, LSCE/IPSL and Université d'Angers to achieve the objectives of our project. Sediment samples will be studied for their mineralogical, geochemical (elemental and isotopic), microfossil (benthic and planktonic foraminifera), palynological (dinoflagellate cysts), magnetic, and siliciclastic grain-size signatures. Such studies will provide foundational information to improving our understanding on the past and present seafloor sediment composition, glacier-ocean interactions, dinoflagellate communities living in Canadian Arctic and Holocene sedimentation history of the eastern Canadian Arctic Archipelago.

Finally, from a student perspective, the expedition was a unique opportunity for Elodie Bracquart (ISMER-UQAR) and Kerstin Brembach (U. Laval) to receive hands-on training on ship.

Table 48-3: List of Van Veen collected

Station ID	Location	Core ID	Date/Time (UTC)	Latitude	Longitude	Depth (m)	Comments	Pre-defined objectives (more TBD after post-cruise processing)	Archived at
RA04	Makinson Inlet	RA2403-bg-vv-RA04-01-X	16/08/2024 15:37	77,39447	-81,03553	32	Meltwater plume/river	Link bathymetry + glacier dynamics (project KB;PL)	ULaval
		RA2403-bg-vv-RA04-02-X	16/08/2024 16:39	77.3744	-81,00003	53.1	Glacier front	Link bathymetry + glacier dynamics (project KB;PL)	ULaval

Table 48-4: List of box cores collected

Station ID	Location	Box core ID	Date/Time (UTC)	Latitude	Longitude	Depth (m)	No. of push cores	Push Cores ID	NRCAN CORE ID	Push Cores Length	Push core experiments	Archived at	Notes Post-processing	MSCL	CT-SCAN	MICRO-CT
RA01	Bylot Island	RA2403-BC-RA01-01-X-BIO	2024-08-13 6:21	72.85744	-75,51306	663.04	2	RA2403-BC-RA01-01-A-X-BIO		A = 45 cm (0 cm compression)	For RED-AO project; vertical continuum sediment trap–seafloor (AL)	UNB				
								RA2403-BC-RA01-01-B-X-BIO		B = 46 cm (0 cm compression)	For Hg species vertical distribution	U.Ottawa	Keep vertical and at 4°C			x
RA02.1	Makinson Fiord	RA2403-BC-RA02.1-02-X-BIO	2024-08-14 23:35	77.26054	-79.16346	587.62	1	RA2403-BC-RA02.1-02-X-BIO		44,5cm (0 cm compression)	Sedimentary proxies (JCMS)	ISMER			x	
		RA2403-BC-RA02.1-01-X-GEO	2024-08-15 0:35	77.25891	-79.16621	573.1	5	RA2403-BC-RA02.1-01-A-X-GEO	2024805-0001	A = 44cm (1 cm compression)	All proxies	NRCan			x	
								RA2403-BC-RA02.1-01-B-X-GEO		B = 45,5 cm (2 cm compression)	All proxies	UNB		x	x	
								RA2403-BC-RA02.1-01-C-X-GEO		C = small core	Living/dead foram communities (JB)	France				
								RA2403-BC-RA02.1-01-D-X-GEO		D = 47,5 cm (1 cm compression)	All proxies	France		x	x	
								RA2403-BC-RA02.1-01-E-X-GEO		E = small core	Sedimentary pigments (Bonnin)	France				
RA03		RA2403-BC-RA03-03-X-BIO	2024-08-16 0:44	77.29192	-80.75977	436.95	1	RA2403-BC-RA03-03-X-BIO		44,7cm (2 cm compression)	Sedimentary proxies (JCMS)	ISMER			x	
		RA2403-BC-RA03-02-X-GEO	2024-08-16 1:32	77.29214	-80.76026	436.41	3	RA2403-BC-RA03-02-A-X-GEO	2024805-0003	A = 41cm (0 cm compression)	Characterization plume deposit (AN)	NRCAN			x	x
								RA2403-BC-RA03-02-B-X-GEO		B = 42,5 cm (1 cm compression)	All proxies	France		x	x	
								RA2403-BC-RA03-02-C-X-GEO		C = 44 cm (2 cm compression)	All proxies	UNB		x	x	
RA04		RA2403-BC-RA04-04-X-BIO	2024-08-16 19:52	77.38149	-81.07576	182.34	0	/		/	/					
		RA2403-BC-RA04-03-X-GEO	2024-08-16 21:20	77.38221	-81.07384	180.23	5	RA2403-BC-RA04-03-A-X-GEO		A = 46 cm (1 cm compression)	For Hg species vertical distribution (DC)	U. Ottawa	Keep vertical and at 4°C			x
								RA2403-BC-RA04-03-B-X-GEO		B = 42 cm (3 cm compression)	Sedimentary proxies (JCMS)	ISMER			x	
								RA2403-BC-RA04-03-C-X-GEO		C = 42,5 cm (3 cm compresion)	All proxies	UNB		x	x	
								RA2403-BC-RA04-03-D-X-GEO		D = 47 cm (0 cm compression)	All proxies	France		x	x	
								RA2403-BC-RA04-03-E-X-GEO	2024805-0005	E = 46 cm (0 cm compression)	All proxies	NRCan			x	
RA06	Dobbin Fiord	RA2403-BC-RA06-05-X-BIO	2024-08-18 22:58	79.68347	-73.08657	246.91	0	/		/	/					
		RA2403-BC-RA06-04-X-GEO	2024-08-18 23:43	79.68286	-73,08763	246.64	4	RA2403-BC-RA06-04-A-X-GEO		A = 31 cm (0 cm compression)	Sedimentary proxies (JCMS)	ISMER			x	
								RA2403-BC-RA06-04-B-X-GEO	2024805-0008	B = 30,5 cm (0 cm compression)	All proxies	NRCan			x	
								RA2403-BC-RA06-04-C-X-GEO		C = 28,5 cm (2 cm compresion)	All proxies	UNB		x	x	
								RA2403-BC-RA06-04-D-X-GEO		D = 33,5 cm (0 cm compression)	All proxies	France		x	x	
RA07		RA2403-BC-RA07-06-X-BIO	2024-08-19 22:08	79.7854	-73.56545	230.25	0	/		/	/					
		RA2403-BC-RA07-05-X-GEO	2024-08-19 22:08	79.78504	-73,56929	229.62	3	RA2403-BC-RA07-05-A-X-GEO		A = 30cm (0 cm compression)	All proxies	France		x	x	
								RA2403-BC-RA07-05-B-X-GEO	2024805-0010	B = 30 cm (0 cm compression)	All proxies	NRcan			x	
								RA2403-BC-RA07-05-C-X-GEO		C = 27,5 cm (2 cm compaction)	Sedimentary proxies (JCMS)	ISMER			x	
RA08		RA2403-BC-RA08-07-X-BIO	2024-08-20 23:35	79.82943	-74.10064	256.75	0	/		/	/					
		RA2403-BC-RA08-06-X-GEO	2024-08-21 0:21	79.82923	-74,09957	257.45	4	RA2403-BC-RA08-06-A-X-GEO		A = 33 cm (1-2 cm compression)	For Hg species vertical distribution (DC)	U. Ottawa	Keep vertical and at 4°C			x
								RA2403-BC-RA08-06-B-X-GEO		B = 33,5 cm (1-2 cm compression)	All proxies	France		x	x	
								RA2403-BC-RA08-06-C-X-GEO	2024805-0012	C = 31 cm (2-3 cm compression)	All proxies	NRCan			x	
								RA2403-BC-RA08-06-D-X-GEO		D = 40 cm (4-5 cm expansion)	Sedimentary proxies (JCMS)	ISMER			x	
RA10	Robeson Channel	RA2403-BC-RA10-07-X-GEO	2024-08-22 21:26	82.14396	-60,98417	440.35	3	RA2403-BC-RA10-07-A-X-GEO		A = 23cm (0 cm compression)	Sedimentary proxies (JCMS)	ISMER			x	
								RA2403-BC-RA10-07-B-X-GEO	2024805-0014	B = 21 cm (0 cm compression)	All proxies	NRCan			x	
								RA2403-BC-RA10-07-C-X-GEO		C = 25 cm (0 cm compression)	All proxies	France		x	x	
RA12	Lady Franklin – Connybeare – Archer system	RA2403-BC-RA12-08-X-BIO	2024-08-24 2:10	81.57056	-67.65297	285.65	0	/		/	/					
		RA2403-BC-RA12-08-X-BIO_2	2024-08-24 16:17	81.56657	-67.72750	302.89	0	/		/	/					
		RA2403-BC-RA12-08-X-GEO	2024-08-24 15:38	81.56623	-67.72754	303.02	4	RA2403-BC-RA12-08-A-X-GEO	2024805-0015	A = 39,5 cm (3 cm compression)	Sedimentary proxies (JCMS)	NRCAN/UNB			x	
								RA2403-BC-RA12-08-B-X-GEO		B = 39,5 cm (1-2 cm compression)	Taxonomy protists (AL)	UNB				
								RA2403-BC-RA12-08-C-X-GEO		C = 38 cm (1-2 cm compresion)	All proxies	France		x	x	
								RA2403-BC-RA12-08-D-X-GEO		D =37 cm (2 cm compression)	All proxies	ISMER			x	
RA14		RA2403-BC-RA14-10-X-BIO	2024-08-26 20:09	81.58394	-65.94761	540.72	0	/		/	/					
		RA2403-BC-RA14-09-X-GEO	2024-08-24 22:59	81.59242	-66.02048	486.53	4	RA2403-BC-RA14-09-A-X-GEO		A = 28,5 cm (1-2 cm compression)	For Hg species vertical distribution (DC)	U. Ottawa	Keep vertical and at 4°C			x
								RA2403-BC-RA14-09-B-X-GEO		B = 33,5 cm (1-2 cm compression)	Sedimentary proxies (JCMS)	ISMER			x	
								RA2403-BC-RA14-09-C-X-GEO		C = 32,5 cm (1-2 cm compresion)	Taxonomy protists (AL)	UNB				
								RA2403-BC-RA14-09-D-X-GEO		D =35,5 cm (1-2 cm compression)	All proxies	France		x	x	
RA13		RA2403-BC-RA13-09-X-BIO	2024-08-25 23:02	81.28816	-68.50477	429.03	0	/		/						
		RA2403-BC-RA13-10-X-GEO	2024-08-25 22:14	81.28877	-68.50459	429.09	4	RA2403-BC-RA13-10-A-X-GEO		A = 34,5 cm (1-2 cm compression)	For Hg species vertical distribution (DC)	U. Ottawa	Keep vertical and at 4°C			x
								RA2403-BC-RA13-10-B-X-GEO		B = 36,5 cm (1-2 cm compression)	Sedimentary proxies (JCMS)	ISMER			x	
								RA2403-BC-RA13-10-C-X-GEO		C = 36,5 cm (1 cm compresion)	Taxonomy protists (AL)	UNB				
								RA2403-BC-RA13-10-D-X-GEO		D =35,5 cm (1 cm compression)	All proxies	France		x	x	
RA15		RA2403-BC-RA15-11-X-BIO	2024-08-27 19:23	81.67012	-64.07153	612.98	0	/		/	/					
		RA2403-BC-RA15-11-X-GEO	2024-08-27 20:21	81.66728	-64.05537	607.92	3	RA2403-BC-RA15-11-A-X-GEO		A = 33,5 cm (1 cm compression)	All proxies	UNB		x	x	
								RA2403-BC-RA15-11-B-X-GEO		B = 33,5 cm (1 cm compression)	All proxies	France		x	x	
								RA2403-BC-RA15-11-C-X-GEO		C = 25,5 cm (1 cm compresion)	Sedimentary proxies (JCMS)	ISMER			x	
RA16	Newman Fjord	RA2403-BC-RA16-12-X-BIO	2024-08-28 20:40	81.72818	-59.23474	121.95	0	/		/	/					
		RA2403-BC-RA16-12-X-GEO	2024-08-28 21:08	81.72863	-59.23784	123.38	3	RA2403-BC-RA16-12-A-X-GEO		A = 30,5 cm (1 cm compression)	All proxies	France		x	x	
								RA2403-BC-RA16-12-B-X-GEO	2024805-0021	B = 29 cm (1 cm compression)	All proxies	NRcan			x	
								RA2403-BC-RA16-12-C-X-GEO		C = 25,5 cm (3 cm compresion)	Sedimentary proxies (JCMS)	ISMER			x	
RA17		RA2403-BC-RA17-13-X-BIO	2024-08-29 13:00	81.62692	-58.90966	98.61	0	/		/						
		RA2403-BC-RA17-13-X-GEO	2024-08-29 13:38	81.62810	-58.90990	96.44	4	RA2403-BC-RA17-13-A-X-GEO		A = 33 cm (1 cm compression)	For Hg species vertical distribution (DC)	U. Ottawa	Keep vertical and at 4°C			x
								RA2403-BC-RA17-13-B-X-GEO	2024805-0023	B = 32,5 cm (1 cm compression)	All proxies	NRCan			x	
								RA2403-BC-RA17-13-C-X-GEO		C = 33 cm (1 cm compresion)	All proxies	France		x	x	
								RA2403-BC-RA17-13-D-X-GEO		D =33 cm (1 cm compression)	Sedimentary proxies (JCMS)	ISMER			x	
RA18		RA2403-BC-RA18-14-X-BIO/GEO	2024-08-30 1:19	81.93904	-60.37830	297.55	2	RA2403-BC-RA18-14-A-X-GEO		A = 30 cm (1 cm compression)	All proxies	France		x	x	
								RA2403-BC-RA18-14-B-X-GEO	2024805-0024	B = 27 cm (2 cm compression)	All proxies	NRCan			x	
RA24	Catogan	RA2403-BC-RA24-15-X-GEO	2024-09-04 10:34	78.03097	-75.6049	234.38	0	/		/	/	/	/			

AL: Audrey Limoges
AN: Alexandre Normandeau
DC: Daniel Cossa
EF: Eva Ferreira
JB: Jérôme Bonin
JCMS: Jean-Carlos Montero-Serrano

Station ID	Location	Box core ID	Date/Time (UTC)	Latitude	Longitude	Depth (m)	No. of push cores	Push Cores ID	Push Cores Length	Push core experiments	Archived at	Notes Post-processing	No. surface samples	Surface sediment experiments	Comments
RA25		RA2404-BC-RA25-14-x-BIO	2024/09/08 21:40:53	81.404	-64.249	516							N=9	germination (4°C , dark), sedaDNA surface (-80°C, N=6), sedaDNA bottom (-80°C, N=2)	
		RA2404-BC-RA25-16-x-GEO	09/09/2024 00:32	81.403	-64.257	510	5	RA2404-BC-RA25-16-A-X-GEO	31 cm	All proxies	TBD		N=4	all biogenic proxies (-80°C), sed. Proxies (4°C), pollen, microplastic	
								RA2404-BC-RA25-16-B-X-GEO	24 cm	All proxies	TBD				
								RA2404-BC-RA25-16-C-x-GEO	32 cm	Hg, CH4	Lars-Eric				
								RA2404-BC-RA25-16-D-Foram-GEO	29 m	Living/dead foram communities (JB)	Bordeaux	Subsampled (onboard with ~1ml for Hg 5-29)			
								RA2404-BC-RA25-16-E-pig-GEO	14 cm	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled (onboard with ~1ml for Hg 0-5)			
RA27		RA2404-BC-RA27-15-x-BIO	2024/09/10 23:01:42	80.385	-68.961	335								Surface not intact, no water on top, a lot of large rocks	
		RA2404-BC-RA27-GEO	2024/09/10 23:31:32	80.380	-68.984	336	0								Not succesful
RA28		Van Veen	2024/09/11 21:44:35	80.345	-69.017	339									
		RA2404-BC-RA28-16-x-BIO	2024/09/11 22:20:35	80.345	-69.017	339								Surface not intact, no water on top, a lot of large rocks	
		RA2404-BC-RA28-GEO	2024/09/11 22:51:24	80.343	-69.010	337	0								Not succesful
RA31		RA2404-BC-RA31-17-x-BIO	2024/09/12 17:45:10	80.253	-67.767	152								Surface not intact, no water on top, a lot of large rocks	
		RA2404-BC-RA31-GEO	2024/09/12 17:58:06	80.252	-67.772	153	0								Not succesful
		RA2404-BC-RA31-GEO	2024/09/12 18:19:16	80.250	-67.783	154	0								
RA36		RA2404-BC-RA36-18-x-BIO	2024/09/13 23:33:31	79.872	-69.941	221							N=9	germination (4°C , dark), sedaDNA surface (-80°C, N=6), sedaDNA bottom (-80°C,	
		RA2404-BC-RA36-x-GEO	2024/09/14 00:01:20	79.870	-69.950	225	0							Surface not intact, no water on top, a lot of large rocks	Not succesful
		RA2404-BC-RA36-17-x-GEO	14/09/2024 00:30	79.868	-69.946	227	3	RA2404-BC-RA36-17-A-X-GEO	36	All proxies	TBD				
								RA2404-BC-RA36-17-B-Foram-GEO	29	Living/dead foram communities (JB)	Bordeaux	Subsampled (onboard with ~1ml for Hg 5-29)			
								RA2404-BC-RA36-17-C-pig-GEO	13	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled (onboard with ~1ml for Hg 0-5)			
RA38		RA2404-BC-RA38-19-x-BIO	2024/09/15 21:21:33	79.441	-71.067	223							N=9	germination (4°C , dark), sedaDNA surface (-80°C, N=6), sedaDNA bottom (-80°C, N=2)	
		RA2404-BC-RA38-18-x-GEO	15/09/2024 21:47	79.441	-71.063	223	7	RA2404-BC-RA38-18-A-X-GEO	39 cm	All proxies	TBD		N=4	all biogenic proxies (-80°C), sed. Proxies (4°C), pollen, microplastic	
								RA2404-BC-RA38-18-B-X-GEO	39 cm	All proxies	TBD				
								RA2404-BC-RA38-18-C-x-GEO	40 cm	Hg, CH4	Lars-Eric				
								RA2404-BC-RA38-18-D-Foram-GEO	36 cm	Living/dead foram communities (JB)	Bordeaux	Subsampled (onboard with ~1ml for Hg 5-36)			
								RA2404-BC-RA38-18-E-pig-GEO	10 cm	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled (onboard with ~1ml for Hg 0-5)			
								RA2404-BC-RA38-18-F-carb-GEO	26 cm	interstitiel waters and sediment	LSCE (B. Lansard)	Subsampled			
								RA2404-BC-RA38-18-G-ThBe-GEO		interstitiel waters and sediment 2 first cr	LEGOS	Subsampled			

RA41	RA2404-BC-RA41-20-x-BIO	16/09/2024 20:17	79.510	-72.830	200	0								Not succesful
RA43	RA2404-BC-RA43-21-x-BIO	17/09/2024 14:38	79.080	-69.450	217									Not succesful - Surface not intact, no water on top, a lot of large rocks
	RA2404-BC-RA43-GEO	2024/09/17 15:03:03	79.080	-69.450	217	0								
	RA2404-BC-RA43-GEO	2024/09/17 15:17:56	79.080	-69.450	217	0								
RA45	RA2404-BC-RA45-22-x-BIO	2024/09/18 22:26:31	78.310	-74.900	510							N=9	germination (4°C , dark), sedaDNA surface (-80°C, N=6), sedaDNA bottom (-80°C, N=2)	water finish to flush on board, cobbles
	RA2404-BC-RA45-19-x-GEO	18/09/2024 22:59	78.300	-74.920	542	3	RA2404-BC-RA45-19-A-X-GEO	19 cm	All proxies	TBD		N=4	all biogenic proxies (-80°C), sed. Proxies (4°C), pollen, microplastic	
							RA2404-BC-RA45-19-D-Foram-GEO	19 cm	Living/dead foram communities (JB)	Bordeaux	Subsampled			
							RA2404-BC-RA45-19-E-pig-GEO	16 cm	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled			
RA47	RA2404-BC-RA47-23-x-BIO	2024/09/21 01:08:28	78.300	-74.002	611							N=7	germination (4°C , dark), sedaDNA surface (-80°C, N=4), sedaDNA bottom (-80°C, N=2)	very high level of sediment water undisturbed
	RA2404-BC-RA47-20-x-GEO	21/09/2024 01:45	78.301	-74.004	607	7	RA2404-BC-RA47-20-A-X-GEO	14 cm	All proxies	TBD		N=4	all biogenic proxies (-80°C), sed. Proxies (4°C), pollen, microplastic	water finish to flush on board, little sediment withfew gravels under; named station 50 in the log but position of RA47
							RA2404-BC-RA47-20-B-X-GEO	17 cm		TBD				
							RA2404-BC-RA47-20-C-Hg-GEO	16 cm		Lars-Eric				
							RA2404-BC-RA47-20-D-Foram-GEO	11 cm	Living/dead foram communities (JB)	Bordeaux	Subsampled (onboard with ~1ml for Hg 5-11)			
							RA2404-BC-RA47-20-E-pig-GEO	11 cm	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled (onboard with ~1ml for Hg 0-5)			
							RA2404-BC-RA47-20-F-carb-GEO	12 cm	interstitiel waters and sediment	LSCE (B. Lansard)	subsampled			
							RA2404-BC-RA47-20-G-ThBe-GEO		interstitiel waters and sediment for 2 first	LEGOS	subsampled			
RA50	RA2404-BC-RA50-x-BIO	20/09/2024 22:51	78.293	-73.592	602									Not succesful, Surface not intact, no water on top, a lot of large rocks, one box damaged
	RA2404-BC-RA50-x-GEO	2024/09/20 23:31:00	78.293	-73.595	603	0								
RA54	RA2404-BC-RA54-24-x-BIO	2024/09/24 00:54:13	76.342	-71.275	657							N=9	germination (4°C , dark), sedaDNA surface (-80°C, N=6), sedaDNA bottom (-80°C,	very high level of sediment water undisturbed
	RA2404-BC-RA54-21-x-GEO	24/09/2024 01:34	76.340	-71.270	659	8	RA2404-BC-RA54-21-A-X-GEO	34 cm	All proxies	TBD		N=4	all biogenic proxies (-80°C), sed. Proxies (4°C), pollen, microplastic	
							RA2404-BC-RA54-21-B-X-GEO	37 cm		TBD				
							RA2404-BC-RA54-21-C-Hg-GEO	40 cm		Lars-Eric				
							RA2404-BC-RA54-21-D-Foram-GEO	33 cm	Living/dead foram communities (JB)	Bordeaux	Subsampled (onboard with ~1ml for Hg 5-33)			
							RA2404-BC-RA54-21-E-pig-GEO	12 cm	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled (onboard with ~1ml for Hg 0-5)			
							RA2404-BC-RA54-21-F-carb-GEO	30 cm	interstitiel waters and sediment	LSCE (B. Lansard)	subsampled			
							RA2404-BC-RA54-21-G- GEO		interstitiel waters	LSCE (F. Thil)	sediment not preserved			
							RA2404-BC-RA54-21-H-ThBe-GEO		interstitiel waters and sediment 2 first cr	LEGOS	subsampled			
RA58	RA2404-BC-RA58-22-x-GEO	2024/09/24 21:26:56	76.307	-73.207	591	5 (+3 incubation)	RA2404-BC-RA58-22-A-X-GEO	37 cm	All proxies	TBD		N=8	germination (4°C , dark), sedaDNA surface (-80°C, N=5), sedaDNA bottom (-80°C,	very high level of sediment water undisturbed
							RA2404-BC-RA58-22-B-X-GEO	38 cm		TBD		N=4	all biogenic proxies (-80°C), sed. Proxies (4°C), pollen, microplastic	Pushcore E (pigments) surface was a bit disurbed (top 2-3 cm)
							RA2404-BC-RA58-22-C-Hg-GEO	36 cm		Lars-Eric				
							RA2404-BC-RA58-22-D-Foram-GEO	39 cm	Living/dead foram communities (JB)	Bordeaux	Subsampled			
							RA2404-BC-RA58-22-E-pig-GEO	12 cm	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled			

RA62	RA2404-BC-RA62-25-x-BIO	2024/09/25 20:13:08	76.2674018	-74.7447612	457							N=9	germination (4°C , dark), sedaDNA surface (-80°C, N=6), sedaDNA bottom (-80°C,	very high level of sediment water undisturbed
	RA2404-BC-RA62-23-x-GEO	25/09/2024 21:17	76.266	-74.747	458	8	RA2404-BC-RA62-23-A-X-GEO	41 cm	All proxies	TBD		N=4	all biogenic proxies (-80°C), sed. Proxies (4°C), pollen, microplastic	
							RA2404-BC-RA62-23-B-X-GEO	39 cm		TBD				
							RA2404-BC-RA62-23-C-Hg-GEO	44 cm		Lars-Eric				
							RA2404-BC-RA62-23-D-Foram-GEO	39 cm	Living/dead foram communities (JB)	Bordeaux	Subsampled (onboard with ~1ml for Hg 5-39)			
							RA2404-BC-RA62-23-E-pig-GEO	13 cm	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled (onboard with ~1ml for Hg 0-5)			
							RA2404-BC-RA62-23-F-carb-GEO	33 cm	interstitiel waters and sediment	LSCE (B. Lansard)	subsampled			
							RA2404-BC-RA62-23-G		interstitiel waters	LSCE (F. Thil)	sediment not preserved			
							RA2404-BC-RA62-23-H-ThBe-GEO		interstitiel waters and sediment 2 first cr	LEGOS	subsampled			
RA67	RA2404-BC-RA67-26-x-BIO	2024/09/26 18:16:50	76.3678802	-77.4173993	389							N=9	germination (4°C , dark), sedaDNA surface (-80°C, N=6), sedaDNA bottom (-80°C,	very high level of sediment water undisturbed
	RA2404-BC-RA67-24-x-GEO	26/09/2024 18:46	76.369	-77.420	391	8	RA2404-BC-RA67-24-A-X-GEO	32 cm	All proxies	TBD		N=4	all biogenic proxies (-80°C), sed. Proxies (4°C), pollen, microplastic	
							RA2404-BC-RA67-24-B-X-GEO	33 cm		TBD				
							RA2404-BC-RA67-24-C-Hg-GEO	32 cm		Lars-Eric				
							RA2404-BC-RA67-24-D-Foram-GEO	31 cm	Living/dead foram communities (JB)	Bordeaux	Subsampled (onboard with ~1ml for Hg 5-31)			
							RA2404-BC-RA67-24-E-pig-GEO	13 cm	Sedimentary pigments (Bonnin)	Bordeaux	Subsampled (onboard with ~1ml for Hg 0-5)			
							RA2404-BC-RA67-24-F-carb-GEO	34 cm	interstitiel waters and sediment	LSCE (B. Lansard)	subsampled			
							RA2404-BC-RA67-24-G		interstitiel waters	LSCE (F. Thil)	sediment not preserved			
							RA2404-BC-RA67-24-H-ThBe-GEO		interstitiel waters and sediment 2 first cr	LEGOS	subsampled			

Table 48-5: List of gravity cores collected

Location	Core ID	NRCAN CORE ID	Date/Time (UTC)	Latitude	Longitude	Depth (m)	Corer Type	Corer length (m)	Core Length (m)	Section lengths (cm)	Sections 1m	Archived at	MSCL	CT-SCAN
Makinson Fiord	RA2403-GGC-RA02.1-01-X		2024-08-15 3:17	77.26071	-79.1705	589.85	Giant Gravity Core	6 m	4,42 m	AB = 100 cm BC = 100 cm CD = 93 cm DE = 100 cm EF = 49 cm	5	ISMER		x
	RA2403-GC-RA03-01-X	2024805-0002	2024-08-15 19:05	77.27862	-80.68378	508.14	Gravity Core	3 m	2,59 m	AB = 100 cm BC = 100 cm CD = 59 cm	3	NRCan		x
	RA2403-GC-RA04-02-X	2024805-0004	2024-08-16 19:15	77.38143	-81.07635	182.54	Gravity Core	3 m	1,35 m	AB = 100 cm BC = 35,5 cm	2	NRCan		x
	RA2403-GC-RA02.2-03-X	2024805-006	2024-08-17 1:45	77.27064	-79.32927	620.41	Gravity Core	3 m	2,84 m	AB = 100 cm BC = 100 cm CD = 84 cm	3	NRCan		x
Dobbin Fiord	RA2403-GGC-RA06-02-X	2024805-0007	2024-08-18 20:43	79.68298	-73.08572	245.66	Giant Gravity Core	6 m	3,75 m	AB = 100 cm BC = 100 cm CD = 108,5 cm DE = 51 cm CC = 15,5 cm	4	NRCan		x
	RA2403-GGC-RA07-03-X	2024805-0009	2024-08-19 19:16	79.7855	-73.55604	232.23	Giant Gravity Core	9 m	4,18 m	AB = 100 cm BC = 100 cm CD = 93 cm DE = 100 cm EF = 18 cm	5	NRCan		x
	RA2403-GGC-RA08-04-X	2024805-0011	2024-08-20 20:26	79.82802	-74.09856	262	Giant Gravity Core	6 m	3,89 m	AB = 100 cm BC = 100 cm CD = 100 cm DE = 89 cm	4	NRCan		x
Robesson Channel	RA2403-GGC-RA10-05-X	2024805-0013	2024-08-22 20:15	82.13587	-61.00908	436.78	Giant Gravity Core	6 m	3,15 m	AB = 100 cm BC = 100 cm CD = 100 cm CC = 15 cm	4	NRCan		x
Lady Franklin – Connybeare – Archer system	RA2403-GGC-RA12-06-X	2024805-0016	2024-08-24 18:07	81.56627	-67.73440	304.14	Giant Gravity Core	6 m	3,74 m	AB = 100 cm BC = 100 cm CD = 100 cm DE = 74 cm	4	NRCan		x
	RA2403-GGC-RA14-07-X	2024805-0017	2024-08-24 21:09	81.59367	-66.02335	488.33	Giant Gravity Core	6 m	2,74 m	AB = 100 cm BC = 100 cm CD = 74 cm	3	NRCan		x
	RA2403-GGC-RA13-08-X	2024805-0018	2024-08-25 20:20	81.28875	-68.50074	429.76	Giant Gravity Core	6 m	3,08 m	AB = 100 cm BC = 100 cm CD = 100 cm DE = 8 cm	4	NRCan		x
	RA2403-GC-RA15-04-X	2024805-0019	2024-08-27 18:30	81.67102	-64.07936	599.87	Gravity Core	3 m	2,44 m	AB = 100 cm BC = 100 cm CD = 44 cm	3	NRCan		x
Newman Fjord	RA2403-GC-RA16-05-X	2024805-0020	2024-08-28 20:07	81.72762	-59.22956	119.08	Gravity Core	3 m	2,38 m	AB = 100 cm BC = 100 cm CD = 38,5 cm	3	NRCan		x
	RA2403-GC-RA17-06-X	2024805-0022	2024-08-29 12:30	81.6269	-58.89863	95.20	Gravity Core	3 m	2,02 m	AB = 86cm BC = 100 cm CD = 16,5 cm	2	NRCan		x

Station ID	Location	Core ID	Date/Time (UTC)	Latitude	Longitude	Depth (m)	Corer Type	Corer length (m)	Core Length (m)	Section lengths (cm)	Comments	Pre-defined objectives (more TBD after post-cruise processing)	Archived at
RA25		RA2404-GGC-RA25-09-X	2024/09/08 23:36:50	81.405	-64.250	520	Giant Gravity Core	9 m	360 cm	AB = 100 cm BC = 100 cm CD = 96 cm DE = 64 cm	There were mud on the barrel up to approximatly 8 meter; 2 bags: core cutter + core catcher		TBD
RA31		RA2404-GGC-RA31	2024/09/12 19:11:37	80.255	-67.807	156	Gravity Core	3m	0 m	NA	The liner was completly emty		
RA38		RA2404-GGC-RA38-10-X	2024/09/15 23:05:23	79.444	-71.037	225	Giant Gravity Core	6 m	393 cm	AB = 100 cm BC = 100 cm CD = 95 cm DE = 98 cm	mud on the barrel almost to the top, 3 bags: core cone+corecatcher + core cutter		TBD
RA47		RA2404-GGC-RA47-11-X	2024/09/20 00:21:20	78.306	-74.023	605	Giant Gravity Core	6 m	368 cm	AB = 99 cm BC = 101 cm CD = 115 cm DE = 53 cm	mud on the weight above the barrel, named station 48 in the log but position of RA47		TBD
RA54		RA2404-GC-RA54-7-X	2024/09/24 02:58:01	76.341	-71.278	657	Gravity Core	3 m	199 cm	AB = 100 cm BC = 99 cm	mud on the barrel almost to the top		TBD
RA58		RA2404-GGC-RA58-12-X	2024/09/24 22:23:22	76.310	-73.222	586	Giant Gravity Core	6 m	346 cm	AB = 100 cm BC = 100 cm CD = 100 cm DE = 46 cm	Good site, 2bags: core cone and core cutter, 1 cylinder core cutter		TBD
RA67		RA2404-GC-RA67-8-X	2024/09/26 19:23:57	76.3681893	-77.4220477	391	Gravity Core	3 m	270 cm	AB = 100 cm BC = 100 cm CD = 70 cm	one bag core catcher		TBD

48.4 References

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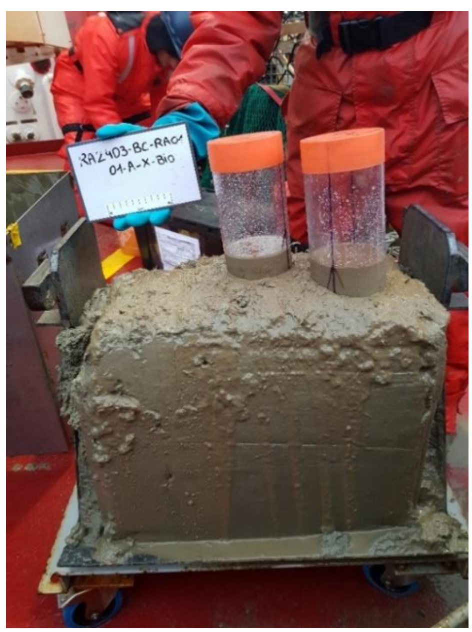
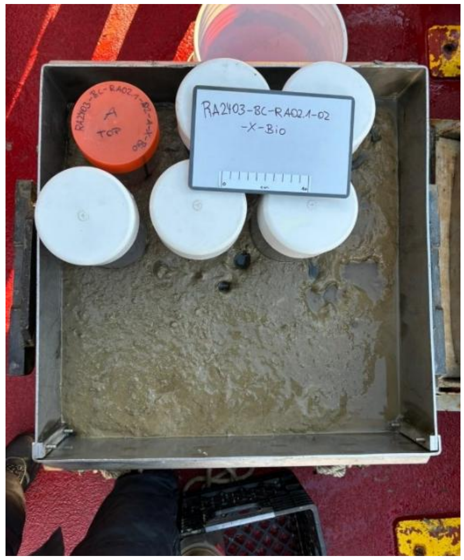
48.5 Appendix

Box Cores (Leg 3)



Station RA2403-BC-RA01-01-X-BIO (Bylot Island)



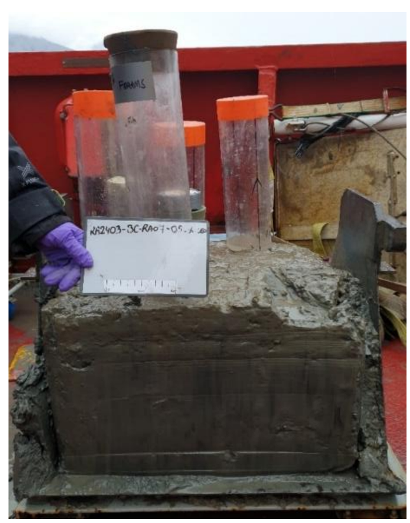
Station RA2403-BC-RA02.1-02-X-BIO (Makinson Inlet)

Station RA2403-BC-RA02.1-01-X-GEO (Makinson Inlet)

Stations RA2403-BC-RA03-03-X-BIO (left) and RA2403-BC-RA03-02-X-GEO (right) (Makinson Inlet)

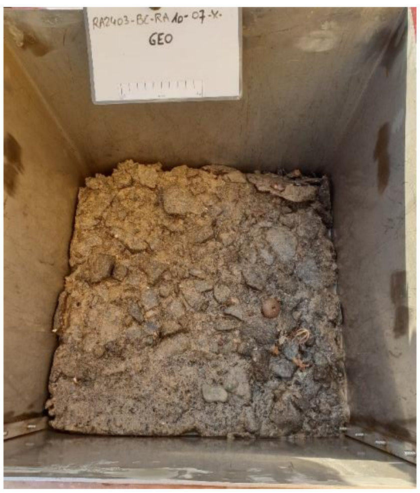
Station RA2403-BC-RA04-03-X-GEO (Makinson Inlet)

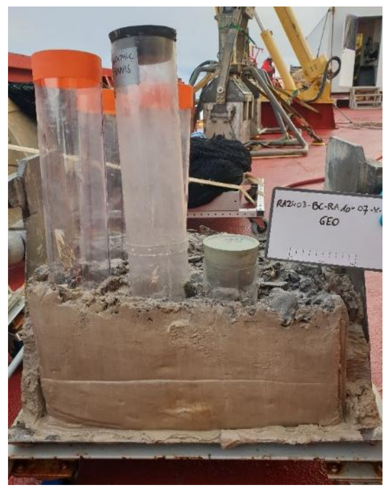
Station RA2403-BC-RA06-04-X-GEO (Dobbin Fjord)



Station RA2403-BC-RA07-05-X-GEO (Dobbin Fjord)

Station RA2403-BC-RA08-06-X-GEO (Dobbin Fjord)





Station RA2403-BC-RA10-07-X-GEO (Robeson Channel - Lincoln Sea)

Station RA2403-BC-RA12-08-X-GEO (Conybeare Fjord-Archer System)

Station RA2403-BC-RA13-10-X-GEO (Archer Fjord-Archer System)

Station RA2403-BC-RA14-09-X-GEO (Archer Fjord-Archer System)

Station RA2403-BC-RA15-11-X-GEO (Lady Franklin Bay-Archer System)

Station RA2403-BC-RA16-12-X-GEO (Newman Fjord)

Station RA2403-BC-RA17-13-X-GEO (Newman Fjord)

Station RA2403-BC-RA18-14-X-GEO (Newman Fjord)

Station RA2403-BC-RA24-15-X-GEO (Cadogan Fjord)

Leg 4

RA2404-BC-RA25-16-x-GEO

RA2404-BC-RA27-GEO

RA2404-BC-RA36-17-x-GEO

RA2404-BC-RA38-18-x-GEO

RA2404-BC-RA45-19-x-GEO

RA2404-BC-RA50-x-GEO

RA2404-BC-RA47-20-x-GEO

RA2404-BC-RA54-21-x-GEO (Missing)

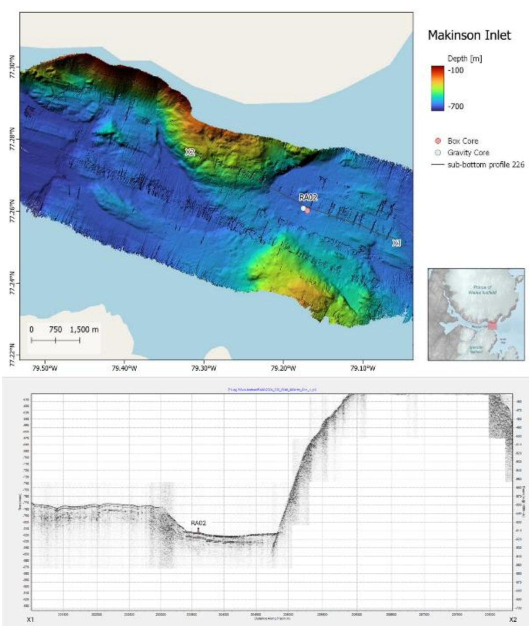
RA2404-BC-RA62-23-x-GEO

RA2404-BC-RA58-22-x-GEO (Missing)

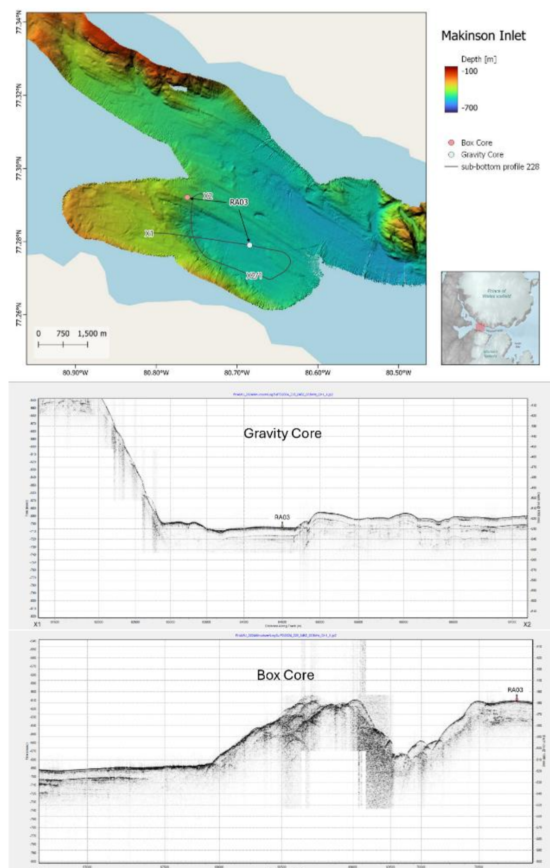
RA2404-BC-RA67-24-x-GEO

Maps and Sub-bottom profiles RA2404-BC-RA58-22-x-GEO

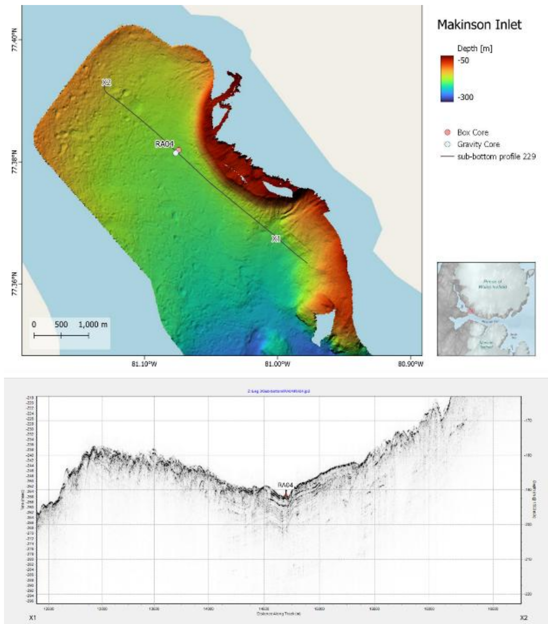
Leg 3



Station RA02 (Makinson Inlet)



Station R03 (Makinson Inlet)



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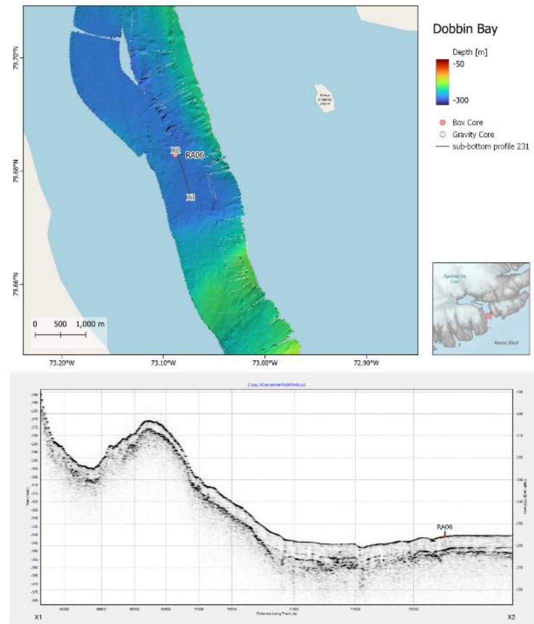
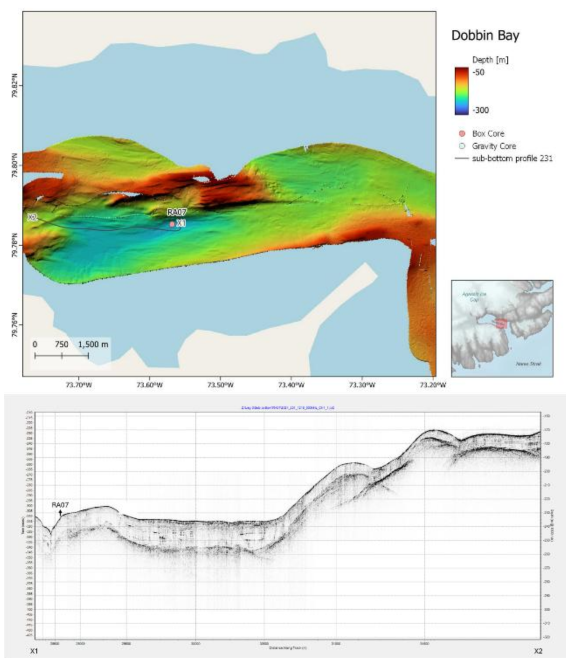
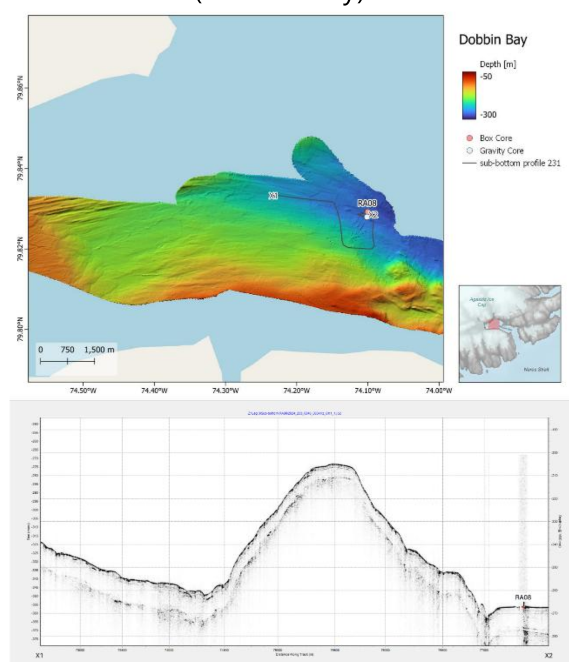


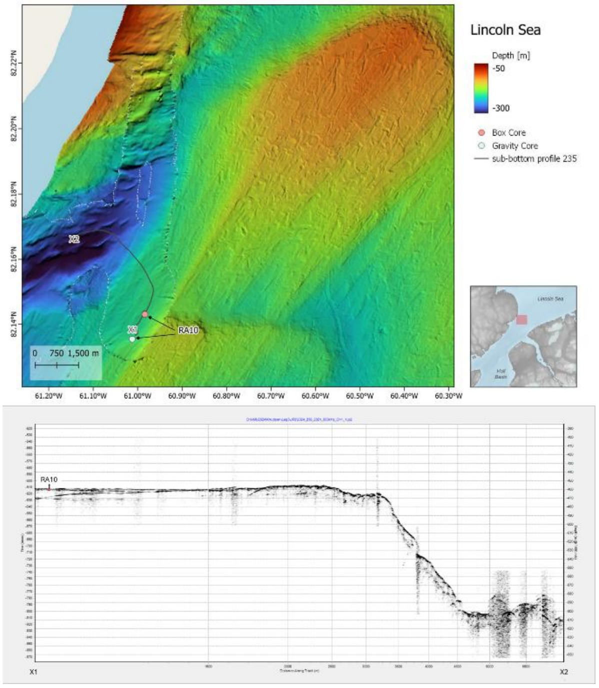
Station RA06 (Dobbin Bay)



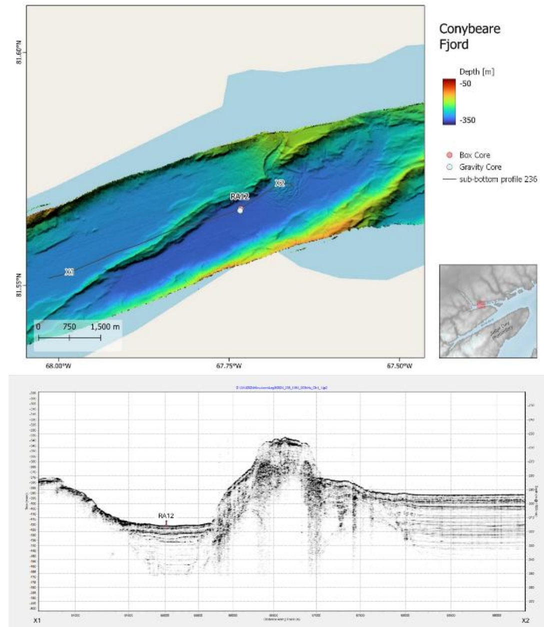
Station RA07 (Dobbin Bay)



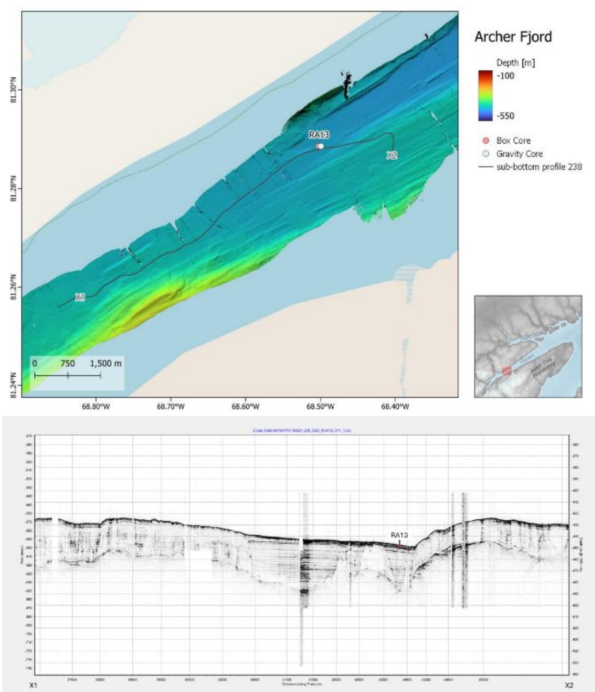
Station RA08 (Dobbin Bay)



Station RA10 (Robeson Channel - Lincoln Sea)



Station RA12 (Conybeare Fjord-Archer System)



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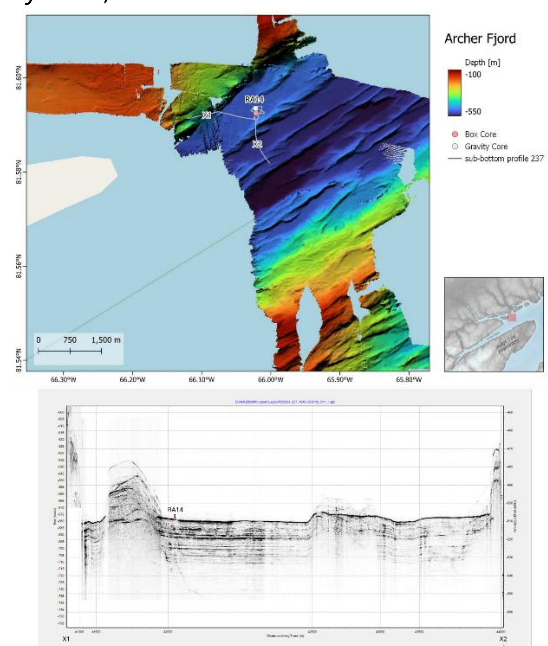

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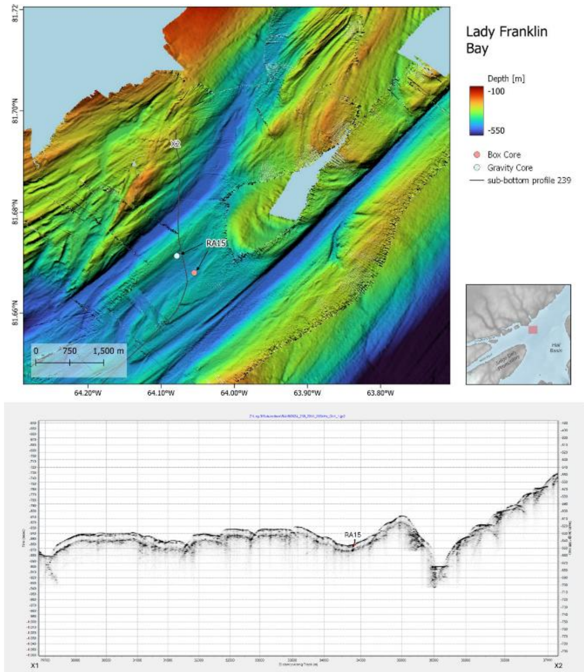
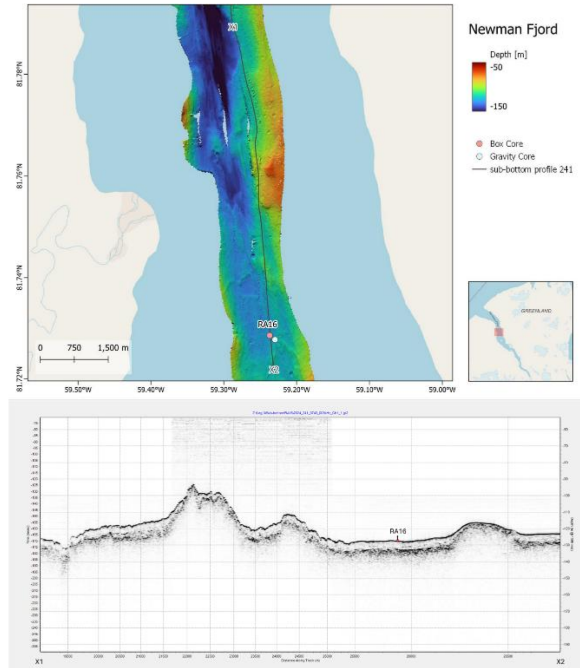


Station RA15 (Lady Franklin Bay-Archer System)



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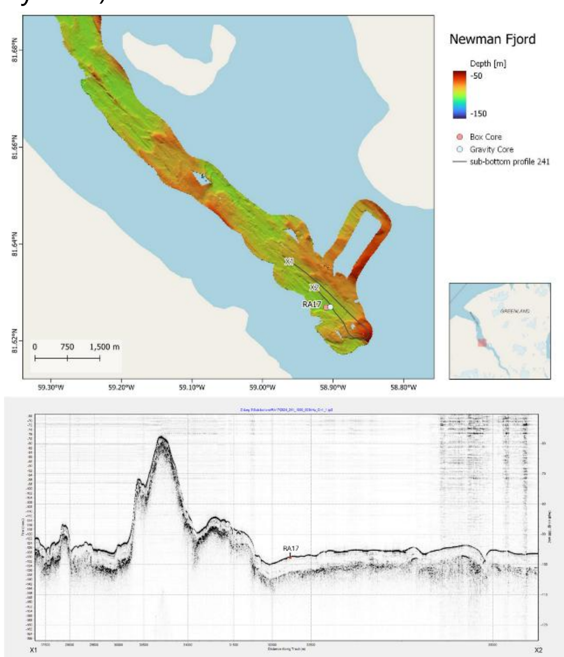
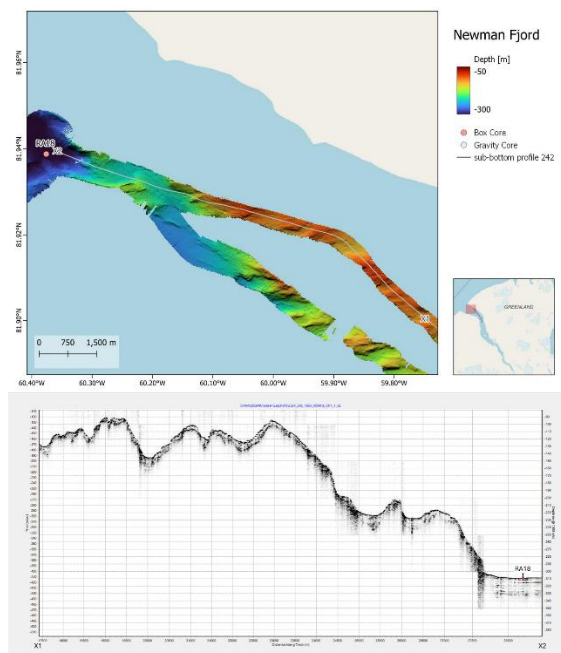
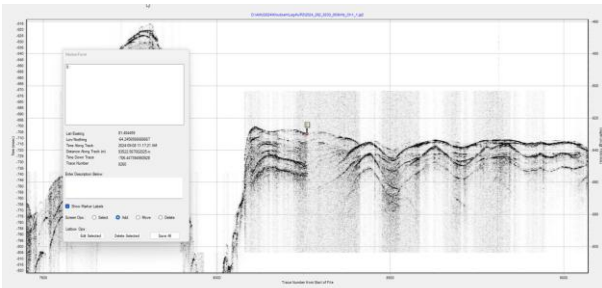


Station RA17 (Newman Fjord)



Station RA18 (Newman Fjord)

Leg 4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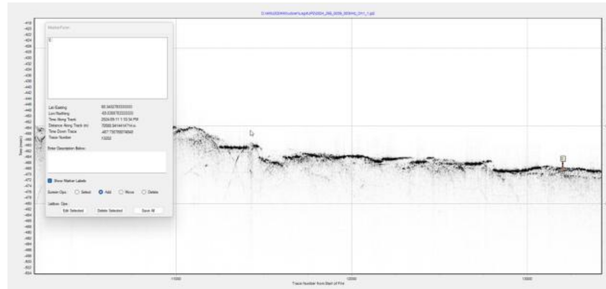
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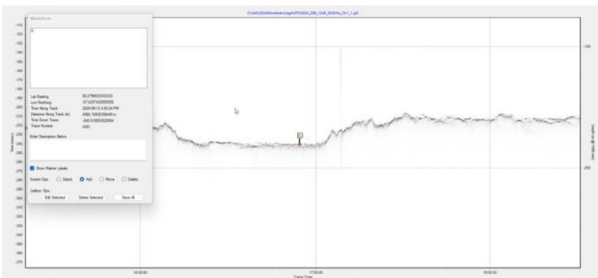
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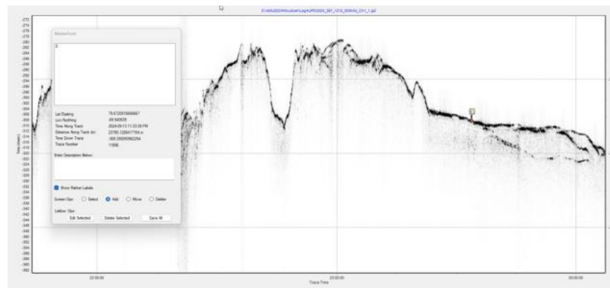
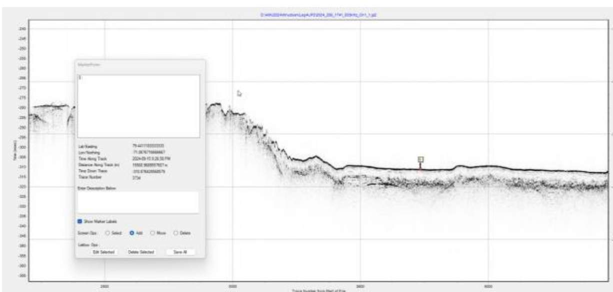
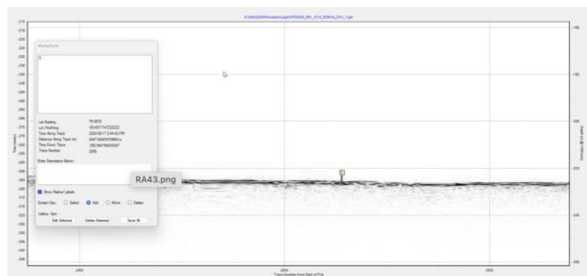

Station RA36 conducted on 2024/09/14


Station RA38 conducted on 2024/09/15



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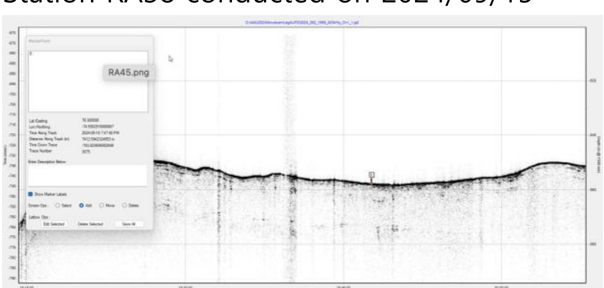

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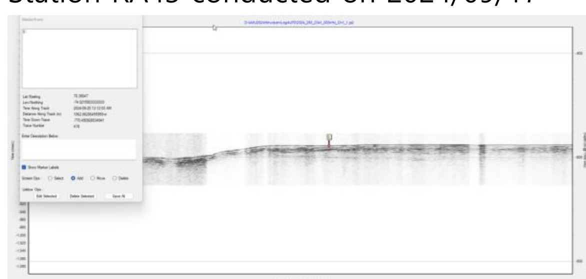
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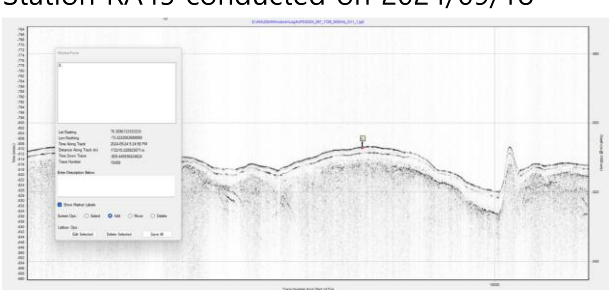
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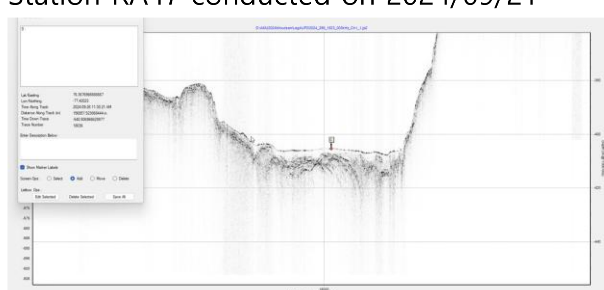
Station RA67 conducted on 2024/09/26

49 Mooring Operations Leg 2a

Principal Investigstor: David Cote[2], Rodd Laing[3], Maxime Geoffroy[1], Audrey Limoges[4], Owen Sherwood[5]

Cruise Participant: James Bartlett

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[2]*DFO, St. John's, Newfoundland and Labrador*

[3]*Nunatsiavut Government, Nain, NL*

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[5]*Dalhousie University, Halifax, NS*

49.1 Introduction and Objectives

The Amundsen Science 2024 mooring program continues a multi year legacy of oceanographic data collection on the Labrador Coast and Canada's Eastern Arctic region. James Bartlett, through ASL Environmental Sciences, was contracted to carry out a lead technical role with the initial phase of the Leg 2a research program, from St John's, NL, to Nain in Labrador's Nunatsiavut region. Three moorings were deployed and one mooring recovered over this 10-day cruise, meeting the objectives for this period. Specifically, moorings were deployed in the Hopedale and Sentinel study areas. The mooring planned for deployment in the Makkovik region was relocated to Sentinel, while the 2023 Hopedale mooring was recovered.

49.2 Methodology

49.2.1 *Mooring Recovery*

On July 13th, the Hopedale-23 (Figure 49-1) mooring was recovered. This site was noted as being deployed with the objective of examining the water and acoustic properties on the shelf break on the eastern edge of Hopedale Saddle in the Labrador Sea for DFO-NL. The recovery was done by triggering the tandem acoustic release from onboard the Amundsen. Some challenges were encountered with the acoustic releases; initially the AMD200 deckbox was used, however it was unable to receive a return signal from the releases. It is assumed that the short cable was not sufficient to avoid interference from the ship. The 8011M model deckbox with longer cable was used to successfully to bring the mooring to the surface. The Zodiac was used to connect a line to the upper frame on the mooring so it could then be hauled onto the vessel with the A-frame and capstan. Upon inspection of the mooring, it was found that one of the acoustic release jaw mechanisms was seized shut due to the residue from a corroded anode collecting on the hinge. Otherwise, no issues were observed with the mooring.

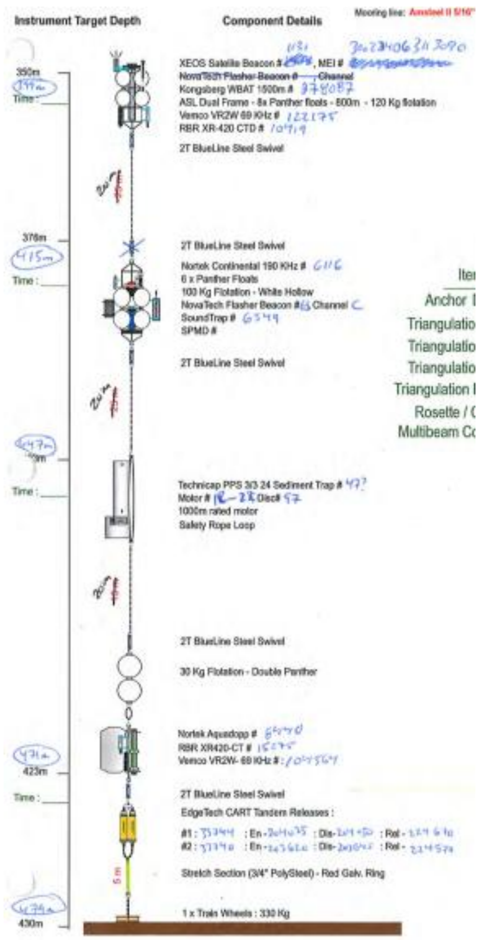

Figure 49-1: Hopedale-23 mooring diagram.

49.2.2 *Mooring Deployment*

Three moorings were deployed during this portion of Leg 2a. These moorings included the Hopedale mooring (Hopedale-24) which was deployed in the same location as the Hopedale-23 mooring. The Sentinel bottom mounted sensors (Sentinel-CROM-24), were deployed near a wall of coral also known as a hanging garden. The Makkovik-24 mooring was planned for deployment near a similar hanging garden feature on the Makkovik Shelf, however rough seas and time restrictions prevented this from being carried out. Time was made at the Sentinel location to deploy this mooring (now called Sentinel-Line-24) and it was deployed within 100m of the CROM mooring. Both the Hopedale24 and Sentinel 24 sites are plotted on a chart in Figure 49-2.

The two tautline moorings were deployed with the “anchor last” method using the zodiac to tow the top of the mooring away from vessel. Once the mooring was fully stretched out and released from the zodiac, the anchor was dropped at the surface using the Seacatch quick release. The Sentinel CROM (Figure 49-3) mooring was lowered to the bottom using an acoustic release fixed to the top of it. Once the mooring was at the bottom the release was triggered to detach from the frame, leaving it on the bottom.

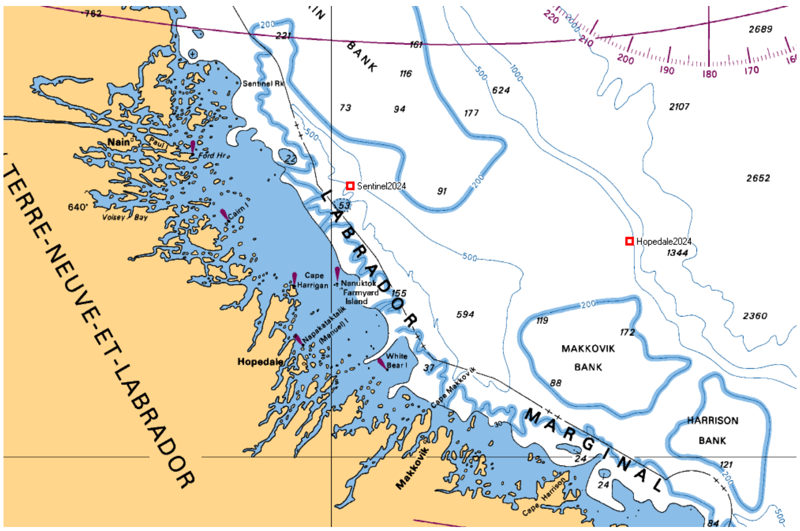

Figure 49-2: Locations of the Hopedale 2024 and Sentinel 2024 sites.

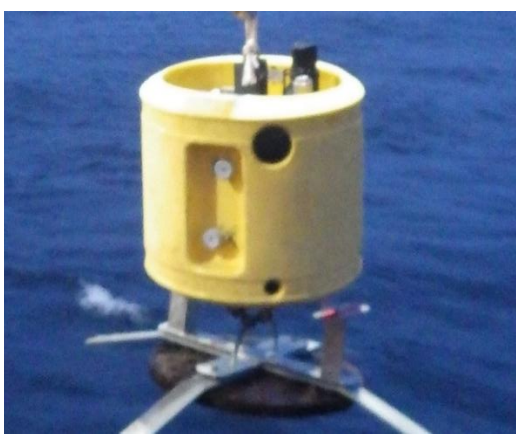

Figure 49-3: Sentinel-CROM-24 mooring image during deployment

A summary of the instruments deployed at all three mooring locations is found in Table 49-1. The mooring locations and times are tabulated in Table 49-2. The mooring diagrams are illustrated in Figure 49-4 and Figure 49-5.

Table 49-1: Mooring instrument summary

Site Name	Instrument type	Serial Number	Deployment depth (m)	Comments
Hopedale-24	Xeos Apollo X3	1220	350	Top of ASL Dual-Cage
	ASL AZFP	55206	350	ASL Dual-Cage
	RBR Concerto	234555	350	ASL Dual-Cage
	Nortek Continental 470 kHz	6064	375	
	Ocean Instruments SoundTrap	6859	375	
	Novatech flasher	C05-070	375	
	Technicap Sediment Trap	0027	400	2m safety line added
	2x PantherPlast floats	N/A	417	
	Nortek Aquadopp	8457	420	Frame with vane
	RBR Concerto	234556	422	Frame with vane
	Innovasea VR2W	139309	423	Frame with vane
	Tandem CART releases	33748 51645	423	E: 204226 D: 204243 R: 224764 E: 303734 D: 303751 R: 324636
Sentinel-Line-24	Xeos Apollo 3	1167	345	Upper bracket on steel float
	ASL AZFP	55208	393	15° frame
	Ocean Instruments SoundTrap	8504	393	15° frame
	Nortek Aquadopp	8426	395	Frame with vane
	RBR XR-420+	10419	395	Frame with vane
	InnovaSea VR2W	139313	405	Line mount, 10m below AQD
	Technicap Sediment Trap	0040	497	2m safety line added
	2x Pantherplast floats	N/A	517	
	Tandem PORT releases	61430 61431	518	E: 604121 D: 604144 R: 624722 E: 604073 D: 604102 R: 624701
Sentinel-CROM-24	Nortek Aquadopp	8448	521	
	InnovaSea VR2W	139311	521	
	Ocean Instruments SoundTrap	8055	521	
	Star ODI	12640	521	Zip-tied to CART
	Xeos Apollo X3	1170	520	
	Edgetech CART release	31904	521	E: 540074 D: 604102 R: 544176

Table 49-2: Mooring positions and date/time of deployment.

Site Name	Date/Time of deployment (UTC)	Latitude (N)	Longitude (W)
Hopedale-24	14 July 2024, 11:27	56° 03.432′	57° 25.718′
Sentinel-CROM-24	19 July 2024, 01:47	56° 19.247′	59′ 50.284′
Sentinel-Line-24	19 July 2024, 11:44	56° 19.274′	59° 50.317′

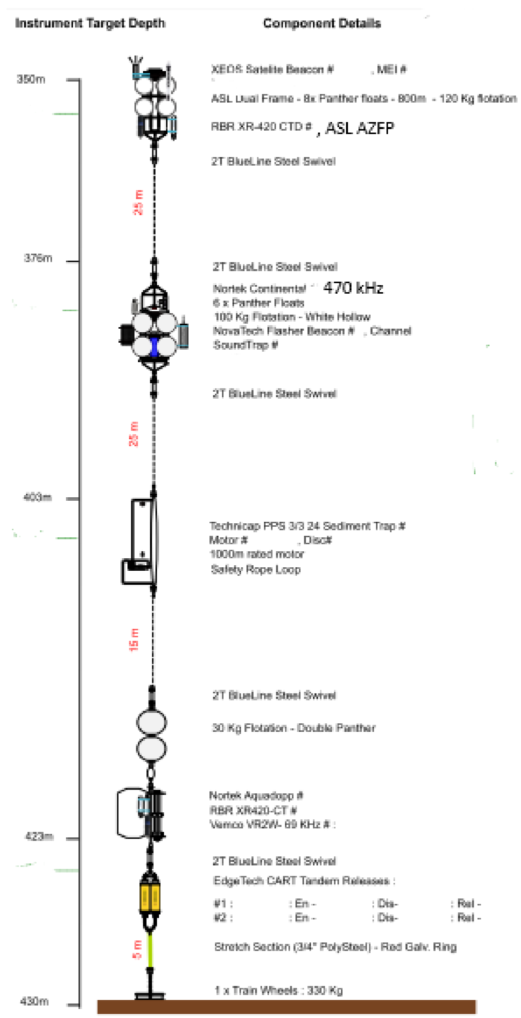

Figure 49-4: Hopedale24 Mooring Diagram, as deployed (not to scale)

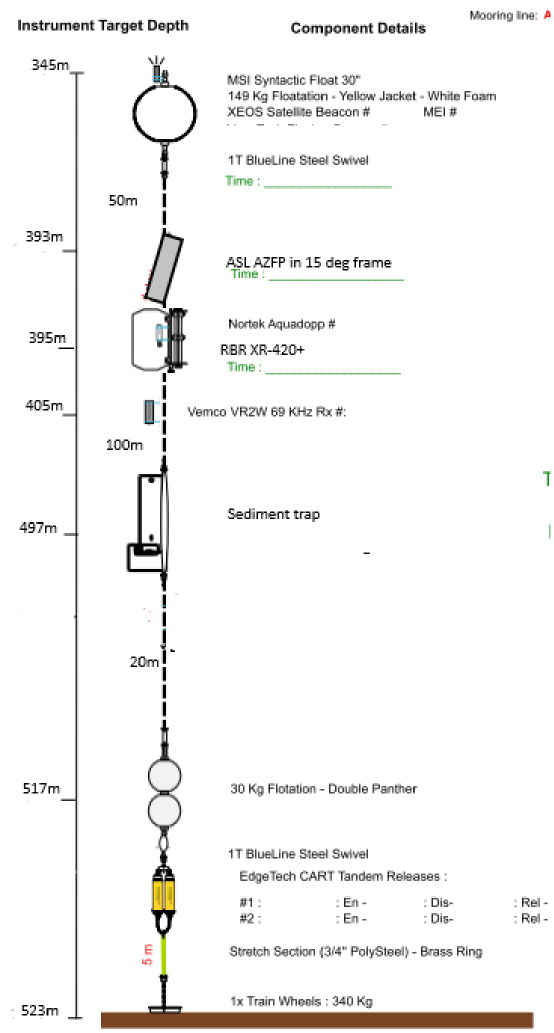

Figure 49-5: Sentinel-Line-24 mooring diagram, as deployed (not to scale).

49.3 Preliminary Results

Data was retrieved from the following instruments on the Hopedale-23 moorings:

Instrument type	Serial Number	Deployment depth (m)	Comments
Xeos Kilo	1131	399	Batteries removed
Kongsberg WBAT	278087	399	Transducers disconnected, data not recovered (did not have software license onboard). Stored in mooring container
RBR XR-420+	10419	399	Fouling on sensor at recovery. Batteries replaced, redeployed on Sentinel-Line-24. Time check: Inst. 2024-07-14 13:50:31, PC. 2024-07-14 13:50:00
Innovasea VR2W	122175	399	Data recovered by Sheena Roul
Nortek Continental 190kHz	6116	415	Data recovered and batteries removed. Time drift: Inst. 2024-7-17 20:38:46, PC: 2024-7-17 20:37:55 Stored in mooring container
Ocean Instruments SoundTrap	6549	415	Data recovered by Sheena Roul
Novatech flasher	C63	415	Batteries removed
Technicap Sediment Trap	47 (?)	447	Bottles recovered and capped, samples stored in chemical locker. Motor remains installed
Nortek Aquadopp	9494	471	SN does not agree with deployment sheets. Instrument stored in AZFP case in the science container. Data recovered and battery removed. Time check: Inst. 2024-07-15 23:54:47, PC. 2024-07-15 23:55:30
RBR XR-420	15275	471	No valid data contained on device, only a single day of data at 1s sampling from January 2023. Batteries removed
Innovasea VR2W	104564	471	Data recovered by Sheena Roul
Tandem CART releases	33744 33740	474	Stored in mooring container, purge plug removed from one release to be used on C4 PORT which was missing

49.4 Recommendations

- ADCP current meters were not calibrated prior to deployment. Post calibration of the compasses on these sensors should be done before the batteries are removed on recovery.
- The two moorings located at the Sentinel site are less than 100m from each other. It is recommended that the taut-line mooring be recovered first to avoid contact between the two.
- Mooring triangulation was not carried out at the time of deployment. Above locations represent anchor drop positions. A multibeam reading of the Hopedale mooring was done at deployment, however if a more precise location is required, then a triangulation could be done prior to recovery.
- Aquadopp lithium batteries are slightly larger than the standard alkaline pack. The foam padding on these packs can be removed to provide a better fit. The battery initially installed on the Sentinel-Line-24 Aquadopp had the wrapping material stripped away during installation which caused the battery to short and fail. It was replaced prior to deployment in the field.
- Be sure there is a comm cable for each instrument to be deployed and recovered in the mooring container during mobilization.

49.5 Additional Information

The Sentinel-Line-24 mooring was modeled prior to deployment using current data from the originally intended Makkovik location. Currents were provided by Bárbara Neves (DFO). The Matlab package “Mooring Design and Dynamics” was used.

```
Height[m]   U [m/s]   V [m/s]   W [m/s] Density [kg/m^3]
 680.00      0.25      0.00      0.00    1024.00
  50.00      0.10      0.00      0.00    1025.85
   0.00      0.00      0.00      0.00    1026.00

First, find neutral (no current) mooring component positions.
...
This is (starting off as) a sub-surface mooring
Searching for a converged solution.
...
This is a sub-surface solution.
Total Tension on Anchor [kg] = 81.7
Vertical load [kg] = 81.5  Horizontal load [kg] = 5.6
Safe wet anchor mass = 136.3 [kg] = 300.0 [lb]
Safe dry steel anchor mass = 156.7 [kg] = 344.8 [lb]
Safe dry concrete anchor mass = 209.8 [kg] = 461.5 [lb]
Weight under anchor = -372.8 [kg]  (negative is down)
```

- Beacon IMEI numbers

1170 - 301434060360900 Sentinel-CROM-24

1167 - 301434060409680 – Sentinel-Line-24

1220 – 301434061208290 – Hopedale-24

50 Mooring Operations Leg 3

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The mooring team onboard: Christian Boutot [3]

Other personal helping with mooring operations: Elizabeth Kitching[2], Megan Lee[2], Luc Michaud[9]

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50.1 Introduction and objectives

The 3rd Leg of the 2024 Amundsen Science expedition, conducted under the Refuge-Arctic program, planned the recovery of eight oceanographic moorings related to various scientific programs. The redeployment of two moorings was also planned. This report outlines the projects associated with these moorings, their key objectives and ship operations.

<ins>Moorings (N=6 recoveries, N=2 redeployments) related to initiatives of the ArcticCORE/RED-AO/KEBABB Consortium:</ins>

The rapid on-going changes in the Arctic cryosphere constitute the most dramatic and far-reaching climate-associated changes taking place in the Arctic Ocean. The transition to ice-free summers, replacement of multiyear by seasonal sea ice, and the accelerated melt of ice caps and ice shelves fundamentally alter Arctic marine ecosystems locally and globally through changes in physical and chemical properties of water masses and biogeochemical fluxes of materials (e.g., AMAP 2021). The ecosystems of Baffin Bay and the North Water polynya are recognized for their high productivity, with Baffin Bay hosting the only commercial fisheries in the Canadian Arctic. These ecosystems are influenced by changes taking place upstream in the Lincoln Sea, the only Arctic region where thick multiyear ice still resides (Lange et al., 2021), and in adjacent ice shelves of Ellesmere Island. There is immediate urgency to characterize and better understand the connected cryosphere-ocean system of the Lincoln Sea – Baffin Bay complex, as a prerequisite to inform the sustainable management and conservation of Arctic marine resources and fisheries as well as downstream ecosystems.

This mooring program was developed in 2023 as an integral part of the RED-AO (Rapidly Changing Ecosystem Dynamics in the Arctic Ocean's Last Ice Area) – ArcticCORE (Conservation, Observation, Research and Engagement) – KEBABB (Knowledge and Ecosystem-Based Approach in Baffin Bay) Consortium, which combines ship-based discrete observational and experimental studies with biogeochemical observatories (moorings). These long-term observatories are essential to characterize physical and chemical changes in the marine system and their impacts on biological processes and species. During the CCGS Amundsen expedition 2023, all six moorings were successfully deployed in Lincoln Sea, Archer Fiord, Nares Strait, near Bylot Island and at station C4 in the KEBABB sampling grid in Baffin Bay. Recovery of five of these moorings was one of the objectives for Leg 3 of the CCGS *Amundsen* expedition 2024. Large amounts of the collected bio-optical and acoustic datasets as well as the vertical particle flux captured in the sediment traps will be analyzed as part of the recently CIRNAC-funded Marine Conservation Targets project "Monitoring past and present productivity of Arctic outflow waters". A mooring equipped with an upward-looking Wideband Autonomous Transceiver (WBAT) was part of the RED-AO project, funded by ArcticNet, MITACS, and the NorthFish project. Its goals were to identify acoustic signals from shrimp and fish to evaluate their abundance and occurrence, and to measure seasonal variations in diel vertical migrations.

The redeployment of two moorings, namely Archer Fiord and Bylot Island, was also planned for Leg 3 under the leadership of Fisheries and Oceans Canada, as part of the ongoing ArcticCORE and KEBABB programs, with support of Amundsen Science and the RED-AO collaborators for specific instruments (sediment traps and acoustic zooplankton fish profiler). The mooring program continues to address fundamental questions in key ecological areas to inform sustainable management and conservation of Arctic marine resources, in particular:

i) the variability of the structure and the seasonality of the unique ecosystem of Archer Fiord, identified as a unique region within the marine protected area of Tuvaijuittuq based on the presence/abundance of marine mammals, as part of ArcticCORE (1 mooring: Archer Fiord);

ii) the variability in biogeochemical and physical properties of the water column at the confluence/entrance of Pond Inlet, identified as one of the Arctic's most biologically productive marine areas with a large abundance of marine mammals and large coastal seabird colonies (1 mooring: Bylot Island).

Moorings (N=1 recovery) related to the "Arctic Sea Ice, Freshwater-Marine Coupling and Climate Change" program:

Another set of moorings, associated with the "Arctic Sea Ice, Freshwater-Marine Coupling and Climate Change" project led by Dr. Dorthe Dahl-Jensen[3], aimed to gather data on ocean currents and thermohaline properties near the North Water polynya area. During Leg 3, the cruise route passed close to one of the mooring's location (M4-CEOS, in Kane Basin), providing an opportunity to attempt recovery of that mooring.

Mooring (N=1 recovery) related to "Arctic seafloor" program:

One mooring equipped with a sediment trap, associated with the "Arctic seafloor" project led by Dr. Jean-Carlos Montero-Serrano, aimed to collect sinking particulate matter in central Jones Sound.

50.2 Methods

50.2.1 *Mooring operations*

During Leg 3, six moorings were successfully recovered, and two moorings were redeployed (Figure 50-1). An attempt to recover mooring M4-CEOS in Kane Basin (Cape Jackson) was made, and communication was established with the acoustic release. However, it was not possible to recover the mooring within the available time window, and it is hypothesized that a failure of the acoustic release mechanism or other mooring malfunction linked to the harsh environmental conditions made the recovery impossible. Additionally, a Maritime Search and

Rescue call led to a re-planning of scientific activities, and operations in Jones Sounds were significantly reduced. As a result, it was not possible to recover the mooring associated with the Arctic seafloor project. This mooring will be retrieved at a later date.

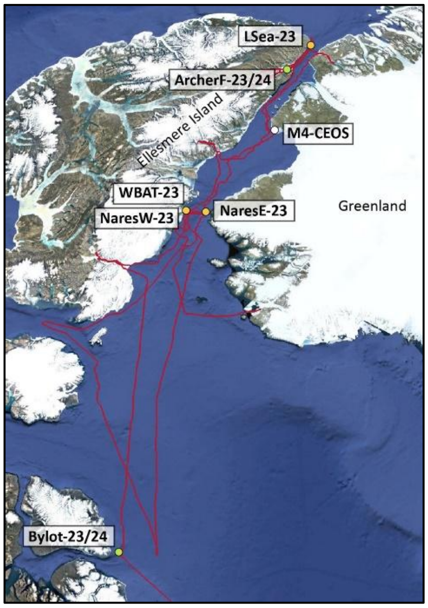

Figure 50-1: The position of the moorings recovered (successful: yellow circles, unsuccessful: while circle) during the 3rd Leg of the 2024 Amundsen Science expedition (grey line shows cruise track). The green circles indicate the sites where moorings were both recovered and redeployed.

Safety during operations was of utmost importance, and a safety meeting was held with Coast Guard crew members and the mooring technician before beginning any mooring operations. The ship's crane and the A-Frame winch on the port-side foredeck were used for all recoveries and deployments. A zodiac was used to communicate with the releases (particularly Benthos) during the mooring recoveries and to tow the subsurface float and mooring line under the frame to bring them back on deck. The zodiac was also used during mooring deployment to tow the subsurface float and mooring line perpendicularly away from the ship (Figure 50-2) to ensure there were no entanglements.

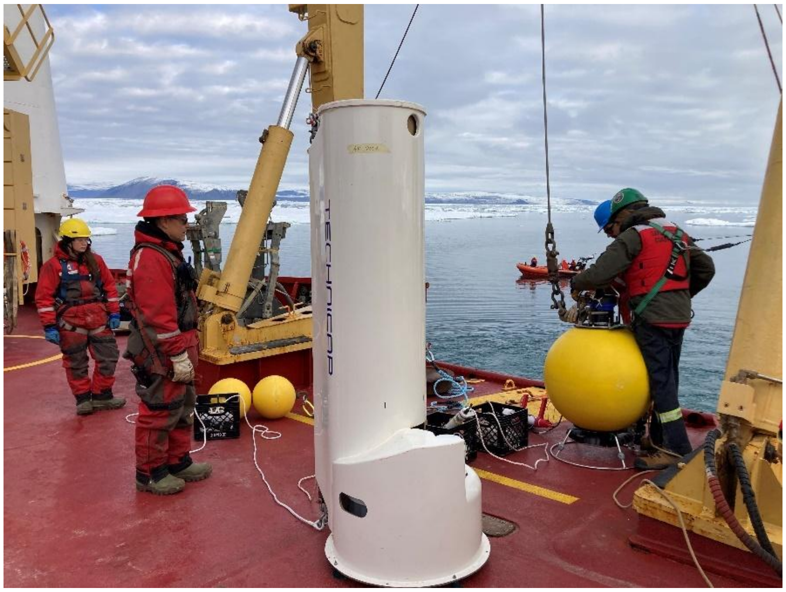

Figure 50-2: AF-24 mooring deployment in Archer Fiord (photo by Laure Vilgrain)

A train wheel was used as the anchor for each mooring. Moorings were deployed starting with the floatation and instruments on top, and the last component released was the anchor (Figure 50-3). Post-deployment triangulation of the acoustic release positions was not conducted for two reasons; water depth was relatively shallow at each position (600 m maximum), and post-deployment surveys conducted with the vessels EK80 and multibeam echosounder were able to detect the large mooring items (e.g., buoys, sediment traps) and their accurate geographical coordinates on echograms (Figure 50-4). All instruments were set to UTC time prior to deploying, and the list of instruments deployed at each mooring is shown in Table 50-1. All instruments recovered were rinsed, scrubbed, and secured, and the list of instruments recovered at each mooring is also shown in Table 50-1. From these recovered instruments, battery storage and data transfer status are listed in

Table 50-6.

Figure 50-3: AF-24 mooring deployment (photo Laure Vilgrain)

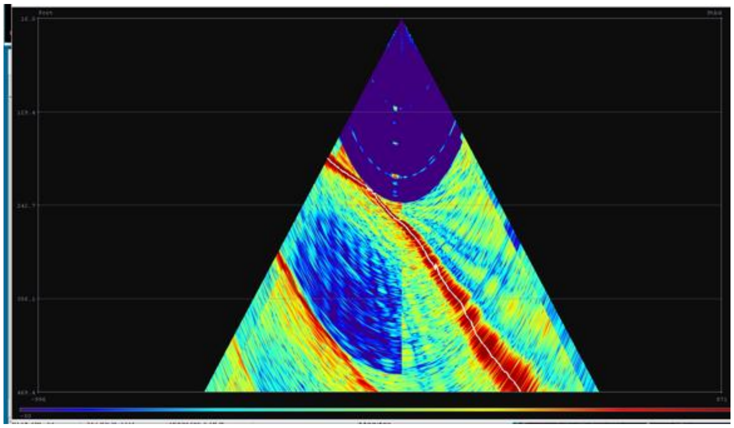

Figure 50-4: An example of multibeam showing the subsurface float and sediment trap at AF-24 mooring.

Table 50-1: The key information on all mooring deployed in leg 3 of the 2024 expedition

Mooring	Coordinates	Deployment date and time (UTC)	Water depth (m)	Instruments	Acoustic releases and codes
ArcherF-24	81° 32.571′ N 64° 53.690′ W	23 Aug 15:03	259	**Nortek Signature250 ADCP** #100389 (119 m) **RBR Maestro CTD-FL-DO-Tu-CDOM** #234330 (120 m) **SBE 37-SM CTD** #79731 (190 m) **RBR solo Tu** #79730 (190 m) **Technicap PPS 4/3** Table 50-3 #75 (200 m) **Vemco hydrophone** #139310 (225 m)	EdgeTech MFE #66084 Rel: 343570 En: 357026 Dis: 357043 EdgeTech MFE #66085 Rel: 343612 En: 357060 Dis: 357111
Bylot-24	72° 52.837′ N 75° 39.275′ W	12 Aug 12:42	423	**Nortek Continental 470 kHz ADCP** #5815 (316 m) **Pro Oceanus Co2V** #41-931-75 (317 m) **SBE 37-SM CT** #23120 (317 m) **Technicap PPS 3/3** Table 50-4 #04-079 (420 m) **Vemco hydrophone**	Benthos R500 #82599 Rel: 49831 En: 99 Benthos R500 #82602 Rel: 49834 En: 2

				#138628 (462 m)	

Table 50-2: The key information on all mooring recovered during Leg 3 of the 2024 Expedition.

Mooring	Coordinates	Recovering date and time (UTC)	Water depth (m)	Instruments	Acoustic releases and codes
Bylot-23	72° 52.92′ N 75° 38.805′ W	12 Aug 14:58	440	**RDI Sentinel V100 ADCP** #495 (119 m) **RBR Maestro CTD** #213848 (120 m) **Pro Oceanus Co2V** #4318175 (120 m) **SBE 37-SM CTD** #23119 (199 m) **RBR Duet-TD** #82866 (250m) **RBR Duet-TD** #82857 (350m) **RBR Duet-TD** #82859 (400m) **RBR solo Tu** #79731 (400 m) **Technicap PPS 4/3** Table 50-3 #56 (400 m) **Vemco hydrophone** [1a] #139314 (225 m)	Benthos R500 #82603 Rel: 49835 En: 3 Benthos R500 #82609 Rel: 49841 En: 9
WBAT-23	78° 19.00′ N 74° 48.05′ W	17 Aug 17:50	573	**Kongsberg WBAT** #1474 (571 m)	EdgeTech CART #61324 Rel: 623341 En: 601140 Dis: 601163 EdgeTech CART #61325 Rel: 623362 En: 601201 Dis: 601222
LSea-23	82° 08.366′ N 61° 13.567′ W	23 Aug 00:03	485	**Nortek Continental 470 kHz ADCP** [2a] #5815 (316 m) **SBE 37-SM CT** #23120 (317 m) **Technicap PPS 3/3**	Benthos R500 #82599 Rel: 49831 En: 99 Benthos R500

				Table 50-4 #04-079 (420 m) **Vemco hydrophone [2b]** #138628 (462 m)	#82602 Rel: 49834 En: 2
ArcherF-23	81° 32.332′ N 64° 57.216′ W	23 Aug 10:51	260	**RDI Sentinel V100 ADCP** #125 (119 m) **RBR Maestro CTD-FL-DO-Tu-CDOM** #214538 (120 m) **SBE 37-SM CT** #11742 (199 m) **RBR solo Tu** #79730 (199 m) **Technicap PPS 4/3** Table 50-3 #119 (200 m) **Vemco hydrophone [1a]** #138629 (225 m)	Benthos R500 #80594 Rel: 47826 En: 94 Benthos R500 #80608 Rel: 49840 En: 8
M4-CEOS (release respond but not recovered)	80° 03.398′ N 67° 03.411′ W	30 Aug 23:20	53 [3a]	**RBR concerto CT** [A] #215411 (52 m) **Nortek Signature500 ADCP** #0261 (52 m)	EdgeTech PORT LF #51801 Rel: 334432 En: 322775 Dis: 323000
NaresW-23	78° 19.582′ N 74° 53.107′ W	19 Sep 2023 14:15	307	**RDI Sentinel V100 ADCP** #496 (206 m) **RBR concerto CTD** #201107 (208 m) **Technicap PPS 3/3** Table 50-6 #53 (281 m)[B] **SBE 37-SM CT** #11741 (283 m) **Vemco hydrophone** #139317 (292 m)	EdgeTech CART #33743 Rel: 224653 En: 203772 Dis: 204016 EdgeTech CART #31091 Rel: 431334 En: 415103 Dis: 415124
NaresE-23	78° 19.438′ N 73° 11.636′ W	20 Sep 2023 10:38	340	**RDI Sentinel V100 ADCP** #497 (195 m) **RBR concerto CTD** #201108 (197 m) **Technicap PPS 3/3** Table 50-6	Benthos R500 #82600 Rel: 49832 En: 0 Benthos R500 #82606

				#52 (273 m)[B] **SBE 37-SM CT** #11432 (275 m) **Vemco hydrophone** #138315 (314 m)	Rel: 49838 En: 6

Notes:

[1a] – the acoustic receiver's battery not been connected before deployment

[2a] – in 2023, the thread of communication with Shawn Meredyk after the mooring had been deployed already, it was found that "the internal unit clock battery could be weak or dead. In this case the unit would not start as the date would not be synchronized". The ADCP was not reprogrammed after the external battery was connected that implies there is a chance of having no records on this unit.

[2b] –in 2023, the acoustic receiver's battery could probably have not been connected before deployment

[3a] –in 2023, the depth in the mooring position is 53 m according to the ship echosounder. However, there might be a chance that the mooring got automatically released before it reached the sea floor. It could happen because the hoist rope was captured and pulled away of the ship by an ice floe. The deck crew team suggested that the mooring got released when it was ~10 m above the bottom still, but this suggestion is not very confident.

[A] in 2023, For validation, all running CT loggers from M1-CEOS and M4-CEOS were placed into the bucket with salt water that was staying on the open deck during a few days before deployments.

[B] The planned program for the sediment traps differed from the actual program, likely due to a communication issue.

50.2.2 *Sediment traps deployed and recovered in the 3rd Leg*

Important notes: it was noticed that there was a discrepancy between the intended and actual sediment trap cup rotation programs, possibly resulting from miscommunication. While the programs for the NaresE and NaresW moorings were successfully loaded, it is recommended to confirm programs from the other sediment traps.

Two time-programmed, multi-cupped sediment traps were deployed at the ArcherF-24 and Bylot-24 (ArcticCORE project) stations (see Table 50-1, Table 50-2). Prior to the deployment, the sediment trap cups were filled with a preservative formalin solution (Hargrave et al., 2002), prepared in advance at UNB. Leftover formalin solution will be used to measure blank values for elemental analyses and pigment measurements (CHN + fluorimeter/HPLC). Recipe dense solution:

19 L seawater (~34 salinity)

+ 1.0L buffered formalin (100% formalin =37 % formaldehyde, 1-L of 37% formaldehyde)

+ 38 g NaCl (to adjust the 19-L, 33-salinity, to 36 salinity)

+ 36 g NaCl to adjust the 1-L formaldehyde to 36 salinity (total is 74 g of salt added)

= 20 L filling solution (5% formalin v/v)

Table 50-3: Program used for the sediment trap for Bylot-24 and ArcherF-24. Time and dates given as Universal Time Coordinated (UTC).

BylotS-24	**Technicap PPS4/3 – 24 bottles (500 mL)**		
	Opening:	$0.125m^2$	AS
	Sample	**Start date**	**Days**
	1	16–Sept–24 00:00:00	15
	2	1–October–24 00:00:00	15
	3	16–October–24 00:00:00	16
	4	1–November–24 00:00:00	15
	5	16-November–24 00:00:00	15
	6	1–December–24 00:00:00	15
	7	16–December–24 00:00:00	16
	8	1–January–25 00:00:00	15
	9	16–January–25 00:00:00	16
	10	1–February–25 00:00:00	15
	11	16–February–25 00:00:00	13
	12	1–March–25 00:00:00	15
	13	16–March–25 00:00:00	16
	14	1–April–25 00:00:00	15
	15	16–April–25 00:00:00	15
	16	1–May–25 00:00:00	15
	17	16–May–25 00:00:00	16
	18	1–June–25 00:00:00	15
	19	16–June–25 00:00:00	15
	20	1–July–25 00:00:00	15
	21	16–July–25 00:00:00	16
	22	1–August–25 00:00:00	15
	23	16–August–25 00:00:00	16
	24	1–Sept–25 24:00:00	15
		END 15–Sept–25 23:59:59	
AF-24	**Technicap PPS4/3 – 12 bottles (500mL)**		
	Opening:	$0.05\ m^2$	AS
	Sample	**Start date**	**Days**
	1	1–October–24 00:00:00	61
	2	1–December–24 00:00:00	62
	3	1–February–25 00:00:00	60
	4	1–April–25 00:00:00	30
	5	1–May–25 00:00:00	31

	6	1–June–25 00:00:00	15
	7	16–June–25 00:00:00	15
	8	1–July–25 00:00:00	15
	9	16–July–25 00:00:00	16
	10	1–August–25 00:00:00	15
	11	16–August–25 00:00:00	16
	12	1–September–25 00:00:00	30
		End 30–September–25 23:59:59	

Table 50-4: Program used for the sediment trap LSea-23. Time and dates given as Universal Time Coordinated (UTC). One of the cavities of the carousel for the LSea-23 trap was broken. The motor was programmed to avoid this hole during the sampling period (only 11 sampling cups used).

LSea-23					
Sample	**Start date**	**Days**	**Sample**	**Start date**	**Days**
1	01 Oct 2023, 00:00	31	7	16 Jun 2024, 00:00	15
2	01 Nov 2023, 00:00	61	8	01 Jul 2024, 00:00	15
3	01 Jan 2024, 00:00	91	9	16 Jul 2024, 00:00	16
4	01 Apr 2024, 00:00	30	10	01 Aug 2024, 00:00	15
5	01 May 2024, 00:00	31	11	16 Aug 2024, 00:00	15
6	01 Jun 2024, 00:00	15	12	Broken	
				End 30 Aug 2024 00:00	

Table 50-5: Program planned to be used for the sediment traps NaresE-23 and NaresW-23. Time and dates given as Universal Time Coordinated (UTC).

NaresE-23 and NaresW-23					
Sample	Start date	Days	Sample	Start date	Days
1	16 Sep 2023, 00:00	15	13	16 Mar 2024, 00:00	16
2	01 Oct 2023, 00:00	15	14	01 Apr 2024, 00:00	15
3	16 Oct 2023, 00:00	16	15	16 Apr 2024, 00:00	15
4	01 Nov 2023, 00:00	15	16	01 May 2024, 00:00	15
5	16 Nov 2023, 00:00	15	17	16 May 2024, 00:00	16
6	01 Dec 2023, 00:00	15	18	01 Jun 2024, 00:00	15
7	16 Dec 2023, 00:00	16	19	16 Jun 2024, 00:00	15
8	01 Jan 2024, 00:00	15	20	01 Jul 2024, 00:00	15

9	16 Jan 2024, 00:00	16	21	16 Jul 2024, 00:00	16
10	01 Feb 2024, 00:00	15	22	01 Aug 2024, 00:00	15
11	16 Feb 2024, 00:00	14	23	16 Aug 2024, 00:00	16
12	01 Mar 2024, 00:00	15	24	01 Sep 2024, 00:00	15
				End 16 Sep 2024, 00:00	

Table 50-6: Program used for the sediment traps for NaresE-23 and NaresW-23. Time and dates given as Universal Time Coordinated (UTC).

Start	---	---	1 Oct 2023	0h00	---	---	NaresE-23, 2023-2024 oct 1 start at 00:00 utc
1	15	0	1 Oct 2023	0h00	1 Oct 23	0h00	Wake Up by Clock (U = 13.2V, I = 0.109A)
2	16	0	16 Oct 2023	0h00	16 Oct 23	0h00	Wake Up by Clock (U = 13.2V, I = 0.106A)
3	15	0	1 Nov 2023	0h00	1 Nov 23	0h00	Wake Up by Clock (U = 13.2V, I = 0.098A)
4	15	0	16 Nov 2023	0h00	16 Nov 23	0h00	Wake Up by Clock (U = 13.2V, I = 0.094A)
5	15	0	1 Dec 2023	0h00	1 Dec 23	0h00	Wake Up by Clock (U = 13.2V, I = 0.099A)
6	16	0	16 Dec 2023	0h00	16 Dec 23	0h00	Wake Up by Clock (U = 13.1V, I = 0.103A)
7	15	0	1 Jan 2024	0h00	1 Jan 24	0h00	Wake Up by Clock (U = 13.1V, I = 0.099A)
8	16	0	16 Jan 2024	0h00	16 Jan 24	0h00	Wake Up by Clock (U = 13.1V, I = 0.101A)
9	15	0	1 Feb 2024	0h00	1 Feb 24	0h00	Wake Up by Clock (U = 13.0V, I = 0.104A)
10	14	0	16 Feb 2024	0h00	16 Feb 24	0h00	Wake Up by Clock (U = 13.0V, I = 0.099A)
11	15	0	1 Mar 2024	0h00	1 Mar 24	0h00	Wake Up by Clock (U = 13.0V, I = 0.098A)
12	16	0	16 Mar 2024	0h00	16 Mar 24	0h00	Wake Up by Clock (U = 13.0V, I = 0.099A)
13	15	0	1 Apr 2024	0h00	1 Apr 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.104A)
14	15	0	16 Apr 2024	0h00	16 Apr 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.096A)
15	15	0	1 May 2024	0h00	1 May 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.101A)
16	8	0	16 May 2024	0h00	16 May 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.098A)
17	8	0	24 May 2024	0h00	24 May 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.096A)
18	7	0	1 Jun 2024	0h00	1 Jun 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.098A)
19	8	0	8 Jun 2024	0h00	8 Jun 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.103A)
20	15	0	16 Jun 2024	0h00	16 Jun 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.101A)
21	15	0	1 Jul 2024	0h00	1 Jul 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.104A)
22	16	0	16 Jul 2024	0h00	16 Jul 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.099A)
23	15	0	1 Aug 2024	0h00	1 Aug 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.099A)
24	16	0	16 Aug 2024	0h00	16 Aug 24	0h00	Wake Up by Clock (U = 12.7V, I = 0.098A)
End	---	---	1 Sep 2024	0h00	1 Sep 24	0h00	Wake Up by Clock (U = 12.7V, I = 0.104A) - Trap : 01/01/03 12h00m46 - PC : 05/09/24 00h1...

Start	---	---	1 Oct 2023	0h00	---	---	NaresW-23, 2023-2024 oct 1 start at 00:00 utc
1	15	0	1 Oct 2023	0h00	1 Oct 23	0h00	Wake Up by Clock (U = 13.0V, I = 0.137A)
2	16	0	16 Oct 2023	0h00	16 Oct 23	0h00	Wake Up by Clock (U = 13.2V, I = 0.127A)
3	15	0	1 Nov 2023	0h00	1 Nov 23	0h00	Wake Up by Clock (U = 13.2V, I = 0.122A)
4	15	0	16 Nov 2023	0h00	16 Nov 23	0h00	Wake Up by Clock (U = 13.1V, I = 0.125A)
5	15	0	1 Dec 2023	0h00	1 Dec 23	0h00	Wake Up by Clock (U = 13.1V, I = 0.127A)
6	16	0	16 Dec 2023	0h00	16 Dec 23	0h00	Wake Up by Clock (U = 13.1V, I = 0.125A)
7	15	0	1 Jan 2024	0h00	1 Jan 24	0h00	Wake Up by Clock (U = 13.0V, I = 0.135A)
8	16	0	16 Jan 2024	0h00	16 Jan 24	0h00	Wake Up by Clock (U = 13.0V, I = 0.130A)
9	15	0	1 Feb 2024	0h00	1 Feb 24	0h00	Wake Up by Clock (U = 13.0V, I = 0.129A)
10	14	0	16 Feb 2024	0h00	16 Feb 24	0h00	Wake Up by Clock (U = 13.0V, I = 0.129A)
11	15	0	1 Mar 2024	0h00	1 Mar 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.127A)
12	16	0	16 Mar 2024	0h00	16 Mar 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.125A)
13	15	0	1 Apr 2024	0h00	1 Apr 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.127A)
14	15	0	16 Apr 2024	0h00	16 Apr 24	0h00	Wake Up by Clock (U = 12.9V, I = 0.124A)
15	15	0	1 May 2024	0h00	1 May 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.122A)
16	8	0	16 May 2024	0h00	16 May 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.120A)
17	8	0	24 May 2024	0h00	24 May 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.124A)
18	7	0	1 Jun 2024	0h00	1 Jun 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.125A)
19	8	0	8 Jun 2024	0h00	8 Jun 24	0h00	Wake Up by Clock (U = 12.8V, I = 0.127A)
20	15	0	16 Jun 2024	0h00	16 Jun 24	0h00	Wake Up by Clock (U = 12.7V, I = 0.127A)
21	15	0	1 Jul 2024	0h00	1 Jul 24	0h00	Wake Up by Clock (U = 12.7V, I = 0.124A)
22	16	0	16 Jul 2024	0h00	16 Jul 24	0h00	Wake Up by Clock (U = 12.7V, I = 0.132A)
23	15	0	1 Aug 2024	0h00	1 Aug 24	0h00	Wake Up by Clock (U = 12.6V, I = 0.127A)
24	16	0	16 Aug 2024	0h00	16 Aug 24	0h00	Wake Up by Clock (U = 12.7V, I = 0.129A)
End	---	---	1 Sep 2024	0h00	1 Sep 24	0h00	Wake Up by Clock (U = 12.7V, I = 0.132A) - Trap : 01/01/03 12h00m20 - PC : 05/09/24 00h2...

Table 50-7: List of equipment and their disposal

Mooring	Instruments	Data transfert	Data name	Disposal	Battery
Bylot-23	RDI Sentinel V100 ADCP #495	N		Aft mooring conteiner	Still in but Cannister battery removed and disposed
	Novatech Flasher beacon #120	N/A	N/A	Front deck mooring container cabinet	Still in
	Co2 ProV #	Y	DFO science crew managed it	Aft mooring conteiner	Battery cannister still on the frame in the Hull
	RBR Maestro CTD-FL-DO-Tu-CDOM#213848	Y	DFO science crew managed it	Aft mooring conteiner	Removed and disposed
	SBE 37-SM CTD #23119	Y	Bylot-23_SBE37_11742.asc	Blue Rubermaid case in aft mooring conteiner	Removed and disposed
	RBR solo Tu #79731	Y	Bylot-23_soloTu_79731.rsk	Reprogramed and put on AF-24 mooring	Removed and disposed
	RBR Duet-TD #82866	Y	Bylot-23_duetTD_82666.rsk	Yellow cases in aft mooring conteiner	Removed and disposed
	RBR Duet-TD #82857	Y	Bylot-23_duetTD_82857.rsk	Yellow cases in aft mooring conteiner	Removed and disposed
	RBR Duet-TD #82859	Y	Bylot-23_duetTD_82859.rsk	Yellow cases in aft mooring conteiner	Removed and disposed
	Technicap PPS 4/3 #56	N/A	N/A	Hull	N/A
	technicap motor # 05-319	N	N/A	Front mooring container cabinet	Removed and disposed
	Vemco hydrophone #139314	Y	VR2W_139314_20240904_1	Front mooring container cabinet	
	Benthos R500 #82603	N/A	N/A	Aft mooring conteiner	
	Benthos R500 #82609	N/A	N/A	Aft mooring conteiner	
WBAT-23	Kongsberg WBAT# 1474	N		Front deck mooring conteiner	Still in but Cannister battery removed and disposed
	XEOS Sat beacon #1474	N/A		Front deck mooring container cabinet	Removed and disposed
	Edgetech Port LF #61324	N/A	N/A	Front deck mooring conteiner	Removed and disposed
	Edgetech Port LF #61325	N/A	N/A	Front deck mooring conteiner	Removed and disposed
Lsea-23	Nortek Continental 470 Khz #5815	N		Aft mooring conteiner	Still in but Cannister battery removed and disposed
	Novatech Flasher beacon #215	N/A	N/A	Front deck mooring container cabinet	Still in
	SBE 37-SM CTD #23120	Y	Lsea-23_SBE37_23120.asc	Blue Rubermaid case in aft mooring conteiner	Removed and disposed
	Technicap PPS 3/3 #?	N/A	N/A	Hull	N/A
	technicap motor # 04079	N	N/A	Front mooring container cabinet	Removed and disposed
	Vemco hydrophone #138628	N	Lost	Lost	
	Benthos R500 #82599	N/A	N/A	Aft mooring conteiner	Removed and disposed
	Benthos R500 #82602	N/A	N/A	Aft mooring conteiner	Removed and disposed
AF-23	RDI Sentinel V100 ADCP #125	N		Aft mooring conteiner	Still in but Cannister battery removed and disposed
	Novatech Flasher beacon #214	N/A	N/A	Front deck mooring container cabinet	Still in
	RBR Maestro CTD-FL-DO-Tu-CDOM #214538	Y	AF-23_RBR_Maestro_21438.rsk	Maestro DFO labeled case in aft container	Removed and disposed
	SBE 37-SM CTD #11742	Y	AF-23_SBE37_11742.asc	Blue Rubermaid case in aft mooring conteiner	Removed and disposed
	RBR solo Tu #79730	N	AF-23_soloTu_79730.rsk	Flooded given to DFO team onboard	Removed and disposed
	Technicap PPS 4/3 #119	N/A	N/A	Hull	N/A
	technicap motor # 12-28	y	N/A	Front mooring container cabinet	Removed and disposed
	Vemco hydrophone #138629	Y	VR2W_138629_20240904_1	?	
	Benthos R500 #80594	N/A	N/A	Aft mooring conteiner	Removed and disposed
	Benthos R500 #80600	N/A	N/A	Aft mooring conteiner	Removed and disposed
NaresE-23	Novatech Flasher beacon #212	N/A	N/A	Front deck mooring container cabinet	Still in
	RDI sentinel V100 300khz #497	N		Front deck mooring container	Still in but Cannister battery removed and disposed
	RBR Concerto CTD #201108	Y	NaresE-23_concerto_201108.rsk	Maestro RBR case in aft mooring container	Removed and disposed
	Technicap PPS 4/3 #52	N/A	N/A	Hull	N/A
	technicap motor # 11-383	y	NaresE-23-motor_program.PNG	Front mooring container cabinet	Removed and disposed
	SBE 37-SM CTD #11432	N		Orange bucket front mooring container	Still in
	Vemco VR22W #139315	Y	VR2W_139315_20240904_1	Front deck mooring container cabinet	Removed and disposed
	Benthos R500 #82600	N/A	N/A	Front deck mooring container	Still in
	Benthos R500 #82606	N/A	N/A	Front deck mooring container	Still in
NaresW-23	Novatech Flasher beacon #211	N/A	N/A	Front deck mooring container cabinet	Still in
	RDI sentinel V100 300khz #496	N		Front deck mooring container	Still in
	RBR Concerto CTD #201107	Y	NaresW-23_Concerto_201107.rsk	Maestro RBR case in aft mooring container	Removed and disposed
	Technicap PPS 4/3 #53	N/A	N/A	Hull	N/A
	technicap motor # 11-384	Y	NaresW-23_motor_program.PNG	Front mooring container cabinet	Removed and disposed
	SBE 37-SM CTD #11741	N	N/A	Orange bucket front mooring container	Removed and disposed
	Vemco VR22W #139317	Y	VR2W_139317_20240904_1	Front deck mooring container cabinet	Removed and disposed
	Edgetech LF #33743	N/A	N/A	Aft mooring conteiner	Still in
	Edgtech LF #31091	N/A	N/A	Aft mooring conteiner	Still in
	All trap disck are in the aft mooring container				
	All ADCP's battery cannister are in the aft mooring container				

50.3 Recommendations

Based on the experiences from Leg 3 of the 2024 expedition, the following recommendations are made to enhance future mooring operations:

Equipment preparation in advance: Ensure that all equipment and associated information are received and reviewed well in advance of the expedition. While the preparation team made significant efforts, delays in equipment and information arrival, though not their fault, impacted operational efficiency. Timely delivery and thorough review are essential to mitigate these issues.

Managing Complexity: Acknowledge the substantial complexity introduced by the involvement of numerous pieces of equipment and teams. Effective coordination and communication among all parties involved are crucial to manage this complexity and streamline operations.

Rigorous Assembly and Testing: Implement a rigorous protocol for equipment assembly and testing, allowing sufficient time to address any issues. Conducting a double check of all assembly work before deployment is recommended to ensure accuracy and functionality in Arctic conditions.

Enhanced Documentation: Improve documentation practices to ensure proper labeling and clear instructions. This will facilitate quicker identification and setup of equipment, especially when dealing with last-minute arrivals.

While the teams demonstrated commendable effort and dedication, addressing these areas for improvement will further enhance the efficiency and reliability of future mooring operations.

50.4 Reference:

AMAP, 2021. AMAP Arctic Climate Change Update 2021: Key Trends and Impacts. Arctic Monitoring and Assessment Programme (AMAP), Tromsø, Norway. viii+148pp

Hargrave, B.T., Walsh, I.D., and Murray, D.W., 2002, Seasonal and spatial patterns in mass and organic matter sedimentation in the North Water: Deep Sea Research Part II: Topical Studies in Oceanography, v. 49, p. 5227–5244.

Lange, B.A., Haas, C., Mucci, A., Beckers, J.F., Casey, J.A., Duerksen, S., Granskog, M.A., Hatam, I., Niemi, A., Reppchen, A., Michel C. (2021) Contribution of snow to Arctic first-year and multi-year sea ice mass balance within the Last Ice Area. Journal of Geophysical Research: Oceans 126 (5), e2021JC016971.

51 Mooring operation Leg 4

Project leader: Dorthe Dahl-Jensen[1] (Dorthe.Dahl-Jensen@umanitoba.ca), Sergei Kirillov[1] (Sergei.Kirillov@umanitoba.ca), Jens Ehn[1] (jens.ehn@umanitoba.ca)

The mooring team onboard: Jens Ehn[1]

Other personal helping with mooring operations: Quentin Lahaye[2], Louis Wilmotte[2] and CCGS crew

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[2]Amundsen Science

51.1 Introduction and objectives

The goal of the mooring program on Leg 4 in 2024 was to recover four oceanographic moorings that were deployed during Leg 3 of the 2023 Amundsen Science expedition. These moorings were deployed as a part of the "Arctic Sea Ice, Freshwater-Marine Coupling and Climate Change" project led by Dr. Dahl-Jensen (Centre for Earth Observation Science at the University of Manitoba) with the objectives to improve our understanding of how local processes within the Canadian Arctic modify water mass properties, and how the regional freshwater balance is impacted. Three out of four moorings (**M1**, **M2** and **M3**) were recovered during the leg. Mooring site **M4** was not visited during Leg 4, and a recovery had been attempted on the earlier on the previous Leg 3. The acoustic release on **M4** was responding but indicated it was in a horizontal position. An ROV recovery attempt for this mooring in 50 m deep water is hopefully possible in the future. Moorings **M1**-**M3** were recovered on Leg 4 and data downloaded from all instruments without any issues. Amundsen Science and Coast Guard crew were very professional and efficient in the recovery operations.

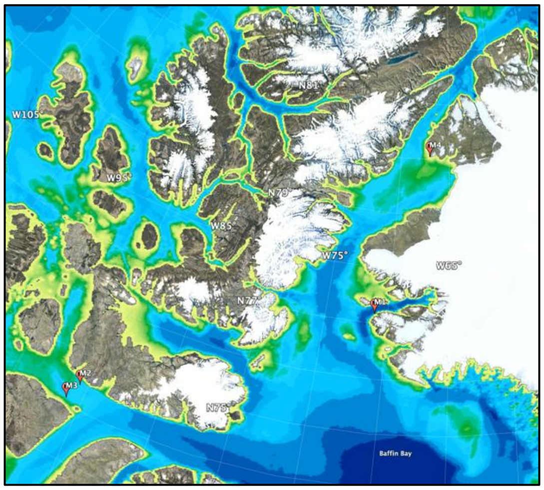

Figure 51-1: The locations of the four moorings: M1 at 77°10.820′N 71°04.302′W, **M2** at 74°27.796′N 90°32.846′W, **M3** at 74°08.752′ N 91°02.828′W, and **M4** at 80°03.398′N 67°03.411′W.

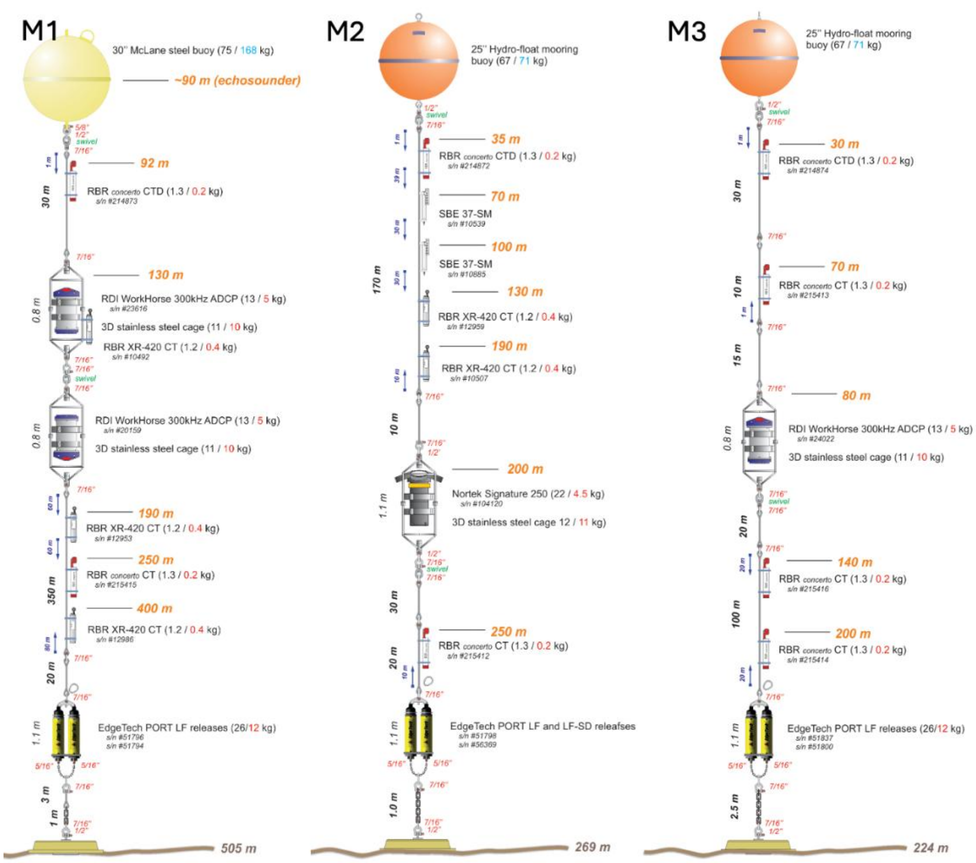

Figure 51-2: Post deployment schematics of the three moorings that were recovered. Depths will be adjusted after post-recovery verification.

51.2 Methods

Upon arriving at a mooring site, operations commenced by surveying the area with the multibeam echosounder. The mooring locations were successfully detected thus at **M2** and **M3** on September 30, 2024 (Figure 51-3). Because of strong wind and wave conditions during the recovery of **M1** on September 22, 2024, the multibeam detection failed and the mooring's acoustic release was triangulated using the range finding option on the deck unit.

After successfully locating the moorings, the CCGS *Amundsen* moved some distance away to conduct a CTD case using the Rosette. The CTD cast numbers associated with **M1**, **M2** and **M3** where 116, 150 and 151, respectively.

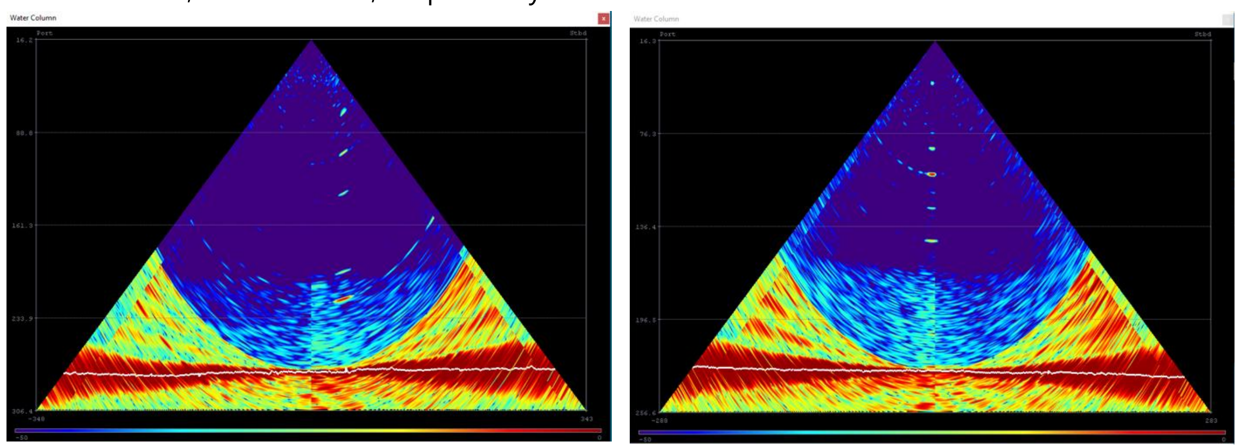

Figure 51-3: Screenshots from the multibeam computer showing the stronger return signal from subsurface floats, current meters and loggers on moorings M2 (left) and M3 (right).

Mooring operations commenced by first deploying the zodiac and preparing the winches and tools on deck. The Deck Unit was then used to communicate with the acoustic release(s) at the base of the moorings, by sending command codes to enable, range, and then release the moorings. No issues were experienced with communication on this leg. Once the mooring buoy had surfaced, the zodiac crew hooked it up and dragged it towards the ship, where it was attached to a smaller winch line on the A-frame. The mooring was then hoisted out of the water and mooring components removed from the line sequentially as they arrived on the deck. These operations progressed smoothly. After successful recover, instruments and frames were cleaned and dried, and data was downloaded. Below is a selection of photos taken during the operation.

Figure 51-4: Zodiac operation during M2 mooring recovery on September 30, 2024.

Figure 51-5: An RBR concerto CT logger emerges from the sea during the M2 mooring recovery operation.

Figure 51-6: A 300 kHz Workhorse ADCP by Teledyne RDI is recovered on mooring M3. It was deployed for over a one year at about 80 m depth and had very little biofouling.

51.3 Preliminary results

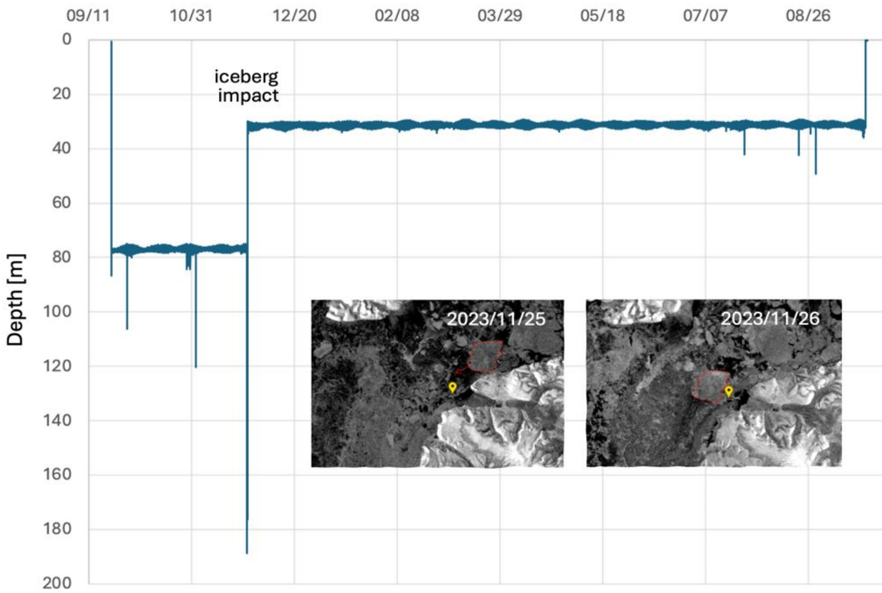

Figure 51-7: The pressure record on the uppermost RBR CTD on the M1 mooring reveals at least 6 impacts by icebergs. The largest one occurred on November 26, 2023, when the CTD logger was briefly pushed down to ~190 m depth. The impact lasted four hours during which the mooring was dragged a short distance to a location that was 44 m shallower. Inset shows two Sentinel-1 images of candidate ice floe/iceberg.

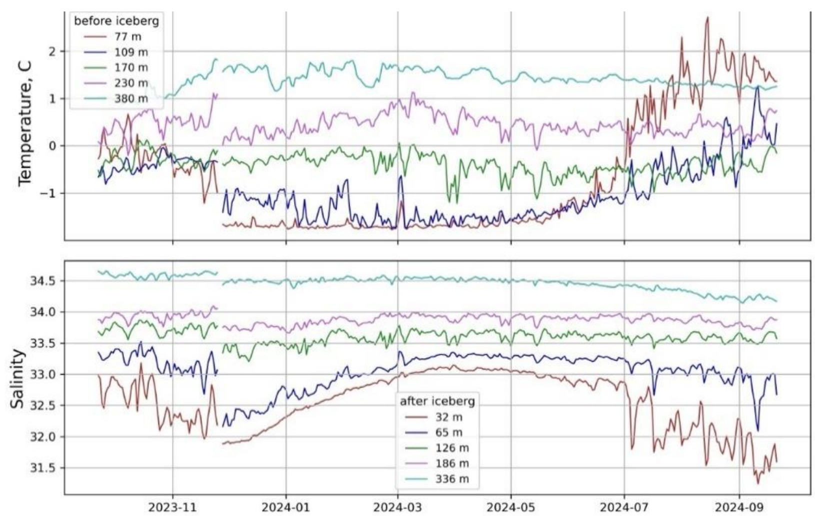

Figure 51-8: Temperature (upper) and salinity (lower) time series on mooring M1. The water column remains stratified throughout the year. After the iceberg incident, the two uppermost CT sensors record increasing salinity until April 2024 associated with brine addition from sea ice freezing.

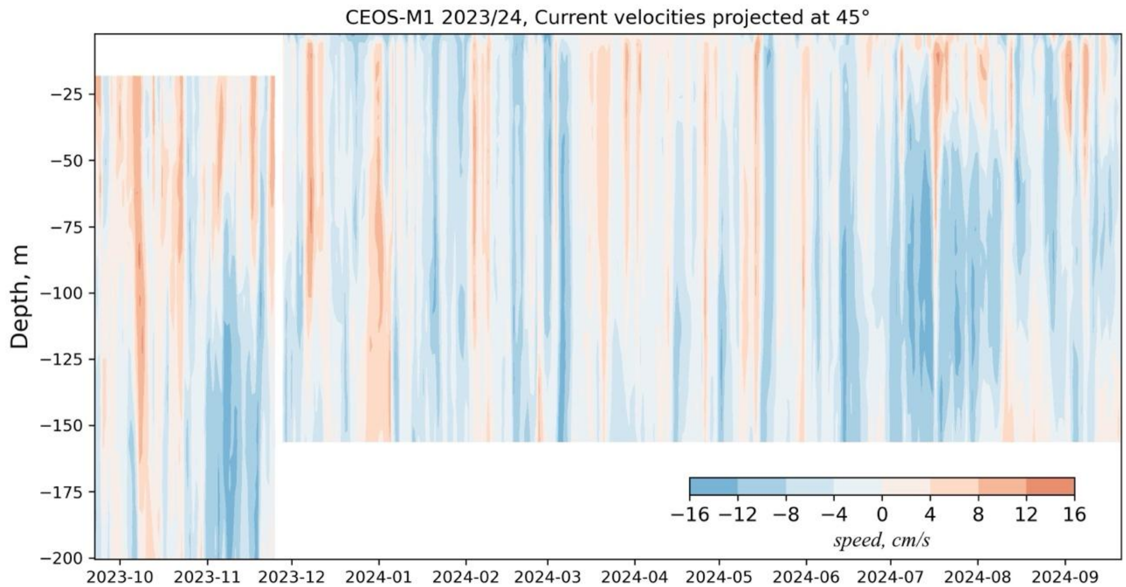

Figure 51-9: Hovmöller plot for in- and outflow (cm/s) at the entrance to Inglefield Fjord using the yearlong ADCP record on **M1**.

Part III – Conclusion

The 2024 *Amundsen* expedition provided to participating scientists, including internationa; and indigenous researchers, the opportunity to increase their knowledge of the Arctic and Subarctic ecosystems. This was accomplished despite notable challenges, including harsh weather, sea ice conditions and a busy schedule divided into five legs. The expedition could not have been a success without the remarkable support from the Canadian Coast Guard, collaboration from the user programs, and indefatigable efforts from the onboard crew and science participants.

The research activities undertaken onboard the CCGS *Amundsen* in 2024 will allow a better understanding of coastal and marine ecosystems of the Canadian Arctic, help understand how climate change affects fragile marine ecosystems and human health, as well as facilitate locally supported objectives targeting the coastal and offshore Arctic environments. Detailed mapping conducted throughout the 18 405 nautical miles of the expedition will also increase the safety of future shipping activities. Researchers and technicians are still processing the data and analyzing the samples collected during the expedition.

The multidisciplinary research conducted from the *Amundsen* will provide crucial physical, chemical, and biological oceanographic data to support fisheries management and conservation measures, and to monitor and assess the impacts of climate change on the Canadian Arctic marine environments. The core oceanographic data generated by the CTD-Rosette operations, as well as meteorological information and data collected using the Moving Vessel Profiler (MVP), the ship-mounted current meter (ADCP) and the thermosalinograph (TSG) are available in the Polar Data Catalogue (PDC) at www.polardata.ca along with meteorological dataset. Bathymetry data collected will be integrated to the Canadian Hydrographic Service database. Research teams also submit their data of metadata on the PDC or on other open platforms.

Planning of the 2025 expedition is already underway and will take place in summer and fall of 2025. The 2025 expedition will encompass seven research programs: Imappivut, KEBABB/KEBABS, TCA Transforming Climate Action, FoxSIPP, SNS Survey, QEI Survey, and Barrow Strait Mooring. The research programs planned for 2025 will study marine ecosystems of the Labrador Sea, Baffin Bay and Queen Elizabeth Islands and Foxe Basin.

Appendix 1: List of stations sampled during 2024 Amundsen Expedition

Leg	Station ID	Date (UTC)	Station Type	Latitude (N)	Longitude (W)	Depth (m)
Leg 2						
2	B5	2024/08/06	KEBABB Full	67.59474417	-58.9738025	1166.26
2	B4	2024/08/06	KEBABB Rosette	67.46145117	-59.627471	1424.22
2	B3	2024/08/05	KEBABB Full	67.32890783	-60.2946665	1077.8
2	B2.5	2024/08/05	KEBABB BC	67.2565365	-60.5740455	885.25
2	B1	2024/08/05	KEBABB Full	67.068926	-61.50978267	122.23
2	B1-C1	2024/08/05	KEBABB BC	67.19975167	-61.98243717	274.03
2	C1	2024/08/05	KEBABB Full	67.33385817	-62.47003933	147.18
2	C2	2024/08/05	KEBABB Rosette	67.54983433	-61.921203	431
2	C2.5	2024/08/04	KEBABB BC	67.6466815	-61.60405967	1303.2
2	C3	2024/08/04	KEBABB Full	67.74771633	-61.26783817	1543.36
2	C5	2024/08/04	KEBABB Full	68.15028567	-59.79719367	1157.07
2	C4-24	2024/08/03	KEBABB Rosette	67.93854333	-60.0410365	1486.96
2	D4	2024/08/03	KEBABB Rosette	68.62342667	-61.98499733	1778.61
2	D3	2024/08/02	KEBABB Full	68.24570583	-62.59641617	1536.57
2	D2	2024/08/02	KEBABB Rosette	67.85679017	-63.15195783	263.83
2	TCA-D1B	2024/08/02	Full	67.6762205	-63.4489285	523.12
2	D1.5	2024/08/02	KEBABB BC	67.64044667	-63.49163067	573.99
2	D1	2024/08/01	Full	67.47314317	-63.69392833	668.35
2	TCA-QF4	2024/08/01	Nutrient	67.37089467	-63.77042267	443.96
2	TCA-5.1	2024/08/01	Coring	67.10217867	-64.6427705	175.24
2	TCA-QFB1	2024/08/01	Basic	67.10547183	-64.63400967	161.67
2	TCA-QFB2	2024/08/01	Nutrient	67.1682285	-64.29206867	361.4
2	TCA-QF3	2024/07/31	Full	67.28344433	-63.89771917	600.96
2	TCA-5.3	2024/07/31	Coring	67.23036117	-64.65607	224.16
2	TCA-QFA1	2024/07/31	Basic	67.218819	-64.717842	190.17
2	TCA-QFA2	2024/07/31	Nutrient	67.2385755	-64.3661135	320.92
2	TCA-QFC2	2024/07/30	Nutrient	67.31235867	-64.37386333	215.78
2	TCA-5.2	2024/07/30	Coring	67.3350575	-64.648808	200.66
2	TCA-QFC1	2024/07/30	Basic	67.35393433	-64.74669433	128.36
2	SV_1	2024/07/30	CTD	67.3266585	-64.521353	261.76
2	Qik Harbour	2024/07/29	Box Core	67.53116883	-64.03942267	34.85
2	Disko_BC_In	2024/07/28	Benthic	68.11864317	-59.72679917	1017.78
2	Disko_BC_Out	2024/07/28	Benthic	68.15077533	-59.70574483	863.21
2	BB1_A	2024/07/27	ROV	67.76364933	-59.04432833	609.42
2	DS_600_A1	2024/07/27	Full	66.20092567	-58.20643433	624.65
2	DS_500_B1	2024/07/26	Full	65.4606525	-58.44010933	496.31
2	DS_600_A2	2024/07/26	Full	65.450001	-58.437468	498.37
2	DS_500_B2	2024/07/26	Full	65.5279045	-59.58771433	491.22
2	Davis Strait 2024	2024/07/25	ROV	64.54760867	-58.5186565	700
2	Killinik 1	2024/07/24	Full	60.8896875	-64.06383933	377.68
2	Killinik 2	2024/07/24	Full	60.85193117	-64.01881817	402.24
2	Kangalaksiorvik Shelf	2024/07/23	Full	59.53161017	-63.276914	172.56
2	Ramah Shelf	2024/07/23	Full	58.88002983	-62.48030717	200.56
2	Nachvak Fjord	2024/07/22	Full	59.082394	-63.47605683	211.99
2	Nackvak2	2024/07/22	Coring	59.098615	-63.40674533	11.17
2	Nachvak1	2024/07/22	AUV+Core	59.11134433	-63.42610467	164.69
2	Nachvak Fjord	2024/07/22	Full	59.0856785	-63.46927517	209.74
2	Okak Bay	2024/07/20	Full + AUV	57.56775867	-62.0599535	90.88
2	Okak Landslide	2024/07/20	Coring	57.517467	-62.147476	69.79
2	Okak Bay	2024/07/20	Full + AUV	57.56950783	-62.0481965	92.11
2	Sentinel North - Sidewall 2	2024/07/19	Mooring + Full	56.6941565	-60.258533	498.69
2	Sentinel North - Drift 1	2024/07/19	Mooring + Full	56.7002045	-60.21379117	759.78

2	Sentinel North -Drift 2	2024/07/19	Mooring + Full	56.69306517	-60.26792517	492.06
2	Sentinel North - Moat	2024/07/19	Mooring + Full	56.69211783	-60.28453533	479.11
2	Sentinel	2024/07/18	ROV + Full	56.31576867	-59.83814167	550.12
2	Hopedale Saddle	2024/07/17	Full	55.7304105	-59.41543267	195.2
2	Hopedale Shelf	2024/07/17	Full	55.72919067	-59.41568567	205.16
2	MAK-2024-M1	2024/07/15	ROV + Full	55.435223	-58.94579617	710.67
2	MAK-2024-M2	2024/07/15	Benthic	55.5149435	-58.9399025	696.32
2	ASL Makkovik IPS5	2024/07/14	Mooring	55.41068967	-58.06385917	104.26
2	ASL Makkovik ADCP	2024/07/14	Mooring	55.40858717	-58.059258	105.08
2	ASL Makkovik IPS5	2024/07/14	Mooring	55.41187733	-58.063868	106.07
2	Hopedale Saddle	2024/07/13	Mooring + Full	56.049	-57.42682733	503.94
Leg 3						
3	RA24	2024/09/04	Full	78.026561	-75.61490933	253.08
3	RA23	2024/09/04	Mooring	78.32590883	-74.87859683	343.74
3	RA22	2024/09/03	Mooring	78.3186885	-73.18191	257.48
3	RA21	2024/09/02	Basic	76.0329315	-83.12048983	651.93
3	RA20	2024/09/02	Basic	75.57017217	-78.86809117	518.63
3	RA19	2024/08/30	CTD	81.25219167	-64.32409867	481.22
3	RA18	2024/08/29	Full	81.9386945	-60.372073	297.38
3	RA17	2024/08/28	Full	81.63576567	-58.97185217	90.79
3	RA16	2024/08/28	Full	81.72862917	-59.2378415	123.38
3	RA15	2024/08/27	Full	81.667275	-64.0553725	607.92
3	RA14	2024/08/26	Full	81.50741717	-65.891607	540.22
3	RA13	2024/08/25	Full	81.28815683	-68.504767	429.03
3	RA14	2024/08/24	Coring	81.59241933	-66.0204795	486.53
3	RA12	2024/08/23	Full	81.5662725	-67.734395	304.14
3	RA11	2024/08/23	Mooring	81.54307033	-64.89530017	250.01
3	RA10	2024/08/22	Mooring	82.1233755	-61.234767	493.34
3	RA09	2024/08/22	Full	82.29410583	-60.88737283	258.47
3	RA08	2024/08/20	Full	79.829231	-74.09957333	257.45
3	RA07	2024/08/19	Full	79.78503583	-73.56929383	229.62
3	RA06	2024/08/18	Full	79.682862	-73.08762867	246.64
3	RA05	2024/08/17	Full	78.31198783	-74.7739185	
3	WBAT	2024/08/17	Mooring	78.31571167	-74.7946885	
3	RA02	2024/08/17	Full	77.23465617	-79.14403833	368.69
3	RA04	2024/08/16	Full	77.3822135	-81.07383767	180.23
3	RA03	2024/08/15	Full	77.29213783	-80.76025917	436.41
3	RA02	2024/08/14	Full	77.26070517	-79.17048333	589.85
3	RA01	2024/08/12	Full	72.85743683	-75.51305667	663.04
Leg 4						
4	RA73 / TCAT2-305A	2024/10/01	Nutrient	74.60233417	-93.70911883	124.13
4	RA73 / TCAT2-305B	2024/10/01	Nutrient	74.48296583	-93.6401635	170.24
4	RA73 / TCAT2-305C	2024/09/30	Nutrient	74.35154817	-93.583786	164.41
4	RA73 / TCAT2-305D	2024/09/30	Nutrient	74.22137683	-93.50970433	155.23
4	RA72 / CEOS-M3-23	2024/09/30	Mooring	74.14030433	-91.05605283	219.68
4	RA71 / CEOS-M2-23	2024/09/30	Mooring	74.46488383	-90.56743183	264.49
4	RA70 / TCA-S3	2024/09/27		73.73692583	-78.61816817	909.88
4	RA69 / RA105	2024/09/27	Basic	76.31778117	-75.75964783	327.06
4	RA68 / RA100	2024/09/26	Nutrient	76.40745183	-77.96080117	232.59
4	RA67 / RA101	2024/09/26	Full	76.36818933	-77.42204767	391.33
4	RA66 / RA102	2024/09/26	CTD	76.374142	-76.98921133	246.62
4	RA65 / RA103	2024/09/26	Nutriment	76.353185	-76.577066	147.78
4	RA64 / RA104	2024/09/26	CTD	76.3428635	-76.1725695	191.41
4	RA63 / RA106	2024/09/25	CTD	76.30609367	-75.356034	378.45
4	RA62 / RA108	2024/09/25	Full	76.26630067	-74.7470975	457.81

4	RA61 / RA107	2024/09/25	Nutrient	76.28108217	-74.98569517	436.79
4	RA60 / RA109	2024/09/25	CTD	76.28980233	-74.11093667	449.42
4	RA59 / RA110	2024/09/24	Nutrient	76.29919583	-73.6365785	524.47
4	RA58 / RA111	2024/09/24	Basic	76.309959	-73.22166833	585.96
4	RA57 / RA112	2024/09/24	CTD	76.31683717	-72.69899333	557.26
4	RA56 / RA113	2024/09/24	Nutrient	76.3186635	-72.2152575	546.32
4	RA55 / RA114	2024/09/24	CTD	76.32426383	-71.77601883	611.39
4	RA54 / RA115	2024/09/23	Full	76.44484817	-71.71751217	492.57
4	RA53 / RA116	2024/09/23	Nutrient	76.38051233	-70.52602483	139.72
4	RA52 / CEOS-M1-23	2024/09/22	Mooring	77.19033433	-71.06062917	792.7
4	RA51	2024/09/21		78.38558467	-73.387286	359.66
4	RA50	2024/09/20	Full	78.30028467	-74.00227633	611.49
4	RA49	2024/09/20	Nutrient	78.28308467	-73.19825317	382.75
4	RA48	2024/09/19	Full	78.306121	-74.0232305	552.25
4	RA47	2024/09/19	Nutrient	78.30170183	-74.00123883	614.65
4	RA46	2024/09/19	Nutrient	78.29833183	-74.34169683	536.45
4	RA45	2024/09/18	Ice coring	78.303347	-74.92138733	538.58
4	RA44	2024/09/17	Nutrient	79.1293985	-69.89679883	301.73
4	RA43	2024/09/17	Full	79.08106983	-69.45205317	217.52
4	RA42	2024/09/17	Nutrient	79.27803633	-70.5876165	229.47
4	RA41	2024/09/16	Full	79.50693667	-72.82566733	232.24
4	RA40	2024/09/16	Nutrient	79.46216867	-72.37621433	246.7
4	RA39	2024/09/16	Nutrient	79.41842217	-71.77473	234.46
4	RA38	2024/09/15	Basic	79.44427067	-71.03727317	224.12
4	RA37	2024/09/15	Basic	79.38058533	-71.163583	195.67
4	RA38	2024/09/15	Sea ice coring	79.41001783	-71.14605583	216.57
4	RA37	2024/09/14		79.94299067	-70.3001545	192.72
4	RA36	2024/09/13	Sea ice coring	79.868363	-69.94634033	227.07
4	RA35	2024/09/13	CTD	80.025878	-69.52540217	247.69
4	helico	2024/09/13	helico	80.33173683	-68.779743	705.44
4	RA33	2024/09/12	CTD	80.300644	-68.36458283	345.14
4	RA32	2024/09/12	CTD	80.266185	-67.93442433	188.49
4	RA31	2024/09/12	Full	80.25473	-67.8070205	155.87
4	RA30	2024/09/12	Nutrient	80.29059817	-68.17882783	326.19
4	RA29	2024/09/12	Nutrient	80.322467	-68.548937	359.79
4	RA28	2024/09/11	Full	80.34532867	-69.01680567	338.57
4	RA27	2024/09/10	Sea ice coring	80.37970417	-68.98424617	336.45
4	RA26	2024/09/09	Sea ice coring	80.89822183	-66.702694	381.04
4	Flamelite	2024/09/09	transit	80.900116	-66.33952767	
4	RA25 / RA-NS_07	2024/09/08	Full	81.40330683	-64.25717233	509.81
Leg 5						
5	JACS-02	2024/10/28	UVP	50.14968983	-63.41896183	86.03
5	JACS-01	2024/10/28	UVP	49.980842	-63.10506	103.01
5	BIS-02	2024/10/27	UVP	51.19543433	-57.03946133	64.66
5	BIS-1	2024/10/27	UVP	51.3204475	-56.98014717	99.09
5	TCAT1_01	2024/10/27	Full	53.66391	-55.54398267	147.96
5	TCAT1_03	2024/10/26	Nuterient	53.98767717	-55.25374333	148.99
5	TCAT1_05	2024/10/26	Basic	54.4872825	-54.75401067	198.21
5	GR24-17	2024/10/24	Basic	58.88201033	-66.293372	32.92
5	UNG--3	2024/10/23	Basic	59.42557867	-67.4565325	182.93
5	LR24-04	2024/10/22	Basic	59.08141867	-68.749738	93.47
5	LR24-05	2024/10/22	Basic	58.96908617	-68.908641	132.87
5	AR24-17	2024/10/21	Baisc	60.01173383	-69.56144167	31.41
5	AR24-19	2024/10/21	Basic	59.98768067	-69.35126633	76.93
5	AR24-20	2024/10/21	Basic	60.00289817	-69.22845567	79.1

5	TCAT6-01 (A1)	2024/10/18	Full	66.60559333	-61.17757883	673.01
5	TCAT6-02 (A2)	2024/10/18	Rosette	66.66850617	-60.454025	522.17
5	TCAT6-03 (A3)	2024/10/17	Full	66.73041383	-59.6110765	868.17
5	TCAT6-04 (A4)	2024/10/17	Rosette	66.80387583	-58.7646205	905.4
5	TCAT6-05 (A5)	2024/10/17	Full	66.87105117	-57.95962433	819.3
5	TCAT6-06 (A6)	2024/10/17	Rosette	66.89657867	-56.92343417	654.87
5	TCAT6-07 (A7)	2024/10/16	Full	66.98288	-56.06880717	133.06
5	TCAT6-08 (A8)	2024/10/16	Rosette	67.04382567	-55.07890467	65.99
5	TCAT6-09 (A9)	2024/10/16	Full	67.09310267	-54.26876733	76.3
5	C4-23	2024/10/15	Mooring	67.9821955	-60.654304	1600.13
5	TCAT3-11	2024/10/12	Full	75.82017767	-66.48499817	594.72
5	TCAT3-13	2024/10/12	Nutrient	75.49423483	-66.48888683	348.35
5	TCAT3-15	2024/10/12	Basic	75.15590733	-66.55454817	473.42
5	TCAT3-16	2024/10/12	Nutrient	74.83558867	-66.63280117	1381.59
5	TCAT3-17	2024/10/11	Full	74.32248583	-66.71780033	2187.2
5	TCAT3-19	2024/10/10	Basic	73.78379517	-66.83776117	
5	TCAT3-20	2024/10/10	Nutrient	73.2721985	-66.9266935	2332.66
5	TCA-BB2	2024/10/09		72.74707033	-67.0119395	2343.5
5	TCAT3-10	2024/10/09	Nutrient	72.724064	-68.47150167	2170.96
5	TCAT3-09	2024/10/09	Basic	72.68761833	-70.10980617	1729.24
5	TCAT3-08	2024/10/08	Full	72.63690517	-71.57420433	1131.39
5	TCAT3-07	2024/10/08	Nutrient	72.60512717	-72.47706767	869.12
5	TCAT3-05	2024/10/08	Basic	72.57927783	-73.51321217	718.89
5	TCAT3-03	2024/10/07	Nutrient	72.5414045	-74.32548	14.28
5	TCAT3-01	2024/10/07	Full	72.5025195	-75.02478783	73.5
5	Wol1	2024/10/06	Boxcore	73.81675767	-81.11438167	649.46
5	TCA-S3	2024/10/06	Full	73.74076917	-78.66810667	877.54
5	Keb-S1	2024/10/05	CTD	74.04807483	-91.15823883	50.01
5	Keb-S2	2024/10/05	CTD	74.065896	-91.12875167	103.48
5	Keb/TCA-S3	2024/10/05	Basic	74.09601967	-91.0877555	150.57
5	Keb-S4	2024/10/05	Rosette	74.14351983	-91.02915317	217.36
5	Keb-S5	2024/10/05	Full	74.22381283	-90.97413967	328.16
5	Keb-S6	2024/10/05	Rosette	74.27400267	-90.86683267	265.37
5	Keb-S7	2024/10/04	CTD	74.33855033	-90.76553467	205.59
5	Keb-S8	2024/10/04	Full	74.4097305	-90.86578083	170.42
5	Keb-S9	2024/10/04	CTD	74.46655983	-90.54264967	263.5
5	Keb-S10	2024/10/04	Rosette	74.54336783	-90.4098085	
5	Keb-S11	2024/10/04	CTD	74.570351	-90.38911633	

Appendix 2 - Scientific log of science activities conducted during the 2024 Amundsen Expedition

Leg	Station ID	Station Type	Date (UTC)	Time (UTC)	Latitude	Longitude	Activity	Event	Depth (m)	Wind Dir		Air (°C)	Water (°C)	Surface Salinity	Pr Baro	Hum (%)	Ice
										Dir	Speed						
Leg 2																	
2	B5	KEBABB Full	2024-08-06	12:04	67,611445	-58,955257	IKMT	Recovery	1137	5	11,5	0	3,4	31	1006		0
2	B5	KEBABB Full	2024-08-06	11:24	67,594744	-58,973803	IKMT	Bottom	1166	357	12	-0,4	3,4	31	1006		0
2	B5	KEBABB Full	2024-08-06	10:58	67,587203	-59,004273	IKMT	Deploymen	1181	358	16,5	-0,2	3,2	31	1006		0
2	B5	KEBABB Full	2024-08-06	10:34	67,579814	-59,011222	Hydrobios	Recovery	1207	1	14,4	-0,2	3,0	31	1006		0
2	B5	KEBABB Full	2024-08-06	9:55	67,584522	-59,017245	Hydrobios	Bottom	1193	0	16,9	0	3,2	31	1006		0
2	B5	KEBABB Full	2024-08-06	9:27	67,588245	-59,022764	Hydrobios	Deploymen	1188	13	16,9	0,1	3,0	31	1006		0
2	B5	KEBABB Full	2024-08-06	8:58	67,575349	-58,991328	Tucker	Recovery	1188	352	13,5	0,4	2,8	31	1006		0
2	B5	KEBABB Full	2024-08-06	8:50	67,578769	-59,002895	Tucker	Bottom	1207	2	13	0,4	2,9	31	1007		0
2	B5	KEBABB Full	2024-08-06	8:40	67,583401	-59,011558	Tucker	Deploymen	1195	12	10,9	0,8	3,1	31	1007		0
2	B5	KEBABB Full	2024-08-06	8:30	67,585864	-59,013059	Plankton Ne	Recovery	1184	8	15,2	0,5	2,9	31	1007		0
2	B5	KEBABB Full	2024-08-06	8:27	67,586194	-59,013792	Plankton Ne	Bottom	1183	9	13,6	0,3	2,9	31	1007		0
2	B5	KEBABB Full	2024-08-06	8:25	67,586396	-59,014300	Plankton Ne	Deploymen	1183	15	13,6	0,4	3,0	31	1007		0
2	B5	KEBABB Full	2024-08-06	8:23	67,586522	-59,014455	Plankton Ne	Recovery	1182	9	13,6	0,4	3,0	31	1007		0
2	B5	KEBABB Full	2024-08-06	8:19	67,586706	-59,014274	Plankton Ne	Bottom	1182	14	15,4	0,4	2,9	31	1007		0
2	B5	KEBABB Full	2024-08-06	8:17	67,586923	-59,014425	Plankton Ne	Deploymen	1182	6	15,6	0,4	3,0	31	1007		0
2	B5	KEBABB Full	2024-08-06	8:00	67,573200	-59,009706	CTD Rosette	Recovery	1200	356	13	0,3	2,9	31	1007		0
2	B5	KEBABB Full	2024-08-06	7:08	67,581904	-59,021463	CTD Rosette	Bottom	1197	18	13,4	0,3	3,0	31	1007		0
2	B5	KEBABB Full	2024-08-06	6:47	67,583816	-59,022683	CTD Rosette	Deploymen	1190	7	14,1	0,3	2,9	31	1007		0
2	B4	KEBABB Ros	2024-08-06	4:44	67,459591	-59,613331	Tucker	Recovery	1418	346	13,6	-0,3	3,5	31	1007		0
2	B4	KEBABB Ros	2024-08-06	4:34	67,461451	-59,627471	Tucker	Bottom	1424	352	13,9	-0,1	3,5	31	1007		0
2	B4	KEBABB Ros	2024-08-06	4:23	67,464231	-59,639578	Tucker	Deploymen	1428	357	17,1	2,3	3,8	31	1008		0
2	B4	KEBABB Ros	2024-08-06	3:57	67,466944	-59,692097	CTD Rosette	Recovery	1417	9	18,5	0,1	3,7	31	1007		0
2	B4	KEBABB Ros	2024-08-06	2:56	67,468216	-59,666524	CTD Rosette	Bottom	1400	354	16,4	1	3,8	31	1008		0
2	B4	KEBABB Ros	2024-08-06	2:30	67,468119	-59,650850	CTD Rosette	Deploymen	1400	353	17,2	1	3,0	31	1008		0
2	B3	KEBABB Full	2024-08-05	23:14	67,328507	-60,300175	Hydrobios	Recovery	1076	354	18,2	-0,7	0,7	30	1009		4
2	B3	KEBABB Full	2024-08-05	22:42	67,328908	-60,294667	Hydrobios	Bottom	1078	3	18	-0,5	1,0	30	1009		4
2	B3	KEBABB Full	2024-08-05	22:15	67,330489	-60,289858	Hydrobios	Deploymen	1079	8	21,4	-0,6	0,8	30	1009		4
2	B3	KEBABB Full	2024-08-05	22:03	67,332351	-60,288619	Plankton Ne	Recovery	1081	11	18,1	-0,4	0,7	30	1009		4
2	B3	KEBABB Full	2024-08-05	22:00	67,333115	-60,288494	Plankton Ne	Bottom	1081	11	20,2	-0,5	0,7	30	1009		4
2	B3	KEBABB Full	2024-08-05	21:58	67,333472	-60,288381	Plankton Ne	Deploymen	1082	12	17,7	-0,4	0,5	29	1009		4
2	B3	KEBABB Full	2024-08-05	21:35	67,315597	-60,261742	CTD Rosette	Recovery	1055	356	15,8	-0,3	0,8	30	1009		4
2	B3	KEBABB Full	2024-08-05	20:46	67,321999	-60,270431	CTD Rosette	Bottom	1064	1	16,7	-0,4	0,7	30	1010		4
2	B3	KEBABB Full	2024-08-05	20:27	67,323912	-60,275027	CTD Rosette	Deploymen	1067	5	16	-0,3	0,3	30	1010		4
2	B2.5	KEBABB BC	2024-08-05	19:04	67,254641	-60,571186	Box Core	Recovery	883	357	20,1	-0,2	1,7	31	1010		0

2	B2.5	KEBABB BC	2024-08-05	18:47	67,256537	-60,574046	Box Core	Bottom	885	360	21	-0,2	1,2	30	1010		0
2	B2.5	KEBABB BC	2024-08-05	18:29	67,256962	-60,571517	Box Core	Deploymen	890	2	20,5	0,1	1,9	30	1010		0
2	B1	KEBABB Full	2024-08-05	15:23	67,084747	-61,502149	Beam Trawl	Recovery	142	353	26,8	1,6	2,0	30	1010		0
2	B1	KEBABB Full	2024-08-05	15:01	67,068926	-61,509783	Beam Trawl	Bottom	122	347	24	1,7	1,9	30	1010		0
2	B1	KEBABB Full	2024-08-05	14:53	67,065160	-61,511021	Beam Trawl	Deploymen	122	347	26,8	1,7	2,0	30	1010		0
2	B1	KEBABB Full	2024-08-05	14:32	67,059346	-61,513381	Monster Ne	Recovery	115	354	27,5	1,7	2,0	30	1010		0
2	B1	KEBABB Full	2024-08-05	14:28	67,058873	-61,513364	Monster Ne	Bottom	115	359	23,6	1,7	2,0	30	1010		0
2	B1	KEBABB Full	2024-08-05	14:25	67,058730	-61,513715	Monster Ne	Deploymen	113	351	24,4	1,6	2,0	30	1010		0
2	B1	KEBABB Full	2024-08-05	13:45	67,063389	-61,466361	Tucker	Recovery	131	332	23,7	1,7	2,3	30	1010		0
2	B1	KEBABB Full	2024-08-05	13:33	67,064131	-61,485263	Tucker	Bottom	124	334	20,2	1,6	2,1	30	1010		0
2	B1	KEBABB Full	2024-08-05	13:19	67,060766	-61,506120	Tucker	Deploymen	117	347	21,6	1,6	2,1	30	1010		0
2	B1	KEBABB Full	2024-08-05	13:08	67,058796	-61,513623	Plankton Ne	Recovery	114	352	29,1	1,7	1,5	31	1010		0
2	B1	KEBABB Full	2024-08-05	13:05	67,058778	-61,513731	Plankton Ne	Bottom	114	352	26,2	1,7	1,5	31	1010		0
2	B1	KEBABB Full	2024-08-05	13:03	67,058876	-61,513957	Plankton Ne	Deploymen	113	350	26,6	1,6	1,4	31	1010		0
2	B1	KEBABB Full	2024-08-05	13:00	67,059033	-61,514443	Plankton Ne	Recovery	113	351	27,7	1,6	0,9	31	1010		0
2	B1	KEBABB Full	2024-08-05	12:57	67,059141	-61,515001	Plankton Ne	Bottom	112	353	29,2	1,6	0,7	31	1010		0
2	B1	KEBABB Full	2024-08-05	12:53	67,059038	-61,515217	Plankton Ne	Deploymen	113	350	26,1	1,6	1,1	30	1010		0
2	B1	KEBABB Full	2024-08-05	12:35	67,061110	-61,509223	CTD Rosette	Recovery	115	349	29,7	1,6	1,6	31	1010		0
2	B1	KEBABB Full	2024-08-05	12:14	67,059994	-61,508498	CTD Rosette	Bottom	115	354	25,7	1,6	0,4	31	1010		0
2	B1	KEBABB Full	2024-08-05	12:12	67,059764	-61,508258	CTD Rosette	Deploymen	116	354	28,8	1,6	0,5	31	1010		0
2	B1-C1	KEBABB BC	2024-08-05	9:53	67,199811	-61,982240	Box Core	Recovery	275	338	21,9	1	2,1	31	1011		0
2	B1-C1	KEBABB BC	2024-08-05	9:47	67,199752	-61,982437	Box Core	Bottom	274	336	20,9	1	1,0	31	1011		0
2	B1-C1	KEBABB BC	2024-08-05	9:43	67,199820	-61,982856	Box Core	Deploymen	275	329	19,4	0,9	2,1	31	1011		0
2	C1	KEBABB Full	2024-08-05	8:06	67,336304	-62,427234	Beam Trawl	Recovery	161	353	14,4	0,8	1,8	31	1011		1
2	C1	KEBABB Full	2024-08-05	7:43	67,333858	-62,470039	Beam Trawl	Bottom	147	342	16,1	1,1	1,9	31	1011		1
2	C1	KEBABB Full	2024-08-05	7:35	67,335240	-62,482701	Beam Trawl	Deploymen	125	347	15,2	1,2	2,1	31	1011		1
2	C1	KEBABB Full	2024-08-05	7:11	67,351253	-62,534369	Hydrobios	Recovery	185	352	17,1	1,2	2,5	31	1011		1
2	C1	KEBABB Full	2024-08-05	7:05	67,351932	-62,534405	Hydrobios	Bottom	189	357	19,4	1,2	1,9	31	1011		1
2	C1	KEBABB Full	2024-08-05	7:02	67,352092	-62,535139	Hydrobios	Deploymen	191	359	18,7	1,2	1,8	31	1011		1
2	C1	KEBABB Full	2024-08-05	6:26	67,340464	-62,482978	Tucker	Recovery	163	350	16,4	1,2	1,9	31	1011		1
2	C1	KEBABB Full	2024-08-05	6:18	67,341036	-62,495219	Tucker	Bottom	160	337	16,2	1,3	2,2	31	1011		1
2	C1	KEBABB Full	2024-08-05	6:09	67,343106	-62,509186	Tucker	Deploymen	144	343	13,1	2,1	2,4	31	1011		1
2	C1	KEBABB Full	2024-08-05	5:53	67,347233	-62,520867	Plankton Ne	Recovery	138	1	17,9	1,3	2,3	31	1011		1
2	C1	KEBABB Full	2024-08-05	5:50	67,347890	-62,521759	Plankton Ne	Bottom	138	354	17,6	1,3	1,8	31	1011		1
2	C1	KEBABB Full	2024-08-05	5:48	67,347954	-62,521843	Plankton Ne	Deploymen	138	356	20,8	1,4	2,3	31	1011		1
2	C1	KEBABB Full	2024-08-05	5:37	67,342667	-62,510523	CTD Rosette	Recovery	145	354	21,7	1,4	1,9	31	1011		1
2	C1	KEBABB Full	2024-08-05	5:12	67,347168	-62,517799	CTD Rosette	Bottom	137	352	18,3	1,4	2,7	31	1011		1
2	C1	KEBABB Full	2024-08-05	5:10	67,347552	-62,518541	CTD Rosette	Deploymen	137	356	21,1	1,4	2,7	31	1011		1

2	C2	KEBABB Ros	2024-08-05	2:51	67,546887	-61,923477	CTD Rosette	Recovery	400	332	15,1	1	1,7	30	1011	100	1
2	C2	KEBABB Ros	2024-08-05	2:17	67,549834	-61,921203	CTD Rosette	Bottom	431	346	14,7	0,9	1,5	31	1011	99	1
2	C2	KEBABB Ros	2024-08-05	2:09	67,550678	-61,921586	CTD Rosette	Deploymen	443	349	16,5	0,9	2,2	31	1011	99	1
2	C2.5	KEBABB BC	2024-08-04	23:50	67,647759	-61,603667	Box Core	Recovery	1307	350	14,8	-0,3	0,4	30	1011	98	4
2	C2.5	KEBABB BC	2024-08-04	23:30	67,646682	-61,604060	Box Core	Bottom	1303	350	12,2	-0,4	0,0	31	1011	98	4
2	C2.5	KEBABB BC	2024-08-04	23:08	67,647384	-61,605241	Box Core	Deploymen	1304	350	14,2	-0,5			1012	98	4
2	C3	KEBABB Full	2024-08-04	21:25	67,747686	-61,267801	CTD Rosette	Recovery	1545	349	9,1	1,9			1011	98	4
2	C3	KEBABB Full	2024-08-04	21:25	67,747716	-61,267838	CTD Rosette	Bottom	1543	349	9	1,9			1011	98	4
2	C3	KEBABB Full	2024-08-04	21:17	67,747938	-61,267181	CTD Rosette	Deploymen	1543	338	8,4	2			1011	98	4
2	C3	KEBABB Full	2024-08-04	20:38	67,729994	-61,266120	Hydrobios	Recovery	1533	344	9,3	1,8			1012	98	4
2	C3	KEBABB Full	2024-08-04	19:54	67,734069	-61,268281	Hydrobios	Bottom	1535	351	8,4	1,7			1012	98	4
2	C3	KEBABB Full	2024-08-04	19:15	67,741463	-61,269464	Hydrobios	Deploymen	1540	329	7,1	1,4	0,6	30	1012	98	4
2	C3	KEBABB Full	2024-08-04	19:03	67,744127	-61,270580	Plankton Ne	Recovery	1541	324	6,6	1,3	0,6	30	1012	98	4
2	C3	KEBABB Full	2024-08-04	19:00	67,744639	-61,270897	Plankton Ne	Bottom	1541	328	6,7	1,2	0,5	30	1012	98	4
2	C3	KEBABB Full	2024-08-04	18:58	67,745207	-61,271150	Plankton Ne	Deploymen	1542	330	7,2	1,2	0,5	30	1012	98	4
2	C3	KEBABB Full	2024-08-04	18:56	67,745774	-61,271598	Plankton Ne	Recovery	1541	323	7,5	1,2	0,4	30	1012	98	4
2	C3	KEBABB Full	2024-08-04	18:53	67,746440	-61,272087	Plankton Ne	Bottom	1542	326	7,9	1,1	0,2	30	1012	98	4
2	C3	KEBABB Full	2024-08-04	18:50	67,746883	-61,272179	Plankton Ne	Deploymen	1546	329	8,3	1,1	1,1	29	1012	98	4
2	C3	KEBABB Full	2024-08-04	18:13	67,721966	-61,236578	CTD Rosette	Recovery	1524	331	10,3	0,6	1,6	29	1012	98	4
2	C3	KEBABB Full	2024-08-04	17:15	67,734821	-61,253782	CTD Rosette	Bottom	1538	281	8,2	0,5	0,9	30	1012	98	4
2	C3	KEBABB Full	2024-08-04	16:48	67,738925	-61,264916	CTD Rosette	Deploymen	1539	301	5,7	0,3	0,7	30	1012	98	4
2	C5	KEBABB Full	2024-08-04	8:31	68,167852	-59,742189	IKMT	Recovery	976	305	7,7	1,7	3,8	31	1012	97	4
2	C5	KEBABB Full	2024-08-04	7:45	68,150286	-59,797194	IKMT	Bottom	1157	303	6,1	1,9	2,4	30	1012	97	4
2	C5	KEBABB Full	2024-08-04	7:15	68,147218	-59,843489	IKMT	Deploymen	1274	296	1,1	2,1	1,4	30	1012	97	4
2	C5	KEBABB Full	2024-08-04	6:49	68,157401	-59,870008	Hydrobios	Recovery	1304	296	6,1	1,6	1,5	30	1012	98	4
2	C5	KEBABB Full	2024-08-04	6:06	68,161467	-59,889675	Hydrobios	Bottom	1317	290	6,1	1	1,1	30	1012	98	4
2	C5	KEBABB Full	2024-08-04	5:32	68,162680	-59,898054	Hydrobios	Deploymen	1317	291	5,3	0,8	0,2	30	1012	98	4
2	C5	KEBABB Full	2024-08-04	5:11	68,163000	-59,908747	Tucker	Recovery	1331	294	6,8	0,8	2,0	30	1012	98	4
2	C5	KEBABB Full	2024-08-04	5:02	68,158901	-59,901079	Tucker	Bottom	1318	293	4,6	0,9	1,3	30	1012	98	4
2	C5	KEBABB Full	2024-08-04	4:53	68,154053	-59,904884	Tucker	Deploymen	1332	307	2,5	1,3	2,4	30	1012	98	4
2	C5	KEBABB Full	2024-08-04	4:27	68,161008	-59,967426	Plankton Ne	Recovery	1345	334	4,3	1,3	-0,4	30	1012	98	4
2	C5	KEBABB Full	2024-08-04	4:25	68,160831	-59,967867	Plankton Ne	Bottom	1346	314	5,3	1,4	0,2	30	1012	97	4
2	C5	KEBABB Full	2024-08-04	4:20	68,160670	-59,969568	Plankton Ne	Deploymen	1347	314	4,2	1,4	0,1	30	1012	97	4
2	C5	KEBABB Full	2024-08-04	4:18	68,160555	-59,970626	Plankton Ne	Recovery	1346	315	5	1,5	-0,1	30	1012	97	4
2	C5	KEBABB Full	2024-08-04	4:15	68,160346	-59,971536	Plankton Ne	Bottom	1347	61	4,2	1,5	-0,7	31	1012	98	4
2	C5	KEBABB Full	2024-08-04	4:13	68,160184	-59,971919	Plankton Ne	Deploymen	1347	308	5,3	1,5	-0,1	30	1012	97	4
2	C5	KEBABB Full	2024-08-04	3:56	68,160052	-59,978838	CTD Rosette	Recovery	1349	298	2,7	1,5	0,4	30	1011	98	4
2	C5	KEBABB Full	2024-08-04	3:01	68,154123	-59,979213	CTD Rosette	Bottom	1343	268	0	1,5	0,2	30	1011	97	4

2	C5	KEBABB Full	2024-08-04	2:36	68,151361	-59,977493	CTD Rosette	Deploymen	1347	313	4,5	1,9	0,1	30	1011	97	4
2	C4-24	KEBABB Ros	2024-08-03	23:41	67,940973	-60,050592	Tucker	Recovery	1491	321	6,9	2,1	3,2	30	1010	97	4
2	C4-24	KEBABB Ros	2024-08-03	23:33	67,938543	-60,041037	Tucker	Bottom	1487	329	7,4	2,1	3,1	30	1010	97	4
2	C4-24	KEBABB Ros	2024-08-03	23:24	67,933334	-60,035493	Tucker	Deploymen	1487	328	5,7	2,2	2,8	30	1010	97	4
2	C4-24	KEBABB Ros	2024-08-03	22:59	67,937470	-60,090339	Hydrobios	Recovery	1504	303	5,5	2,4	2,1	30	1010	97	4
2	C4-24	KEBABB Ros	2024-08-03	22:10	67,936245	-60,094989	Hydrobios	Bottom	1507	312	4,4	2,7	2,7	30	1010	97	4
2	C4-24	KEBABB Ros	2024-08-03	21:31	67,935248	-60,107827	Hydrobios	Deploymen	1510	314	1,9	3,6	2,6	30	1010	96	4
2	C4-24	KEBABB Ros	2024-08-03	21:11	67,939413	-60,129382	CTD Rosette	Recovery	1518	37	2,1	4,2	2,4	30	1010	96	4
2	C4-24	KEBABB Ros	2024-08-03	20:10	67,939296	-60,152129	CTD Rosette	Bottom	1525	89	1,3	4,2	3,2	30	1009	97	4
2	C4-24	KEBABB Ros	2024-08-03	19:44	67,939158	-60,161200	CTD Rosette	Deploymen	1524	14	1,9	3,8	2,5	30	1009	97	4
2	C4-24	Mooring	2024-08-03	18:48	67,948367	-60,200728	Mooring de	Bottom	1525	3	1,9	3,5	3,0	30	1009	97	4
2	C4-24	Mooring	2024-08-03	17:33	67,943876	-60,223610	Mooring de	Deploymen	1536	15	1,3	3,1	3,0	30	1008	97	4
2	D4	KEBABB Ros	2024-08-03	3:52	68,617478	-62,000776	CTD Rosette	Recovery	1775	69	6,1	3,2	-0,3	30	1008	85	4
2	D4	KEBABB Ros	2024-08-03	2:48	68,623427	-61,984997	CTD Rosette	Bottom	1779	104	8,2	3,7	0,6	29	1009	85	4
2	D4	KEBABB Ros	2024-08-03	2:16	68,625760	-61,979315	CTD Rosette	Deploymen	1777	99	7,5	3,8	0,2	30	1009	84	4
2	D3	KEBABB Full	2024-08-02	20:57	68,248239	-62,590931	Box Core	Recovery	1545	143	8,5	3,5	0,8	29	1009	90	3
2	D3	KEBABB Full	2024-08-02	20:27	68,245706	-62,596416	Box Core	Bottom	1537	144	8,7	3,5	1,2	29	1009	91	3
2	D3	KEBABB Full	2024-08-02	19:59	68,244200	-62,597441	Box Core	Deploymen	1529	150	10,7	3,4	0,1	30	1009	89	3
2	D3	KEBABB Full	2024-08-02	19:29	68,248669	-62,626642	CTD Rosette	Recovery	1518	215	1,7	3,9	-0,5	31	1009	91	3
2	D3	KEBABB Full	2024-08-02	18:29	68,240553	-62,612364	CTD Rosette	Bottom	1526	114	1,4	3,9	-0,5	30	1009	93	3
2	D3	KEBABB Full	2024-08-02	18:01	68,241320	-62,602911	CTD Rosette	Deploymen	1529	184	7,9	3,2	-0,1	30	1009	94	3
2	D3	KEBABB Full	2024-08-02	17:22	68,241191	-62,614707	Hydrobios	Recovery	1525	151	11,3	2,8	-0,1	30	1009	94	3
2	D3	KEBABB Full	2024-08-02	16:54	68,242137	-62,603794	Hydrobios	Bottom	1529	159	9	3	0,6	30	1009	93	3
2	D3	KEBABB Full	2024-08-02	16:26	68,244409	-62,595567	Hydrobios	Deploymen	1534	87	0	3,7	0,5	30	1010	91	3
2	D3	KEBABB Full	2024-08-02	15:27	68,234202	-62,599276	CTD Rosette	Recovery	1546	188	3,7	3,5	0,2	30	1010	94	3
2	D3	KEBABB Full	2024-08-02	15:19	68,235219	-62,597799	CTD Rosette	Bottom	1545	150	8	3,4	0,2	30	1010	96	3
2	D3	KEBABB Full	2024-08-02	15:17	68,235597	-62,597316	CTD Rosette	Deploymen	1545	145	7,5	3,7	0,1	30	1010	96	3
2	D3	KEBABB Full	2024-08-02	14:28	68,244550	-62,608500	Tucker Net	Recovery	1523	154	8,3	2,8	0,5	30	1010	96	3
2	D3	KEBABB Full	2024-08-02	14:17	68,243507	-62,594033	Tucker Net	Bottom	1534	167	3,6	3,3	0,5	30	1010	93	3
2	D3	KEBABB Full	2024-08-02	14:07	68,238398	-62,592164	Tucker Net	Deploymen	1542	64	1,7	3,2	0,1	30	1010	93	3
2	D3	KEBABB Full	2024-08-02	13:51	68,239862	-62,592853	Plankton Ne	Recovery	1539	160	5,1	3,2	0,0	30	1010	91	3
2	D3	KEBABB Full	2024-08-02	13:49	68,240162	-62,592946	Plankton Ne	Bottom	1539	127	5,7	3,2	0,2	30	1010	92	3
2	D3	KEBABB Full	2024-08-02	13:45	68,240509	-62,593322	Plankton Ne	Deploymen	1538	125	2,6	3,1	0,4	30	1010	92	3
2	D3	KEBABB Full	2024-08-02	13:42	68,240580	-62,593370	Plankton Ne	Recovery	1538	137	6,5	3	0,2	30	1010	92	3
2	D3	KEBABB Full	2024-08-02	13:39	68,240767	-62,593657	Plankton Ne	Bottom	1537	156	8,1	3	0,4	30	1010	92	3
2	D3	KEBABB Full	2024-08-02	13:37	68,240732	-62,593797	Plankton Ne	Deploymen	1537	162	6,1	3	0,4	30	1010	92	3
2	D2	KEBABB Ros	2024-08-02	7:03	67,855657	-63,162110	CTD Rosette	Recovery	276	136	8,1	3,9	2,5	31	1010	96	1
2	D2	KEBABB Ros	2024-08-02	6:33	67,856790	-63,151958	CTD Rosette	Bottom	264	144	8,3	4,1	2,6	31	1010	94	1

2	D2	KEBABB Ros	2024-08-02	6:29	67,857055	-63,150207	CTD Rosette	Deploymen	265	83	3,6	4,2	2,6	31	1010	94	1
2	TCA-D1E	Full	2024-08-02	4:52	67,677055	-63,447606	CTD Rosette	Recovery	521	153	11,4	4,7	3,1	31	1010	92	1
2	TCA-D1E	Full	2024-08-02	4:10	67,676221	-63,448929	CTD Rosette	Bottom	523	192	4,2	4,8	2,8	31	1010	92	1
2	TCA-D1E	Full	2024-08-02	4:01	67,675923	-63,449250	CTD Rosette	Deploymen	525	109	5,7	4,9	2,7	31	1010	92	1
2	D1.5	KEBABB BC	2024-08-02	3:16	67,640768	-63,491879	Box Core	Recovery	574	154	10,6	4,7	2,2	31	1010	94	1
2	D1.5	KEBABB BC	2024-08-02	3:05	67,640447	-63,491631	Box Core	Bottom	574	153	11,3	4,5	2,2	31	1010	96	1
2	D1.5	KEBABB BC	2024-08-02	2:55	67,640645	-63,491720	Box Core	Deploymen	574	157	10,3	4,4	2,1	31	1011	96	1
2	D1	Full	2024-08-02	1:18	67,473067	-63,694615	Box Core	Recovery	673	63	7	5	4,0	30	1011	96	1
2	D1	Full	2024-08-02	1:06	67,473143	-63,693928	Box Core	Bottom	668	44	7,7	5,1	3,9	30	1011	96	1
2	D1	Full	2024-08-02	0:53	67,473335	-63,693632	Box Core	Deploymen	669	65	7,2	5,3	3,7	30	1011	96	1
2	D1	Full	2024-08-02	0:29	67,469433	-63,676933	IKMT	Recovery	573				3,9	30			1
2	D1	Full	2024-08-01	23:53	67,461824	-63,721243	IKMT	Bottom	650	75	6,3	5,8	3,7	30	1011	91	1
2	D1	Full	2024-08-01	23:31	67,472505	-63,717386	IKMT	Deploymen	516	110	1,7	6,7	4,1	30	1011	90	1
2	D1	Full	2024-08-01	23:09	67,473445	-63,700335	Hydrobios	Recovery	648	55	5,5	6	4,1	30	1011	91	1
2	D1	Full	2024-08-01	22:47	67,473112	-63,698522	Hydrobios	Bottom	671	37	3,3	6,2	3,6	30	1011	90	1
2	D1	Full	2024-08-01	22:29	67,473123	-63,696823	Hydrobios	Deploymen	669	43	3,7	5,8	2,0	31	1011	93	1
2	D1	Full	2024-08-01	22:04	67,464521	-63,700658	Tucker Net	Recovery	653	54	6,5	5,8	2,9	31	1011	93	1
2	D1	Full	2024-08-01	21:57	67,468099	-63,705704	Tucker Net	Bottom	667	44	5	6,6	2,6	31	1011	90	1
2	D1	Full	2024-08-01	21:48	67,471544	-63,699694	Tucker Net	Deploymen	669	45	2,6	6,2	2,2	31	1011	90	1
2	D1	Full	2024-08-01	21:30	67,471851	-63,698565	Plankton Ne	Recovery	668	52	4,1	6,3	1,5	31	1011	91	1
2	D1	Full	2024-08-01	21:28	67,471943	-63,698228	Plankton Ne	Bottom	668	42	4,6	6,4	1,5	31	1011	89	1
2	D1	Full	2024-08-01	21:26	67,472015	-63,697786	Plankton Ne	Deploymen	669	47	5,2	6,1	1,9	31	1011	93	1
2	D1	Full	2024-08-01	21:23	67,472131	-63,697305	Plankton Ne	Recovery	668	51	4	6,3	1,7	31	1011	92	1
2	D1	Full	2024-08-01	21:21	67,472235	-63,696901	Plankton Ne	Bottom	667	163	4,3	6,5	1,5	31	1011	92	1
2	D1	Full	2024-08-01	21:19	67,472222	-63,696622	Plankton Ne	Deploymen	667	55	5	6,8	1,0	31	1011	87	1
2	D1	Full	2024-08-01	21:08	67,472310	-63,694778	CTD Rosette	Recovery	669	55	3,4	7,3	2,0	31	1011	88	1
2	D1	Full	2024-08-01	20:35	67,473035	-63,691025	CTD Rosette	Bottom	652	20	1,5	7,7	2,0	31	1011	84	1
2	D1	Full	2024-08-01	20:23	67,473056	-63,690989	CTD Rosette	Deploymen	652	147	3,3	7,7	2,5	31	1011	87	1
2	TCA-QF4	Nutrient	2024-08-01	18:56	67,368273	-63,771955	CTD Rosette	Recovery	468	36	6,3	6,9	2,8	30	1011	96	0
2	TCA-QF4	Nutrient	2024-08-01	18:21	67,370895	-63,770423	CTD Rosette	Bottom	444	35	4	7,5	2,6	30	1011	96	0
2	TCA-QF4	Nutrient	2024-08-01	18:13	67,371183	-63,770988	CTD Rosette	Deploymen	446	18	6	7,5	3,2	30	1011	96	0
2	TCA-5.1	Coring	2024-08-01	13:50	67,108438	-64,640009	Beam Trawl	Recovery	183	47	5,5	10,3	6,8	25	1012	82	0
2	TCA-5.1	Coring	2024-08-01	13:38	67,102179	-64,642771	Beam Trawl	Bottom	175	68	5,5	9,8	6,7	25	1012	84	0
2	TCA-5.1	Coring	2024-08-01	13:28	67,097177	-64,648757	Beam Trawl	Deploymen	156	82	5,3	10,3	6,7	25	1012	83	0
2	TCA-5.1	Coring	2024-08-01	13:02	67,095971	-64,655877	Gravity Cor	Recovery	166	210	2,3	11,7	5,2	27	1013	78	0
2	TCA-5.1	Coring	2024-08-01	12:57	67,095976	-64,656422	Gravity Cor	Bottom	165	184	0,6	11,8	5,4	26	1013	79	0
2	TCA-5.1	Coring	2024-08-01	12:53	67,095997	-64,656790	Gravity Cor	Deploymen	165	164	0	11,7	4,5	26	1013	80	0
2	TCA-5.1	Coring	2024-08-01	11:18	67,096086	-64,657184	Gravity Cor	Recovery	165	17	0,2	10,4	5,0	27	1013	86	1

2	TCA-5.1	Coring	2024-08-01	11:14	67,096188	-64,657165	Gravity Cor	Bottom	164	251	0,4	10	5,5	26	1013	87	1
2	TCA-5.1	Coring	2024-08-01	11:10	67,096202	-64,657138	Gravity Cor	Deploymen	164	242	1	9,7	5,7	27	1013	87	1
2	TCA-5.1	Coring	2024-08-01	10:16	67,095652	-64,656329	Box Core	Recovery	165	206	2,7	8,6	5,5	26	1013	92	1
2	TCA-5.1	Coring	2024-08-01	10:12	67,095725	-64,656296	Box Core	Bottom	165	200	2,8	8,4	5,7	26	1013	94	1
2	TCA-5.1	Coring	2024-08-01	10:08	67,095792	-64,656255	Box Core	Deploymen	165	172	1,1	8,2	5,6	26	1013	94	1
2	TCA-5.1	Coring	2024-08-01	9:55	67,096019	-64,656197	Box Core	Recovery	165	210	3,8	8,8	5,5	26	1013	91	1
2	TCA-5.1	Coring	2024-08-01	9:50	67,096115	-64,656418	Box Core	Bottom	164	224	5,1	9,1	5,2	27	1013	89	1
2	TCA-5.1	Coring	2024-08-01	9:47	67,096204	-64,656575	Box Core	Deploymen	165	247	5,7	9,1	5,9	26	1013	89	1
2	TCA-QFI	Basic	2024-08-01	9:19	67,109678	-64,634519	Tucker Net	Recovery	193	254	6,1	8,8	6,5	25	1013	92	1
2	TCA-QFI	Basic	2024-08-01	9:10	67,105472	-64,634010	Tucker Net	Bottom	162	253	4,4	8,9	6,5	25	1013	89	1
2	TCA-QFI	Basic	2024-08-01	9:02	67,101502	-64,639269	Tucker Net	Deploymen	160	298	1,4	9,3	6,5	25	1013	89	1
2	TCA-QFI	Basic	2024-08-01	8:40	67,094281	-64,659578	Monster Ne	Recovery	164	230	3,6	8,2	5,8	26	1013	93	1
2	TCA-QFI	Basic	2024-08-01	8:33	67,094519	-64,659061	Monster Ne	Bottom	165	210	1,5	7,9	5,7	26	1013	96	1
2	TCA-QFI	Basic	2024-08-01	8:30	67,094649	-64,658728	Monster Ne	Deploymen	165	260	1	7,9	5,7	26	1013	96	1
2	TCA-QFI	Basic	2024-08-01	8:11	67,095363	-64,657363	Plankton Ne	Recovery	165	191	1,9	8,3	5,9	26	1013	96	1
2	TCA-QFI	Basic	2024-08-01	8:11	67,095374	-64,657344	Plankton Ne	Bottom	165	193	1,7	8,3	5,9	26	1013	96	1
2	TCA-QFI	Basic	2024-08-01	8:08	67,095468	-64,657242	Plankton Ne	Deploymen	165	226	1,3	8,3	5,9	26	1013	96	1
2	TCA-QFI	Basic	2024-08-01	7:57	67,095760	-64,657088	CTD Rosette	Recovery	165	243	2	8,6	5,9	26	1013	93	1
2	TCA-QFI	Basic	2024-08-01	7:35	67,095995	-64,657848	CTD Rosette	Bottom	164	258	2,3	8	5,3	26	1013	96	1
2	TCA-QFI	Basic	2024-08-01	7:32	67,096100	-64,657743	CTD Rosette	Deploymen	165	265	2,7	7,9	5,6	26	1013	96	1
2	TCA-QFI	Nutrient	2024-08-01	3:17	67,167714	-64,290796	CTD Rosette	Recovery	361	231	2,8	8,6	5,1	27	1013	89	1
2	TCA-QFI	Nutrient	2024-08-01	2:46	67,168229	-64,292069	CTD Rosette	Bottom	361	290	3,3	8,2	5,8	27	1013	92	1
2	TCA-QFI	Nutrient	2024-08-01	2:39	67,168239	-64,292672	CTD Rosette	Deploymen	362	294	2,3	8,1	5,3	26	1013	94	1
2	TCA-QF3	Full	2024-08-01	0:42	67,283223	-63,896785	Box Core	Recovery	601	65	8,4	7,6	3,1	30	1013	74	1
2	TCA-QF3	Full	2024-08-01	0:31	67,283444	-63,897719	Box Core	Bottom	601	65	6,9	7,6	3,1	30	1013	77	1
2	TCA-QF3	Full	2024-08-01	0:21	67,283441	-63,898754	Box Core	Deploymen	601	69	8,2	7,5	2,8	30	1013	81	1
2	TCA-QF3	Full	2024-07-31	23:52	67,272223	-63,879376	CTD Rosette	Recovery	517	63	9,3	7,9	3,4	29	1012	75	1
2	TCA-QF3	Full	2024-07-31	23:46	67,272410	-63,879848	CTD Rosette	Bottom	536	63	10,6	7,6	3,8	29	1012	77	1
2	TCA-QF3	Full	2024-07-31	23:43	67,272649	-63,879793	CTD Rosette	Deploymen	542	60	9,9	7,8	3,7	29	1012	81	1
2	TCA-QF3	Full	2024-07-31	23:08	67,284971	-63,845624	IKMT	Recovery	513	43	11,9	6,2	5,7	26	1012	96	1
2	TCA-QF3	Full	2024-07-31	22:23	67,283231	-63,916158	IKMT	Bottom	600	74	9,9	6,4	3,4	29	1012	92	1
2	TCA-QF3	Full	2024-07-31	21:56	67,291404	-63,950574	IKMT	Deploymen	553	108	5,4	8,2	4,4	28	1012	88	1
2	TCA-QF3	Full	2024-07-31	21:14	67,272333	-63,876011	Hydrobios	Recovery	530	59	12,5	6	3,5	29	1012	96	1
2	TCA-QF3	Full	2024-07-31	20:59	67,272685	-63,876647	Hydrobios	Bottom	542	62	12,5	5,9	3,8	29	1012	96	1
2	TCA-QF3	Full	2024-07-31	20:46	67,273193	-63,877569	Hydrobios	Deploymen	557	44	11,2	6	3,8	29	1012	93	1
2	TCA-QF3	Full	2024-07-31	20:04	67,268919	-63,885099	Tucker Net	Recovery	466	58	12,5	6,4	6,3	26	1012	92	0
2	TCA-QF3	Full	2024-07-31	19:57	67,270637	-63,893509	Tucker Net	Bottom	508	55	11,7	6,2	5,8	25	1012	94	0
2	TCA-QF3	Full	2024-07-31	19:48	67,274671	-63,897227	Tucker Net	Deploymen	544	191	11,4	6,6	6,6	25	1012	91	0

2	TCA-QF3	Full	2024-07-31	19:32	67,271575	-63,878350	Plankton Ne	Recovery	501	70	13,2	6,6	3,8	29	1012	93	0
2	TCA-QF3	Full	2024-07-31	19:30	67,271910	-63,878173	Plankton Ne	Bottom	502	59	15	6,5	3,6	28	1011	91	0
2	TCA-QF3	Full	2024-07-31	19:26	67,272257	-63,878109	Plankton Ne	Deploymen	514	62	13,8	6,5	4,1	29	1012	94	0
2	TCA-QF3	Full	2024-07-31	19:25	67,272236	-63,878420	Plankton Ne	Recovery	506	57	14,7	6,5	3,7	29	1012	94	0
2	TCA-QF3	Full	2024-07-31	19:21	67,272251	-63,879062	Plankton Ne	Bottom	516	57	13,1	6,5	3,5	29	1012	96	0
2	TCA-QF3	Full	2024-07-31	19:19	67,272183	-63,879584	Plankton Ne	Deploymen	525	63	14,7	6,6	3,3	29	1012	94	0
2	TCA-QF3	Full	2024-07-31	19:08	67,269410	-63,880633	CTD Rosette	Recovery	477	58	13,8	6,7	3,4	29	1012	91	0
2	TCA-QF3	Full	2024-07-31	18:27	67,271111	-63,879767	CTD Rosette	Bottom	517	59	13,4	6,4	4,1	28	1012	91	0
2	TCA-QF3	Full	2024-07-31	18:18	67,271458	-63,880039	CTD Rosette	Deploymen	523	52	13,4	6,3	3,4	29	1012	93	0
2	TCA-5.3	Coring	2024-07-31	15:42	67,230443	-64,655889	Gravity Cor	Recovery	224	181	0	9,4	2,4	29	1011	70	0
2	TCA-5.3	Coring	2024-07-31	15:36	67,230361	-64,656070	Gravity Cor	Bottom	224	257	2,2	8,6	2,7	29	1012	74	0
2	TCA-5.3	Coring	2024-07-31	15:32	67,230289	-64,656280	Gravity Cor	Deploymen	224	223	4,4	7,7	2,1	29	1012	79	0
2	TCA-5.3	Coring	2024-07-31	14:38	67,230092	-64,655037	Gravity Cor	Recovery	224	326	2,7	7,2	2,7	29	1011	85	0
2	TCA-5.3	Coring	2024-07-31	14:31	67,230076	-64,655276	Gravity Cor	Bottom	224	344	1,7	8,1	2,6	28	1012	84	0
2	TCA-5.3	Coring	2024-07-31	14:23	67,230028	-64,655610	Gravity Cor	Deploymen	224	63	0	8,9	2,3	29	1012	73	0
2	TCA-5.3	Coring	2024-07-31	13:36	67,229991	-64,657163	Box Core	Recovery	224	309	2,8	8	2,4	28	1012	84	0
2	TCA-5.3	Coring	2024-07-31	13:30	67,230004	-64,657417	Box Core	Bottom	223	80	3,3	8,2	3,7	28	1012	76	0
2	TCA-5.3	Coring	2024-07-31	13:23	67,230016	-64,657513	Box Core	Deploymen	223	235	3,4	7,9	3,9	28	1012	77	0
2	TCA-5.3	Coring	2024-07-31	13:11	67,229898	-64,657944	Box Core	Recovery	223	243	2,5	7,5	3,8	27	1012	81	0
2	TCA-5.3	Coring	2024-07-31	13:05	67,229869	-64,657977	Box Core	Bottom	223	275	4,8	7,2	3,7	28	1012	78	0
2	TCA-5.3	Coring	2024-07-31	12:59	67,229841	-64,658170	Box Core	Deploymen	224	290	4,2	6,6	2,5	26	1012	83	0
2	TCA-5.3	Coring	2024-07-31	11:33	67,221045	-64,721520	Box Core	Recovery	193	283	8,6	6,7	2,7	28	1012	77	1
2	TCA-5.3	Coring	2024-07-31	11:27	67,221056	-64,721542	Box Core	Bottom	193	284	8,9	6,7	2,6	29	1012	77	1
2	TCA-5.3	Coring	2024-07-31	11:22	67,221070	-64,721754	Box Core	Deploymen	193	286	8	6,7	2,0	28	1012	76	1
2	TCA-5.3	Coring	2024-07-31	11:07	67,221272	-64,722303	Box Core	Recovery	193	278	8	6	3,3	27	1011	80	1
2	TCA-5.3	Coring	2024-07-31	11:02	67,221130	-64,722456	Box Core	Bottom	192	281	8,1	5,7	2,6	28	1012	81	1
2	TCA-5.3	Coring	2024-07-31	10:57	67,221091	-64,722202	Box Core	Deploymen	192	297	4,9	5,9	2,8	30	1011	84	1
2	TCA-QF4	Basic	2024-07-31	10:04	67,225420	-64,706669	Beam Trawl	Recovery	204	317	1,7	6,2	5,1	25	1011	81	1
2	TCA-QF4	Basic	2024-07-31	9:51	67,218819	-64,717842	Beam Trawl	Bottom	190	310	3,2	5,5	4,5	26	1011	90	1
2	TCA-QF4	Basic	2024-07-31	9:40	67,214996	-64,730934	Beam Trawl	Deploymen	171	295	4,3	6,3	4,9	26	1011	81	1
2	TCA-QF4	Basic	2024-07-31	9:16	67,220591	-64,723296	Hydrobios	Recovery	191	303	6,9	6,3	2,4	29	1011	83	1
2	TCA-QF4	Basic	2024-07-31	9:09	67,220852	-64,723280	Hydrobios	Bottom	191	260	4,8	6,1	2,4	29	1011	88	1
2	TCA-QF4	Basic	2024-07-31	9:04	67,220793	-64,722970	Hydrobios	Deploymen	192	265	3,7	6,7	1,7	29	1011	84	1
2	TCA-QF4	Basic	2024-07-31	8:36	67,225218	-64,695768	Tucker Net	Recovery	210	234	2,9	5,6	5,3	25	1011	87	0
2	TCA-QF4	Basic	2024-07-31	8:27	67,221816	-64,702132	Tucker Net	Bottom	203	291	4,9	5,5	5,2	26	1011	90	0
2	TCA-QF4	Basic	2024-07-31	7:50	67,223630	-64,711529	Tucker Net	Deploymen	202	282	5,5	6	5,0	25	1011	79	0
2	TCA-QF4	Basic	2024-07-31	7:26	67,220763	-64,722635	Plankton Ne	Recovery	192	282	8,4	6,4	2,9	28	1010	80	0
2	TCA-QF4	Basic	2024-07-31	7:22	67,220701	-64,722713	Plankton Ne	Bottom	193	280	9,6	6,3	2,0	28	1010	79	0

2	TCA-QFA	Basic	2024-07-31	7:20	67,220692	-64,722709	Plankton Ne	Deploymen	193	272	9,5	6	4,6	26	1010	79	0
2	TCA-QFA	Basic	2024-07-31	7:12	67,222252	-64,716944	CTD Rosette	Recovery	197	274	7,5	6,4	2,7	29	1010	79	0
2	TCA-QFA	Basic	2024-07-31	6:40	67,221052	-64,722082	CTD Rosette	Bottom	193	283	7,7	5,6	2,5	29	1010	85	0
2	TCA-QFA	Basic	2024-07-31	6:36	67,220990	-64,722383	CTD Rosette	Deploymen	193	285	7,2	5,6	2,4	29	1010	85	0
2	TCA-QFA	Nutrient	2024-07-31	4:56	67,238068	-64,363497	CTD Rosette	Recovery	324	317	4,6	7,9	4,0	28	1010	74	0
2	TCA-QFA	Nutrient	2024-07-31	4:22	67,238576	-64,366114	CTD Rosette	Bottom	321	316	3,8	8,9	5,2	26	1010	75	0
2	TCA-QFA	Nutrient	2024-07-31	4:16	67,238647	-64,366326	CTD Rosette	Deploymen	321	263	0,4	10,2	4,2	26	1010	73	0
2	TCA-QFC	Nutrient	2024-07-30	19:07	67,311586	-64,373113	CTD Rosette	Recovery	228	322	14,8	12	2,6	29	1006	59	0
2	TCA-QFC	Nutrient	2024-07-30	18:39	67,312359	-64,373863	CTD Rosette	Bottom	216	316	14,5	11,7	2,7	29	1006	64	0
2	TCA-QFC	Nutrient	2024-07-30	18:34	67,312523	-64,374162	CTD Rosette	Deploymen	220	314	15,7	11,4	2,8	28	1006	60	0
2	TCA-5.2	Coring	2024-07-30	17:03	67,335114	-64,648676	Gravity Cor	Recovery	201	304	7,7	10,6	1,4	30	1005	74	0
2	TCA-5.2	Coring	2024-07-30	16:57	67,335058	-64,648808	Gravity Cor	Bottom	201	345	8,3	10,6	1,3	30	1005	72	0
2	TCA-5.2	Coring	2024-07-30	16:51	67,335003	-64,648759	Gravity Cor	Deploymen	201	332	10,1	11	1,4	30	1005	67	0
2	TCA-5.2	Coring	2024-07-30	15:38	67,334583	-64,646848	Gravity Cor	Recovery	202	322	18,7	11	1,6	30	1004	67	0
2	TCA-5.2	Coring	2024-07-30	15:33	67,334703	-64,647089	Gravity Cor	Bottom	202	326	19,6	10,5	1,6	30	1004	73	0
2	TCA-5.2	Coring	2024-07-30	15:25	67,334885	-64,647070	Gravity Cor	Deploymen	202	325	15,3	10,2	1,7	30	1004	80	0
2	TCA-5.2	Coring	2024-07-30	14:49	67,335102	-64,650145	Gravity Cor	Recovery	201	326	5,9	11,8	1,7	30	1004	72	0
2	TCA-5.2	Coring	2024-07-30	14:43	67,335066	-64,649740	Gravity Cor	Bottom	201	350	2,7	11,8	1,7	30	1004	72	0
2	TCA-5.2	Coring	2024-07-30	14:38	67,335117	-64,649617	Gravity Cor	Deploymen	201	350	5,6	11,7	1,7	30	1004	73	0
2	TCA-5.2	Coring	2024-07-30	13:43	67,335195	-64,650078	Box Core	Recovery	201	293	3	11,5	1,8	30	1004	79	0
2	TCA-5.2	Coring	2024-07-30	13:38	67,335248	-64,650191	Box Core	Bottom	200	257	2,5	11,1	1,7	30	1004	82	0
2	TCA-5.2	Coring	2024-07-30	13:34	67,335287	-64,650347	Box Core	Deploymen	201	297	5,2	10,9	1,8	30	1004	82	0
2	TCA-5.2	Coring	2024-07-30	13:22	67,335347	-64,650870	Box Core	Recovery	201	312	4	10,4	1,9	30	1004	87	0
2	TCA-5.2	Coring	2024-07-30	13:17	67,335439	-64,651094	Box Core	Bottom	200	280	3,8	10,5	2,5	29	1004	87	0
2	TCA-5.2	Coring	2024-07-30	13:12	67,335426	-64,651419	Box Core	Deploymen	201	287	3,7	10,3	3,4	26	1004	88	0
2	TCA-QFC	Basic	2024-07-30	12:37	67,349383	-64,754208	Beam Trawl	Recovery	121	40	1,7	8,8	3,2	27	1004	94	0
2	TCA-QFC	Basic	2024-07-30	12:24	67,353934	-64,746694	Beam Trawl	Bottom	128	356	7	8,4	3,0	27	1003	94	0
2	TCA-QFC	Basic	2024-07-30	12:13	67,351929	-64,731948	Beam Trawl	Deploymen	142	0	8,9	8	3,7	27	1003	96	0
2	TCA-QFC	Basic	2024-07-30	11:14	67,353637	-64,757043	Monster Ne	Recovery	116	193	0	6,4	1,5	30	1003	97	0
2	TCA-QFC	Basic	2024-07-30	11:10	67,353619	-64,756258	Monster Ne	Bottom	117	191	0,4	6,4	1,8	30	1003	97	0
2	TCA-QFC	Basic	2024-07-30	11:06	67,353549	-64,755631	Monster Ne	Deploymen	117	163	2,1	6,3	1,8	30	1003	97	0
2	TCA-QFC	Basic	2024-07-30	10:36	67,353616	-64,746257	Tucker Net	Recovery	129	126	4,9	5,6	3,1	28	1003	97	0
2	TCA-QFC	Basic	2024-07-30	10:29	67,350618	-64,747364	Tucker Net	Bottom	130	141	6,7	5,3	3,2	27	1003	97	0
2	TCA-QFC	Basic	2024-07-30	10:22	67,350447	-64,756636	Tucker Net	Deploymen	120	160	8,5	5,4	2,3	30	1003	97	0
2	TCA-QFC	Basic	2024-07-30	10:07	67,354325	-64,757933	Plankton Ne	Recovery	114	157	6,1	6	1,3	31	1003	97	0
2	TCA-QFC	Basic	2024-07-30	10:04	67,354277	-64,757643	Plankton Ne	Bottom	114	152	6,2	5,9	1,4	30	1003	97	0
2	TCA-QFC	Basic	2024-07-30	10:01	67,354207	-64,757308	Plankton Ne	Deploymen	114	153	6,2	6,1	1,5	30	1003	97	0
2	TCA-QFC	Basic	2024-07-30	9:50	67,353850	-64,756146	CTD Rosette	Recovery	115	233	3,7	7,3	1,4	30	1002	96	1

2	TCA-QF(	Basic	2024-07-30	9:32	67,353439	-64,755046	CTD Rosett	Bottom	118	168	2,7	7,4	1,7	30	1002	90	1
2	TCA-QF(	Basic	2024-07-30	9:29	67,353407	-64,754927	CTD Rosett	Deploymen	118	151	2,2	7,4	1,8	30	1002	90	1
2	SV_1	CTD	2024-07-30	4:51	67,326741	-64,520065	CTD Rosett	Recovery	262	326	16	6,9	2,3	29	1000	96	1
2	SV_1	CTD	2024-07-30	4:45	67,326659	-64,521353	CTD Rosett	Bottom	262	325	15,4	7	1,3	30	1000	96	1
2	SV_1	CTD	2024-07-30	4:40	67,326569	-64,522486	CTD Rosett	Deploymen	262	317	15,5	7	1,7	30	1000	96	1
2			2024-07-30	4:35	67,326670	-64,524441	Mapping	Deploymen	262	314	14,2	6,9	1,8	29	1000	96	1
2	Qik Har	Box Core	2024-07-29	21:27	67,531095	-64,039409	Box Core	Recovery	36	35	19,6	4,8	1,9	31	995	97	1
2	Qik Har	Box Core	2024-07-29	21:25	67,531169	-64,039423	Box Core	Bottom	35	39	20,4	4,6	2,1	31	995	97	1
2	Qik Har	Box Core	2024-07-29	21:23	67,531219	-64,039553	Box Core	Deploymen	35	30	19,4	4,5	2,2	31	995	97	1
2	Qik Har	Box Core	2024-07-29	20:51	67,530890	-64,040030	Box Core	Recovery	39	44	21,2	4,6			994	97	1
2	Qik Har	Box Core	2024-07-29	20:49	67,530932	-64,040169	Box Core	Bottom	39	48	20	4,5			994	98	1
2	Qik Har	Box Core	2024-07-29	20:47	67,530964	-64,040304	Box Core	Deploymen	39	36	18,7	4,5	2,4	30	994	98	1
2	Disko_B	Benthic	2024-07-28	7:57	68,118697	-59,727324	Plankton Ne	Recovery	1019	213	16,9	1,5	1,7	31	988		1
2	Disko_B	Benthic	2024-07-28	7:55	68,118643	-59,726799	Plankton Ne	Bottom	1018	215	19,1	1,5	1,4	31	988		1
2	Disko_B	Benthic	2024-07-28	7:53	68,118496	-59,726486	Plankton Ne	Deploymen	1017	206	17	1,5	1,4	31	988		1
2	Disko_B	Benthic	2024-07-28	7:44	68,123720	-59,728346	Drop Camer	Recovery	1022	212	18,6	1,6	1,7	31	988		1
2	Disko_B	Benthic	2024-07-28	7:01	68,117631	-59,722768	Drop Camer	Bottom	1008	210	19,2	1,6	2,0	31	988		1
2	Disko_B	Benthic	2024-07-28	6:48	68,116360	-59,719454	Drop Camer	Deploymen	1006	205	22,4	1,5	2,2	31	988		1
2	Disko_B	Benthic	2024-07-28	5:47	68,151185	-59,719547	Drop Camer	Recovery	918	199	21,3	1	1,9	31	989	100	1
2	Disko_B	Benthic	2024-07-28	5:03	68,150775	-59,705745	Drop Camer	Bottom	863	198	17,2	-0,3	1,8	31	990	100	1
2	Disko_B	Benthic	2024-07-28	4:52	68,150670	-59,700377	Drop Camer	Deploymen	846	199	15,2	-0,4	1,8	30	990	100	1
2	Disko_B	Benthic	2024-07-28	4:33	68,153806	-59,723469	Plankton Ne	Recovery	934	196	16,9	-0,7	2,1	31	990	100	1
2	Disko_B	Benthic	2024-07-28	4:30	68,153964	-59,721854	Plankton Ne	Bottom	927	203	16	-0,8	2,1	31	990	100	1
2	Disko_B	Benthic	2024-07-28	4:28	68,153672	-59,720571	Plankton Ne	Deploymen	921	204	15,7	-0,8	1,5	31	990	100	1
2	BB1_A	ROV	2024-07-28	0:27	67,763430	-59,044447	Plankton Ne	Recovery	610				2,9	31			1
2	BB1_A	ROV	2024-07-28	0:25	67,763649	-59,044328	Plankton Ne	Bottom	609	261	4,6	-0,2	2,9	31	992	100	1
2	BB1_A	ROV	2024-07-28	0:23	67,763772	-59,043778	Plankton Ne	Deploymen	608	267	4,7	-0,2	2,9	31	992	100	1
2	BB1_A	ROV	2024-07-28	0:15	67,764071	-59,042015	CTD Rosett	Recovery	603	235	3,7	-0,2	2,9	31	992	100	1
2	BB1_A	ROV	2024-07-27	23:37	67,768142	-59,041091	CTD Rosett	Bottom	580	284	4	-0,3	3,0	31	992	100	1
2	BB1_A	ROV	2024-07-27	23:27	67,769297	-59,042161	CTD Rosett	Deploymen	582	296	6,6	-0,3	2,9	31	992	100	1
2	BB1_A	ROV	2024-07-27	22:54	67,772113	-59,045625	ROV Dive	Recovery		277	1,4	0,3	2,8	31	992	100	1
2	BB1_A	Full	2024-07-27	15:53	67,772883	-59,067897	ROV Dive	Bottom		19	5,1	2,6	3,1	31	991	100	1
2	BB1_A	Full	2024-07-27	15:10	67,772834	-59,067891	ROV Dive	Deployment		23	4,4	2,3	3,1	31	991	100	1
2	DS_600_	Full	2024-07-27	3:31	66,201203	-58,206311	Plankton Ne	Recovery	625	130	9	3	2,1	31	987	99	1
2	DS_600_	Full	2024-07-27	3:28	66,200926	-58,206434	Plankton Ne	Bottom	625	128	8,5	3	2,1	31	987	99	1
2	DS_600_	Full	2024-07-27	3:26	66,200669	-58,206595	Plankton Ne	Deploymen	625	126	8,4	3	2,1	31	987	99	1
2	DS_600_	Full	2024-07-27	3:11	66,200170	-58,208063	Box Core	Recovery	625	119	8,8	3	2,1	31	987	99	1
2	DS_600_	Full	2024-07-27	3:00	66,200427	-58,208137	Box Core	Bottom	625	131	8,8	3	2,2	31	987	99	1

2	DS_600	Full	2024-07-27	2:48	66,199345	-58,208180	Box Core	Deploymen	625	134	10,7	3,1	2,2	31	987	99	1
2	DS_600	Full	2024-07-27	2:30	66,206245	-58,209787	Drop Camer	Recovery	625	140	11,4	3	2,0	30	987	99	1
2	DS_600	Full	2024-07-27	1:50	66,201936	-58,208192	Drop Camer	Bottom	625	148	11	2,9	1,9	31	987	99	1
2	DS_600	Full	2024-07-27	1:42	66,201142	-58,208327	Drop Camer	Deploymen	624	153	11	2,9	1,7	31	987	99	1
2	DS_600	Full	2024-07-27	1:15	66,204402	-58,230072	CTD Rosette	Recovery	625	81	10,6	3,5	1,9	30	987	99	1
2	DS_600	Full	2024-07-27	0:36	66,201881	-58,220472	CTD Rosette	Bottom	624	161	17,4	3,3	1,8	31	987	99	1
2	DS_600	Full	2024-07-27	0:25	66,202422	-58,218304	CTD Rosette	Deploymen	624	314	16	3,2	1,9	30	987	99	1
2	DS_500	Full	2024-07-26	19:05	65,469198	-58,526018	IKMT	Recovery	479	181	11,3	3,7	2,7	31	987	99	1
2	DS_500	Full	2024-07-26	18:11	65,460653	-58,440109	IKMT	Bottom	496	193	10,3	3,8	2,7	31	987	99	1
2	DS_500	Full	2024-07-26	17:48	65,451870	-58,417137	IKMT	Deploymen	498	184	10,8	5	2,8	31	987	99	1
2	DS_500	Full	2024-07-26	17:15	65,456435	-58,441859	Hydrobios	Recovery	497	193	12,8	3,8	2,9	31	987	99	1
2	DS_500	Full	2024-07-26	16:59	65,454174	-58,440106	Hydrobios	Bottom	498	193	12,5	3,7	3,0	31	987	99	1
2	DS_500	Full	2024-07-26	16:42	65,451442	-58,437669	Hydrobios	Deploymen	498	200	16,8	3,8	2,5	31	987	99	1
2	DS_500	Full	2024-07-26	16:31	65,451949	-58,436761	Plankton Ne	Recovery	498	197	17,9	3,9	2,7	31	988	99	1
2	DS_500	Full	2024-07-26	16:28	65,451935	-58,436627	Plankton Ne	Bottom	498	200	15,4	3,8	2,7	31	988	99	1
2	DS_500	Full	2024-07-26	16:26	65,451737	-58,436370	Plankton Ne	Deploymen	498	200	15,9	3,8	2,9	31	988	99	1
2	DS_500	Full	2024-07-26	15:29	65,451770	-58,432944	Box Core	Recovery	498	204	18,5	3,8	2,6	31	988	99	1
2	DS_500	Full	2024-07-26	15:19	65,451710	-58,434474	Box Core	Bottom	498	201	17,5	3,7	2,6	31	988	99	1
2	DS_500	Full	2024-07-26	15:10	65,451625	-58,434288	Box Core	Deploymen	499	204	17,1	3,7	2,6	31	988	99	1
2	DS_500	Full	2024-07-26	14:47	65,450617	-58,441967	Drop Camer	Recovery	498	209	17,6	3,7	2,6	31	989	99	1
2	DS_500	Full	2024-07-26	14:08	65,453436	-58,433787	Drop Camer	Bottom	499	211	15,9	3,7	2,8	31	989	98	1
2	DS_500	Full	2024-07-26	14:00	65,453996	-58,431916	Drop Camer	Deploymen	500	214	17,5	3,8	2,9	31	989	98	1
2	DS_500	Full	2024-07-26	13:34	65,446694	-58,444401	CTD Rosette	Recovery		216	15,9	3,8	2,4	31	989	98	1
2	DS_600	Full	2024-07-26	13:00	65,450001	-58,437468	CTD Rosette	Bottom	498	215	18,2	3,8	2,5	31	989	98	1
2	DS_600	Full	2024-07-26	12:51	65,450811	-58,437074	CTD Rosette	Deploymen	498	206	17,4	3,8	2,3	31	989	98	1
2	DS_500	Full	2024-07-26	8:37	65,527484	-59,585363	Hydrobios	Recovery	491	237	18,9	3,2	2,4	30	989	97	0
2	DS_500	Full	2024-07-26	8:20	65,527905	-59,587714	Hydrobios	Bottom	491	244	19,3	3,1	2,4	30	989	98	0
2	DS_500	Full	2024-07-26	8:08	65,528495	-59,588833	Hydrobios	Deploymen	490	250	18,5	2,9	1,9	31	989	98	0
2	DS_500	Full	2024-07-26	7:46	65,530899	-59,592068	Plankton Ne	Recovery	492	237	18,4	2,7	2,4	30	989	98	0
2	DS_500	Full	2024-07-26	7:44	65,530654	-59,591798	Plankton Ne	Bottom	491	239	17,1	2,7	2,4	30	989	98	0
2	DS_500	Full	2024-07-26	7:42	65,530687	-59,591069	Plankton Ne	Deploymen	492	239	20	2,8	2,4	30	989	98	0
2	DS_500	Full	2024-07-26	7:26	65,521934	-59,599404	Box Core	Recovery	488	247	20,4	2,7	2,4	30	989	98	0
2	DS_500	Full	2024-07-26	7:17	65,522960	-59,597677	Box Core	Bottom	487	241	15,3	2,7	2,2	30	989	98	0
2	DS_500	Full	2024-07-26	7:08	65,523217	-59,598814	Box Core	Deploymen	488	248	20,5	2,6	1,7	30	989	98	0
2	DS_500	Full	2024-07-26	6:47	65,530584	-59,597589	Drop Camer	Recovery	491	232	18,5	2,8	2,5	30	989	97	0
2	DS_500	Full	2024-07-26	6:10	65,525745	-59,600647	Drop Camer	Bottom	490	253	21,6	2,7	2,5	30	989	97	0
2	DS_500	Full	2024-07-26	6:04	65,525166	-59,601363	Drop Camer	Deploymen	490	251	16,5	2,7	2,2	30	989	97	0
2	DS_500	Full	2024-07-26	5:36	65,539389	-59,598113	CTD Rosette	Recovery	501	254	20,2	2,8	2,4	30	989	97	0

2	DS_500_	Full	2024-07-26	5:06	65,535549	-59,607149	CTD Rosette	Bottom	495	253	19,7	2,9	2,4	30	989	97	0
2	DS_500_	Full	2024-07-26	4:55	65,534564	-59,609936	CTD Rosette	Deploymen	493	268	19,7	2,9	1,5	31	989	97	0
2	Davis St	ROV	2024-07-25	16:07	64,547547	-58,521946	ROV	Recovery		356	14,5	7,5	6,0	33	985	97	0
2	Davis St	ROV	2024-07-25	12:08	64,547609	-58,518657	ROV	Bottom	700	299	8,7	4,7	6,0	33	989	98	0
2	Davis St	ROV	2024-07-25	11:14	64,548688	-58,521439	ROV	Deployment		109	8,3	4,6	5,9	33	988	98	0
2	Davis St	ROV	2024-07-25	9:08	64,538388	-58,524239	CTD Rosette	Recovery	697	239	5,6	4,6	6,1	33	991	98	0
2	Davis St	ROV	2024-07-25	8:27	64,544476	-58,518395	CTD Rosette	Bottom	695	227	9,5	4,7	6,0	33	992	98	0
2	Davis St	ROV	2024-07-25	8:14	64,546250	-58,518384	CTD Rosette	Deploymen	695	240	9,6	4,7	6,0	33	992	98	0
2	Killinik 1	Full	2024-07-24	8:00	60,889943	-64,056027	Drop Camer	Recovery	381	258	20,5	3,3	0,9	32	1007	99	0
2	Killinik 1	Full	2024-07-24	7:54	60,889688	-64,063839	Drop Camer	Bottom	378	267	24,4	3	0,8	32	1007	99	0
2	Killinik 1	Full	2024-07-24	7:47	60,888997	-64,073403	Drop Camer	Deploymen	376	267	25,9	3,1	0,9	32	1007	99	0
2	Killinik 2	Full	2024-07-24	6:00	60,853441	-63,998837	Hydrobios	Recovery	400	270	20,6	2,6	0,7	32	1007	99	0
2	Killinik 2	Full	2024-07-24	5:48	60,851931	-64,018818	Hydrobios	Bottom	402	275	25,8	2,1	0,7	32	1007	99	0
2	Killinik 2	Full	2024-07-24	5:36	60,849982	-64,042223	Hydrobios	Deploymen	403	269	19,6	1,7	0,7	32	1008	99	0
2	Killinik 2	Full	2024-07-24	4:21	60,862108	-63,996188	Tucker	Recovery	402	272	21,1	1,7	1,1	32	1007	99	0
2	Killinik 2	Full	2024-07-24	4:11	60,856075	-64,019838	Tucker	Bottom	404	245	14,8	1,6	1,1	32	1007	99	0
2	Killinik 2	Full	2024-07-24	4:01	60,850425	-64,045200	Tucker	Deploymen	406	272	19,2	1,4	1,0	32	1008	99	0
2	Killinik 2	Full	2024-07-24	3:20	60,848894	-64,059910	Plankton Ne	Recovery	407	277	22,6	1,2	1,4	32	1007	99	0
2	Killinik 2	Full	2024-07-24	3:18	60,848603	-64,061489	Plankton Ne	Bottom	406	279	24,4	1,3	1,5	32	1007	99	0
2	Killinik 2	Full	2024-07-24	3:16	60,848511	-64,062546	Plankton Ne	Deploymen	406	286	21,5	1,3	1,4	32	1007	99	0
2	Killinik 2	Full	2024-07-24	3:09	60,849230	-64,059906	Plankton Ne	Recovery	406	279	19,1	1,7	1,2	32	1008	99	0
2	Killinik 2	Full	2024-07-24	3:08	60,848817	-64,061517	Plankton Ne	Bottom	406	276	19,3	1,7	1,3	32	1008	99	0
2	Killinik 2	Full	2024-07-24	3:06	60,848532	-64,062534	Plankton Ne	Deploymen	406	279	17,9	1,7	1,2	32	1008	99	0
2	Killinik 2	Full	2024-07-24	2:52	60,849564	-64,063893	Box Core	Recovery	405	271	21,9	1,9	1,1	32	1007	99	0
2	Killinik 2	Full	2024-07-24	2:43	60,848868	-64,063502	Box Core	Bottom	406	268	18,9	2	0,9	32	1008	99	0
2	Killinik 2	Full	2024-07-24	2:36	60,848780	-64,063400	Box Core	Deploymen	406	273	22,5	2,1	1,0	32	1008	99	0
2	Killinik 2	Full	2024-07-24	2:34	60,848772	-64,063170	Box Core	Recovery	406	277	20,5	2,2	0,9	32	1008	99	0
2	Killinik 2	Full	2024-07-24	2:27	60,848263	-64,063292	Box Core	Bottom	406	277	21,1	2,3	1,0	32	1008	99	0
2	Killinik 2	Full	2024-07-24	2:18	60,848429	-64,063412	Box Core	Deploymen	407	276	25,4	2,4	1,1	32	1007	99	0
2	Killinik 2	Full	2024-07-24	1:49	60,855715	-64,074795	CTD Rosette	Recovery	403	173	0,6	2,6	1,1	32	1008	99	0
2	Killinik 2	Full	2024-07-24	1:22	60,849567	-64,068524	CTD Rosette	Bottom	405	290	3,2	2,5	1,3	32	1008	99	0
2	Killinik 2	Full	2024-07-24	1:15	60,848580	-64,065088	CTD Rosette	Deploymen	406	325	13,2	2,4	1,5	32	1008	99	0
2	Kangala	Full	2024-07-23	17:27	59,531497	-63,296272	Beam Trawl	Recovery	176	223	8,4	5,3	4,3	31	1010	98	0
2	Kangala	Full	2024-07-23	17:10	59,531610	-63,276914	Beam Trawl	Bottom	173	243	3,8	6,5	4,1	31	1010	98	0
2	Kangala	Full	2024-07-23	17:02	59,528452	-63,279112	Beam Trawl	Deploymen	174	249	0	6,4	3,6	31	1010	98	0
2	Kangala	Full	2024-07-23	16:29	59,532291	-63,283964	Hydrobios	Recovery	178	77	4,1	6,4	3,7	31	1010	98	0
2	Kangala	Full	2024-07-23	16:23	59,533541	-63,284308	Hydrobios	Bottom	180	79	4,8	6,2	3,4	31	1009	98	0
2	Kangala	Full	2024-07-23	16:18	59,533612	-63,284290	Hydrobios	Deploymen	180	79	5,5	6,3	3,3	31	1009	98	0

2	Kangala	Full	2024-07-23	14:52	59,525712	-63,278075	Tucker	Recovery	173	65	4,4	5,3	3,3	31	1010	98	0
2	Kangala	Full	2024-07-23	14:43	59,528104	-63,284932	Tucker	Bottom	168	83	2,3	5,5	3,4	31	1010	98	0
2	Kangala	Full	2024-07-23	14:34	59,532361	-63,285622	Tucker	Deploymen	178	60	1,2	5,3	3,3	31	1010	98	0
2	Kangala	Full	2024-07-23	14:28	59,533968	-63,285764	Plankton Ne	Recovery	180	28	6,8	4,9	3,2	31	1010	98	0
2	Kangala	Full	2024-07-23	14:26	59,534039	-63,285516	Plankton Ne	Bottom	180	26	7,2	4,9	3,3	31	1010	98	0
2	Kangala	Full	2024-07-23	14:23	59,533811	-63,285155	Plankton Ne	Deploymen	180	26	6,2	4,9	3,3	31	1010	98	0
2	Kangala	Full	2024-07-23	14:07	59,533980	-63,285983	Box Core	Recovery	180	16	5,7	4,9	3,3	31	1009	98	0
2	Kangala	Full	2024-07-23	14:02	59,534051	-63,285737	Box Core	Bottom	180	26	5,9	4,9	3,3	31	1009	98	0
2	Kangala	Full	2024-07-23	13:58	59,534200	-63,285651	Box Core	Deploymen	181	19	6,9	5	3,2	31	1009	98	0
2	Kangala	Full	2024-07-23	13:43	59,535976	-63,292431	Drop Camer	Recovery	184	5	8,4	5,1	3,3	31	1009	98	0
2	Kangala	Full	2024-07-23	13:09	59,534399	-63,286725	Drop Camer	Bottom	181	359	10,2	5,2	3,3	31	1009	98	0
2	Kangala	Full	2024-07-23	13:04	59,534142	-63,285959	Drop Camer	Deploymen	181	12	9,8	5,1	3,2	31	1009	98	0
2	Kangala	Full	2024-07-23	12:43	59,535220	-63,295795	CTD Rosette	Recovery	181	355	7,9	5	3,2	31	1009	98	0
2	Kangala	Full	2024-07-23	12:21	59,534240	-63,288662	CTD Rosette	Bottom	181	353	7,8	5,1	3,0	31	1009	98	0
2	Kangala	Full	2024-07-23	12:16	59,534220	-63,287527	CTD Rosette	Deploymen	181	351	5,3	5,2	3,0	31	1009	98	0
2	Ramah S	Full	2024-07-23	7:36	58,873220	-62,463413	Beam Trawl	Recovery	199	355	15,4	4,7	4,3	31	1006	98	0
2	Ramah S	Full	2024-07-23	7:21	58,880030	-62,480307	Beam Trawl	Bottom	201	357	14,8	4,8	3,3	31	1006	98	0
2	Ramah S	Full	2024-07-23	7:10	58,885757	-62,487523	Beam Trawl	Deploymen	200	356	13,6	7,2	3,1	31	1006	97	0
2	Ramah S	Full	2024-07-23	6:39	58,883793	-62,487334	Hydrobios	Recovery	202	2	19,6	5	4,1	31	1006	98	0
2	Ramah S	Full	2024-07-23	6:29	58,885622	-62,489082	Hydrobios	Bottom	201	359	17,1	4,8	4,3	31	1006	98	0
2	Ramah S	Full	2024-07-23	6:23	58,887101	-62,490490	Hydrobios	Deploymen	201	356	20	4,7	4,3	31	1006	98	0
2	Ramah S	Full	2024-07-23	5:53	58,879098	-62,478761	Tucker	Recovery	201	345	15,5	4,5	4,9	31	1006	98	0
2	Ramah S	Full	2024-07-23	5:46	58,881428	-62,483881	Tucker	Bottom	202	341	13,8	4,6	4,9	31	1006	98	0
2	Ramah S	Full	2024-07-23	5:38	58,884586	-62,490955	Tucker	Deploymen	203	352	14,4	5	5,0	31	1006	98	0
2	Ramah S	Full	2024-07-23	4:53	58,888322	-62,490911	Plankton Ne	Recovery	201	346	16,8	5,1	4,9	31	1006	98	0
2	Ramah S	Full	2024-07-23	4:51	58,888536	-62,491314	Plankton Ne	Bottom	201	347	19,2	5,2	4,9	31	1006	98	0
2	Ramah S	Full	2024-07-23	4:48	58,888642	-62,491674	Plankton Ne	Deploymen	201	353	19	5,4	4,9	31	1006	98	0
2	Ramah S	Full	2024-07-23	4:32	58,887672	-62,491587	Box Core	Recovery	202	1	20,9	5,2	4,6	31	1006	98	0
2	Ramah S	Full	2024-07-23	4:28	58,887547	-62,491858	Box Core	Bottom	202	1	18,4	5,1	4,2	31	1005	98	0
2	Ramah S	Full	2024-07-23	4:23	58,887486	-62,492263	Box Core	Deploymen	202	1	18,1	5,1	4,4	31	1005	98	0
2	Ramah S	Full	2024-07-23	4:06	58,886646	-62,484361	Drop Camer	Recovery	201	346	20	5	4,6	31	1005	98	0
2	Ramah S	Full	2024-07-23	3:32	58,886380	-62,493434	Drop Camer	Bottom	203	348	16,9	4,9	4,8	31	1005	99	0
2	Ramah S	Full	2024-07-23	3:29	58,886564	-62,494280	Drop Camer	Deploymen	203	352	19,8	4,9	4,8	31	1005	99	0
2	Ramah S	Full	2024-07-23	3:03	58,888797	-62,487100	CTD Rosette	Recovery	201	346	19,5	4,8	4,9	31	1005	99	0
2	Ramah S	Full	2024-07-23	2:38	58,887535	-62,491005	CTD Rosette	Bottom	202	359	21,9	4,9	4,6	31	1005	99	0
2	Ramah S	Full	2024-07-23	2:33	58,887622	-62,491138	CTD Rosette	Deploymen	202	353	18,3	4,8	3,9	31	1005	99	0
2	Nachvak	Full	2024-07-22	22:27	59,085146	-63,457692	Beam Trawl	Recovery	211	59	7,4	7,8	4,3	30	1004	99	0
2	Nachvak	Full	2024-07-22	22:12	59,082394	-63,476057	Beam Trawl	Bottom	212	134	3	8,3	4,0	31	1004	99	0

2	Nachvak	Full	2024-07-22	22:01	59,085968	-63,483684	Beam Trawl	Deploymen	210	75	8,5	8,2	4,5	30	1004	99	0
2	Nachvak	Full	2024-07-22	21:31	59,085939	-63,469110	Hydrobios	Recovery	210	78	6,3	9	3,0	31	1004	99	0
2	Nachvak	Full	2024-07-22	21:24	59,085872	-63,469378	Hydrobios	Bottom	210	76	6,4	9,3	3,0	31	1004	99	0
2	Nachvak	Full	2024-07-22	21:18	59,085851	-63,469254	Hydrobios	Deploymen	210	52	8,2	8,7	3,3	31	1004	100	0
2	Nachvak	Full	2024-07-22	20:48	59,085364	-63,477001	Tucker	Recovery	210	94	8,9	8	3,8	31	1004	99	0
2	Nachvak	Full	2024-07-22	20:41	59,083667	-63,483757	Tucker	Bottom	211	112	6,3	8,2	4,0	30	1004	99	0
2	Nachvak	Full	2024-07-22	20:32	59,086695	-63,484600	Tucker	Deploymen	209	144	1,3	9,4	5,1	29	1004	99	0
2	Nachvak	Full	2024-07-22	20:22	59,085764	-63,466726	Plankton Ne	Recovery	210	109	3,3	9,4	3,5	31	1004	99	0
2	Nachvak	Full	2024-07-22	20:19	59,085862	-63,466774	Plankton Ne	Bottom	210	71	3,5	9,3	3,6	31	1004	100	0
2	Nachvak	Full	2024-07-22	20:17	59,085837	-63,466927	Plankton Ne	Deploymen	210	86	4	9,6	3,5	31	1004	99	0
2	Nackvak	Coring	2024-07-22	19:32	59,098944	-63,406369	Gravity Cor	Recovery	188	123	15	8,1	3,0	31	1003	100	0
2	Nackvak	Coring	2024-07-22	19:26	59,098615	-63,406745	Gravity Cor	Bottom	11	123	16,9	7,8	3,4	31	1003	100	0
2	Nackvak	Coring	2024-07-22	19:22	59,098611	-63,406380	Gravity Cor	Deploymen	18	133	18,7	8	3,3	31	1003	100	0
2	Nachvak	AUV+Core	2024-07-22	18:29	59,111413	-63,426099	Gravity Cor	Recovery	165	137	10,9	7	2,1	31	1003	100	0
2	Nachvak	AUV+Core	2024-07-22	18:24	59,111344	-63,426105	Gravity Cor	Bottom	165	128	10,8	7	2,1	31	1003	100	0
2	Nachvak	AUV+Core	2024-07-22	18:20	59,111386	-63,426122	Gravity Cor	Deploymen	165	124	10,8	7,2	2,1	31	1003	100	0
2	Nackvak	AUV+Core	2024-07-22	17:49	59,108999	-63,404145	AUV	Recovery	179	152	3,6	10,5	3,0	31	1002		0
2	Nachvak	Full	2024-07-22	16:17	59,085785	-63,468454	Box Core	Recovery	210	276	10	11,2	3,2	31	1003		0
2	Nachvak	Full	2024-07-22	16:13	59,085679	-63,469275	Box Core	Bottom	210	296	13,1	10,6	3,8	30	1003		0
2	Nachvak	Full	2024-07-22	16:09	59,085578	-63,468906	Box Core	Deploymen	210	282	13,7	9,7	3,6	31	1003		0
2	Nachvak	Full	2024-07-22	15:41	59,087013	-63,460861	Drop Camer	Recovery	208	302	13,5	10,4			1003		0
2	Nachvak	Full	2024-07-22	15:06	59,085746	-63,468888	Drop Camer	Bottom	210	295	5,8	10,3			1003		0
2	Nachvak	Full	2024-07-22	15:01	59,085586	-63,469006	Drop Camer	Deploymen	210	260	15,4	9,6			1003		0
2	Nachvak	AUV+Core	2024-07-22	14:00	59,103553	-63,413383	AUV	Deploymen	183	124	0	7,5	3,2	31	1003		0
2	Nachvak	Full	2024-07-22	13:06	59,085711	-63,468912	CTD Rosett	Recovery	210	268	14,3	9,2	3,4	31	1003		0
2	Nachvak	Full	2024-07-22	12:45	59,085278	-63,468705	CTD Rosett	Bottom	211	268	21,1	7,9	3,4	31	1002		0
2	Nachvak	Full	2024-07-22	12:42	59,085277	-63,468919	CTD Rosett	Deploymen	211	277	22,2	7,2	3,4	31	1002		0
2	Okak Ba	Full + AUV	2024-07-20	22:19	57,561174	-62,061081	Beam Trawl	Recovery	86	76	11	6,5	6,6	30	1012		0
2	Okak Ba	Full + AUV	2024-07-20	22:09	57,567759	-62,059954	Beam Trawl	Bottom	91	86	13,5	7,1	6,4	30	1011		0
2	Okak Ba	Full + AUV	2024-07-20	22:04	57,569262	-62,055019	Beam Trawl	Deploymen	92	104	7	10,7	6,1	30	1012		0
2	Okak Ba	Full + AUV	2024-07-20	21:38	57,569522	-62,049107	Monster	Recovery	93	84	15,5	6,1	5,1	30	1011		0
2	Okak Ba	Full + AUV	2024-07-20	21:35	57,569538	-62,049135	Monster	Bottom	93	88	16,4	6,1	4,9	30	1011		0
2	Okak Ba	Full + AUV	2024-07-20	21:32	57,569663	-62,048995	Monster	Deploymen	93	87	15,7	6,2	5,2	30	1011		0
2	Okak Ba	Full + AUV	2024-07-20	21:01	57,560884	-62,066478	Tucker	Recovery	77	86	9,8	6,2	6,8	30	1012		0
2	Okak Ba	Full + AUV	2024-07-20	20:55	57,564246	-62,067022	Tucker	Bottom	90	86	8,8	6,2	7,0	30	1012		0
2	Okak Ba	Full + AUV	2024-07-20	20:48	57,567424	-62,064079	Tucker	Deploymen	90	94	12,6	6,3	6,9	30	1012		0
2	Okak La	Coring	2024-07-20	20:00	57,517335	-62,147428	Gravity Cor	Recovery	70	71	11,8	7,5	3,3	30	1011		0
2	Okak La	Coring	2024-07-20	19:57	57,517467	-62,147476	Gravity Cor	Bottom	70	93	12,9	7,7	3,0	31	1011		0

2	Okak La	Coring	2024-07-20	19:55	57,517458	-62,147528	Gravity Cor	Deploymen	70	96	9,9	8	3,0	31	1011		0
2	Okak La	Coring	2024-07-20	19:19	57,515368	-62,148188	AUV	Recovery	69	70	12	7	7,1	29	1012		0
2	Okak Ba	Full + AUV	2024-07-20	17:23	57,569406	-62,048676	Box Core	Recovery	92	92	12,1	6,7	5,8	30	1012		0
2	Okak Ba	Full + AUV	2024-07-20	17:20	57,569508	-62,048197	Box Core	Bottom	92	87	15,2	6,7	5,5	30	1012		0
2	Okak Ba	Full + AUV	2024-07-20	17:17	57,569614	-62,048190	Box Core	Deploymen	92	91	16,5	6,7	5,4	30	1012		0
2	Okak La	Coring	2024-07-20	15:37	57,514047	-62,157197	AUV	Deploymen	70	77	12,8	7,3	6,8	29	1011		0
2	Okak Ba	Full + AUV	2024-07-20	14:10	57,570010	-62,049842	CTD Rosett	Recovery	92	85	12,3	9,5	5,9	30	1012		0
2	Okak Ba	Full + AUV	2024-07-20	13:50	57,569553	-62,050348	CTD Rosett	Bottom	91	81	15,1	7	5,4	30	1012		0
2	Okak Ba	Full + AUV	2024-07-20	13:47	57,569720	-62,049751	CTD Rosett	Deploymen	92	75	14,3	7,1	5,6	30	1012		0
2	Sentinel	Mooring + F	2024-07-19	23:35	56,692756	-60,259002	Box Core	Recovery	498	351	10,3	7,2	7,1	31	1009		1
2	Sentinel	Mooring + F	2024-07-19	23:25	56,694157	-60,258533	Box Core	Bottom	499	351	10,5	7,2	7,3	31	1010		1
2	Sentinel	Mooring + F	2024-07-19	23:16	56,694794	-60,259590	Box Core	Deploymen	499	359	10,4	7,2	6,8	31	1009		1
2	Sentinel	Mooring + F	2024-07-19	22:12	56,704941	-60,184413	Box Core	Recovery	306	6	9,7	7,2	5,2	32	1009		1
2	Sentinel	Mooring + F	2024-07-19	22:06	56,705843	-60,183861	Box Core	Bottom	299	18	11,4	7,2	5,9	32	1009		1
2	Sentinel	Mooring + F	2024-07-19	22:01	56,705977	-60,184115	Box Core	Deploymen	300	27	13,5	7,3	6,6	31	1008		1
2	Sentinel	Mooring + F	2024-07-19	21:33	56,699534	-60,214964	Box Core	Recovery	440	16	11,6	7,4	6,4	32	1008		1
2	Sentinel	Mooring + F	2024-07-19	21:23	56,700205	-60,213791	Box Core	Bottom	760	30	16,5	7,3	5,9	31	1008		1
2	Sentinel	Mooring + F	2024-07-19	21:14	56,701494	-60,216067	Box Core	Deploymen	433	19	12,9	7,3	6,9	31	1008		1
2	Sentinel	Mooring + F	2024-07-19	20:20	56,691202	-60,267292	Box Core	Recovery	488	40	14,1	7,5	5,3	31	1008		1
2	Sentinel	Mooring + F	2024-07-19	20:05	56,693065	-60,267925	Box Core	Bottom	492	39	14,3	7,5	4,3	31	1008		1
2	Sentinel	Mooring + F	2024-07-19	19:54	56,693624	-60,269153	Box Core	Deploymen	1211	44	12	7,5	6,4	31	1008		0
2	Sentinel	Mooring + F	2024-07-19	19:32	56,690823	-60,284120	Box Core	Recovery	476	44	13,5	7,6	4,5	31	1008		0
2	Sentinel	Mooring + F	2024-07-19	19:22	56,692118	-60,284535	Box Core	Bottom	479	60	15	7,5	6,7	31	1008		0
2	Sentinel	Mooring + F	2024-07-19	19:13	56,692653	-60,284320	Box Core	Deploymen	480	59	16,6	7,5	7,5	31	1008		0
2	Sentinel	Mooring + F	2024-07-19	18:31	56,689790	-60,263121	CTD Rosett	Recovery	493	46	14,3	7,2	6,8	31	1007		0
2	Sentinel	Mooring + F	2024-07-19	18:04	56,692308	-60,262331	CTD Rosett	Bottom	498	55	16,9	7,1	7,3	31	1007		0
2	Sentinel	Mooring + F	2024-07-19	17:55	56,691968	-60,260818	CTD Rosett	Deploymen	496	57	17,8	7,1	6,1	32	1007		0
2	Sentinel	ROV + Full	2024-07-19	13:15	56,315284	-59,837103	CTD Rosett	Recovery	554	30	13,2	7	5,7	31	1004		0
2	Sentinel	ROV + Full	2024-07-19	13:02	56,315769	-59,838142	CTD Rosett	Bottom	550	51	14,1	7	6,2	31	1004		0
2	Sentinel	ROV + Full	2024-07-19	12:52	56,316259	-59,838415	CTD Rosett	Deploymen	550	51	14,6	7	6,4	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	11:44	56,320903	-59,838699	Mooring	Bottom	533	70	15,1	7	6,6	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	11:36	56,322030	-59,838223	Mooring	Deploymen	512	69	13,7	7	6,5	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	9:15	56,275917	-59,872612	IKMT	Recovery	450	74	12	6,8	6,4	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	8:37	56,302958	-59,865370	IKMT	Bottom	401	78	11,8	6,9	6,6	31	1003		1
2	Sentinel	ROV + Full	2024-07-19	8:17	56,314224	-59,856025	IKMT	Deploymen	482	79	12	7,2	6,7	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	7:52	56,312904	-59,839249	Hydrobios	Recovery	513	95	14	6,9	6,7	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	7:35	56,316949	-59,838832	Hydrobios	Bottom	551	92	14,7	6,9	6,6	31	1003		1
2	Sentinel	ROV + Full	2024-07-19	7:23	56,320148	-59,840202	Hydrobios	Deploymen	537	96	13,9	6,8	6,5	31	1003		1

2	Sentinel	ROV + Full	2024-07-19	6:52	56,308571	-59,841394	Hydrobios	Recovery	474	91	12,3	6,8	6,3	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	6:34	56,313270	-59,841455	Hydrobios	Bottom	517	86	10,6	6,7	6,3	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	6:21	56,317482	-59,841067	Hydrobios	Deploymen	555	79	12,3	6,7	6,3	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	5:40	56,313133	-59,850452	Tucker	Recovery	507	75	8,4	6,6	6,2	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	5:34	56,316540	-59,850288	Tucker	Bottom	548	83	8,9	6,6	6,2	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	5:27	56,320312	-59,848028	Tucker	Deploymen	558	83	8,6	6,7	6,2	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	4:25	56,319663	-59,840576	Box Core	Recovery	558	101	11,1	6,6	6,3	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	4:14	56,319606	-59,839907	Box Core	Bottom	542	97	12,3	6,6	6,3	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	4:00	56,320024	-59,838796	Box Core	Deploymen	529	106	10,5	6,6	6,4	31	1004		1
2	Sentinel	ROV + Full	2024-07-19	3:30	56,316680	-59,836511	CTD Rosette	Recovery	545	105	9,8	6,6	6,5	31	1005		1
2	Sentinel	ROV + Full	2024-07-19	2:46	56,318342	-59,837989	CTD Rosette	Bottom	571	227	1,5	6,7	6,5	31	1005		1
2	Sentinel	ROV + Full	2024-07-19	2:35	56,319046	-59,837584	CTD Rosette	Deploymen	582	108	10,9	6,6	6,6	31	1005		1
2	Sentinel	ROV + Full	2024-07-19	1:53	56,320675	-59,838757	Mooring	Recovery	529	112	12,4	6,5	6,7	31	1005		1
2	Sentinel	ROV + Full	2024-07-19	1:44	56,320612	-59,838742	Mooring	Bottom	529	111	10,9	6,5	6,7	31	1005		1
2	Sentinel	ROV + Full	2024-07-19	1:34	56,320575	-59,838713	Mooring	Deployment		117	10,3	6,5	6,7	31	1005		1
2	Sentinel	ROV + Full	2024-07-19	1:25	56,320637	-59,838744	Mooring	Recovery		111	10	6,5	6,7	31	1006		1
2	Sentinel	ROV + Full	2024-07-19	1:17	56,320598	-59,838718	Mooring	Bottom		121	11,6	6,5	6,8	31	1005		1
2	Sentinel	ROV + Full	2024-07-19	1:05	56,320560	-59,838692	Mooring	Deployment		123	10,7	6,5	6,8	31	1006		1
2	Sentinel	ROV + Full	2024-07-19	0:20	56,320448	-59,838402	ROV	Recovery		119	15	6,5	6,8	31	1005		1
2	Sentinel	ROV + Full	2024-07-18	21:00	56,321174	-59,839680	ROV	Bottom		138	10,9	6,8	6,9	31	1005		1
2	Sentinel	ROV + Full	2024-07-18	20:09	56,321178	-59,839686	ROV	Deployment		143	15,2	6,8	6,9	31	1005		1
2	Sentinel	ROV + Full	2024-07-18	18:21	56,320384	-59,838484	Drop Camer	Recovery	529	248	0	7,3			1005		1
2	Sentinel	ROV + Full	2024-07-18	17:34	56,320437	-59,837947	Drop Camer	Bottom	531	118	3,1	7,2	6,8	31	1005		1
2	Sentinel	ROV + Full	2024-07-18	17:26	56,320443	-59,837974	Drop Camer	Deploymen	531	196	1,9	7,2	6,8	31	1006		1
2	Sentinel	ROV + Full	2024-07-18	13:17	56,303860	-59,850045	Drop Camer	Recovery	440	161	12,1	7,1	6,4	31	1006		1
2	Sentinel	ROV + Full	2024-07-18	12:41	56,308039	-59,846007	Drop Camer	Bottom	513	163	14,8	7,1	6,4	31	1006		1
2	Sentinel	ROV + Full	2024-07-18	12:34	56,308661	-59,845231	Drop Camer	Deploymen	499	156	13,9	7,1	6,8	31	1006		1
2	Sentinel	ROV + Full	2024-07-18	11:38	56,317183	-59,842963	Drop Camer	Recovery	562	171	14,6	7,1	6,2	31	1006		1
2	Sentinel	ROV + Full	2024-07-18	10:55	56,319860	-59,838851	Drop Camer	Bottom	576	163	16,2	7	6,4	31	1006		1
2	Sentinel	ROV + Full	2024-07-18	10:45	56,320602	-59,837006	Drop Camer	Deploymen	542	179	14,8	6,9	6,5	31	1006		1
2	Hopeda	Full	2024-07-17	19:07	55,730411	-59,415433	MBES	Deploymen	195	137	13	8,7	9,4	30	1005		1
2	Hopeda	Full	2024-07-17	19:06	55,729191	-59,415686	MBES	Deploymen	205	154	8,7	8,8	9,4	30	1005		1
2	Hopeda	Full	2024-07-17	18:51	55,717642	-59,409263	Beam Trawl	Recovery	259	123	18,7	8,4	9,5	30	1005		1
2	Hopeda	Full	2024-07-17	18:35	55,721668	-59,391637	Beam Trawl	Bottom	275	119	21,2	8,3	9,3	30	1005		1
2	Hopeda	Full	2024-07-17	18:14	55,726105	-59,371770	Beam Trawl	Deploymen	305	127	16,9	8,2	9,3	30	1006		1
2	Hopeda	Full	2024-07-17	17:35	55,717420	-59,395366	Hydrobios	Recovery	212	138	21,4	8,2	8,1	31	1005		1
2	Hopeda	Full	2024-07-17	17:28	55,717447	-59,395012	Hydrobios	Bottom	205	138	23,9	8,2	9,2	30	1005		1
2	Hopeda	Full	2024-07-17	17:21	55,717623	-59,394274	Hydrobios	Deploymen	211	140	24	8,2	8,5	31	1005		1

2	Hopeda	Full	2024-07-17	16:38	55,717156	-59,415721	Tucker	Recovery	293	132	20,6	8,3	9,2	30	1005		1
2	Hopeda	Full	2024-07-17	16:29	55,719588	-59,407210	Tucker	Bottom	242	126	18,4	8,2	9,2	30	1005		1
2	Hopeda	Full	2024-07-17	16:24	55,720769	-59,402854	Tucker	Bottom	259	115	19	8,3	9,2	30	1005		1
2	Hopeda	Full	2024-07-17	16:18	55,721952	-59,396849	Tucker	Deploymen	243	131	18,5	8,8	9,2	30	1005		1
2	Hopeda	Full	2024-07-17	15:12	55,717685	-59,394831	Box Core	Recovery	217	129	22,4	8	8,2	31	1005		1
2	Hopeda	Full	2024-07-17	15:07	55,717580	-59,394361	Box Core	Bottom	212	125	23,4	8	9,3	30	1005		1
2	Hopeda	Full	2024-07-17	15:02	55,717543	-59,393967	Box Core	Deploymen	209	126	20,2	8	8,7	30	1005		1
2	Hopeda	Full	2024-07-17	14:51	55,717582	-59,395259	Box Core	Recovery	217	128	21	8	8,5	30	1005		1
2	Hopeda	Full	2024-07-17	14:45	55,717507	-59,394580	Box Core	Bottom	209	130	18,8	7,9	8,6	30	1005		1
2	Hopeda	Full	2024-07-17	14:40	55,717357	-59,393989	Box Core	Deploymen	203	129	21,9	7,9	8,5	30	1005		1
2	Hopeda	Full	2024-07-17	14:18	55,719875	-59,400689	Drop Camer	Recovery	247	123	21	8	8,8	31	1005		1
2	Hopeda	Full	2024-07-17	13:39	55,717030	-59,393036	Drop Camer	Bottom	193	138	22,3	8	8,5	30	1005		1
2	Hopeda	Full	2024-07-17	13:35	55,717168	-59,393438	Drop Camer	Deploymen	196	139	22,7	7,9	6,9	30	1005		1
2	Hopeda	Full	2024-07-17	12:41	55,716902	-59,393580	CTD Rosette	Recovery	190	133	16,7	7,8	9,1	30	1005		1
2	Hopeda	Full	2024-07-17	12:16	55,717329	-59,393576	CTD Rosette	Bottom	200	131	22,8	7,9	9,1	30	1005		1
2	Hopeda	Full	2024-07-17	12:12	55,717422	-59,393711	CTD Rosette	Deploymen	201	133	19,7	7,9	9,2	30	1005		1
2	MAK-20	ROV + Full	2024-07-16	19:40	55,434486	-58,946049	Box Core	Recovery	691	128	20,2	9,6	8,2	31	1004	97	1
2	MAK-20	ROV + Full	2024-07-16	19:25	55,435223	-58,945796	Box Core	Bottom	711	134	21,8	9,6	8,3	31	1003	97	1
2	MAK-20	ROV + Full	2024-07-16	19:09	55,433892	-58,945828	Box Core	Deploymen	709	140	22,1	9,6	7,4	31	1004	97	1
2	MAK-20	ROV + Full	2024-07-16	18:15	55,432828	-58,942844	CTD Rosette	Recovery	706	133	21,4	9,5	8,2	31	1004	96	1
2	MAK-20	ROV + Full	2024-07-16	17:59	55,432355	-58,944665	CTD Rosette	Bottom	707	144	25,3	9,6	8,0	31	1003	96	1
2	MAK-20	ROV + Full	2024-07-16	17:46	55,432057	-58,945778	CTD Rosette	Deploymen	707	142	22,2	9,7	8,0	31	1004	96	1
2	MAK-20	ROV + Full	2024-07-16	9:17	55,435240	-58,943875	IKMT	Recovery	712	134	18,4	10,8	7,8	31	1005	96	1
2	MAK-20	ROV + Full	2024-07-16	8:30	55,431218	-58,952197	IKMT	Bottom	689	149	15,1	10,2	7,9	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	8:04	55,438375	-58,937727	IKMT	Deploymen	718	148	12,6	10,6	8,1	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	7:31	55,435560	-58,937792	Hydrobios	Recovery	710	143	14,2	10	8,0	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	7:10	55,434587	-58,937253	Hydrobios	Bottom	702	152	13,7	9,9	7,5	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	6:52	55,434391	-58,938071	Hydrobios	Deploymen	705	158	13,6	10,2	6,5	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	6:21	55,435506	-58,955614	Tucker	Recovery	578	160	16,7	10,1	8,1	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	6:10	55,438760	-58,946970	Tucker	Bottom	712	159	13,9	10,1	7,9	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	5:56	55,435890	-58,939680	Tucker	Deploymen	714	159	1,9	9,9	8,1	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	4:57	55,433963	-58,938829	Box Core	Recovery	705	154	15,7	9,3	7,7	31	1007	96	1
2	MAK-20	ROV + Full	2024-07-16	4:46	55,433649	-58,937230	Box Core	Bottom	682	144	15,4	9,1	7,5	31	1006	96	1
2	MAK-20	ROV + Full	2024-07-16	4:34	55,433839	-58,936399	Box Core	Deploymen	631	143	15,8	8,9	7,5	31	1007	96	1
2	MAK-20	ROV + Full	2024-07-16	4:15	55,432997	-58,939225	Box Core	Recovery	699	137	16,4	8,8	6,8	31	1007	96	1
2	MAK-20	ROV + Full	2024-07-16	4:03	55,433334	-58,937957	Box Core	Bottom	695	129	19,3	8,7	7,5	31	1007	96	1
2	MAK-20	ROV + Full	2024-07-16	3:51	55,433765	-58,937667	Box Core	Deploymen	697	137	16	8,6	7,1	31	1007	96	1
2	MAK-20	ROV + Full	2024-07-16	3:01	55,432451	-58,937000	CTD Rosette	Recovery	684	119	13,9	9,8	7,5	31	1008	94	1

2	MAK-20	ROV + Full	2024-07-16	2:26	55,433479	-58,936386	CTD Rosette	Bottom	688	115	9,4	9,4	7,5	31	1008	96	1
2	MAK-20	ROV + Full	2024-07-16	2:14	55,434021	-58,936746	CTD Rosette	Deploymen	700	105	6,4	10,1	7,4	31	1008	94	1
2	MAK-20	ROV + Full	2024-07-16	1:21	55,433282	-58,939018	Box Core	Recovery	701	125	18,5	8,4	7,4	31	1008	96	1
2	MAK-20	ROV + Full	2024-07-16	1:06	55,433434	-58,939490	Box Core	Bottom	703	128	15,9	8,6	7,1	31	1008	96	1
2	MAK-20	ROV + Full	2024-07-16	0:54	55,433807	-58,940591	Box Core	Deploymen	708	129	18,2	8,6	7,0	31	1008	96	1
2	MAK-20	ROV + Full	2024-07-16	0:34	55,433057	-58,938956	Box Core	Recovery	700	121	16,7	8,5	7,5	31	1008	96	1
2	MAK-20	ROV + Full	2024-07-16	0:21	55,433459	-58,940169	Box Core	Bottom	706	124	19,9	8,6	7,3	31	1008	95	1
2	MAK-20	ROV + Full	2024-07-16	0:09	55,433666	-58,941562	Box Core	Deploymen	708	118	19,4	8,8	6,5	31	1008	94	1
2	MAK-20	ROV + Full	2024-07-15	23:40	55,433129	-58,941819	CTD Rosette	Recovery	708	116	11,5	14,1	7,1	31	1008	73	1
2	MAK-20	ROV + Full	2024-07-15	23:25	55,433782	-58,942202	CTD Rosette	Bottom	710	131	11,5	15,2	7,3	31	1008	68	1
2	MAK-20	ROV + Full	2024-07-15	23:13	55,434312	-58,942328	CTD Rosette	Deploymen	710	115	16	11	6,7	31	1008	81	1
2	MAK-20	ROV + Full	2024-07-15	22:15	55,434001	-58,942354	Gravity Cor	Recovery	710	222	3,6	9,3	7,2	31	1008	92	1
2	MAK-20	ROV + Full	2024-07-15	22:02	55,433639	-58,941191	Gravity Cor	Bottom	707	169	7,9	9,2	6,4	31	1008	92	1
2	MAK-20	ROV + Full	2024-07-15	21:49	55,433589	-58,941472	Gravity Cor	Deploymen	708	97	0,8	9,3	6,8	31	1008	92	1
2	MAK-20	ROV + Full	2024-07-15	20:39	55,434148	-58,936742	Gravity Cor	Recovery	695	123	13,7	9,3	7,9	31	1009	91	1
2	MAK-20	ROV + Full	2024-07-15	20:24	55,433904	-58,935585	Gravity Cor	Bottom	599	185	0,4	9,5	7,4	31	1009	90	1
2	MAK-20	ROV + Full	2024-07-15	20:10	55,433966	-58,935978	Gravity Cor	Deploymen	632	88	0,9	9,4	7,4	31	1009	90	1
2	MAK-20	ROV + Full	2024-07-15	18:36	55,433031	-58,935751	ROV	Recovery	568	121	11,9	9,3	7,6	31	1009	90	1
2	MAK-20	ROV + Full	2024-07-15	12:33	55,432904	-58,934741	ROV	Bottom	497	132	9	10,5	7,6	31	1010	79	1
2	MAK-20	ROV + Full	2024-07-15	11:25	55,433115	-58,934607	ROV	Deploymen	489	161	7,9	9,3	7,1	31	1009	89	1
2	MAK-20	ROV + Full	2024-07-15	9:02	55,435361	-58,943734	CTD Rosette	Recovery	711	140	5,9	8,5	7,4	31	1008	93	0
2	MAK-20	ROV + Full	2024-07-15	8:46	55,435916	-58,944752	CTD Rosette	Bottom	711	142	6,9	8,6	7,6	31	1008	93	0
2	MAK-20	ROV + Full	2024-07-15	8:34	55,435822	-58,946458	CTD Rosette	Deploymen	710	153	6,6	9,1	7,2	31	1008	92	0
2	MAK-20	Benthic	2024-07-15	5:08	55,513761	-58,939158	Box Core	Recovery	698	112	3	8,7	7,7	32	1008	96	0
2	MAK-20	Benthic	2024-07-15	4:56	55,514944	-58,939903	Box Core	Bottom	696	148	3,5	9	7,6	32	1008	95	0
2	MAK-20	Benthic	2024-07-15	4:42	55,514653	-58,940616	Box Core	Deploymen	696	179	4,4	9	7,8	32	1008	95	0
2	MAK-20	Benthic	2024-07-15	4:29	55,514764	-58,941978	CTD Rosette	Recovery	687	143	4,7	9,2	7,8	32	1008	93	0
2	MAK-20	Benthic	2024-07-15	4:14	55,515438	-58,942893	CTD Rosette	Bottom	673	134	6,2	9,8	7,8	32	1008	91	0
2	MAK-20	Benthic	2024-07-15	4:02	55,516525	-58,943303	CTD Rosette	Deploymen	676	196	4,7	12,2	7,7	32	1008	78	0
2	MAK-20	Benthic	2024-07-15	3:20	55,514942	-58,937962	Box Core	Recovery	697	134	7,2	9,4	8,3	32	1008	91	0
2	MAK-20	Benthic	2024-07-15	3:06	55,514894	-58,938052	Box Core	Bottom	697	147	8,1	9,4	8,5	32	1008	93	0
2	MAK-20	Benthic	2024-07-15	2:52	55,515015	-58,938056	Box Core	Deploymen	696	152	7,2	10	7,4	32	1008	90	0
2	MAK-20	Benthic	2024-07-15	2:27	55,512709	-58,936013	CTD Rosette	Recovery	660	68	1,9	9,4	8,4	32	1008	94	0
2	MAK-20	Benthic	2024-07-15	2:11	55,513402	-58,936699	CTD Rosette	Bottom	664	146	5,3	9,7	8,2	32	1008	92	0
2	MAK-20	Benthic	2024-07-15	1:59	55,514283	-58,937458	CTD Rosette	Deploymen	690	122	6,1	9,9	8,3	32	1008	92	0
2	ASL Mak	Mooring	2024-07-14	22:47	55,406533	-58,063194	CTD Rosette	Recovery	106	35	0,4	11,6	8,9	31	1008	75	0
2	ASL Mak	Mooring	2024-07-14	22:43	55,406490	-58,063283	CTD Rosette	Bottom	106	97	1,4	11,6	8,8	31	1008	75	0
2	ASL Mak	Mooring	2024-07-14	22:38	55,406434	-58,064050	CTD Rosette	Deploymen	106	116	2,4	11,6	8,8	31	1008	75	0

2	ASL Mak	Mooring	2024-07-14	22:07	55,410690	-58,063859	Mooring De	Bottom	104	105	4,9	11,5	9,0	31	1008	75	0
2	ASL Mak	Mooring	2024-07-14	22:03	55,410593	-58,063895	Mooring De	Deploymen	104	116	4,9	11,4	8,4	31	1008	75	0
2	ASL Mak	Mooring	2024-07-14	21:26	55,408587	-58,059258	Mooring De	Bottom	105	191	3,2	13,4	8,4	31	1009	74	0
2	ASL Mak	Mooring	2024-07-14	21:26	55,408568	-58,059276	Mooring De	Deploymen	105	123	3,1	13,4	8,6	31	1009	73	0
2	ASL Mak	Mooring	2024-07-14	18:42	55,409384	-58,059626	Mooring Re	Recovery	105	42	1	11,7	7,4	31	1009	79	0
2	ASL Mak	Mooring	2024-07-14	18:12	55,411877	-58,063868	Mooring Re	Recovery	106	331	1	11,5	7,8	31	1009	79	0
2	ASL Mak	Mooring	2024-07-14	17:35	55,411178	-58,065427	CTD Rosette	Recovery	106	200	3,4	11,3	7,9	31	1009	85	0
2	ASL Mak	Mooring	2024-07-14	17:29	55,410904	-58,065286	CTD Rosette	Bottom	106	191	3,7	11,7	7,9	31	1009	89	0
2	ASL Mak	Mooring	2024-07-14	17:27	55,410767	-58,065277	CTD Rosette	Deploymen	106	189	4,7	11,8	7,7	31	1009	88	0
2	Hopeda	Mooring + F	2024-07-14	13:17	56,046877	-57,427053	CTD Rosette	Recovery	489	220	6,5	7,8	5,0	33	1011	96	0
2	Hopeda	Mooring + F	2024-07-14	13:05	56,049000	-57,426827	CTD Rosette	Bottom	504	220	7,6	7,7	5,5	33	1011	96	0
2	Hopeda	Mooring + F	2024-07-14	12:55	56,051124	-57,426647	CTD Rosette	Deploymen	497	210	7,4	7,5	5,2	33	1011	96	0
2	Hopeda	Mooring + F	2024-07-14	11:28	56,056873	-57,428468	Mooring De	Bottom	477	189	5,5	10,8	6,3	33	1011	75	0
2	Hopeda	Mooring + F	2024-07-14	11:12	56,057792	-57,428530	Mooring De	Deploymen	480	200	9,8	7,9	6,2	33	1011	89	0
2	Hopeda	Mooring + F	2024-07-14	8:01	56,059325	-57,354609	IKMT	Recovery	1070	248	3,2	7,6	6,8	33	1012	88	0
2	Hopeda	Mooring + F	2024-07-14	7:17	56,035603	-57,382206	IKMT	Bottom	930	281	3,2	7,5	6,7	33	1013	87	0
2	Hopeda	Mooring + F	2024-07-14	7:01	56,033823	-57,398975	IKMT	Deploymen	763	146	0	7	6,5	33	1012	91	0
2	Hopeda	Mooring + F	2024-07-14	6:27	56,052118	-57,413314	Hydrobios	Recovery	577	275	5	6,6	6,7	33	1013	94	0
2	Hopeda	Mooring + F	2024-07-14	6:10	56,053896	-57,417492	Hydrobios	Bottom	551	284	3,8	6,5	6,2	33	1013	94	0
2	Hopeda	Mooring + F	2024-07-14	5:57	56,055815	-57,421665	Hydrobios	Deploymen	536	262	4,4	6,4	6,5	33	1013	96	0
2	Hopeda	Mooring + F	2024-07-14	5:05	56,046275	-57,398735	Tucker	Recovery	773	265	7,3	6,2	6,6	33	1013	96	0
2	Hopeda	Mooring + F	2024-07-14	4:52	56,046479	-57,388231	Tucker	Bottom	863	296	7,4	6,3	6,6	33	1013	96	0
2	Hopeda	Mooring + F	2024-07-14	4:40	56,041699	-57,389281	Tucker	Deploymen	877	282	7,2	6,7	6,7	33	1013	94	0
2	Hopeda	Mooring + F	2024-07-14	3:25	55,985317	-57,310889	Box Core	Recovery	1184	285	7,9	6,4	6,4	33	1013	95	0
2	Hopeda	Mooring + F	2024-07-14	3:05	55,987774	-57,315594	Box Core	Bottom	1188	304	6,9	6,4	5,8	33	1013	94	0
2	Hopeda	Mooring + F	2024-07-14	2:44	55,990279	-57,320265	Box Core	Deploymen	1195	305	6,4	6,4	6,1	33	1013	94	0
2	Hopeda	Mooring + F	2024-07-14	2:24	55,981862	-57,309882	Drop Camer	Recovery	1203	309	6,9	6,5	6,9	33	1013	92	0
2	Hopeda	Mooring + F	2024-07-14	1:36	55,986873	-57,314319	Drop Camer	Bottom	1190	304	9,6	6,3	6,7	33	1013	92	0
2	Hopeda	Mooring + F	2024-07-14	1:20	55,988212	-57,316534	Drop Camer	Deploymen	1190	303	10,7	6,2	6,8	33	1013	94	0
2	Hopeda	Mooring + F	2024-07-13	23:55	56,047315	-57,420521	Mooring Re	Recovery	564	310	8,4	6,5	6,8	33	1012	92	
2	Hopeda	Mooring + F	2024-07-13	23:24	56,052311	-57,421882	Mooring Re	Deploymen	517	309	11,4	6,5	6,7	33	1012	92	
2	Hopeda	Mooring + F	2024-07-13	22:19	56,047050	-57,408928	CTD Rosette	Recovery	709	339	12,8	6,9	6,7	33	1012	87	
2	Hopeda	Mooring + F	2024-07-13	22:01	56,050171	-57,409772	CTD Rosette	Bottom	639	340	16	7	6,7	33	1012	86	
2	Hopeda	Mooring + F	2024-07-13	21:58	56,050701	-57,410363	CTD Rosette	Bottom	625	335	15,2	7	6,7	33	1012	87	
2	Hopeda	Mooring + F	2024-07-13	21:57	56,051089	-57,410593	CTD Rosette	Bottom	619	338	16,5	7	6,7	33	1012	87	
2	Hopeda	Mooring + F	2024-07-13	21:56	56,051357	-57,410707	CTD Rosette	Bottom	614	338	17,3	7	6,7	33	1012	86	
2	Hopeda	Mooring + F	2024-07-13	21:45	56,053680	-57,411791	CTD Rosette	Deploymen	593	334	15,7	7,1	6,6	33	1012	86	
Leg 2																		

3	RA24		2024-09-04	15:43	78,030177	-75,603430	Tucker	Recovery	252,4	45	6,9	0,3	-1,175	29,418	1003		
3	RA24		2024-09-04	15:34	78,026561	-75,614909	Tucker	Bottom	253,1	65	7,6	0,6	-1,251	29,473	1003		
3	RA24		2024-09-04	15:20	78,030287	-75,616674	Tucker	Deploymen	166,8	23	9,1	0,9	-1,19	29,472	1003		
3	RA24	Full	2024-09-04	14:40	78,031193	-75,604398	BoxCore	Recovery	235,6	79	11,1	1	-1,144	29,494	1003		
3	RA24	Full	2024-09-04	14:34	78,030975	-75,604897	BoxCore	Bottom	234,4	80	11,6	1,8	-1,24	29,584	1003		
3	RA24	Full	2024-09-04	14:21	78,030909	-75,603442	BoxCore	Recovery	246,6	352	14,3	1,1	-1,252	29,497	1003		
3	RA24	Full	2024-09-04	14:15	78,031151	-75,602492	BoxCore	Bottom	246,9	86	7,9	1,4	-1,299	29,545	1003		
3	RA24	Full	2024-09-04	14:05	78,031440	-75,600693	BoxCore	Deploymen	251	93	9,4	1,9	-1,206	29,451	1003		
3	RA24	Full	2024-09-04	13:22	78,029125	-75,607577	Monster	Recovery	247	27	4,6	2,1	-1,144	29,401	1003		
3	RA24	Full	2024-09-04	13:18	78,029653	-75,606483	Optique (ba	Recovery	246,1	51	6,1	2,1	-1,238	29,496	1003		
3	RA24	Full	2024-09-04	13:15	78,029888	-75,606226	Optique (ba	Bottom	243,3	220	7,4	1,4	-1,269	29,52	1003		
3	RA24	Full	2024-09-04	13:13	78,030045	-75,606043	Monster	Bottom	242,8	66	7,7	1,3	-1,283	29,532	1003		
3	RA24	Full	2024-09-04	13:09	78,030353	-75,605733	Optique (ba	Deploymen	241,3	54	8,9	1,5	-1,128	29,385	1003		
3	RA24	Full	2024-09-04	13:05	78,030470	-75,605728	Monster	Deploymen	239,1	167	7,9	1,7	-1,114	29,417	1003		
3	RA24	Full	2024-09-04	13:00	78,030752	-75,605417	Optique ds		236,6	59	8,7	1,2	-1,228	29,502	1003		
3	RA24	Full	2024-09-04	12:53	78,030832	-75,604604	CTD-R #2	Recovery	240,9	63	11	1	-1,26	29,54	1003		
3	RA24	Full	2024-09-04	12:18	78,031779	-75,605035	CTD-R #2	Bottom	217,3	5	7	1,3	-1,109	29,435	1003		
3	RA24	Full	2024-09-04	12:07	78,032260	-75,605605	CTD-R #2	Deploymen	208	69	7,7	2,6	-1,118	29,369	1003		
3	RA24	Full	2024-09-04	11:51	78,031320	-75,604497	TM #1	Recovery	235,2	50	8,6	1,6	-1,097	29,358	1003		
3	RA24	Full	2024-09-04	11:25	78,032657	-75,603310	TM #1	Bottom	210	10	6,2	2	-1,043	29,34	1003		
3	RA24	Full	2024-09-04	11:12	78,032594	-75,603883	TM #1	Deploymen	211,7	61	8,6	1	-1,054	29,345	1003		
3	RA24	Full	2024-09-04	10:51	78,029240	-75,599185	CTD-R #1	Recovery	298,7	53	9,9	2,3	-1,172	29,447	1003		
3	RA24	Full	2024-09-04	10:23	78,032004	-75,600453	CTD-R #1	Bottom	246,8	39	10,6	1,6	-1,174	29,47	1003		
3	RA24	Full	2024-09-04	10:14	78,032557	-75,602978	CTD-R #1	Deploymen	219,4	51	10,6	4,1	-1,202	29,557	1003		
3	RA23	Mooring	2024-09-04	1:28	78,325909	-74,878597	Mooring re	Recovery	343,7	34	13,1	0,6	-1,121	30,416	1003		
3	RA23	Mooring	2024-09-04	1:11	78,324085	-74,899238	Mooring re	Deploymen	290,6	32	12,5	0,4	-1,127	30,295	1004		
3	RA23	Mooring	2024-09-04	0:44	78,320968	-74,838410	CTD-R #1	Recovery	483,5	29	11,6	0,1	-1,138	29,921	1004		
3	RA23	Mooring	2024-09-04	0:30	78,321603	-74,842156	CTD-R #1	Bottom	481,4	26	11,5	-0,6	-1,169	30,032	1004		
3	RA23	Mooring	2024-09-04	0:18	78,322569	-74,844302	CTD-R #1	Deploymen	468,1	46	14,3	0,5	-1,115	30,218	1004		
3	RA22	Mooring	2024-09-03	21:26	78,318689	-73,181910	Mooring re	Recovery	257,5	332	0	0,7	1,468	31,013	1004		
3	RA22	Mooring	2024-09-03	21:09	78,320910	-73,185804	Zodiac reco	Recovery	542,7	41	12,5	0,1	1,393	30,995	1005		
3	RA22	Mooring	2024-09-03	20:55	78,321113	-73,195347	Mooring re	Deploymen	309,3	60	12,4	-0,1	1,328	30,978	1005		
3	RA22	Mooring	2024-09-03	20:24	78,318911	-73,182635	CTD-R #1	Recovery	257,4	75	18,2	0,4	1,567	31,037	1005		
3	RA22	Mooring	2024-09-03	20:16	78,319159	-73,183879	CTD-R #1	Bottom	258,7	75	17	0,3	1,62	31,059	1005		

3	RA22	Mooring	2024-09-03	20:07	78,319859	-73,187038	CTD-R #1	Deploymen	276	61	13,2	0,2	1,815	31,077	1005			
3	RA21	Basic	2024-09-02	22:52	76,034549	-83,116678	Hydrobios	Recovery	652,8	172	13,4	5,8	0,54	29,403	1003			
3	RA21	Basic	2024-09-02	22:31	76,032932	-83,120490	Hydrobios	Bottom	651,9	158	14,3	1,5	0,595	29,24	1003			
3	RA21	Basic	2024-09-02	22:14	76,031484	-83,122260	Hydrobios	Deploymen	650,6	167	12,1	2	0,555	29,251	1003			
3	RA21	Basic	2024-09-02	21:57	76,029959	-83,112971	CTD-R #1	Recovery	651,4	180	9,3	5,3	0,592	29,241	1003			
3	RA21	Basic	2024-09-02	21:16	76,030249	-83,117032	CTD-R #1	Bottom	651,4	167	13,6	3,5	0,582	29,271	1003			
3	RA21	Basic	2024-09-02	20:58	76,030079	-83,120522	CTD-R #1	Deploymen	651,8	130	11,2	4,1	0,427	29,722	1002			
3	RA20	Basic	2024-09-02	14:47	75,569461	-78,873671	Hydrobios	Recovery	518,1	278	4,7	0,3	0,242	29,35	1003			
3	RA20	Basic	2024-09-02	14:28	75,570172	-78,868091	Hydrobios	Bottom	518,6	284	3,6	0,3	-0,106	29,145	1003			
3	RA20	Basic	2024-09-02	14:14	75,570484	-78,866239	Hydrobios	Deploymen	520	297	4,1	1,2	-0,099	29,154	1003			
3	RA20	Basic	2024-09-02	13:41	75,568570	-78,871978	CTD-R #1	Recovery	517,5	2	2,2	0,7	0,231	29,335	1003			
3	RA20	Basic	2024-09-02	12:59	75,570027	-78,862802	CTD-R #1	Bottom	519,8	107	4,4	0,3	-0,068	29,147	1003			
3	RA20	Basic	2024-09-02	12:45	75,570487	-78,859725	CTD-R #1	Deploymen	524,7	114	4,1	0	0,245	29,672	1003			
3	RA19	CTD	2024-08-30	11:10	81,242993	-64,382209	CTD-R	Recovery	501,2	231	4,6	-3,7	-1,573	29,812	1001			
3	RA19	CTD	2024-08-30	10:24	81,252192	-64,324099	CTD-R	Bottom	481,2	316	4,8	-3,1	-1,555	29,873	1000			
3	RA19	CTD	2024-08-30	10:11	81,254803	-64,307493	CTD-R	Deploymen	476,5	332	2,5	-3	-1,54	29,859	1001			
3	RA18	Full	2024-08-30	2:51	81,943002	-60,374679	Drop Cam	Recovery	294,2	62	7,1	-3,5	-1,377	29,049	1000			
3	RA18	Full	2024-08-30	2:14	81,938695	-60,372073	Drop Cam	Bottom	297,4	66	9	-3,2	-1,39	28,972	1000			
3	RA18	Full	2024-08-30	2:07	81,938124	-60,372816	Drop Cam	Deploymen	297,3	57	6,7	-3,2	-1,405	28,442	1000			
3	RA18	Full	2024-08-30	1:27	81,939729	-60,379679	BoxCore Bio	Recovery	297,8	72	11,3	-3,4	-1,369	28,696	1000			
3	RA18	Full	2024-08-30	1:19	81,939036	-60,378303	BoxCore Bio	Bottom	297,6	65	11,3	-3,3	-1,385	28,79	1000			
3	RA18	Full	2024-08-30	1:11	81,938782	-60,376178	BoxCore Bio	Deploymen	297,4	47	11,3	-3,6	-1,277	28,346	1000			
3	RA18	Full	2024-08-30	0:44	81,938032	-60,363685	CTD-R #2	Recovery	297,1	53	14,1	-3,7	-1,223	28,706	1000			
3	RA18	Full	2024-08-30	0:08	81,938239	-60,362674	CTD-R #2	Bottom	296,8	64	7,8	-3,7	-1,354	28,84	1000			
3	RA18	Full	2024-08-29	23:56	81,938291	-60,364317	CTD-R #2	Deploymen	297	61	12,2	-3,6	-1,411	29,07	1000			
3	RA18	Full	2024-08-29	23:32	81,938142	-60,361298	TM-R #1	Recovery	296,4	46	11,5	-3,6	-1,34	28,631	999			
3	RA18	Full	2024-08-29	23:09	81,938383	-60,362752	TM-R #1	Bottom	296,8	63	10	-3,5	-1,454	28,987	999			
3	RA18	Full	2024-08-29	22:55	81,938552	-60,355352	TM-R #1	Deploymen	296,4	58	13,4	-3,5	-1,4	28,606	999			
3	RA18	Full	2024-08-29	22:37	81,938517	-60,348906	CTD-R #1	Recovery	295,8	52	12,5	-3,6	-1,426	29,196	999			
3	RA18	Full	2024-08-29	22:08	81,939339	-60,356019	CTD-R #1	Bottom	296,7	44	10,5	-3,6	-1,384	28,977	999			
3	RA18	Full	2024-08-29	21:57	81,939872	-60,358271	CTD-R #1	Deploymen	296,3	48	12,8	-3,7	-1,327	28,644	999			
3	RA17	Full	2024-08-29	14:55	81,630673	-58,914484	Beam Trawl	Recovery	92,25	67	8,4	-1,7	-0,327	21,577	998			
3	RA17	Full	2024-08-29	14:39	81,635766	-58,971852	Beam Trawl	Bottom	90,79	11	8,1	-1,4	-0,043	20,865	998			
3	RA17	Full	2024-08-29	14:28	81,635892	-58,920248	Beam Trawl	Deploymen	78,1	69	15,9	-2	-0,246	22,386	998			

3	RA17	Full	2024-08-29	13:42	81,627997	-58,909413	BoxcoreBio	Recovery	96,2	95	7	-1,4	-0,414	24,822	999		
3	RA17	Full	2024-08-29	13:38	81,628104	-58,909901	BoxcoreBio	Bottom	96,44	150	1,9	-1,5	-0,434	24,051	999		
3	RA17	Full	2024-08-29	13:34	81,628071	-58,910771	BoxcoreBio	Deploymen	96,98	98	4,8	-1,5	-0,382	23,643	999		
3	RA17	Full	2024-08-29	13:04	81,626936	-58,910347	BoxcoreGe	Recovery	98,83	89	7,4	-1,8	-0,442	23,097	999		
3	RA17	Full	2024-08-29	13:00	81,626921	-58,909656	BoxcoreGe	Bottom	98,61	139	8	-1,9	-0,468	22,629	999		
3	RA17	Full	2024-08-29	12:55	81,626904	-58,909866	BoxcoreGe	Deploymen	98,8	83	11	-1,9	-0,449	22,689	999		
3	RA17	Full	2024-08-29	12:32	81,626519	-58,897708	Gravity Cor	Recovery	95,63	83	7,5	-1,4	-0,435	23,955	999		
3	RA17	Full	2024-08-29	12:30	81,626905	-58,898627	Gravity Cor	Bottom	95,2	31	4,4	-1,5	-0,401	25,699	999		
3	RA17	Full	2024-08-29	12:25	81,627006	-58,903743	Gravity Cor	Deploymen	96,72	72	8,6	-1,4	-0,472	26,727	999		
3	RA17	Full	2024-08-29	11:10	81,630682	-58,941175	Tucker	Recovery	93,53	85	7,7	-1,6	-0,376	23,141	999		
3	RA17	Full	2024-08-29	10:55	81,634723	-58,922457	Tucker	Bottom	78,5	87	6	-1,7	-0,064	20,888	999		
3	RA17	Full	2024-08-29	10:50	81,633283	-58,907338	Tucker	Deploymen	76,74	82	12,9	-1,8	-0,131	21,831	999		
3	RA17	Full	2024-08-29	10:24	81,630668	-58,912432	Monster	Recovery	93,47	278	0	-1,3	-0,374	27,329	999		
3	RA17	Full	2024-08-29	10:20	81,631079	-58,912760	Monster	Bottom	90,49	92	5,1	-1,2	-0,331	27,214	999		
3	RA17	Full	2024-08-29	10:16	81,631563	-58,913634	Monster	Deploymen	90,8	329	0	-1,2	-0,242	24,821	999		
3	RA17	Full	2024-08-29	3:23	81,627706	-58,890974	Drop Cam	Recovery	92,87	31	14,8	-2,1	-0,287	27,223	999		
3	RA17	Full	2024-08-29	2:51	81,630038	-58,908178	Drop Cam	Bottom	91,7	21	16,2	-2,2	-0,236	27,18	999		
3	RA17	Full	2024-08-29	2:48	81,630281	-58,910158	Drop Cam	Deploymen	90,82	13	14,6	-2,2	-0,034	25,701	999		
3	RA17	Full	2024-08-29	2:16	81,630053	-58,902967	CTD-R #2	Recovery	90	27	15,2	-2,3	-0,072	25,781	999		
3	RA17	Full	2024-08-29	1:47	81,629682	-58,909562	CTD-R #2	Bottom	92,61	23	18,3	-2,2	-0,262	27,113	999		
3	RA17	Full	2024-08-29	1:39	81,629779	-58,912057	CTD-R #2	Deploymen	93,84	28	18,5	-1,6	-0,087	25,252	999		
3	RA17	Full	2024-08-29	1:19	81,628891	-58,926553	TM-R #1	Recovery	98,46	23	19,7	-2,2	-0,46	27,347	999		
3	RA17	Full	2024-08-29	1:04	81,629257	-58,926201	TM-R #1	Bottom	99,38	25	17,9	-1,9	-0,424	27,009	999		
3	RA17	Full	2024-08-29	1:00	81,629315	-58,927176	TM-R #1	Deploymen	99,48	20	15,6	-1,8	-0,502	27,215	999		
3	RA17	Full	2024-08-29	0:30	81,629902	-58,921345	CTD-R #1	Recovery	95,4		19	-1,6	-0,254	27,182	999		
3	RA17	Full	2024-08-29	0:06	81,630898	-58,916547	CTD-R #1	Bottom	94,48	41	16,1	-1,3	-0,463	27,679	998		
3	RA17	Full	2024-08-28	23:59	81,630923	-58,916316	CTD-R #1	Deploymen	94,16	23	11,3	-1,1	-0,082	26,392	999		
3	RA16	Full	2024-08-28	21:12	81,728571	-59,238581	BoxcoreGe	Recovery	123,5	42	23,3	-1,6	-0,833	27,703	999		
3	RA16	Full	2024-08-28	21:08	81,728629	-59,237842	BoxcoreGe	Bottom	123,4	42	17,9	-1	-0,922	27,748	999		
3	RA16	Full	2024-08-28	21:03	81,728580	-59,237125	BoxcoreGe	Deploymen	122,8	46	18,6	-1,1	-0,755	27,336	999		
3	RA16	Full	2024-08-28	20:43	81,728216	-59,234789	BoxcoreBio	Recovery	122,1	48	23,1	-0,1	-0,867	27,912	999		
3	RA16	Full	2024-08-28	20:40	81,728185	-59,234739	BoxcoreBio	Bottom	122	47	21,5	-1,7	-0,876	28,02	999		
3	RA16	Full	2024-08-28	20:33	81,728282	-59,233593	BoxcoreBio	Deploymen	121,2	33	21,5	-1,6	-0,876	28,33	999		
3	RA16	Full	2024-08-28	20:11	81,727623	-59,229116	Gravity Cor	Recovery	119,3	49	16,5	0	-0,889	27,872	999		

3	RA16	Full	2024-08-28	20:07	81,727624	-59,229557	Gravity Cor	Bottom	119,1	46	19,1	-0,2	-0,929	28,172	999			
3	RA16	Full	2024-08-28	20:04	81,727749	-59,229796	Gravity Cor	Deploymen	120	51	18,9	-0,9	-0,866	28,179	999			
3	RA16	Full	2024-08-28	19:22	81,710988	-59,242527	Beam trawl	Recovery	103,2	48	18,5	0	-0,001	24,223	999			
3	RA16	Full	2024-08-28	19:07	81,710151	-59,194400	Beam trawl	Bottom	108,8	45	24,3	-1	0,229	23,456	998			
3	RA16	Full	2024-08-28	18:56	81,706865	-59,218583	Beam trawl	Deploymen	106,2	44	20	-0,9	0,117	24,05	998			
3	RA16	Full	2024-08-28	18:00	81,711932	-59,220491	Phytoplankt	Recovery	111,9	46	22,5	-1,2	-0,457	27,659	998			
3	RA16	Full	2024-08-28	17:54	81,712981	-59,219203	Phytoplankt	Bottom	114,5	41	20,9	-1,1	-0,487	27,542	999			
3	RA16	Full	2024-08-28	17:48	81,713362	-59,214553	Phytoplankt	Deploymen	113,4	44	20,1	-1,2	-0,234	26,026	999			
3	RA16	Full	2024-08-28	17:32	81,714519	-59,229333	Optics from	Recovery	111,6	36	15,9	-1,3	-0,765	28,321	999			
3	RA16	Full	2024-08-28	17:20	81,716744	-59,228895	Optics from	Bottom	115,9	34	15	-1,2	-0,32	27,153	999			
3	RA16	Full	2024-08-28	17:04	81,719331	-59,228425	Optics from	Deploymen	116,4	30	14,6	-0,9	-0,74	27,854	999			
3	RA16	Full	2024-08-28	16:56	81,718709	-59,226054	Monster	Recovery	115,8	30	16	-0,9	-0,533	27,271	999			
3	RA16	Full	2024-08-28	16:51	81,719138	-59,222715	Monster	Bottom	115,3	36	16,9	1	-0,682	27,194	999			
3	RA16	Full	2024-08-28	16:48	81,719291	-59,223819	Monster	Deploymen	115,6	70	11,7	2,2	-0,872	28,399	999			
3	RA16	Full	2024-08-28	16:23	81,717398	-59,206633	Tucker	Recovery	115,1	41	16,8	-0,8	-0,51	26,425	999			
3	RA16	Full	2024-08-28	16:16	81,720487	-59,220321	Tucker	Bottom	119,6	39	16,2	-0,7	0,015	26,119	999			
3	RA16	Full	2024-08-28	16:07	81,724580	-59,231357	Tucker	Deploymen	113,7	41	15,6	-0,4	-0,808	27,929	999			
3	RA16	Full	2024-08-28	15:31	81,718716	-59,210250	Drop Cam	Recovery	116,6	42	12,6	0,6	-1,085	28,663	999			
3	RA16	Full	2024-08-28	14:56	81,719265	-59,209424	Drop Cam	Bottom	119,4	42	7,2	2,2	-0,699	27,347	1000			
3	RA16	Full	2024-08-28	14:52	81,719338	-59,210721	Drop Cam	Deploymen	119	37	7,1	2,9	-0,711	26,717	1000			
3	RA16	Full	2024-08-28	14:16	81,716998	-59,215237	TM-R #2	Recovery	117,1	199	11,3	-0,8	-0,748	28,163	1000			
3	RA16	Full	2024-08-28	13:58	81,719258	-59,218004	TM-R #2	Bottom	116,7	30	9,2	-0,7	-0,798	28,202	1000			
3	RA16	Full	2024-08-28	13:49	81,719925	-59,220670	TM-R #2	Deploymen	115,3	42	8,5	0,3	-0,302	26,511	1000			
3	RA16	Full	2024-08-28	13:38	81,719119	-59,223196	TM-R #2	Recovery	115,4	40	7,1	2,2	-0,788	28,07	1000			
3	RA16	Full	2024-08-28	13:20	81,719773	-59,227945	TM-R #2	Bottom	117,2	50	9,5	0,8	-0,941	28,439	1000			
3	RA16	Full	2024-08-28	13:10	81,719889	-59,230298	TM-R #2	Deploymen	116,2	51	8,9	1,1	-0,539	27,487	1000			
3	RA16	Full	2024-08-28	12:54	81,718506	-59,233468	CTD-R #2	Recovery	115	21	7,1	0,7	-0,488	27,546	1000			
3	RA16	Full	2024-08-28	12:30	81,719757	-59,231839	CTD-R #2	Bottom	116	29	7,3	-0,4	-0,612	28,102	1000			
3	RA16	Full	2024-08-28	12:14	81,720245	-59,231589	CTD-R #2	Deploymen	116,6	28	4,1	0,2	-0,657	27,758	1001			
3	RA16	Full	2024-08-28	11:25	81,719617	-59,230629	TM-R #1	Recovery	116,2	9	4	0,5	-0,623	28,025	1001			
3	RA16	Full	2024-08-28	11:11	81,719675	-59,228408	TM-R #1	Bottom	117,6	10	6,7	-0,4	-0,597	27,576	1001			
3	RA16	Full	2024-08-28	11:00	81,720186	-59,226980	TM-R #1	Deploymen	117,6	352	2,9	0,7	-0,613	27,812	1001			
3	RA16	Full	2024-08-28	10:43	81,719379	-59,226985	CTD-R #1	Recovery	117,1	45	4,4	0,6	-0,576	28,143	1000			
3	RA16	Full	2024-08-28	10:12	81,720964	-59,228520	CTD-R #1	Bottom	118,2	39	5,6	0,8	-0,943	28,102	1000			

3	RA16	Full	2024-08-28	10:06	81,721450	-59,229709	CTD-R #1	Deploymen	118,5	29	6,8	0,7	-1,076	28,537	1000		
3	RA15	Full	2024-08-27	20:33	81,666837	-64,043080	BoxcoreGeo	Recovery	602,3	259	5,2	1,8	-1,318	30,722	998		
3	RA15	Full	2024-08-27	20:21	81,667275	-64,055373	BoxcoreGeo	Bottom	607,9	171	1,2	1,9	-1,366	30,597	998		
3	RA15	Full	2024-08-27	20:07	81,667944	-64,054825	BoxcoreGeo	Deploymen	608,9	234	10,3	3,3	-1,335	30,626	998		
3	RA15	Full	2024-08-27	19:35	81,669839	-64,068374	BoxcoreBio	Recovery	616,5	231	6,5	2,7	-1,316	30,585	998		
3	RA15	Full	2024-08-27	19:23	81,670124	-64,071529	BoxcoreBio	Bottom	613	250	15,4	0,9	-1,382	30,753	998		
3	RA15	Full	2024-08-27	19:07	81,670567	-64,077503	BoxcoreBio	Deploymen	607,7	258	12,7	0,9	-1,338	30,603	998		
3	RA15	Full	2024-08-27	18:44	81,670389	-64,082027	Gravity Cor	Recovery	603,3	251	11,4	1,5	-1,38	30,688	998		
3	RA15	Full	2024-08-27	18:30	81,671017	-64,079357	Gravity Cor	Bottom	599,9	255	13,2	1,8	-1,351	30,648	998		
3	RA15	Full	2024-08-27	18:21	81,671289	-64,078607	Gravity Cor	Deploymen	597,3	253	11,5	3,4	-1,323	30,459	998		
3	RA15	Full	2024-08-27	17:37	81,670456	-64,084784	Hydrobios	Recovery	596,5	245	14,2	3,1	-1,408	30,642	998		
3	RA15	Full	2024-08-27	17:20	81,672243	-64,081340	Hydrobios	Bottom	588,1	249	13,4	2,1	-1,391	30,541	998		
3	RA15	Full	2024-08-27	17:04	81,673497	-64,080831	Hydrobios	Deploymen	580,5	244	14,7	2,4	-1,361	30,496	998		
3	RA15	Full	2024-08-27	15:33	81,671619	-64,115603	Tucker	Recovery	597,3	242	13,1	1,1	-1,365	30,268	997		
3	RA15	Full	2024-08-27	15:22	81,667606	-64,088971	Tucker	Bottom	618,9	243	11,6	0,9	-1,294	30,141	997		
3	RA15	Full	2024-08-27	15:10	81,661162	-64,089142	Tucker	Deploymen	599,4	272	8,7	1,5	-1,296	30,112	997		
3	RA15	Full	2024-08-27	14:37	81,689217	-64,110369	TM-R #2	Recovery	504,8	244	13,8	1,5	-1,4	30,552	997		
3	RA15	Full	2024-08-27	14:20	81,691159	-64,116930	TM-R #2	Bottom	508,3	208	5,6	0,5	-1,4	30,603	997		
3	RA15	Full	2024-08-27	13:53	81,694338	-64,116343	TM-R #2	Deploymen	515,4	213	8,7	1,4	-1,311	30,479	997		
3	RA15	Full	2024-08-27	13:34	81,694416	-64,121775	CTD-R #2	Recovery	519	225	4,7	1,3	-1,307	30,713	997		
3	RA15	Full	2024-08-27	12:51	81,698272	-64,118019	CTD-R #2	Bottom	542,1	233	4,4	2	-1,415	30,69	997		
3	RA15	Full	2024-08-27	12:32	81,699086	-64,115084	CTD-R #2	Deploymen	540,4	304	10	2,4	-1,373	30,764	997		
3	RA15	Full	2024-08-27	11:49	81,697064	-64,076087	TM-R #1	Recovery	516,6	293	9,8	2,1	-1,404	30,314	997		
3	RA15	Full	2024-08-27	11:25	81,698158	-64,065201	TM-R #1	Bottom	525,2	279	13,3	2,2	-1,385	30,718	997		
3	RA15	Full	2024-08-27	11:10	81,698794	-64,066385	TM-R #1	Deploymen	523,9	292	11,8	2,5	-1,407	30,653	997		
3	RA15	Full	2024-08-27	10:55	81,700165	-64,078796	CTD-R #1	Recovery	515,7	261	9	3,4	-1,347	30,492	997		
3	RA15	Full	2024-08-27	10:17	81,700262	-64,085108	CTD-R #1	Bottom	506,5	284	11,5	1,2	-1,371	30,596	997		
3	RA15	Full	2024-08-27	10:03	81,700593	-64,090165	CTD-R #1	Deploymen	541,3	280	9,2	1,6	-1,369	30,513	997		
3	RA15	Full	2024-08-27	2:51	81,702525	-64,139371	Drop Cam	Recovery	501,9	83	7,5	-1,7	-1,389	30,651	996		
3	RA15	Full	2024-08-27	2:08	81,701334	-64,109375	Drop Cam	Bottom	531,9	84	8,4	-1,7	-1,368	30,823	996		
3	RA15	Full	2024-08-27	1:57	81,700769	-64,103564	Drop Cam	Deploymen	530,6	88	9	-1,8	-1,385	30,774	996		
3	RA14	Full	2024-08-26	22:58	81,507986	-65,730093	IKMT	Recovery	498,4	336	2,8	2,8	-0,098	26,707	996		
3	RA14	Full	2024-08-26	22:22	81,507417	-65,891607	IKMT	Bottom	540,2	149	3,7	2,1	0,007	26,636	997		
3	RA14	Full	2024-08-26	22:01	81,507665	-65,973589	IKMT	Deploymen	499,9	124	4,7	1,5	-0,045	27,154	997		

3	RA14	Full	2024-08-26	20:20	81,584072	-65,951597	BoxcoreBio	Recovery	517,4	113	10,5	1,4	-1,294	30,097	997		
3	RA14	Full	2024-08-26	20:09	81,583943	-65,947613	BoxcoreBio	Bottom	540,7	125	6,3	1,6	-1,282	29,813	997		
3	RA14	Full	2024-08-26	19:54	81,584883	-65,943750	BoxcoreBio	Deploymen	521,9	101	9,3	1,7	-1,185	29,029	998		
3	RA14	Full	2024-08-26	19:25	81,593697	-65,992815	Barge recov	Recovery	464,2	91	8,7	3,1	-1,264	29,955	998		
3	RA14	Full	2024-08-26	18:36	81,589199	-66,019980	Hydrobios	Recovery	462,4	99	10,6	2,4	-1,273	30,102	998		
3	RA14	Full	2024-08-26	18:19	81,588836	-65,995625	Hydrobios	Bottom	516,9	133	9,9	2,3	-1,106	29,991	998		
3	RA14	Full	2024-08-26	18:04	81,588501	-65,978852	Hydrobios	Deploymen	511,9	115	10,5	2,5	-1,322	30,477	998		
3	RA14	Full	2024-08-26	17:35	81,586957	-65,967160	Phytoplankt	Recovery	520,3	124	10,7	2,7	-1,274	30,145	998		
3	RA14	Full	2024-08-26	17:30	81,587099	-65,962002	Phytoplankt	Bottom	524,5	138	9,3	2,9	-1,214	29,998	998		
3	RA14	Full	2024-08-26	17:24	81,587484	-65,953151	Phytoplankt	Deployment		147	8,5	2,9	-1,257	30,196	998		
3	RA14	Full	2024-08-26	17:00	81,584740	-65,978680	Barge deplo	Deploymen	509,8	173	14,1	3,2	-0,905	29,282	998		
3	RA14	Full	2024-08-26	16:29	81,586639	-65,934728	Drop Cam	Recovery	505,6	153	7,1	2,3	-1,152	30,157	999		
3	RA14	Full	2024-08-26	15:47	81,588288	-65,935435	Drop Cam	Bottom	525,4	126	10,5	2,5	-1,217	30,113	999		
3	RA14	Full	2024-08-26	15:37	81,588750	-65,933656	Drop Cam	Deploymen	528,2	131	10,3	3,6	-0,991	29,446	999		
3	RA14	Full	2024-08-26	15:10	81,588861	-65,900113	TM-R #2	Recovery	518,9	203	3,2	4,1	-0,862	29,147	999		
3	RA14	Full	2024-08-26	14:40	81,587825	-65,906899	TM-R #2	Bottom	521,7	241	0	4,1	-1,236	30,273	1000		
3	RA14	Full	2024-08-26	14:23	81,586338	-65,905603	TM-R #2	Deploymen	527,9	96	6,6	3,6	0,175	25,447	1000		
3	RA14	Full	2024-08-26	14:03	81,580499	-65,865642	Tucker	Recovery	507,3	176	13,8	3,3	-0,68	28,839	1000		
3	RA14	Full	2024-08-26	13:50	81,581681	-65,907143	Tucker	Bottom	485,4	118	4	2,9	-0,394	28,184	1000		
3	RA14	Full	2024-08-26	13:45	81,583343	-65,921775	Tucker	Deploymen	512,7	117	3,6	2,9	-0,677	28,547	1000		
3	RA14	Full	2024-08-26	13:24	81,584509	-65,932662	CTD-R #2	Recovery	541,3	98	5,7	2,9	-1,022	29,632	1000		
3	RA14	Full	2024-08-26	12:40	81,586358	-65,940226	CTD-R #2	Bottom	502,8	224	5,9	3,1	-1,082	29,836	1000		
3	RA14	Full	2024-08-26	12:25	81,586182	-65,941589	CTD-R #2	Deploymen	502,2	246	7,9	3,1	-0,966	29,551	1000		
3	RA14	Full	2024-08-26	11:48	81,587836	-65,926117	TM-R #1	Recovery	518,4	272	1,8	3,2	-0,997	29,482	1001		
3	RA14	Full	2024-08-26	11:26	81,588559	-65,927726	TM-R #1	Bottom	522,9	227	1,3	3,3	-0,923	29,812	1001		
3	RA14	Full	2024-08-26	11:08	81,588663	-65,933495	TM-R #1	Deploymen	529,1	187	1,5	3,9	-0,973	29,855	1001		
3	RA14	Full	2024-08-26	10:54	81,588772	-65,934711	CTD-R #1	Recovery	529	177	2,5	3,2	-1,165	30,097	1001		
3	RA14	Full	2024-08-26	10:20	81,589180	-65,926409	CTD-R #1	Bottom	529,2	217	3,4	2,6	-0,973	29,944	1001		
3	RA14	Full	2024-08-26	10:05	81,588405	-65,929497	CTD-R #1	Deploymen	527,4	229	4,9	3	-0,925	29,61	1001		
3	RA13	Full	2024-08-25	23:11	81,288578	-68,502167	BoxcoreBio	Recovery	429,5	91	2,9	2,3	-0,843	29,48	999		
3	RA13	Full	2024-08-25	23:02	81,288157	-68,504767	BoxcoreBio	Bottom	429	107	3,4	3,2	-0,815	29,271	999		
3	RA13	Full	2024-08-25	22:52	81,287945	-68,505188	BoxcoreBio	Deploymen	429,1	109	2,3	2,8	-0,795	29	999		
3	RA13	Full	2024-08-25	22:24	81,288621	-68,504913	Boxcore GE	Recovery	429,7	152	1,4	1,9	-0,794	29,096	999		
3	RA13	Full	2024-08-25	22:14	81,288771	-68,504590	Boxcore GE	Bottom	429,1	184	3,2	2,5	-0,788	28,847	999		

3	RA13	Full	2024-08-25	22:01	81,288618	-68,502399	Boxcore GE	Deploymen	429,5	181	1,2	2	-0,683	28,034	999		
3	RA13	Full	2024-08-25	20:29	81,288658	-68,506065	Gravity core	Recovery	429,2	50	0,4	2,8	-0,648	27,342	999		
3	RA13	Full	2024-08-25	20:20	81,288751	-68,500741	Gravity core	Bottom	429,8	290	0	2,7	-0,682	28,064	998		
3	RA13	Full	2024-08-25	20:11	81,288594	-68,499455	Gravity core	Deploymen	430,3	3	1	2,1	-0,738	28,7	998		
3	RA13	Full	2024-08-25	18:42	81,288364	-68,383459	Hydrobios	Recovery	410,8	78	0,9	1,8	-0,721	28,725	998		
3	RA13	Full	2024-08-25	18:29	81,288230	-68,384496	Hydrobios	Bottom	411,1	170	1,7	2	-0,74	29,689	998		
3	RA13	Full	2024-08-25	18:17	81,287699	-68,386735	Hydrobios	Deploymen	411,8	160	0	3,5	-0,883	29,62	998		
3	RA13	Full	2024-08-25	17:03	81,279178	-68,418459	Tucker	Recovery	400,9	172	3,2	1,1	-0,511	26,626	998		
3	RA13	Full	2024-08-25	16:52	81,283988	-68,407451	Tucker	Bottom	409,1	168	3	1,2	-0,441	26,343	998		
3	RA13	Full	2024-08-25	16:41	81,288519	-68,377745	Tucker	Deployment		134	2,7	1,2	-0,663	27,969	998		
3	RA13	Full	2024-08-25	15:35	81,287579	-68,382517	Drop Cam	Recovery	410,4	116	3	0,8	-0,725	28,082	998		
3	RA13	Full	2024-08-25	15:02	81,287066	-68,382384	Drop Cam	Bottom	409,3	117	3,7	-0,1	-0,738	28,963	998		
3	RA13	Full	2024-08-25	14:44	81,287611	-68,383160	Drop Cam	Deploymen	409,8	114	3,2	0,1	-0,643	26,865	998		
3	RA13	Full	2024-08-25	14:13	81,287917	-68,392710	TM-R #2	Recovery	410,1	117	1,6	1,2	-0,766	28,877	998		
3	RA13	Full	2024-08-25	13:54	81,287736	-68,393849	TM-R #2	Bottom	410,1	78	1,3	1,2	-0,719	28,284	998		
3	RA13	Full	2024-08-25	13:36	81,287862	-68,395368	TM-R #2	Deploymen	410,4	32	1,9	0,5	-0,763	28,696	998		
3	RA13	Full	2024-08-25	13:18	81,287940	-68,397075	CTD-R #2	Recovery	410,8	176	2,8	0,5	-0,77	28,657	998		
3	RA13	Full	2024-08-25	12:40	81,287921	-68,396784	CTD-R #2	Bottom	410,8	264	0	0,5	-0,676	27,497	998		
3	RA13	Full	2024-08-25	12:25	81,287365	-68,393566	CTD-R #2	Deploymen	411,2	325	0	0,3	-0,689	28,045	998		
3	RA13	Full	2024-08-25	11:48	81,287920	-68,393720	TM-R #1	Recovery	410,1	201	1,5	-0,1	-0,704	27,711	998		
3	RA13	Full	2024-08-25	11:22	81,288259	-68,394284	TM-R #1	Bottom	410,9	96	0,8	1,5	-0,604	26,965	998		
3	RA13	Full	2024-08-25	11:10	81,287640	-68,398463	TM-R #1	Deploymen	410,9	240	0	1,2	-0,628	26,849	998		
3	RA13	Full	2024-08-25	10:51	81,286277	-68,403288	CTD-R #1	Recovery	413,1	335	0	0,9	-0,733	28,408	998		
3	RA13	Full	2024-08-25	10:19	81,286502	-68,399988	CTD-R #1	Bottom	412,8	283	0,8	0,5	-0,664	27,037	998		
3	RA13	Full	2024-08-25	10:06	81,286970	-68,401166	CTD-R #1	Deploymen	412,6	9	3,8	0,1	-0,61	28,817	998		
3	RA14	Coring	2024-08-24	23:09	81,592261	-66,021383	Box core GE	Recovery	486,4	142	4	0,5	-1,371	29,988	999		
3	RA14	Coring	2024-08-24	22:59	81,592419	-66,020480	Box core GE	Bottom	486,5	154	3,4	0,4	-1,308	29,902	999		
3	RA14	Coring	2024-08-24	22:47	81,592535	-66,021574	Box core GE	Deploymen	487	166	2,5	0,4	-1,127	29,389	999		
3	RA14	Coring	2024-08-24	21:19	81,593737	-66,024325	Gravity Core	Recovery	488,9	259	1,3	1,4	-1,173	29,733	999		
3	RA14	Coring	2024-08-24	21:09	81,593672	-66,023349	Gravity Core	Bottom	488,3	265	0	1,9	-1,27	29,964	999		
3	RA14	Coring	2024-08-24	20:59	81,593533	-66,022068	Gravity Core	Deploymen	488,4	308	3	1,8	-1,186	29,849	999		
3	RA12	Full	2024-08-24	18:25	81,566825	-67,730666	Gravity Core	Recovery	303,8	111	2,7	3,2	-0,91	29,257	999		
3	RA12	Full	2024-08-24	18:07	81,566273	-67,734395	Gravity Core	Bottom	304,1	170	2,5	2,2	-0,941	29,07	999		
3	RA12	Full	2024-08-24	17:59	81,566010	-67,733853	Gravity Core	Deploymen	304,2	182	2,5	1,7	-1,044	29,854	999		

3	RA12	Full	2024-08-24	16:24	81,566747	-67,724933	Boxcore BIO	Recovery	303	286	0	1,1	-0,993	29,154	1000		
3	RA12	Full	2024-08-24	16:17	81,566565	-67,727505	Boxcore BIO	Bottom	302,9	209	0	1,1	-0,914	29,366	1000		
3	RA12	Full	2024-08-24	16:09	81,566542	-67,730454	Boxcore BIO	Deploymen	303,4	318	0	1,1	-0,804	28,637	1000		
3	RA12	Full	2024-08-24	15:44	81,566144	-67,724295	Boxcore Ge	Recovery	302,8	156	1,5	0,7	-0,624	27,873	1000		
3	RA12	Full	2024-08-24	15:38	81,566226	-67,727536	Boxcore Ge	Bottom	303	170	0,4	0,7	-0,529	27,854	1000		
3	RA12	Full	2024-08-24	15:27	81,566437	-67,732925	Boxcore Ge	Deploymen	303,1	153	1,9	0,7	-0,75	26,611	1000		
3	RA12	Full	2024-08-24	14:43	81,572403	-67,484817	IKMT	Recovery	232,6	150	4,5	0,4	-0,325	26,824	1000		
3	RA12	Full	2024-08-24	14:15	81,565291	-67,604800	IKMT	Bottom	230	149	3,5	0,6	0,202	24,371	1000		
3	RA12	Full	2024-08-24	13:53	81,569475	-67,636071	IKMT	Deploymen	293	325	2,5	1	-0,619	27,548	1000		
3	RA12	Full	2024-08-24	2:15	81,570596	-67,655862	BoxCoreBio	Recovery	282,8	117	4,7	0,3	-1,006	29,434	1000		
3	RA12	Full	2024-08-24	2:10	81,570564	-67,652970	BoxCoreBio	Bottom	285,7	122	5,4	0,4	-0,875	28,855	1000		
3	RA12	Full	2024-08-24	2:00	81,570453	-67,651943	BoxCoreBio	Deploymen	285,4	93	5,5	0,5	-0,694	28,279	1000		
3	RA12	Full	2024-08-24	1:27	81,569798	-67,623419	Tucker	Recovery	293,5	129	7,6	-0,1	0,122	24,25	1000		
3	RA12	Full	2024-08-24	1:20	81,568209	-67,650353	Tucker	Bottom	291,2	140	7,7	0	0,302	23,911	1000		
3	RA12	Full	2024-08-24	1:10	81,568386	-67,685720	Tucker	Deploymen	290,9	158	7,5	0,1	-0,563	29,238	1000		
3	RA12	Full	2024-08-24	0:44	81,569324	-67,649203	Hydrobios	Recovery	288,1	131	2,1	0,8	-1,104	29,7	1000		
3	RA12	Full	2024-08-24	0:34	81,569181	-67,648628	Hydrobios	Bottom	288,4	120	2,7	1,1	-1,149	30,093	1000		
3	RA12	Full	2024-08-24	0:26	81,569197	-67,647837	Hydrobios	Deploymen	289,7	115	2,3	1,4	-1,108	30,241	1000		
3	RA12	Full	2024-08-23	23:48	81,569415	-67,611269	Drop Cam	Recovery	293,4	123	4	1,5	-1,141	29,777	1000		
3	RA12	Full	2024-08-23	23:13	81,569530	-67,636231	Drop Cam	Bottom	293	37	0,7	1,1	-1,161	30,027	1000		
3	RA12	Full	2024-08-23	23:07	81,569745	-67,639643	Drop Cam	Deploymen	293,3	95	1	1,1	-1,092	29,584	1000		
3	RA12	Full	2024-08-23	22:44	81,570625	-67,633552	TM-R #2	Recovery	294	136	3,1	0,4	-1,129	29,843	1000		
3	RA12	Full	2024-08-23	22:15	81,570512	-67,637386	TM-R #2	Bottom	294,2	92	4,1	0,4	-1,099	29,986	1000		
3	RA12	Full	2024-08-23	22:06	81,570360	-67,638484	TM-R #2	Deploymen	294,1	121	3,2	0,4	-1,108	29,853	1000		
3	RA12	Full	2024-08-23	21:11	81,566557	-67,632028	CTD-R #2	Recovery	286,9	137	5,5	1,8	-0,832	28,24	999		
3	RA12	Full	2024-08-23	20:33	81,567852	-67,620902	CTD-R #2	Bottom	291,3	135	5,6	1,8	-0,765	29,267	999		
3	RA12	Full	2024-08-23	20:22	81,567812	-67,621202	CTD-R #2	Deploymen	291,1	150	5,1	2,2	-0,925	28,344	999		
3	RA12	Full	2024-08-23	20:03	81,567494	-67,625337	TM-R #1	Recovery	291,8	98	3,3	1,8	-1,065	29,712	999		
3	RA12	Full	2024-08-23	19:40	81,568269	-67,615350	TM-R #1	Bottom	291,2	123	6,9	1	-0,657	27,331	999		
3	RA12	Full	2024-08-23	19:23	81,569642	-67,610143	TM-R #1	Deploymen	295	123	7	1,3	-1,016	29,424	999		
3	RA12	Full	2024-08-23	19:02	81,570228	-67,610834	CTD-R #1	Recovery	294,8	123	4,5	2,1	-1,076	29,294	999		
3	RA12	Full	2024-08-23	18:30	81,570232	-67,612740	CTD-R #1	Bottom	295,1	142	4,6	1,5	-1,205	30,288	999		
3	RA12	Full	2024-08-23	18:19	81,570154	-67,609641	CTD-R #1	Deploymen	295	135	4,5	1,8	-1,253	30,295	999		
3	RA11	Mooring	2024-08-23	15:05	81,543070	-64,895300	Mooring de	Bottom	250	323	2,5	3,3	-1,017	28,221	999		

3	RA11	Mooring	2024-08-23	14:46	81,541746	-64,918063	Mooring de	Deploymen	245,7	129	3,2	2,5	-0,886	27,508	999		
3	RA11	Mooring	2024-08-23	13:41	81,537555	-64,920033	CTD-Moorir	Recovery	101,5	279	11,1	3,3	-0,415	26,915	998		
3	RA11	Mooring	2024-08-23	13:12	81,537057	-64,953035	CTD-Moorir	Bottom	115,7	259	11,9	2,6	-0,305	27,048	999		
3	RA11	Mooring	2024-08-23	13:03	81,537112	-64,956946	CTD-Moorir	Deploymen	125,6	61	1,3	2	-0,343	26,492	999		
3	RA10	Mooring	2024-08-23	1:32	82,114376	-61,289319	CTD-Moorir	Recovery	497,9	131	4,6	-1,4	-1,508	30,391	998		
3	RA10	Mooring	2024-08-23	0:51	82,123376	-61,234767	CTD-Moorir	Bottom	493,3	115	8,7	-2	-1,512	30,39	998		
3	RA10	Mooring	2024-08-23	0:35	82,126658	-61,220271	CTD-Moorir	Deploymen	490,3	95	9,1	-2,2	-1,511	30,391	998		
3	RA10	Mooring	2024-08-23	0:03	82,134898	-61,200494	Mooring Re	Recovery	487,9	158	7,6	-2,1	-1,502	30,39	998		
3	RA10	Coring	2024-08-22	21:35	82,144628	-60,978416	Box Core GI	Recovery	440,7	280	11,6	-0,3	-1,52	30,141	997		
3	RA10	Coring	2024-08-22	21:26	82,143962	-60,984166	Box Core GI	Bottom	440,4	289	15,1	-0,1	-1,445	30,162	997		
3	RA10	Coring	2024-08-22	21:12	82,143051	-60,983957	Box Core GI	Deploymen	442,3	279	20,2	-0,1	-1,502	30,18	996		
3	RA10	Coring	2024-08-22	20:24	82,137261	-61,000059	Giant Gravi	Recovery	439,7	302	12,3	0,6	-1,508	30,172	996		
3	RA10	Coring	2024-08-22	20:15	82,135866	-61,009078	Giant Gravi	Bottom	436,8	80	0	0,3	-1,528	30,167	997		
3	RA10	Coring	2024-08-22	20:07	82,135415	-61,012329	Giant Gravi	Deploymen	435,8	325	10,9	-0,2	-1,51	30,167	996		
3	RA09	Full	2024-08-22	18:07	82,293965	-60,884616	Optics	Recovery	262,5	227	21,4	0,5	-1,463	30,535	995		
3	RA09	Full	2024-08-22	18:02	82,294106	-60,887373	Optics	Bottom	258,5	228	18,7	0,1	-1,462	30,575	995		
3	RA09	Full	2024-08-22	17:54	82,295100	-60,888830	Optics	Deployment		236	23,3	2,2	-1,396	30,62	995		
3	RA09	Full	2024-08-22	17:48	82,299905	-60,881979	Optics	Recovery	250,7	244	20,7	-0,2	-1,459	30,56	995		
3	RA09	Full	2024-08-22	17:40	82,301549	-60,885774	Optics	Bottom	242,5	240	24,5	-0,2	-1,465	30,56	995		
3	RA09	Full	2024-08-22	17:29	82,303662	-60,891921	Optics	Deploymen	230,7	243	19,5	-0,1	-1,453	30,591	995		
3	RA09	Full	2024-08-22	17:17	82,310299	-60,885923	Hydrobios	Recovery	219,2	45	14,3	-0,3	-1,439	30,57	995		
3	RA09	Full	2024-08-22	17:10	82,312980	-60,886997	Hydrobios	Bottom	216,9	238	20,6	-0,3	-1,463	30,584	995		
3	RA09	Full	2024-08-22	17:04	82,314910	-60,888146	Hydrobios	Deploymen	211,2	224	14,6	0	-1,473	30,614	995		
3	RA09	Full	2024-08-22	16:39	82,324700	-60,865136	Phytoplank	Recovery	196,5	225	20,9	-0,2	-1,462	30,66	995		
3	RA09	Full	2024-08-22	16:30	82,327106	-60,861575	Phytoplank	Bottom	194,3	230	26,7	0,1	-1,475	30,644	995		
3	RA09	Full	2024-08-22	16:25	82,329711	-60,859474	Phytoplank	Deploymen	192,4	235	27,9	1,1	-1,427	30,636	995		
3	RA09	Full	2024-08-22	16:01	82,341847	-60,845995	Drop Cam	Recovery	182,3	277	12,4	0	-1,481	30,634	995		
3	RA09	Full	2024-08-22	15:54	82,343776	-60,848055	Drop Cam	Bottom		248	16,7	0,4	-1,486	30,63	995		
3	RA09	Full	2024-08-22	15:19	82,356479	-60,822962	Drop Cam	Deploymen	194,8	245	12,7	3	-1,468	30,732	995		
3	RA09	Full	2024-08-22	14:33	82,376797	-60,809213	TM-R #2	Recovery	189,2	246	23,2	1,1	-1,462	30,814	994		
3	RA09	Full	2024-08-22	14:16	82,383949	-60,810778	TM-R #2	Bottom	170,1	250	25,5	2,2	-1,475	30,797	995		
3	RA09	Full	2024-08-22	14:02	82,386453	-60,807970	TM-R #2	Deployment		257	24,8	1,6	-1,456	30,837	995		
3	RA09	Full	2024-08-22	13:28	82,387680	-60,841912	CTD-R #2	Recovery	152,2	247	21,4	1,3	-1,402	30,629	995		
3	RA09	Full	2024-08-22	13:00	82,391328	-60,863497	CTD-R #2	Bottom	138,5	232	11,5	1,3	-1,434	30,773	995		

3	RA09	Full	2024-08-22	12:51	82,392295	-60,865582	CTD-R #2	Deploymen	139,8	215	14,9	0,9	-1,465	30,617	995		
3	RA09	Full	2024-08-22	12:35	82,395441	-60,864426	TM-R #1	Recovery	151	207	19,1	0,6	-1,468	30,61	995		
3	RA09	Full	2024-08-22	12:17	82,396379	-60,863285	TM-R #1	Bottom	150,2	223	21,8	0,8	-1,458	30,766	996		
3	RA09	Full	2024-08-22	12:01	82,395745	-60,879024	TM-R #1	Deploymen	156,1	234	19	0,2	-1,464	30,567	996		
3	RA09	Full	2024-08-22	11:13	82,408165	-60,856620	CTD-R #1	Recovery	109,4	212	14,9	0,6	-1,407	30,522	996		
3	RA09	Full	2024-08-22	10:42	82,398441	-60,847689	CTD-R #1	Bottom	135,9	353	18	-0,4	-1,468	30,528	996		
3	RA09	Full	2024-08-22	10:37	82,396043	-60,851846	CTD-R #1	Deploymen	142	242	16,2	-0,1	-1,395	30,467	996		
3	RA08	Full	2024-08-21	0:27	79,829480	-74,101190	BoxCoreGE(	Recovery	257,7				0,71	28,623			
3	RA08	Full	2024-08-21	0:21	79,829231	-74,099573	BoxCoreGE(	Bottom	257,5	175	9,2	1,1	0,945	27,9	1005	95,9	
3	RA08	Full	2024-08-21	0:14	79,829226	-74,100120	BoxCoreGE(	Deploymen	257,9	191	10,7	1	0,864	28,376	1005	95,8	
3	RA08	Full	2024-08-20	23:42	79,829135	-74,101886	BoxCoreBio	Recovery	257,5	186	11,1	0,9	1,555	27,425	1005	96	
3	RA08	Full	2024-08-20	23:35	79,829435	-74,100642	BoxCoreBio	Bottom	256,8	192	10,6	0,9	0,652	28,398	1005	96	
3	RA08	Full	2024-08-20	23:27	79,829742	-74,098570	BoxCoreBio	Deploymen	258,2	194	11,2	0,9	0,761	27,986	1005	96,1	
3	RA08	Full	2024-08-20	22:46	79,843954	-74,173821	Beam trawl	Recovery	222,4	191	7,8	1,6	2,672	22,756	1005	96	
3	RA08	Full	2024-08-20	22:34	79,836968	-74,149536	Beam trawl	Bottom	242,6	156	3,1	1,5	2,699	22,487	1005	96,2	
3	RA08	Full	2024-08-20	22:21	79,833467	-74,166837	Beam trawl	Deploymen	246,5	178	9,2	1,2	2,155	26,699	1005	96,2	
3	RA08	Full	2024-08-20	20:33	79,828154	-74,100139	Gravity core	Recovery	261,4	171	11,3	1,2	0,956	27,832	1005	96,3	
3	RA08	Full	2024-08-20	20:26	79,828022	-74,098560	Gravity core	Bottom	262	172	10,4	1,2	1,298	26,795	1005	96,3	
3	RA08	Full	2024-08-20	20:18	79,827955	-74,101186	Gravity core	Deploymen	257,3	170	10,9	1,2	2,035	24,246	1005	96,3	
3	RA08	Full	2024-08-20	18:29	79,817845	-74,141840	Tucker	Recovery	169,2	157	7,9	1	1,213	26,858	1006	96,6	
3	RA08	Full	2024-08-20	18:21	79,821656	-74,128734	Tucker	Bottom	206,5	167	10	1	2,392	25,599	1006	96,6	
3	RA08	Full	2024-08-20	18:12	79,826395	-74,119035	Tucker	Deploymen	246,5	174	10,6	0,9	1,289	27,047	1005	96,6	
3	RA08	Full	2024-08-20	17:51	79,827307	-74,100651	Phytoplankt	Recovery	257,7	180	9,9	0,9	0,654	27,754	1006	96,6	
3	RA08	Full	2024-08-20	17:48	79,827337	-74,098239	Phytoplankt	Bottom	254,3	175	9,8	0,9	0,919	27,899	1006	96,6	
3	RA08	Full	2024-08-20	17:45	79,827448	-74,095656	Phytoplankt	Deploymen	256,7	175	9,8	1	0,876	27,175	1006	96,6	
3	RA08	Full	2024-08-20	17:13	79,830175	-74,139173	Monster	Recovery	256,7	175	7,2	1,4	0,996	27,342	1006	96,5	
3	RA08	Full	2024-08-20	17:05	79,829863	-74,135797	Monster	Bottom	257,2	178	6,3	1,5	1,076	27,69	1006	96,4	
3	RA08	Full	2024-08-20	16:55	79,829150	-74,129119	Monster	Deploymen	255,9	173	5,1	1,3	1,026	27,611	1006	96,4	
3	RA08	Full	2024-08-20	15:58	79,828855	-74,133039	Drop Cam	Recovery	254,7	188	3,8	2,2	0,767	27,935	1006	96,1	
3	RA08	Full	2024-08-20	15:24	79,827874	-74,103515	Drop Cam	Bottom	259	161	5,2	2,2	0,873	27,721	1006	96,1	
3	RA08	Full	2024-08-20	15:11	79,827806	-74,091171	Drop Cam	Deploymen	264	174	3,5	1,4	0,892	27,871	1006	96,4	
3	RA08	Full	2024-08-20	14:39	79,828996	-74,109476	TM-R #2	Recovery	261,4	167	5,5	1,7	0,827	27,747	1006	96,3	
3	RA08	Full	2024-08-20	14:23	79,828105	-74,110204	TM-R #2	Bottom	260	171	6,7	1,3	0,924	27,186	1006	96,4	
3	RA08	Full	2024-08-20	14:09	79,828409	-74,107799	TM-R #2	Deploymen	257,9	169	7,5	1,2	0,908	27,14	1006	96,4	

3	RA08	Full	2024-08-20	13:50	79,828972	-74,125699	CTD-R #2	Recovery	255,7	320	8	1,2	0,543	28,695	1007	96,3	
3	RA08	Full	2024-08-20	13:16	79,828867	-74,118654	CTD-R #2	Bottom	256,9	175	7,7	1,3	0,653	28,299	1007	96,3	
3	RA08	Full	2024-08-20	13:05	79,828691	-74,114536	CTD-R #2	Deploymen	257,8	157	7,8	1,5	0,82	28,057	1007	96,3	
3	RA08	Full	2024-08-20	12:49	79,828782	-74,106506	TM-R #1	Recovery	259,8	177	9,5	1	0,361	29,18	1007	96,4	
3	RA08	Full	2024-08-20	12:20	79,828227	-74,108155	TM-R #1	Bottom	256	237	1,1	1,7	1,301	27,258	1007	96,1	
3	RA08	Full	2024-08-20	12:07	79,827882	-74,098171	TM-R #1	Deploymen	261,6	182	5,3	2,1	1,13	28,059	1007	95,8	
3	RA08	Full	2024-08-20	11:19	79,829628	-74,105278	CTD-R #1	Recovery	254,7	188	7,8	1,9	0,513	28,714	1007	95,9	
3	RA08	Full	2024-08-20	10:50	79,829056	-74,100541	CTD-R #1	Bottom	12,04	140	8,7	2,5	0,789	28,177	1007	95,8	
3	RA08	Full	2024-08-20	10:39	79,828703	-74,097007	CTD-R #1	Deployment		163	10	1,7	0,964	26,327	1007	96	
3	RA07	Full	2024-08-19	22:47	79,785060	-73,571465	BoxCoreGE(	Recovery	230,1	156	7,7	1,6	0,503	28,866	1005	97	
3	RA07	Full	2024-08-19	22:41	79,785036	-73,569294	BoxCoreGE(	Bottom	229,6	160	9	1,5	0,969	28,425	1004	97	
3	RA07	Full	2024-08-19	22:34	79,785225	-73,568530	BoxCoreGE(	Deploymen	230,3	142	8,8	1,6	0,428	28,615	1004	97,1	
3	RA07	Full	2024-08-19	22:14	79,785400	-73,565018	BoxCoreBio	Recovery	230,7	151	8,2	1,5	0,72	28,403	1004	97,1	
3	RA07	Full	2024-08-19	22:08	79,785402	-73,565448	BoxCoreBio	Bottom	230,3	155	8,3	1,5	0,769	28,454	1004	97	
3	RA07	Full	2024-08-19	22:02	79,785399	-73,565790	BoxCoreBio	Deploymen	230,8	149	9,1	1,6	1,077	28,3	1004	97	
3	RA07	Full	2024-08-19	19:23	79,785831	-73,554068	Gravity Cor	Recovery	230,9	177	11,3	1,5	0,59	29,045	1002	97,2	
3	RA07	Full	2024-08-19	19:16	79,785499	-73,556039	Gravity Cor	Bottom	232,2	178	14,3	1,4	0,366	29,02	1002	97,1	
3	RA07	Full	2024-08-19	19:10	79,785273	-73,556103	Gravity Cor	Deploymen	232,3	178	13,2	1,2	0,051	29,511	1002	97,1	
3	RA07	Full	2024-08-19	17:38	79,784528	-73,511713	Tucker	Recovery	210,6	197	3,6	1,6	1,242	27,014	1001	97,1	
3	RA07	Full	2024-08-19	17:29	79,782378	-73,531599	Tucker	Bottom	203,8	174	10,8	1,8	1,851	26,396	1000	97	
3	RA07	Full	2024-08-19	17:19	79,785655	-73,553934	Tucker	Deploymen	233,3	177	10,7	1,6	1,557	27,345	1000	97,1	
3	RA07	Full	2024-08-19	15:08	79,786656	-73,570336	Monster	Recovery	196,8	164	3,7	3,7	0,422	28,906	999	96,2	
3	RA07	Full	2024-08-19	15:03	79,786537	-73,569101	Monster	Bottom	202	175	7,1	3,9	0,277	29,213	999	96,2	
3	RA07	Full	2024-08-19	14:53	79,786470	-73,567502	Monster	Deploymen	207,1	171	4,2	3,7	0,429	28,982	999	96,3	
3	RA07	Full	2024-08-19	14:23	79,785840	-73,562372	TM-R #2	Recovery	226,6	326	5,9	3,1	0,101	29,372	998	96,4	
3	RA07	Full	2024-08-19	13:57	79,785955	-73,561840	TM-R #2	Bottom	223,3	160	5,2	3,5	0,378	29,145	998	96,4	
3	RA07	Full	2024-08-19	13:49	79,785874	-73,561979	TM-R #2	Deploymen	225,4	177	4,5	3,6	0,662	29,016	998	96,3	
3	RA07	Full	2024-08-19	13:24	79,785599	-73,575276	CTD-R #2	Recovery	230	149	5,3	2,5	0,465	28,887	998	96,7	
3	RA07	Full	2024-08-19	12:44	79,785456	-73,568924	CTD-R #2	Bottom	230,4	154	4,2	2,2	0,566	28,655	998	97,1	
3	RA07	Full	2024-08-19	12:34	79,784990	-73,568082	CTD-R #2	Deploymen	231,4	162	3,2	2,1	0,556	28,559	998	97,3	
3	RA07	Full	2024-08-19	12:14	79,785350	-73,563884	TM-R #1	Recovery	231,3	166	4	2	0,449	28,896	998	97,3	
3	RA07	Full	2024-08-19	11:51	79,785130	-73,562405	TM-R #1	Bottom	230,7	191	2,9	2,1	0,452	28,706	997	97,3	
3	RA07	Full	2024-08-19	11:40	79,785117	-73,561826	TM-R #1	Deploymen	230,6	194	3,1	2,1	0,246	28,911	997	97,3	
3	RA07	Full	2024-08-19	10:51	79,785601	-73,558992	CTD-R #1	Recovery	230,6	136	2,1	1,8	0,283	29,152	997	97,3	

3	RA07	Full	2024-08-19	10:19	79,785539	-73,558021	CTD-R #1	Bottom	230,7	162	2,6	1,6	0,443	28,788	997	97,2	
3	RA07	Full	2024-08-19	10:08	79,785265	-73,556437	CTD-R #1	Deploymen	230,3	154	3,1	1,6	0,244	28,633	997	97,1	
3	RA07	Full	2024-08-19	2:38	79,785737	-73,536676	Drop cam	Recovery	229	175	5,3	2,2	0,082	29,131	995	96,5	
3	RA07	Full	2024-08-19	2:02	79,784826	-73,554352	Drop cam	Bottom	233	163	2,3	2,9	0,35	28,812	995	96,5	
3	RA07	Full	2024-08-19	1:56	79,784858	-73,554344	Drop cam	Deploymen	233	111	2,1	2,7	0,45	28,922	995	96,6	
3	RA06	Full	2024-08-18	23:50	79,682967	-73,086857	BoxCoreGE(	Recovery	246,8	202	2,2	1,1	-0,678	29,442	996	96,7	
3	RA06	Full	2024-08-18	23:43	79,682862	-73,087629	BoxCoreGE(	Bottom	246,6	206	2,2	1,3	-0,773	29,347	996	96,6	
3	RA06	Full	2024-08-18	23:37	79,682900	-73,088442	BoxCoreGE(	Deploymen	246,7	202	1,4	1	-0,759	29,281	996	96,7	
3	RA06	Full	2024-08-18	23:05	79,683534	-73,087142	BoxCoreBio	Recovery	247,4	194	1,3	1,8	-0,796	29,468	997	96,4	
3	RA06	Full	2024-08-18	22:58	79,683467	-73,086568	BoxCoreBio	Bottom	246,9	214	3,2	1,8	-0,66	29,392	997	96,4	
3	RA06	Full	2024-08-18	22:51	79,683430	-73,086143	BoxCoreBio	Deploymen	247,5	225	4,1	1,8	-0,676	29,354	997	96,5	
3	RA06	Full	2024-08-18	20:50	79,683033	-73,085430	Gravity Cor	Recovery	246,6	349	0	1,6	-0,597	29,02	997	96,3	
3	RA06	Full	2024-08-18	20:43	79,682976	-73,085715	Gravity Cor	Bottom	245,7	187	4	1,9	-0,604	29,224	997	96,2	
3	RA06	Full	2024-08-18	20:37	79,682966	-73,085465	Gravity Cor	Deploymen	246,3	199	4,9	1,9	-0,673	29,193	997	96,2	
3	RA06	Full	2024-08-18	19:34	79,685470	-73,100961	Tucker	Recovery	248,1	205	4,6	1,3	1,413	25,61	998	96,1	
3	RA06	Full	2024-08-18	19:30	79,684640	-73,092857	Tucker	Bottom	250,8	221	3,9	1,8	1,469	24,384	998	96	
3	RA06	Full	2024-08-18	19:16	79,679423	-73,067824	Tucker	Deploymen	249,8	202	3	1,8	-0,669	29,101	998	96	
3	RA06	Full	2024-08-18	18:46	79,678809	-73,081958	Drop cam	Recovery	250,6	295	1,5	1,3	-0,678	28,902	998	96,2	
3	RA06	Full	2024-08-18	18:08	79,682134	-73,091438	Drop cam	Bottom	248,8	56	0	1,5	-0,542	29,041	998	96	
3	RA06	Full	2024-08-18	18:03	79,682284	-73,093608	Drop cam	Deploymen	249,4	233	4,1	1,6	-0,793	29,065	998	96,1	
3	RA06	Full	2024-08-18	17:30	79,683224	-73,086020	Monster	Recovery	248,1	269	2,9	1,4	-0,526	28,787	998	95,9	
3	RA06	Full	2024-08-18	17:16	79,683218	-73,086012	Monster	Bottom	248,2	266	1,9	1,6	-0,715	29,214	998	95,7	
3	RA06	Full	2024-08-18	17:08	79,683429	-73,087150	Monster	Deploymen	248	257	1,1	1,6	-0,884	29,208	999	92,6	
3	RA06	Full	2024-08-18	14:41	79,687611	-73,098276	TM-R #2	Recovery	247,6	45	2,1	1	-0,521	29,004	1000	88,1	
3	RA06	Full	2024-08-18	14:13	79,685815	-73,091121	TM-R #2	Bottom	252,4	307	5	2,1	-0,49	28,848	1001	80	
3	RA06	Full	2024-08-18	14:02	79,684673	-73,091948	TM-R #2	Deploymen	251,8	302	3,7	1,4	-0,559	28,752	1001	83,9	
3	RA06	Full	2024-08-18	13:43	79,685702	-73,109610	CTD-R #2	Recovery	249,1	278	3,8	2,3	-0,705	29,151	1001	71,1	
3	RA06	Full	2024-08-18	13:08	79,684470	-73,097410	CTD-R #2	Bottom	250,1	223	3,4	2,4	-0,436	28,814	1001	69,4	
3	RA06	Full	2024-08-18	12:53	79,683758	-73,093604	CTD-R #2	Deploymen	249,7	336	6,6	1,7	-0,172	28,788	1002	76,8	
3	RA06	Full	2024-08-18	12:27	79,685157	-73,100406	TM-R #1	Recovery	249,2	180	6,2	2,1	-0,164	28,548	1002	72,3	
3	RA06	Full	2024-08-18	12:10	79,684036	-73,093156	TM-R #1	Bottom	250	192	0,4	1,7	-0,436	28,98	1002	71,7	
3	RA06	Full	2024-08-18	11:54	79,683688	-73,090592	TM-R #1	Deploymen	247,7	124	9,7	2,4	-0,511	28,865	1002	64,1	
3	RA06	Full	2024-08-18	11:02	79,683500	-73,089322	CTD-R #1	Recovery	247,2	212	5,7	1,9	-0,438	29,098	1003	67,1	
3	RA06	Full	2024-08-18	10:24	79,683165	-73,087173	CTD-R #1	Bottom	246	238	1,8	2,4	-0,48	28,947	1004	54,6	

3	RA06	Full	2024-08-18	10:13	79,683347	-73,086945	CTD-R #1	Deploymen	247	224	2,3	2,2	-0,367	29,128	1004	57	
3	RA05	Full	2024-08-17	17:23	78,305917	-74,749498	CTD-R	Recovery		73	10,2	0,6	-0,954	28,983	1010	96,9	
3	RA05	Full	2024-08-17	16:28	78,311988	-74,773919	CTD-R	Bottom		92	9,4	1,5	-0,748	28,874	1010	96,8	
3	RA05	Full	2024-08-17	16:09	78,313921	-74,785078	CTD-R	Deployment		37	1,9	1,9	-0,765	28,944	1010	96,3	
3	WBAT	Mooring	2024-08-17	15:47	78,315712	-74,794689	Mooring re	Recovery		110	2,1	2,2	-0,89	29,004	1010	91,2	
3	RA02	Full	2024-08-17	3:20	77,234762	-79,142436	TM-R #1	Recovery	374,2	330	21,7	8,6	0,784	28,572	1007		
3	RA02	Full	2024-08-17	2:59	77,234656	-79,144038	TM-R #1	Bottom	368,7	265	12,4	6,6	0,777	28,575	1007		
3	RA02	Full	2024-08-17	2:39	77,234922	-79,148438	TM-R #1	Deploymen	344,6	349	18,2	8,1	0,752	28,602	1007		
3	RA02	Full	2024-08-17	1:59	77,270628	-79,326736	Gravity core	Recovery	618,5	312	35,5	4,9	0,795	28,513	1007		
3	RA02	Full	2024-08-17	1:45	77,270644	-79,329273	Gravity core	Bottom	620,4	312	20,3	6,4	0,802	28,496	1006		
3	RA02	Full	2024-08-17	1:35	77,270475	-79,330386	Gravity core	Deploymen	620,6	319	24,7	3,9	0,857	28,469	1007	4,7	
3	RA04	Full	2024-08-16	21:25	77,382351	-81,073714	Box core GE	Recovery	179,8	181	4,4	2,6	0,283	29,299	1008	18,7	
3	RA04	Full	2024-08-16	21:20	77,382214	-81,073838	Box core GE	Bottom	180,2	201	2,9	3	0,29	29,253	1008	13,8	
3	RA04	Full	2024-08-16	21:12	77,381932	-81,074381	Box core GE	Deploymen	181	14	3,6	3,1	0,376	29,014	1008	13,8	
3	RA04	Full	2024-08-16	20:28	77,381311	-81,076803	Box core GE	Recovery	182,6	93	2,8	1,8	0,407	29,103	1007	17,8	
3	RA04	Full	2024-08-16	20:22	77,381521	-81,077167	Box core GE	Bottom	182	20	2,9	1,8	0,423	28,994	1007	16,5	
3	RA04	Full	2024-08-16	20:17	77,381606	-81,077204	Box core GE	Deploymen	182	54	4,4	1,9	0,608	28,494	1007	15,1	
3	RA04	Full	2024-08-16	19:56	77,381496	-81,075554	Box core BIO	Recovery	182,4	340	3,7	2	0,474	28,904	1007	13,7	
3	RA04	Full	2024-08-16	19:52	77,381494	-81,075758	Box core BIO	Bottom	182,3	344	3	1,9	0,488	28,915	1007	14	
3	RA04	Full	2024-08-16	19:47	77,381531	-81,076276	Box core BIO	Deploymen	182,3	0	2,6	1,9	0,494	28,869	1007	13,7	
3	RA04	Full	2024-08-16	19:20	77,381267	-81,075739	Gravity Core	Recovery	183,2	11	3,5	1,9	0,48	28,805	1007	11,8	
3	RA04	Full	2024-08-16	19:15	77,381426	-81,076348	Gravity Core	Bottom	182,5	355	2,1	1,9	0,5	28,815	1007	10,7	
3	RA04	Full	2024-08-16	19:10	77,381441	-81,076562	Gravity Core	Deploymen	182,7	7	1,5	2	0,617	28,311	1007	10,3	
3	RA04	Full	2024-08-16	18:57	77,380970	-81,078215	Gravity Core	Recovery	182,4	33	3	1,9	0,482	28,982	1007	9,6	
3	RA04	Full	2024-08-16	18:50	77,381063	-81,080208	Gravity Core	Bottom	182,1	26	1,9	2,1	0,465	28,979	1007	8,2	
3	RA04	Full	2024-08-16	18:47	77,381251	-81,081770	Gravity Core	Deploymen	182,2	58	1,9	2,1	0,476	28,961	1007	7,5	
3	RA04	Full	2024-08-16	17:57	77,360670	-81,067985	Phytoplankt	Recovery	207,7	355	11,9	1,9	0,95	27,93	1007	9	
3	RA04	Full	2024-08-16	17:54	77,361000	-81,069175	Phytoplankt	Bottom	206,6	355	14,3	1,8	1,025	28,022	1007	9,3	
3	RA04	Full	2024-08-16	17:49	77,361518	-81,070266	Phytoplankt	Deploymen	204,4	354	15,6	1,8	0,865	28,16	1007	10,3	
3	RA04	Full	2024-08-16	17:25	77,361096	-81,051858	Tucker	Recovery	209,3	359	9	2	1,373	27,068	1007	9,5	
3	RA04	Full	2024-08-16	17:18	77,361623	-81,064445	Tucker	Bottom	207,5	353	8,6	2,1	1,284	27,248	1007	8,4	
3	RA04	Full	2024-08-16	17:09	77,363415	-81,081268	Tucker	Deploymen	198,1	356	9,6	2,4	1,206	27,392	1007	7,4	
3	RA04	Full	2024-08-16	16:00	77,358308	-81,060079	Drop Cam	Recovery	213,4	2	11,8	1,8	0,962	27,915	1007	9,7	
3	RA04	Full	2024-08-16	15:54	77,358936	-81,062281	Drop Cam	Bottom	212,5	5	10,3	1,6	0,925	27,806	1007	12,8	

3	RA04	Full	2024-08-16	15:17	77,363520	-81,067946	Drop Cam	Deploymen	204,2	360	8,5	2,2	0,794	28,184	1007	12,7	
3	RA04	Full	2024-08-16	14:29	77,363536	-81,071622	Hydrobios	Recovery	202,9	345	7,4	3,1	0,853	28,111	1008	4,7	
3	RA04	Full	2024-08-16	14:22	77,363623	-81,072982	Hydrobios	Bottom	201,6	11	5,7	3,2	0,796	28,527	1008	4,1	
3	RA04	Full	2024-08-16	14:16	77,363465	-81,072823	Hydrobios	Deploymen	201,7	1	5,9	2,9	0,743	28,33	1008	4,8	
3	RA04	Full	2024-08-16	13:47	77,362535	-81,070591	CTD-R #2	Recovery	203,2	33	5,4	2,1	0,65	28,542	1008	7,4	
3	RA04	Full	2024-08-16	13:10	77,362392	-81,072357	CTD-R #2	Bottom	203,1	9	7,6	2,3	0,735	28,271	1009	5,1	
3	RA04	Full	2024-08-16	13:00	77,362683	-81,073015	CTD-R #2	Deploymen	202,6	1	6,1	2,3	0,702	28,431	1009	4,4	
3	RA04	Full	2024-08-16	12:31	77,363780	-81,070960	TM-R #1	Recovery	202,4	0	4,8	2,1	0,688	28,526	1009	5,3	
3	RA04	Full	2024-08-16	12:02	77,362760	-81,065563	TM-R #1	Bottom	194,5	33	4,2	2,3	0,81	28,187	1010	4	
3	RA04	Full	2024-08-16	11:46	77,362493	-81,068069	TM-R #1	Deploymen	205,7	187	6,6	2,9	0,803	27,982	1010		
3	RA04	Full	2024-08-16	10:57	77,360690	-81,080790	CTD-R #1	Recovery	197,2	108	4,2	3,5	0,719	28,417	1010		
3	RA04	Full	2024-08-16	10:20	77,361017	-81,081995	CTD-R #1	Bottom	197,4	73	2,7	2,2	0,858	27,036	1010		
3	RA04	Full	2024-08-16	10:07	77,361288	-81,081180	CTD-R #1	Deploymen	197,6	42	0,7	1,8	0,971	27,525	1011	0,2	
3	RA04	Full	2024-08-16	3:47	77,288858	-80,743609	TM-R #3 Te	Recovery	465,7	289	6,6	2,2	1,375	27,173	1010		
3	RA04	Full	2024-08-16	3:35	77,288521	-80,745040	TM-R #3 Te	Bottom	469,3	305	9,6	5,5	1,274	27,466	1010		
3	RA04	Full	2024-08-16	2:56	77,291115	-80,753413	TM-R #3 Te	Deploymen	449,2	241	18,4	5,3	1,1	27,281	1010		
3	RA03	Full	2024-08-16	1:42	77,291854	-80,759636	Box core GE	Recovery	437,1	321	12,4	5,1	1,27	27,153	1010		
3	RA03	Full	2024-08-16	1:32	77,292138	-80,760259	Box core GE	Bottom	436,4	305	13,3	2,6	1,383	27,484	1010	1,1	
3	RA03	Full	2024-08-16	1:23	77,292085	-80,761718	Box core GE	Deploymen	431,6	299	12,6	2,6	1,399	26,9	1010	1,3	
3	RA03	Full	2024-08-16	0:53	77,291765	-80,760729	Box core BI	Recovery	434	269	7,1	2,9	1,397	27,214	1010		
3	RA03	Full	2024-08-16	0:44	77,291924	-80,759768	Box core BI	Bottom	437	344	3,8	3,5	1,431	27,13	1010		
3	RA03	Full	2024-08-16	0:33	77,292295	-80,759877	Box core BI	Deploymen	438	258	9,5	5,5	1,294	27,519	1010		
3	RA03	Full	2024-08-15	23:49	77,296684	-80,694341	IKMT	Recovery	491,9	348	8,4	2,9	1,254	27,278	1009		
3	RA03	Full	2024-08-15	23:33	77,299867	-80,680262	IKMT	Bottom	503,7	342	16,5	2,8	1,209	27,42	1009		
3	RA03	Full	2024-08-15	23:05	77,290161	-80,715578	IKMT	Deploymen	477,9	101	15,6	6,1	1,341	26,972	1009		
3	RA03	Full	2024-08-15	22:08	77,294452	-80,739104	Barge IN		454,4	313	16,8	2,6	1,234	27,383	1009	4,2	
3	RA03	Full	2024-08-15	21:23	77,287776	-80,677657	Tucker	Recovery	492,6	305	15,6	2,7	1,16	27,461	1008	3,9	
3	RA03	Full	2024-08-15	21:01	77,290089	-80,737168	Tucker	Deploymen	463,8	289	5,4	4	1,266	27,154	1009		
3	RA03	Full	2024-08-15	20:42	77,290218	-80,740324	Drop Cam	Recovery	460,9	268	9,6	7	1,123	27,774	1008		
3	RA03	Full	2024-08-15	20:03	77,290163	-80,740478	Drop Cam	Bottom	460,7	264	10	7,9	1,206	27,441	1008		
3	RA03	Full	2024-08-15	19:54	77,290498	-80,739250	Drop Cam	Deploymen	460	303	14,7	3,6	1,311	27,451	1008	0,3	
3	RA03	Full	2024-08-15	19:14	77,278608	-80,681645	Gravity Cor	Recovery	508,6	298	17,8	2,6	1,286	27,039	1008	5,2	
3	RA03	Full	2024-08-15	19:05	77,278618	-80,683784	Gravity Cor	Bottom	508,1	299	17,2	2,6	1,308	27,036	1008	4,9	
3	RA03	Full	2024-08-15	18:56	77,278992	-80,684502	Gravity Cor	Deploymen	508,5	306	19,6	2,7	1,309	27,05	1008	3,2	

3	RA03	Full	2024-08-15	18:14	77,288271	-80,745666	CTD-R #3	Recovery	471,3	293	13,5	8,7	1,315	27,139	1008		
3	RA03	Full	2024-08-15	17:36	77,289732	-80,743096	CTD-R #3	Bottom	461,6	274	8,6	7,2	1,06	27,776	1008		
3	RA03	Full	2024-08-15	17:20	77,291302	-80,748732	CTD-R #3	Deploymen	449,9	307	17,1	6,6	1,083	28,128	1008		
3	RA03	Full	2024-08-15	16:04	77,292571	-80,728220	Hydrobios	Recovery	464,3	309	18,1	2,2	1,202	27,382	1007	10,2	
3	RA03	Full	2024-08-15	15:49	77,292130	-80,729138	Hydrobios	Bottom	464,5	300	16	2,1	1,195	27,339	1007	9,2	
3	RA03	Full	2024-08-15	15:38	77,291234	-80,726817	Hydrobios	Deploymen	471,9	312	20,1	2,2	1,156	28,005	1006	7	
3	RA03	Full	2024-08-15	14:56	77,293645	-80,734119	CTD-R #2	Recovery	461,8	311	7,1	3,4	1,234	27,388	1006	0,1	
3	RA03	Full	2024-08-15	14:25	77,293504	-80,748499	CTD-R #2	Bottom	452,3	313	9,4	3,4	1,482	27,616	1006		
3	RA03	Full	2024-08-15	13:57	77,291876	-80,751690	CTD-R #2	Deploymen	446,7	313	12,3	5,3	0,957	28,471	1006		
3	RA03	Full	2024-08-15	13:34	77,291649	-80,756630	TM-R #1	Recovery	438	291	17,1	1,8	1,279	27,142	1006	9,8	
3	RA03	Full	2024-08-15	13:01	77,291721	-80,759094	TM-R #1	Bottom	430,8	301	18,4	1,7	0,842	27,905	1006	8,8	
3	RA03	Full	2024-08-15	12:41	77,292056	-80,758189	TM-R #1	Deploymen	435	296	17,9	1,8	1,296	27,066	1005	7,1	
3	RA03	Full	2024-08-15	11:00	77,293243	-80,740421	CTD-R #1	Recovery	453,7	310	15,9	8,6	0,939	28,258	1005		
3	RA03	Full	2024-08-15	10:21	77,292551	-80,737314	CTD-R #1	Bottom	460,2	329	9,8	6,6	1,112	28,241	1005		
3	RA03	Full	2024-08-15	10:08	77,292600	-80,739017	CTD-R #1	Deployment		307	13,7	6,5	0,885	28,703	1004		
3	RA02	Full	2024-08-15	3:30	77,259694	-79,163671	Gravity Cor	Recovery	578,7	321	29,7	4	0,279	29,57	998		
3	RA02	Full	2024-08-15	3:17	77,260705	-79,170483	Gravity Cor	Bottom	589,9	338	23,2	3,6	0,292	29,648	999	2,8	
3	RA02	Full	2024-08-15	3:05	77,260773	-79,174913	Gravity Cor	Deploymen	590,3	333	16,7	6,3	0,268	29,663	999		
3	RA02	Full	2024-08-15	0:44	77,259075	-79,168294	Box core GE	Recovery	573,8	326	27,5	3,6	0,366	29,575	998	30,6	
3	RA02	Full	2024-08-15	0:35	77,258912	-79,166213	Box core GE	Bottom	573,1	113	28,5	3,8	0,153	29,61	998	42,4	
3	RA02	Full	2024-08-15	0:22	77,260084	-79,169851	Box core GE	Deploymen	584,7	314	24,7	5,8	0,215	29,604	998	7,2	
3	RA02	Full	2024-08-14	23:47	77,260153	-79,162305	Box core BI	Recovery	584,3	326	25,1	6,5	0,329	29,629	998	10,5	
3	RA02	Full	2024-08-14	23:35	77,260542	-79,163465	Box core BI	Bottom	587,6	315	29,1	5	0,458	29,618	997	33,5	
3	RA02	Full	2024-08-14	23:24	77,260845	-79,161239	Box core BI	Deploymen	585,9	315	28,5	2,8	0,275	29,659	997	57,2	
3	RA02	Full	2024-08-14	21:47	77,237013	-78,964368	Tucker	Recovery	590,1	323	11	5,3	0,506	28,346	997	49,1	
3	RA02	Full	2024-08-14	21:25	77,241646	-79,020987	Tucker	Bottom	585,2	326	25,2	3,5	0,528	28,512	997	55,3	
3	RA02	Full	2024-08-14	21:05	77,243121	-79,077628	Tucker	Deploymen	586	317	24,9	3,1	0,524	28,59	996	58,7	
3	RA02	Full	2024-08-14	20:44	77,244593	-79,104895	Drop cam	Recovery	529,5	329	30,1	3	0,438	28,999	996	60,8	
3	RA02	Full	2024-08-14	20:01	77,242667	-79,109523	Drop cam	Bottom	523,7	327	25,8	2,9	0,407	29,093	996	62,3	
3	RA02	Full	2024-08-14	19:48	77,242600	-79,112953	Drop cam	Deploymen	522,9	327	29,8	3,1	0,484	28,69	996	60,5	
3	RA02	Full	2024-08-14	19:04	77,238801	-79,114604	Hydrobios	Recovery	491,7	340	15,5	5,2	0,576	28,671	996	54,5	
3	RA02	Full	2024-08-14	18:47	77,238028	-79,115164	Hydrobios	Bottom	488,2	323	26	3,1	0,546	28,879	996	72,7	
3	RA02	Full	2024-08-14	18:30	77,238488	-79,122209	Hydrobios	Deploymen	489,8	324	26,8	3,3	0,638	28,723	996	75,3	
3	RA02	Full	2024-08-14	16:24	77,236540	-79,019889	TM-R #2	Recovery	590,8	339	14,8	4,1	0,461	28,568	995	55,5	

3	RA02	Full	2024-08-14	14:51	77,237711	-79,122135	TM-R #2	Deploymen	492,5	6	17,8	4,5	0,441	28,463	994	35,2	
3	RA02	Full	2024-08-14	14:23	77,243894	-79,095319	CTD-R #2	Recovery	538	332	28	5	0,463	28,501	993	22,9	
3	RA02	Full	2024-08-14	13:45	77,241885	-79,114010	CTD-R #2	Bottom	519,8	340	25,1	4,7	0,553	28,359	993	10	
3	RA02	Full	2024-08-14	13:27	77,240294	-79,127981	CTD-R #2	Deploymen	511,7	326	28,8	3,7	0,504	28,303	993	11,7	
3	RA02	Full	2024-08-14	12:59	77,239306	-79,117766	TM-R #1	Recovery	494	331	17,9	4,3	0,541	28,359	993	7,5	
3	RA02	Full	2024-08-14	12:27	77,238953	-79,118002	TM-R #1	Bottom	489,6	339	29,3	3,9	0,628	28,384	993	3,1	
3	RA02	Full	2024-08-14	12:07	77,239063	-79,124435	TM-R #1	Deploymen	501,4	336	24,4	4,2	0,678	28,38	993	7,2	
3	RA02	Full	2024-08-14	11:20	77,232654	-79,091266	CTD-R #1	Recovery	474,7	342	22,1	6	0,436	28,324	992		
3	RA02	Full	2024-08-14	10:44	77,233404	-79,104994	CTD-R #1	Bottom	460,8	344	28,2	3,8	0,467	28,381	992	10	
3	RA02	Full	2024-08-14	10:29	77,233971	-79,114453	CTD-R #1	Deploymen	474,4	349	19,6	6,2	0,629	28,354	992	3,2	
3	RA01	Full	2024-08-13	6:36	72,859165	-75,516686	Box Core	Recovery	659,4	235	14,9	6,6	3,634	31,29	992	29,6	
3	RA01	Full	2024-08-13	6:21	72,857437	-75,513057	Box Core	Bottom	663	249	16,3	6,7	3,643	31,299	993	29,3	
3	RA01	Full	2024-08-13	6:09	72,855919	-75,513472	Box Core	Deploymen	663,2	223	11,7	6,2	3,582	31,296	993	30,6	
3	RA01	Full	2024-08-13	5:05	72,878824	-75,673759	IKMT	Recovery	411,6	244	6,9	4,7	3,449	31,201	993	42,5	
3	RA01	Full	2024-08-13	4:17	72,872958	-75,647745	IKMT	Deploymen	488,6	291	4	3,7	3,389	31,191	994	49,8	
3	RA01	Full	2024-08-13	3:36	72,863729	-75,658100	Hydrobios	Recovery	543,8	191	3,6	4,3	3,317	31,158	994	43,8	
3	RA01	Full	2024-08-13	3:18	72,864549	-75,652816	Hydrobios	Bottom	546	168	6,8	4,4	3,271	31,003	994	44,6	
3	RA01	Full	2024-08-13	3:03	72,865993	-75,649382	Hydrobios	Deploymen	545,4	141	9,8	4	3,264	31,085	994	44,8	
3	RA01	Full	2024-08-13	2:23	72,860989	-75,643005	Tucker Net	Recovery	562,8	130	12	4,1	3,201	30,899	994	43,9	
3	RA01	Full	2024-08-13	2:02	72,870682	-75,639005	Tucker Net	Deploymen	509,4	119	11,3	4,2	3,409	31,191	995	42,6	
3	RA01	Full	2024-08-13	1:38	72,857941	-75,658765	Drop Camer	Recovery	549,1	122	9,8	4,2	2,967	30,815	995	41,2	
3	RA01	Full	2024-08-13	0:23	72,864236	-75,656893	Drop Camer	Bottom	545,6	139	11,7	4,9	3,406	31,14	995	29,6	
3	RA01	Full	2024-08-13	0:12	72,864453	-75,654551	Drop Camer	Deploymen	546,4	134	10,2	4,8	3,289	31,137	995	30,1	
3	RA01	Full	2024-08-12	23:06	72,867405	-75,652337	TM #2	Recovery	541,2	109	7,4	4,5	3,459	31,185	995	48,9	
3	RA01	Full	2024-08-12	22:34	72,869043	-75,648993	TM #2	Bottom	531,3	114	12,5	4,7	3,398	31,198	995	62,9	
3	RA01	Full	2024-08-12	22:08	72,869932	-75,646660	TM #2	Deploymen	514	104	14,7	4,8	3,439	31,198	995	69,7	
3	RA01	Full	2024-08-12	20:56	72,880542	-75,654003	Mooring de	Bottom	425,1	132	10,2	4,8	3,499	31,206	995	61,6	
3	RA01	Full	2024-08-12	20:25	72,880872	-75,649518	Mooring de	Deploymen	437,3	141	13,6	4,7	3,559	31,217	994	61,5	
3	RA01	Full	2024-08-12	19:19	72,881050	-75,662492	CTD-R #2	Recovery	408,9	161	6,9	4,5	3,442	31,195	995	43,2	
3	RA01	Full	2024-08-12	18:40	72,881965	-75,656805	CTD-R #2	Bottom	416,6	129	6	4,3	3,392	31,192	995	30	
3	RA01	Full	2024-08-12	18:25	72,881488	-75,653355	CTD-R #2	Deploymen	426,5	115	7	4,4	3,397	31,196	995	23,3	
3	RA01	Full	2024-08-12	17:55	72,880198	-75,653479	TM #1	Recovery	427,5	63	7,9	4,6	3,424	31,208	995	20,8	
3	RA01	Full	2024-08-12	17:29	72,880292	-75,650489	TM #1	Bottom	434,7	86	5,6	4,7	3,359	31,183	995	22,1	
3	RA01	Full	2024-08-12	17:04	72,880395	-75,650814	TM #1	Deploymen	433,8	66	8,2	4,9	3,388	31,206	994	16,3	

3	RA01	Full	2024-08-12	16:26	72,880156	-75,647142	CTD-R #1	Recovery	445,2	26	0	4,6	3,318	31,165	994	15,6	
3	RA01	Full	2024-08-12	15:46	72,880190	-75,648187	CTD-R #1	Bottom	439,7	54	9,1	4,8	3,286	31,138	994	16,6	
3	RA01	Full	2024-08-12	15:28	72,880459	-75,649920	CTD-R #1	Deploymen	434,8	41	9,7	4,3	3,312	31,127	994	20,6	
3	RA01	Full	2024-08-12	14:57	72,875291	-75,648010	Mooring re	Recovery	463,5	18	11,8	4,5	3,375	31,198	993	19,6	
3	RA01	Full	2024-08-12	14:56	72,875458	-75,647768	Mooring re	Deploymen	461,6	13	17,6	4,5	3,382	31,201	993	20	
Leg 4																	
4	RA73 / T	Nutrient	2024-10-01	2:23	74,601427	-93,710242	Rosette nut	Recovery	125,5	27	8,4		0,521	29,03	1006		
4	RA73 / T	Nutrient	2024-10-01	2:06	74,602334	-93,709119	Rosette nut	Bottom	124,1	46	12,2		0,547	29,047	1005		
4	RA73 / T	Nutrient	2024-10-01	2:03	74,602420	-93,709381	Rosette nut	Deploymen	123,9	30	10,5		0,563	29,038	1005		
4	RA73 / T	Nutrient	2024-10-01	1:08	74,483204	-93,638974	Rosette nut	Recovery	171,1	65	12,4		0,431	29,605	1005		
4	RA73 / T	Nutrient	2024-10-01	0:48	74,482966	-93,640164	Rosette nut	Bottom	170,2	58	13,2		0,238	30,174	1005		
4	RA73 / T	Nutrient	2024-10-01	0:44	74,482817	-93,641014	Rosette nut	Deploymen	168,2	64	13,1		0,355	29,909	1005		
4	RA73 / T	Nutrient	2024-09-30	23:34	74,351086	-93,586042	Rosette nut	Recovery	162,6	44	11,6		0,022	30,232	1004		
4	RA73 / T	Nutrient	2024-09-30	23:12	74,351548	-93,583786	Rosette nut	Bottom	164,4	39	14		-0,015	30,249	1003		
4	RA73 / T	Nutrient	2024-09-30	23:09	74,351599	-93,583487	Rosette nut	Deploymen	164,6	43	15,4		0,122	30,181	1003		
4	RA73 / T	Nutrient	2024-09-30	22:04	74,220234	-93,477568	Rosette nut	Recovery	158,9	27	2,1		1,921	26,664	1003		
4	RA73 / T	Nutrient	2024-09-30	21:43	74,221377	-93,509704	Rosette nut	Bottom	155,2	34	4,2		1,741	26,624	1003		
4	RA73 / T	Nutrient	2024-09-30	21:40	74,221594	-93,514104	Rosette nut	Deploymen	152,2	123	4,4		1,74	26,626	1003		
4	RA72 / C	Mooring	2024-09-30	16:16	74,140356	-91,056135	Rosette CTD	Recovery	219,7	29	4,4		-0,172	30,674	999		
4	RA72 / C	Mooring	2024-09-30	16:10	74,140304	-91,056053	Rosette CTD	Bottom	219,7	4	3,7		-0,132	30,661	999		
4	RA72 / C	Mooring	2024-09-30	16:06	74,140167	-91,056017	Rosette CTD	Deploymen	219,7	33	2,5		-0,105	30,608	999		
4	RA71 / C	Mooring	2024-09-30	13:52	74,457635	-90,550121	Mooring re	Recovery	258	231	7,7		0,933	29,898	998		
4	RA71 / C	Mooring	2024-09-30	12:26	74,464692	-90,567426	Rosette CTD	Recovery	264,5	29	0		1,043	29,933	998		
4	RA71 / C	Mooring	2024-09-30	12:20	74,464884	-90,567432	Rosette CTD	Bottom	264,5	103	1,1		1,004	29,941	998		
4	RA71 / C	Mooring	2024-09-30	12:13	74,464838	-90,566560	Rosette CTD	Deploymen	264,7	95	0		0,977	29,97	998		
4	RA70 / T		2024-09-27	21:47	73,733923	-78,575891	Rosette #2	Recovery	920,4	100	6,6	0	0,603	29,964	1010		
4	RA70 / T		2024-09-27	20:56	73,736926	-78,618168	Rosette #2	Bottom	909,9	82	9,2	0,1	0,582	29,833	1010		
4	RA70 / T		2024-09-27	20:40	73,738240	-78,633110	Rosette #2	Deploymen	898	74	8,7	0,1	0,587	29,857	1010		
4	RA70 / T		2024-09-27	19:29	73,729496	-78,551894	Rosette bio	Recovery	894,9	101	5,2	0,2	0,571	30,227	1010		
4	RA70 / T		2024-09-27	18:55	73,733291	-78,593003	Rosette bio	Bottom	903,8	95	2,7	0,3	0,583	29,997	1010		
4	RA70 / T		2024-09-27	18:39	73,735013	-78,617361	Rosette bio	Deploymen	904,7	94	5,4	0,2	0,626	29,999	1010		
4	RA69 / F	Basic	2024-09-27	3:03	76,314502	-75,765322	Rosette bio	Recovery	326,2	62	20,5	-1,4	0,204	31,145	1012		
4	RA69 / F	Basic	2024-09-27	2:29	76,317781	-75,759648	Rosette bio	Bottom	327,1	65	25,2	-1,4	0,188	31,208	1012		
4	RA69 / F	Basic	2024-09-27	2:23	76,318136	-75,760217	Rosette bio	Deploymen	326,5	67	26,5	-1,4	0,333	31,438	1012		
4	RA69 / F	Basic	2024-09-27	1:39	76,313257	-75,763054	Rosette bio	Recovery	325,5	65	22,7	-1,5	0,169	31,405	1013		
4	RA69 / F	Basic	2024-09-27	1:15	76,315798	-75,760233	Rosette bio	Bottom	325,2	65	23,3	-1,4	0,159	31,15	1013		
4	RA69 / F	Basic	2024-09-27	1:09	76,316301	-75,759416	Rosette bio	Deploymen	325,4	69	25,1	-1,5	0,203	31,27	1013		
4	RA69 / F	Basic	2024-09-27	0:47	76,313434	-75,761419	Rosette TM	Recovery	324,8	65	23	-1,5	0,18	31,17	1013		

4	RA69 / F	Basic	2024-09-27	0:38	76,313667	-75,761758	Rosette TM	Bottom	324,9	67	22,6	-1,2	0,204	31,28	1013		
4	RA69 / F	Basic	2024-09-27	0:29	76,315216	-75,759812	Rosette TM	Deploymen	326,3				0,164	31,092			
4	RA68 / F	Nutrient	2024-09-26	21:23	76,405191	-77,953107	Rosette CTD	Recovery	214,6	72	29,3	-1,7	-1,04	29,731	1015		
4	RA68 / F	Nutrient	2024-09-26	20:57	76,407452	-77,960801	Rosette CTD	Bottom	232,6	69	31,7	-1,7	-1,048	29,725	1015		
4	RA68 / F	Nutrient	2024-09-26	20:53	76,407530	-77,959672	Rosette CTD	Deploymen	232,7	81	24,4	-1,7	-1,046	29,728	1015		
4	RA67 / F	Full	2024-09-26	19:33	76,365865	-77,426132	Gravity Cor	Recovery	392	77	28,7	-1,6	-0,25	30,705	1015		
4	RA67 / F	Full	2024-09-26	19:23	76,368189	-77,422048	Gravity Cor	Bottom	391,3	77	34,1	-1,6	-0,303	30,709	1015		
4	RA67 / F	Full	2024-09-26	19:13	76,370617	-77,421381	Gravity Cor	Deploymen	389,8	68	33,9	-1,6	-0,303	30,71	1015		
4	RA67 / F	Full	2024-09-26	18:55	76,367956	-77,422360	Boxcore ge	Recovery	391,3	66	30,8	-1,6	-0,329	30,67	1015		
4	RA67 / F	Full	2024-09-26	18:46	76,368646	-77,420053	Boxcore ge	Bottom	390,8	68	30,7	-1,6	-0,338	30,671	1015		
4	RA67 / F	Full	2024-09-26	18:37	76,371133	-77,419849	Boxcore ge	Deploymen	389,4	68	29,6	-1,6	-0,327	30,66	1015		
4	RA67 / F	Full	2024-09-26	18:25	76,366883	-77,418502	Boxcore bio	Recovery	390,3	68	29,5	-1,6	-0,332	30,679	1015		
4	RA67 / F	Full	2024-09-26	18:16	76,367880	-77,417399	Boxcore bio	Bottom	388,6	78	32,6	-1,6	-0,328	30,683	1015		
4	RA67 / F	Full	2024-09-26	18:06	76,370602	-77,422560	Boxcore bio	Deploymen	390,2	61	25,6	-1,6	-0,337	30,675	1015		
4	RA67 / F	Full	2024-09-26	17:20	76,401132	-77,312688	IKMT	Recovery	307,4	71	31,5	-1,6	-0,197	30,905	1015		
4	RA67 / F	Full	2024-09-26	16:38	76,386111	-77,370827	IKMT	Bottom	342,3	71	31,9	-1,6	-0,281	30,741	1016		
4	RA67 / F	Full	2024-09-26	16:24	76,384484	-77,393650	IKMT	Deploymen	343,4	69	27,6	-1,6	-0,364	30,709	1016		
4	RA67 / F	Full	2024-09-26	16:00	76,384387	-77,406596	Tucker	Recovery	354,5	68	29,7	-1,6	-0,557	30,653	1016		
4	RA67 / F	Full	2024-09-26	15:52	76,383332	-77,410195	Tucker	Bottom	359,8	70	31,3	-1,7	-0,748	30,487	1016		
4	RA67 / F	Full	2024-09-26	15:15	76,378876	-77,412685	Monster	Recovery	369,6	60	25,1	-1,6	-0,744	30,487	1016		
4	RA67 / F	Full	2024-09-26	15:02	76,381050	-77,412421	Monster	Bottom	367,7	65	28,2	-1,7	-0,786	30,436	1016		
4	RA67 / F	Full	2024-09-26	14:53	76,383608	-77,411553	Monster	Deploymen	361,9	64	30,8	-1,7	-0,772	30,456	1016		
4	RA67 / F	Full	2024-09-26	14:11	76,374089	-77,425992	Rosette TM	Recovery	390	61	31,1	-1,6	-0,903	30,204	1016		
4	RA67 / F	Full	2024-09-26	13:57	76,376283	-77,423291	Rosette TM	Bottom	386,1	64	28,9	-1,6	-0,892	30,219	1016		
4	RA67 / F	Full	2024-09-26	13:43	76,380362	-77,418757	Rosette TM	Deploymen	374,7	67	30,4	-1,5	-0,888	30,229	1016		
4	RA67 / F	Full	2024-09-26	13:23	76,378992	-77,402849	Rosette bio	Recovery	362,1	62	27	-1,4	-0,779	30,222	1016		
4	RA67 / F	Full	2024-09-26	12:53	76,385856	-77,397498	Rosette bio	Bottom	341	62	29,8	-1,4	-0,929	29,997	1017		
4	RA67 / F	Full	2024-09-26	12:45	76,386989	-77,396124	Rosette bio	Deploymen	338,2	68	25,7	-1,4	-0,923	30,016	1017		
4	RA67 / F	Full	2024-09-26	11:40	76,365772	-77,421416	Rosette TM	Recovery	390,7	74	22,5	-1,3	-1,023	29,801	1017		
4	RA67 / F	Full	2024-09-26	11:19	76,368633	-77,419336	Rosette TM	Bottom	389,9	66	24,9	-1,3	-1,051	29,819	1017		
4	RA67 / F	Full	2024-09-26	11:06	76,372070	-77,418870	Rosette TM	Deploymen	385,2	64	24,9	-1,3	-0,976	29,865	1017		
4	RA67 / F	Full	2024-09-26	10:43	76,369393	-77,400320	Rosette bio	Recovery	371	63	24,1	-1,2	-1,027	29,876	1017		
4	RA67 / F	Full	2024-09-26	10:18	76,374344	-77,394753	Rosette bio	Bottom	359,2	72	26,9	-1,3	-1,02	29,915	1017		
4	RA67 / F	Full	2024-09-26	10:11	76,375589	-77,395372	Rosette bio	Deploymen	357,8	67	22,3	-1,3	-0,986	29,913	1018		
4	RA66 / F	CTD	2024-09-26	3:05	76,374384	-76,990494	Rosette CTD	Recovery	246,5	71	18,5	-1,1	-0,226	31,019	1019		
4	RA66 / F	CTD	2024-09-26	2:59	76,374142	-76,989211	Rosette CTD	Bottom	246,6	64	20,2	-1	-0,193	31,193	1019		
4	RA66 / F	CTD	2024-09-26	2:54	76,374597	-76,988258	Rosette CTD	Deploymen	245,6	72	17,9	-1,1	-0,236	30,965	1019		
4	RA65 / F	Nutriment	2024-09-26	2:06	76,352238	-76,578254	Rosette nut	Recovery	147,7	80	17,7	-1,1	-0,684	30,723	1019		

4	RA65 / F	Nutriment	2024-09-26	1:45	76,353185	-76,577066	Rosette nut	Bottom	147,8	75	18,4	-1,1	-0,526	30,851	1019		
4	RA65 / F	Nutriment	2024-09-26	1:41	76,353213	-76,576928	Rosette nut	Deploymen	148	77	17,1	-1,1	-0,588	30,834	1019		
4	RA64 / F	CTD	2024-09-26	0:49	76,342654	-76,173803	Rosette CTD	Recovery	194,4	74	14,9	-1	-0,698	30,072	1019		
4	RA64 / F	CTD	2024-09-26	0:45	76,342864	-76,172570	Rosette CTD	Bottom	191,4	78	16,3	-0,9	-0,558	30,286	1019		
4	RA64 / F	CTD	2024-09-26	0:41	76,342974	-76,172131	Rosette CTD	Deploymen	192,6	77	13,1	-0,9	-0,477	30,575	1019		
4	RA63 / F	CTD	2024-09-25	23:23	76,305807	-75,355451	Rosette CTD	Recovery	378,3	88	10,6	-1,2	-0,264	30,468	1019		
4	RA63 / F	CTD	2024-09-25	23:16	76,306094	-75,356034	Rosette CTD	Bottom	378,5	89	10,5	-1,2	-0,224	30,485	1019		
4	RA63 / F	CTD	2024-09-25	23:09	76,306738	-75,355680	Rosette CTD	Deploymen	378,3	82	11,4	-1,2	-0,231	30,494	1019		
4	RA62 / F	Full	2024-09-25	22:08	76,265942	-74,746440	Gravity Cor	Recovery	458,2	81	7,8	-1,1	0,13	31,026	1019		
4	RA62 / F	Full	2024-09-25	21:56	76,266591	-74,746196	Gravity Cor	Bottom	457,3	83	6,5	-1,2	0,125	30,984	1019		
4	RA62 / F	Full	2024-09-25	21:46	76,266571	-74,745944	Gravity Cor	Deploymen	458	87	6,7	-1,3	0,127	31,008	1019		
4	RA62 / F	Full	2024-09-25	21:29	76,266274	-74,749485	Boxcore ge	Recovery	459,4	79	5,7	-1,2	0,108	30,93	1019		
4	RA62 / F	Full	2024-09-25	21:17	76,266301	-74,747098	Boxcore ge	Bottom	457,8	95	6	-1,2	0,132	31,07	1019		
4	RA62 / F	Full	2024-09-25	21:08	76,266553	-74,745880	Boxcore ge	Deploymen	458	84	5,3	-1,2	0,151	31,054	1019		
4	RA62 / F	Full	2024-09-25	20:42	76,260958	-74,728264	Barge recov	Recovery	454,9	99	5,5	-1,2	0,052	30,941	1019		
4	RA62 / F	Full	2024-09-25	20:23	76,267140	-74,745427	Boxcore bio	Recovery	457,7	107	6,1	-1,2	0,078	30,926	1019		
4	RA62 / F	Full	2024-09-25	20:13	76,267402	-74,744761	Boxcore bio	Bottom	457,5	103	6	-1,1	0,185	31,129	1019		
4	RA62 / F	Full	2024-09-25	20:03	76,267655	-74,743618	Boxcore bio	Deploymen	458,2	105	4,8	-1	0,086	30,929	1019		
4	RA62 / F	Full	2024-09-25	19:45	76,280301	-74,677335	Agassiz Trav	Recovery	445,8	123	4,3	-0,9	0,166	31,228	1019		
4	RA62 / F	Full	2024-09-25	19:27	76,282121	-74,642252	Agassiz Trav	Bottom	444,8	56	1,1	-0,7	0,267	31,204	1019		
4	RA62 / F	Full	2024-09-25	19:14	76,275801	-74,627556	Agassiz Trav	Deploymen	445,2	127	2,2	-0,8	0,24	31,307	1019		
4	RA62 / F	Full	2024-09-25	18:52	76,273603	-74,626533	Monster	Recovery	447,9	168	2,7	-1,2	0,322	31,301	1019		
4	RA62 / F	Full	2024-09-25	18:47	76,273369	-74,625230	Monster	Bottom	447,7	169	3,1	-1,2	0,322	31,303	1019		
4	RA62 / F	Full	2024-09-25	18:43	76,273126	-74,624227	Monster	Deploymen	447,6	199	2,7	-1,2	0,318	31,3	1019		
4	RA62 / F	Full	2024-09-25	18:12	76,267821	-74,743828	IKMT	Recovery	457,5	195	6,1	-1,3	0,063	30,922	1019		
4	RA62 / F	Full	2024-09-25	17:29	76,272859	-74,623296	IKMT	Bottom	447,3	179	5,3	-1,1	0,255	31,173	1019		
4	RA62 / F	Full	2024-09-25	17:15	76,267265	-74,595622	IKMT	Deploymen	443,1	157	3	-0,9	0,11	30,967	1019		
4	RA62 / F	Full	2024-09-25	16:51	76,263201	-74,590973	Barge deplo	Deploymen	441,3	177	8,6	-1,2	0,197	31,078	1018		
4	RA62 / F	Full	2024-09-25	16:15	76,274090	-74,630018	Tucker	Recovery	446,5	199	0,8	-1,2	0,097	30,977	1018		
4	RA62 / F	Full	2024-09-25	16:05	76,269667	-74,615324	Tucker	Bottom	445,7	73	1	-1,4	0,097	30,973	1018		
4	RA62 / F	Full	2024-09-25	15:57	76,265508	-74,605220	Tucker	Deploymen	445,9	119	1,6	-1,3	0,051	30,893	1018		
4	RA62 / F	Full	2024-09-25	15:39	76,264786	-74,597484	Phytoplankt	Recovery	443,2	213	2	-1,6	0,152	31,013	1018		
4	RA62 / F	Full	2024-09-25	15:31	76,264562	-74,596531	Phytoplankt	Bottom	443,6	219	2,4	-1,8	0,12	30,988	1018		
4	RA62 / F	Full	2024-09-25	15:30	76,264517	-74,596371	Phytoplankt	Deploymen	443,7	230	2,5	-1,8	0,12	30,987	1018		
4	RA62 / F	Full	2024-09-25	15:14	76,264512	-74,594353	Hydrobios	Recovery	443,4	200	3,4	-1,9	0,374	31,347	1018		
4	RA62 / F	Full	2024-09-25	14:59	76,264166	-74,594724	Hydrobios	Bottom	443,6	231	3,8	-1,7	0,409	31,571	1018		
4	RA62 / F	Full	2024-09-25	14:47	76,264351	-74,595573	Hydrobios	Deploymen	443,2	239	3,6	-2	0,266	31,19	1018		
4	RA62 / F	Full	2024-09-25	14:17	76,264239	-74,599480	Rosette TM	Recovery	444,4	219	4,4	-2,1	0,139	30,989	1018		

4	RA62 / F	Full	2024-09-25	14:04	76,264214	-74,600293	Rosette TM	Bottom	444,9	4	0	-1,8	0,116	30,988	1018		
4	RA62 / F	Full	2024-09-25	13:50	76,264104	-74,599895	Rosette TM	Deploymen	444,6	18	0	-1,9	0,042	30,893	1018		
4	RA62 / F	Full	2024-09-25	13:25	76,264370	-74,603313	Rosette bio	Recovery	445,6	113	1	-1,6	0,04	30,896	1018		
4	RA62 / F	Full	2024-09-25	12:50	76,263632	-74,599848	Rosette bio	Bottom	444,5	243	2,6	-1,6	0,168	31,112	1018		
4	RA62 / F	Full	2024-09-25	12:41	76,263873	-74,599219	Rosette bio	Deploymen	444,7	215	4,4	-1,6	0,015	30,863	1018		
4	RA62 / F	Full	2024-09-25	11:42	76,261978	-74,601718	Rosette TM	Recovery	443	300	0	-1,2	0,029	30,884	1018		
4	RA62 / F	Full	2024-09-25	11:28	76,262493	-74,600793	Rosette TM	Bottom	445,3	163	0,8	-1,4	0,186	31,096	1018		
4	RA62 / F	Full	2024-09-25	11:14	76,263249	-74,600348	Rosette TM	Deploymen	445,1	195	2,5	-1,2	0,036	30,887	1018		
4	RA62 / F	Full	2024-09-25	10:56	76,263188	-74,602791	Rosette bio	Recovery	445,7	205	1	-1,1	0,048	30,898	1018		
4	RA62 / F	Full	2024-09-25	10:25	76,262907	-74,604942	Rosette bio	Bottom	444,3	209	1,9	-0,8	0,105	30,953	1017		
4	RA62 / F	Full	2024-09-25	10:17	76,262986	-74,603318	Rosette bio	Deploymen	444,5	199	2,1	-0,8	0,167	31,128	1017		
4	RA61 / F	Nutrient	2024-09-25	3:52	76,282115	-74,988134	Rosette nut	Recovery	436,6	178	4,9	0,5	-0,15	30,608	1016		
4	RA61 / F	Nutrient	2024-09-25	3:16	76,281082	-74,985695	Rosette nut	Bottom	436,8	189	6,2	1,1	-0,144	30,591	1016		
4	RA61 / F	Nutrient	2024-09-25	3:07	76,280994	-74,985373	Rosette nut	Deploymen	436,7	187	5,6	1,1	-0,068	30,731	1016		
4	RA60 / F	CTD	2024-09-25	1:38	76,289973	-74,109012	Rosette CTD	Recovery	448,5	185	6,9	3,8	0,082	31,099	1016	4,5	
4	RA60 / F	CTD	2024-09-25	1:28	76,289802	-74,110937	Rosette CTD	Bottom	449,4	190	5,8	4,4	0,178	31,259	1016	36,8	
4	RA60 / F	CTD	2024-09-25	1:20	76,289987	-74,111568	Rosette CTD	Deploymen	448,8	203	4,4	3,3	0,214	31,422	1016		
4	RA59 / F	Nutrient	2024-09-25	0:22	76,299367	-73,639449	Rosette nut	Recovery	525,6	203	8	5	-0,017	30,747	1016		
4	RA59 / F	Nutrient	2024-09-24	23:45	76,299196	-73,636579	Rosette nut	Bottom	524,5	209	9	4,5	-0,003	30,813	1015		
4	RA59 / F	Nutrient	2024-09-24	23:36	76,299788	-73,637256	Rosette nut	Deploymen	525,9	215	9,2	4,5	-0,043	30,787	1015		
4	RA58 / F	Basic	2024-09-24	22:34	76,310346	-73,219689	Gravity Cor	Recovery	588,7	89	6,9	6,1	0,085	30,512	1015		
4	RA58 / F	Basic	2024-09-24	22:23	76,309959	-73,221668	Gravity Cor	Bottom	586	164	6,9	6,5	0,419	31,799	1015		
4	RA58 / F	Basic	2024-09-24	22:12	76,310185	-73,223019	Gravity Cor	Deploymen	586,2	161	6,5	6	0,46	31,568	1015		
4	RA58 / F	Basic	2024-09-24	21:39	76,307071	-73,204972	Boxcore	Recovery	588,6	186	8	5,6	0,096	30,846	1015		
4	RA58 / F	Basic	2024-09-24	21:26	76,306898	-73,207475	Boxcore	Bottom	591,3	184	8,4	6,4	0,102	31,378	1015		
4	RA58 / F	Basic	2024-09-24	21:13	76,306632	-73,210293	Boxcore	Deploymen	592,1	182	8,9	7,2	0,081	31,429	1015		
4	RA58 / F	Basic	2024-09-24	20:46	76,297073	-73,361863	IKMT	Recovery	565,5	198	11,8	10,7	-0,061	30,457	1015		
4	RA58 / F	Basic	2024-09-24	19:58	76,310136	-73,246020	IKMT	Bottom	588,8	194	9,3	4,3	0,141	31,017	1015		
4	RA58 / F	Basic	2024-09-24	19:41	76,307334	-73,207674	IKMT	Deploymen	587,5	198	8,7	-1,3	0,123	31,417	1015		
4	RA58 / F	Basic	2024-09-24	19:08	76,311355	-73,221171	Barge recov	Recovery	599,5	193	10,5	-0,2	0,137	31,156	1015		
4	RA58 / F	Basic	2024-09-24	18:56	76,309460	-73,221965	Monster	Recovery	585,5	204	9,6	-2,1	0,159	31,06	1015		
4	RA58 / F	Basic	2024-09-24	18:36	76,307512	-73,218060	Monster	Bottom	592,1	193	10,5	-0,2	0,164	31,27	1015		
4	RA58 / F	Basic	2024-09-24	18:21	76,306306	-73,213032	Monster	Deploymen	589,5	184	9,9	0,1	0,143	30,899	1015		
4	RA58 / F	Basic	2024-09-24	17:58	76,313749	-73,233163	Rosette Bio	Recovery	596,6	192	11,4	0,5	0,167	31,043	1015		
4	RA58 / F	Basic	2024-09-24	17:18	76,309063	-73,221100	Rosette Bio	Bottom	585,6	178	11,1	0,8	0,105	30,709	1015		
4	RA58 / F	Basic	2024-09-24	17:08	76,308042	-73,218619	Rosette Bio	Deploymen	588,8	171	8,9	0,8	0,1	30,726	1015		
4	RA58 / F	Basic	2024-09-24	16:52	76,306738	-73,213592	Barge deplo	Deploymen	590,8	160	9,7	0,9	0,114	30,865	1015		
4	RA58 / F	Basic	2024-09-24	16:11	76,309510	-73,220444	Rosette TM	Recovery	584,4	162	10,6	0,9	0,096	30,804	1015		

4	RA58 / F	Basic	2024-09-24	15:47	76,307916	-73,216039	Rosette TM	Bottom	587,5	156	7,6	0,9	0,098	30,826	1015		
4	RA58 / F	Basic	2024-09-24	15:25	76,306753	-73,214220	Rosette TM	Deploymen	590,3	169	8	1	0,095	30,844	1015		
4	RA58 / F	Basic	2024-09-24	15:12	76,307641	-73,218966	Rosette bio	Recovery	589,5	179	8	1	0,089	30,82	1015		
4	RA58 / F	Basic	2024-09-24	14:40	76,306006	-73,214537	Rosette bio	Bottom	587,2	190	9,8	0,6	0,047	30,685	1016		
4	RA58 / F	Basic	2024-09-24	14:29	76,305920	-73,214265	Rosette bio	Deploymen	587,1	180	8,9	0,5	0,056	30,744	1016		
4	RA57 / F	CTD	2024-09-24	13:30	76,317195	-72,697150	Rosette CTD	Recovery	552,7	160	9	0,6	-0,053	32,182	1016		
4	RA57 / F	CTD	2024-09-24	13:18	76,316837	-72,698993	Rosette CTD	Bottom	557,3	166	10,6	0,6	-0,072	32,18	1016		
4	RA57 / F	CTD	2024-09-24	13:08	76,316296	-72,700524	Rosette CTD	Deploymen	558,6	156	9,3	0,5	-0,069	32,176	1016		
4	RA56 / F	Nutrient	2024-09-24	12:09	76,316986	-72,211317	Rosette Nut	Recovery	542,5	167	13,5	0,7	-0,049	32,223	1016		
4	RA56 / F	Nutrient	2024-09-24	11:32	76,318664	-72,215258	Rosette Nut	Bottom	546,3	158	11,6	0,9	-0,123	32,316	1017		
4	RA56 / F	Nutrient	2024-09-24	11:22	76,319428	-72,216792	Rosette Nut	Deploymen	543,9	167	11,7	1	-0,138	32,312	1017		
4	RA55 / F	CTD	2024-09-24	10:34	76,323335	-71,775455	Rosette CTD	Recovery	610,5	173	16	2	0,259	32,194	1017		
4	RA55 / F	CTD	2024-09-24	10:22	76,324264	-71,776019	Rosette CTD	Bottom	611,4	173	17,7	2	0,237	32,326	1017		
4	RA55 / F	CTD	2024-09-24	10:11	76,324798	-71,778265	Rosette CTD	Deploymen	610,5	177	17	2,1	0,247	32,076	1017		
4	RA54 / F	Full	2024-09-24	4:29	76,444848	-71,717512	Wave buoy	Recovery	492,6	143	15,3	3,3	0,086	32,684	1019		
4	RA54 / F	Full	2024-09-24	3:10	76,341902	-71,286382	Gravity Cor	Recovery	650,1	147	11,7	2,1	0,244	32,599	1020		
4	RA54 / F	Full	2024-09-24	2:58	76,340800	-71,278008	Gravity Cor	Bottom	656,8	146	12,6	2,1	0,245	32,6	1020		
4	RA54 / F	Full	2024-09-24	2:45	76,340117	-71,272269	Gravity Cor	Deploymen	659,4	141	10,3	2	0,226	32,6	1020		
4	RA54 / F	Full	2024-09-24	2:27	76,341063	-71,279308	Gravity Cor	Recovery	656,5	149	11,7	2,1	0,386	32,603	1020		
4	RA54 / F	Full	2024-09-24	2:16	76,339943	-71,274629	Gravity Cor	Bottom	659,2	163	12,7	2,2	0,27	32,604	1020		
4	RA54 / F	Full	2024-09-24	2:04	76,339799	-71,269522	Gravity Cor	Deploymen	659,6	161	13,2	2,1	0,318	32,604	1020		
4	RA54 / F	Full	2024-09-24	1:47	76,340501	-71,272684	Boxcore ge	Recovery	658,7	151	10,8	2	0,352	32,604	1021		
4	RA54 / F	Full	2024-09-24	1:34	76,340462	-71,270417	Boxcore ge	Bottom	659,1	162	13,1	2,2	0,285	32,604	1021		
4	RA54 / F	Full	2024-09-24	1:19	76,339419	-71,265157	Boxcore ge	Deploymen	660,7	164	13,2	2,3	0,287	32,605	1021		
4	RA54 / F	Full	2024-09-24	1:07	76,342321	-71,280016	Boxcore bio	Recovery	654,7	157	10	2	0,335	32,613	1021		
4	RA54 / F	Full	2024-09-24	0:54	76,341571	-71,275090	Boxcore bio	Bottom	657	178	12,4	2,3	0,319	32,611	1021		
4	RA54 / F	Full	2024-09-24	0:39	76,340028	-71,269159	Boxcore bio	Deploymen	659,6	171	11,2	1,9	0,29	32,609	1021		
4	RA54 / F	Full	2024-09-24	0:16	76,344706	-71,309317	Agassiz Tra	Recovery	656,5	154	10,6	2,3	0,244	32,64	1021		
4	RA54 / F	Full	2024-09-23	23:56	76,340591	-71,275697	Agassiz Tra	Bottom	657,7	156	14,2	2,4	0,281	32,623	1021		
4	RA54 / F	Full	2024-09-23	23:38	76,335978	-71,243774	Agassiz Tra	Deploymen	663,8	169	15,9	2,2	0,277	32,605	1021		
4	RA54 / F	Full	2024-09-23	23:22	76,336605	-71,222482	Catamaran	Recovery	659,6	162	17,2	2,3	0,367	32,605	1021		
4	RA54 / F	Full	2024-09-23	22:52	76,334155	-71,201583	Rosette TM	Recovery	655	158	15,4	2,6	0,327	32,602	1021		
4	RA54 / F	Full	2024-09-23	22:47	76,334069	-71,200007	Rosette TM	Bottom	656,1	164	14,9	2,1	0,306	32,602	1021		
4	RA54 / F	Full	2024-09-23	22:41	76,333680	-71,199757	Rosette TM	Deploymen	657,5	159	12,4	2,5	0,295	32,602	1021		
4	RA54 / F	Full	2024-09-23	21:58	76,342197	-71,394371	IKMT	Recovery	655,9	149	10,1	2,1	0,052	32,744	1021		
4	RA54 / F	Full	2024-09-23	21:14	76,338915	-71,260555	IKMT	Bottom	663	145	13,4	2,8	0,304	32,613	1022		
4	RA54 / F	Full	2024-09-23	20:56	76,336277	-71,219307	IKMT	Deploymen	659,5	144	10,6	4,4	0,295	32,602	1022		
4	RA54 / F	Full	2024-09-23	20:39	76,333503	-71,204885	Phytoplank	Recovery	667,6	131	11,8	2,8	0,277	32,602	1022		

4	RA54 / F	Full	2024-09-23	20:32	76,332335	-71,203755	Phytoplank	Bottom	669,5	156	14,9	2,8	0,282	32,602	1022		
4	RA54 / F	Full	2024-09-23	20:30	76,332011	-71,203633	Phytoplank	Deploymen	668,6	147	13	2,7	0,291	32,601	1022		
4	RA54 / F	Full	2024-09-23	20:11	76,340059	-71,228771	Monster	Recovery	660,6	118	9,9	2,7	0,279	32,601	1022		
4	RA54 / F	Full	2024-09-23	19:48	76,337901	-71,218176	Monster	Bottom	658,1	82	4,8	4,7	0,31	32,601	1022		
4	RA54 / F	Full	2024-09-23	19:32	76,334174	-71,210506	Monster	Deploymen	664,2	145	10,4	4,6	0,271	32,601	1022		
4	RA54 / F	Full	2024-09-23	19:13	76,346504	-71,224875	Optics from	Recovery	650,6	144	9,3	2,2	0,38	32,602	1022		
4	RA54 / F	Full	2024-09-23	19:03	76,343289	-71,212894	Optics from	Bottom	650,9	114	7,8	2,3	0,296	32,604	1022		
4	RA54 / F	Full	2024-09-23	18:54	76,341226	-71,203255	Optics from	Deploymen	651,6	141	10,1	2,6	0,299	32,603	1022		
4	RA54 / F	Full	2024-09-23	18:46	76,340122	-71,195892	Optics from	Bottom	651,6	140	12,6	2,6	0,267	32,603	1022		
4	RA54 / F	Full	2024-09-23	18:40	76,337360	-71,191077	Optics from	Recovery	652,3	131	10,6	2,4	0,257	32,604	1022		
4	RA54 / F	Full	2024-09-23	18:34	76,335229	-71,185706	Optics from	Bottom	652,6				0,246	32,602			
4	RA54 / F	Full	2024-09-23	18:27	76,332932	-71,176886	Optics from	Deploymen	651,6	136	9,3	2,6	0,207	32,601	1022		
4	RA54 / F	Full	2024-09-23	17:59	76,335029	-71,260334	Tucker	Recovery	661,6	125	7,2	2,6	0,248	32,617	1022		
4	RA54 / F	Full	2024-09-23	17:49	76,334082	-71,235254	Tucker	Bottom	665	138	7,6	2,6	0,19	32,603	1022		
4	RA54 / F	Full	2024-09-23	17:38	76,332566	-71,204171	Tucker	Deploymen	669,1	130	6	2,7	0,217	32,605	1022		
4	RA54 / F	Full	2024-09-23	17:22	76,329678	-71,188173	Catamaran	Deploymen	639,2	109	6,3	2,4	0,206	32,603	1022		
4	RA54 / F	Full	2024-09-23	16:59	76,340708	-71,231013	Rosette TM	Recovery	659,6	118	6,5	2,3	0,23	32,604	1023		
4	RA54 / F	Full	2024-09-23	16:26	76,334497	-71,217625	Rosette TM	Bottom	664,7	139	9,3	1,9	0,245	32,603	1023		
4	RA54 / F	Full	2024-09-23	16:01	76,330381	-71,196286	Rosette TM	Deploymen	634,4	148	9,8	1,9	0,205	32,603	1023		
4	RA54 / F	Full	2024-09-23	15:33	76,343009	-71,226604	Rosette bio	Recovery	656,4	142	11,2	1,9	0,212	32,622	1023		
4	RA54 / F	Full	2024-09-23	14:48	76,335779	-71,209636	Rosette bio	Bottom	652	170	13,6	1,7	0,215	32,639	1022		
4	RA54 / F	Full	2024-09-23	14:35	76,333955	-71,208784	Rosette bio	Deploymen	665,8	172	14,8	1,8	0,202	32,648	1022		
4	RA54 / F	Full	2024-09-23	14:11	76,340204	-71,220055	Rosette TM	Recovery	651,2	174	16,2	1,7	0,139	32,643	1022		
4	RA54 / F	Full	2024-09-23	13:45	76,337150	-71,210132	Rosette TM	Bottom	649,2	180	17,9	1,9	0,138	32,642	1022		
4	RA54 / F	Full	2024-09-23	13:24	76,333765	-71,204383	Rosette TM	Deploymen	661,6	182	15,4	1,7	0,17	32,649	1022		
4	RA54 / F	Full	2024-09-23	13:00	76,336920	-71,210063	Rosette bio	Recovery	649,3	196	16,1	1,7	0,128	32,638	1023		
4	RA54 / F	Full	2024-09-23	12:26	76,334265	-71,207586	Rosette bio	Bottom	659,1	185	15,3	1,8	0,144	32,647	1022		
4	RA54 / F	Full	2024-09-23	12:14	76,333862	-71,206551	Rosette bio	Deploymen	662,4	187	16,5	1,8	0,274	32,647	1022		
4	RA53 / F	Nutrient	2024-09-23	10:39	76,379035	-70,532482	Rosette nut	Recovery	142,7	181	8,9	2,2	0,5	32,218	1022		
4	RA53 / F	Nutrient	2024-09-23	10:16	76,380512	-70,526025	Rosette nut	Bottom	139,7	191	9,5	2,2	0,479	32,24	1022		
4	RA53 / F	Nutrient	2024-09-23	10:12	76,380679	-70,525830	Rosette nut	Deploymen	138,7	188	10,4	2,2	0,498	32,235	1022		
4	RA52 / C	Mooring	2024-09-22	19:41	77,189288	-71,048757	Monstern n	Recovery	699,8	9	11,6	4,1	1,368	30,862	1017		
4	RA52 / C	Mooring	2024-09-22	19:32	77,189864	-71,052200	Monstern n	Bottom	749,2	18	12,9	4,2	1,449	30,905	1017		
4	RA52 / C	Mooring	2024-09-22	19:28	77,190141	-71,054245	Monstern n	Deploymen	781,6	40	13,3	4,6	1,338	30,949	1017		
4	RA52 / C	Mooring	2024-09-22	19:06	77,190433	-71,059382	Monstern n	Recovery	808,2	33	17,7	3,7	1,287	30,929	1017		
4	RA52 / C	Mooring	2024-09-22	19:00	77,190334	-71,060629	Monstern n	Bottom	792,7	21	16	2,9	1,316	30,91	1017		
4	RA52 / C	Mooring	2024-09-22	18:57	77,190191	-71,062689	Monstern n	Deploymen	791,1	14	15,6	3,2	1,317	30,883	1017		
4	RA52 / C	Mooring	2024-09-22	17:41	77,177574	-71,077999	Mooring re	Recovery	846,4	36	15,7	4,5	1,423	30,848	1016		

4	RA52 / (	Mooring	2024-09-22	15:43	77,196726	-71,062721	Rosette CTI	Recovery	875	189	26,2	7,7	1,338	30,8	1016		
4	RA52 / (	Mooring	2024-09-22	15:20	77,193098	-71,065492	Rosette CTI	Bottom	853,4	25	3,2	5,9	1,352	30,813	1016		
4	RA52 / (	Mooring	2024-09-22	15:04	77,193059	-71,069145	Rosette CTI	Deploymen	854,8	56	5,2	4,7	1,415	30,818	1016		
4	RA51	CTD	2024-09-21	20:33	78,354611	-73,660620	Catamaran	Recovery	552,5	73	4,8	-1,9	-1,377	29,322	1019		1
4	RA51		2024-09-21	14:17	78,385585	-73,387286	Catamaran	Deploymen	359,7	79	9,1	-1,9	-1,385	29,202	1019		1
4	RA51	CTD	2024-09-21	13:56	78,384210	-73,386382	CTD Rosette	Recovery	371	89	8,5	-1,8	-1,427	29,146	1019		1
4	RA51	CTD	2024-09-21	13:37	78,381543	-73,385597	CTD Rosette	Bottom	365,6	93	9,9	-1,9	-1,405	29,214	1019		1
4	RA51	CTD	2024-09-21	13:29	78,380613	-73,384829	CTD Rosette	Deploymen	352,9	90	7,9	-1,8	-1,362	29,319	1020		1
4	RA50	Full	2024-09-21	1:57	78,301881	-74,001357	Boxcore geo	Recovery	611	53	7,8	-2,9	-1,21	29,998	1024		1
4	RA50	Full	2024-09-21	1:45	78,301433	-74,003630	Boxcore geo	Bottom	607,3	49	8,2	-2,9	-1,238	29,976	1024		1
4	RA50	Full	2024-09-21	1:33	78,301128	-74,003406	Boxcore geo	Deploymen	608,2	57	7,9	-2,9	-1,234	29,938	1024		1
4	RA50	Full	2024-09-21	1:21	78,300939	-74,003448	Boxcore geo	Recovery	608,7	55	8,5	-3	-1,217	30,049	1024		1
4	RA50	Full	2024-09-21	1:08	78,300285	-74,002276	Boxcore geo	Bottom	611,5	47	7,4	-3	-1,235	29,974	1024		1
4	RA50	Full	2024-09-21	0:55	78,299752	-74,002578	Boxcore geo	Deploymen	609,8	66	8,8	-3,1	-1,279	29,939	1024		1
4	RA50	Full	2024-09-20	23:43	78,293042	-73,595005	Boxcore geo	Recovery	605,1	96	8,4	-2,4	-1,199	30,07	1024		1
4	RA50	Full	2024-09-20	23:31	78,293246	-73,594652	Boxcore geo	Bottom	603,3	91	9,5	-2,5	-1,208	30,054	1024		1
4	RA50	Full	2024-09-20	23:18	78,293447	-73,593707	Boxcore geo	Deploymen	601	97	8,9	-2,6	-1,202	30,06	1024		1
4	RA50	Full	2024-09-20	23:05	78,292969	-73,592638	Boxcore bio	Recovery	604,2	89	9,9	-2,7	-1,175	30,117	1024		1
4	RA50	Full	2024-09-20	22:51	78,293253	-73,592477	Boxcore bio	Bottom	601,7	88	8,8	-2,8	-1,176	30,134	1024		1
4	RA50	Full	2024-09-20	22:39	78,294380	-73,591013	Boxcore bio	Deploymen	596,2	89	9,4	-3	-1,184	30,143	1024		1
4	RA50	Full	2024-09-20	21:49	78,265313	-73,539983	Agassiz Trav	Recovery	705,2	94	9,6	-3,2	-1,159	30,087	1024		1
4	RA50	Full	2024-09-20	21:26	78,277636	-73,567893	Agassiz Trav	Bottom	676	85	9,8	-3,4	-1,238	29,954	1024		1
4	RA50	Full	2024-09-20	21:05	78,290351	-73,571063	Agassiz Trav	Deploymen	648,2	77	9,5	-3,4	-1,212	30,069	1024		1
4	RA50	Full	2024-09-20	20:17	78,226521	-73,534465	Catamaran	Recovery	519,5	80	12,2	-3,7	-1,167	30,39	1024		1
4	RA50	Full	2024-09-20	19:45	78,219779	-73,572768	Barge recov	Recovery	568,1	71	4,8	-3,3	-1,271	30,394	1024		1
4	RA50	Full	2024-09-20	19:23	78,232766	-73,555248	IKMT	Recovery	468	47	10,9	-3,8	-1,237	30,346	1024		1
4	RA50	Full	2024-09-20	18:36	78,266180	-73,631048	IKMT	Bottom	636,9	58	12,9	-4,5	-1,323	30,281	1024		1
4	RA50	Full	2024-09-20	18:20	78,275870	-73,644800	IKMT	Deploymen	265,8	67	13,3	-4,5	-1,286	30,279	1024		1
4	RA50	Full	2024-09-20	17:49	78,285625	-73,624222	Tucker	Recovery	697,1	55	13,8	-4,8	-1,199	30,208	1024		1
4	RA50	Full	2024-09-20	17:41	78,290824	-73,627749	Tucker	Bottom	636,8	61	15,5	-4,8	-1,171	30,2	1024		1
4	RA50	Full	2024-09-20	17:33	78,296277	-73,637021	Tucker	Deploymen	591,2	45	13,7	-4,9	-1,173	30,077	1024		1
4	RA50	Full	2024-09-20	17:19	78,303637	-73,632562	Barge deplo	Deploymen	660,6	51	10,5	-4,5	-1,158	30,112	1025		1
4	RA50	Full	2024-09-20	16:44	78,302028	-73,578494	Hydrobios	Recovery	567,9	77	18	-5	-1,126	30,101	1025		1
4	RA50	Full	2024-09-20	16:23	78,302424	-73,589085	Hydrobios	Bottom	589,2	70	18,9	-5,1	-0,958	30,117	1025		1
4	RA50	Full	2024-09-20	16:09	78,304616	-73,586266	Hydrobios	Deploymen	571,6	67	19,4	-5,1	-0,978	30,176	1025		1
4	RA50	Full	2024-09-20	15:46	78,301079	-73,603930	Phytoplankt	Recovery	595,8	63	17,9	-5,3	-0,944	30,257	1025		1
4	RA50	Full	2024-09-20	15:39	78,301500	-73,604787	Phytoplankt	Bottom	592,9	67	18,7	-5,3	-0,973	30,212	1025		1
4	RA50	Full	2024-09-20	15:37	78,301623	-73,605513	Phytoplankt	Deploymen	591,9	78	17,9	-5,3	-0,969	30,193	1025		1

4	RA50	Full	2024-09-20	15:04	78,300662	-73,598138	Rosette TM	Recovery	602,9	69	19	-5,7	-0,985	30,076	1026		1
4	RA50	Full	2024-09-20	14:39	78,296985	-73,599214	Rosette TM	Bottom	633,1	73	22,3	-5,8	-0,932	30,172	1026		1
4	RA50	Full	2024-09-20	14:22	78,294975	-73,601965	Rosette TM	Deploymen	610,5	77	19,9	-5,8	-0,949	30,127	1026		1
4	RA50	Full	2024-09-20	13:51	78,295886	-73,591877	Rosette bio	Recovery	583,7	63	20,2	-5,9	-0,905	30,06	1026		1
4	RA50	Full	2024-09-20	13:18	78,294318	-73,594127	Rosette bio	Bottom	599,8	69	22,6	-5,9	-1,138	30,117	1026		1
4	RA50	Full	2024-09-20	13:07	78,293383	-73,594245	Rosette bio	Deploymen	601,9	75	20,8	-5,9	-1,047	30,246	1027		1
4	RA50	Full	2024-09-20	12:16	78,281437	-73,637851	Rosette TM	Recovery	719,2	77	23,1	-5,4	-1,127	30,291	1027		1
4	RA50	Full	2024-09-20	11:46	78,281122	-73,645263	Rosette TM	Bottom	711	81	22,4	-5,1	-1,09	30,347	1027		1
4	RA50	Full	2024-09-20	11:26	78,282186	-73,643295	Rosette TM	Deploymen	696,2	87	21,1	-5	-1,145	30,275	1027		1
4	RA50	Full	2024-09-20	11:05	78,284590	-73,634996	Rosette bio	Recovery	679,8	91	22,7	-5	-1,047	30,36	1027		1
4	RA50	Full	2024-09-20	10:25	78,289536	-73,617562	Rosette bio	Bottom	657,5	81	24,5	-5,1	-1,15	30,272	1027		1
4	RA50	Full	2024-09-20	10:13	78,290833	-73,614753	Rosette bio	Deploymen	640,4	78	24,3	-5	-1,143	30,242	1028		
4	RA49	Nutrient	2024-09-20	3:04	78,283704	-73,195162	CTD Rosett	Recovery	390,4	70	22,5	-4,5	-0,899	30,668	1028		
4	RA49	Nutrient	2024-09-20	2:31	78,283085	-73,198253	CTD Rosett	Bottom	382,8	64	21,5	-4,5	-0,941	30,688	1028		
4	RA49	Nutrient	2024-09-20	2:23	78,282331	-73,197774	CTD Rosett	Deploymen	381,3	70	19,3	-4,5	-0,888	30,713	1028		
4	RA48	Full	2024-09-20	0:40	78,305749	-74,025580	Gravity Cor	Recovery	551,4	67	17,2	-4,7	-0,948	30,273	1029		
4	RA48	Full	2024-09-20	0:21	78,306121	-74,023231	Gravity Cor	Bottom	552,3	68	18,4	-4,8	-1,006	30,222	1028		
4	RA48	Full	2024-09-20	0:11	78,306489	-74,021403	Gravity Cor	Deploymen	554,2	75	20	-4,8	-1,029	30,206	1029		
4	RA48	Full	2024-09-20	0:01	78,303467	-74,020492	Gravity Cor	Deploymen	570,4	70	19,2	-4,7	-1,042	30,204	1029		
4	RA48	Full	2024-09-19	20:25	78,261626	-74,830351	Zodiac surf	Recovery	600,7	98	19,4	-4,4	-1,129	30,115	1028		
4	RA48	Full	2024-09-19	20:04	78,270011	-74,826535	Zodiac surf	Deploymen	612,8	94	18,5	-4,5	-1,215	29,956	1028		
4	RA48	Full	2024-09-19	19:44	78,277439	-74,821579	Phytoplank	Recovery	616,1	95	20,1	-4,4	-1,206	29,931	1027		
4	RA48	Full	2024-09-19	19:36	78,280627	-74,816052	Phytoplank	Bottom	618,9	95	17,2	-4,3	-1,209	29,92	1028		
4	RA48	Full	2024-09-19	19:35	78,281325	-74,814609	Phytoplank	Deploymen	619,3	98	19,6	-4,3	-1,156	29,919	1028		
4	RA48	Full	2024-09-19	18:53	78,294928	-74,783078	Rosette TM	Recovery	622,2	96	19,7	-4,4	-1,248	29,923	1027		
4	RA48	Full	2024-09-19	18:29	78,301171	-74,773827	Rosette TM	Bottom	614,8	99	18,3	-4,1	-1,238	29,938	1027		
4	RA48	Full	2024-09-19	18:11	78,306218	-74,767287	Rosette TM	Deploymen	613,3	88	17,9	-4,2	-1,26	29,909	1027		
4	RA48	Full	2024-09-19	16:54	78,289745	-74,912344	Catmaran r	Recovery	551,9	97	19,1	-3,9	-1,183	29,773	1027		
4	RA48	Full	2024-09-19	16:04	78,295224	-74,864555	Helicopter s	Recovery	578,2	94	20,7	-4	-1,176	29,904	1027		
4	RA48	Full	2024-09-19	15:17	78,300002	-74,834061	Catamaran	Deploymen	596,4	86	16,5	-3,4	-1,196	29,715	1027		
4	RA48	Full	2024-09-19	14:15	78,303386	-74,812656	Rosette bio	Recovery	562,3	79	18,3	-3,5	-1,182	29,691	1026		
4	RA48	Full	2024-09-19	13:34	78,306962	-74,800205	Rosette bio	Bottom	575,2	77	16,8	-3,6	-1,145	29,674	1026		
4	RA48	Full	2024-09-19	13:23	78,308385	-74,799079	Rosette bio	Deploymen	566,7	82	19,3	-3,6	-1,132	29,686	1026		
4	RA48	Full	2024-09-19	12:24	78,298903	-74,779310	Rosette TM	Recovery	616,2	87	17,6	-3,4	-1,037	29,764	1026		1
4	RA48	Full	2024-09-19	11:54	78,304028	-74,768447	Rosette TM	Bottom	605,8	72	18	-3,6	-1,11	29,93	1026		1
4	RA48	Full	2024-09-19	11:30	78,308583	-74,759407	Rosette TM	Deploymen	612,2	84	19,1	-3,6	-0,88	30,459	1026		1
4	RA48	Full	2024-09-19	11:01	78,300732	-74,753893	Rosette bio	Recovery	597,1	87	20,4	-3,3	-1,226	29,488	1025		1
4	RA48	Full	2024-09-19	10:24	78,311206	-74,747895	Rosette bio	Bottom	617,1	81	17,2	-3,3	-1,026	29,96	1025		1

4	RA48	Full	2024-09-19	10:13	78,314044	-74,739269	Rosette bio	Deploymen	618	81	15,7	-3,3	-0,958	30,048	1025		1
4	RA47	Nutrient	2024-09-19	3:31	78,306624	-73,996046	CTD Rosette	Recovery	620,6	78	15,9	-2,8	-1,022	30,191	1022		2
4	RA47	Nutrient	2024-09-19	2:53	78,301702	-74,001239	CTD Rosette	Bottom	614,7	79	23,5	-3	-1,004	30,151	1022		2
4	RA47	Nutrient	2024-09-19	2:42	78,299722	-73,998522	CTD Rosette	Deploymen	612,5	84	24,5	-3	-0,992	30,15	1022		2
4	RA46	Nutrient	2024-09-19	1:35	78,304149	-74,343334	CTD Rosette	Recovery	544,7	77	18,1	-2,7	-1,239	29,863	1022		2
4	RA46	Nutrient	2024-09-19	0:52	78,298332	-74,341697	CTD Rosette	Bottom	536,5	70	18,3	-2,9	-1,208	29,851	1021		2
4	RA46	Nutrient	2024-09-19	0:42	78,297176	-74,341509	CTD Rosette	Deploymen	540,6	67	16	-2,9	-1,132	29,971	1021		2
4	RA45	Ice coring	2024-09-18	23:11	78,302544	-74,924264	Boxcore geo	Recovery	539,1	63	17,1	-2,4	-1,149	29,796	1021		2
4	RA45	Ice coring	2024-09-18	22:59	78,303347	-74,921387	Boxcore geo	Bottom	538,6	82	19,3	-2,4	-1,077	29,904	1021		2
4	RA45	Ice coring	2024-09-18	22:47	78,304500	-74,915305	Boxcore geo	Deploymen	541,2	83	18,7	-2,5	-1,093	29,807	1021		2
4	RA45	Ice coring	2024-09-18	22:38	78,305036	-74,911906	Boxcore bio	Recovery	540,4	86	20,8	-2,6	-1,122	29,774	1021		2
4	RA45	Ice coring	2024-09-18	22:26	78,307030	-74,902103	Boxcore bio	Bottom	550,2	83	20,3	-2,6	-1,167	29,766	1021		2
4	RA45	Ice coring	2024-09-18	22:12	78,307807	-74,904871	Boxcore bio	Deploymen	545,4	78	19	-2,6	-1,143	29,872	1021		2
4	RA45	Ice coring	2024-09-18	21:06	78,282308	-75,032798	Sea ice cori	Recovery	421,9	88	18	-3	-1,186	30,432	1021		2
4	RA45	Ice coring	2024-09-18	20:46	78,287827	-75,019471	Catamaran	Recovery	325,4	73	13,8	-2,8	-1,174	30,146	1021		2
4	RA45	Ice coring	2024-09-18	13:43	78,333115	-74,854093	Tucker	Recovery	286,6	74	12,3	-2,4	-1,254	30,354	1019		2
4	RA45	Ice coring	2024-09-18	13:34	78,337130	-74,857622	Tucker	Bottom	227,1	234	13,7	-0,9	-1,221	30,018	1019		2
4	RA45	Ice coring	2024-09-18	13:25	78,339079	-74,829037	Tucker	Deploymen	270,9	239	0	-2,3	-1,202	30,029	1019		2
4	RA45	Ice coring	2024-09-18	13:05	78,333087	-74,824743	Hydrobios	Recovery	334,5	65	13,1	-2,6	-1,151	30,314	1019		2
4	RA45	Ice coring	2024-09-18	12:56	78,332749	-74,821779	Hydrobios	Bottom	343,1	69	12,1	-2,7	-1,173	30,297	1019		2
4	RA45	Ice coring	2024-09-18	12:44	78,333074	-74,821209	Hydrobios	Deploymen	335,8	74	15,2	-2,7	-1,181	30,291	1019		2
4	RA45	Ice coring	2024-09-18	11:34	78,326723	-74,789595	Catamaran	Deploymen	511,1	60	9,5	-2,9	-1,137	30,075	1019		2
4	RA45	Ice coring	2024-09-18	11:17	78,327461	-74,786137	CTD Rosette	Recovery	500,4	75	11,4	-3	-1,106	30,463	1019		2
4	RA45	Ice coring	2024-09-18	10:40	78,328976	-74,785354	CTD Rosette	Bottom	480,3	74	14,1	-2,7	-1,159	30,186	1019		2
4	RA45	Ice coring	2024-09-18	10:31	78,329603	-74,781546	CTD Rosette	Deploymen	479,7	71	12,1	-2,7	-1,173	30,125	1019		2
4	RA44	Nutrient	2024-09-17	17:37	79,127461	-69,898508	CTD Rosette	Recovery	299,8	202	1,1	-1,8	-1,219	28,874	1017		2
4	RA44	Nutrient	2024-09-17	17:23	79,129399	-69,896799	CTD Rosette	Bottom	301,7	150	0,7	-1,8	-1,181	28,927	1017		2
4	RA44	Nutrient	2024-09-17	17:18	79,129989	-69,896303	CTD Rosette	Deploymen	301,8	290	0	-1,9	-1,194	28,855	1017		2
4	RA43	Full	2024-09-17	15:33	79,081277	-69,451447	Catamaran	Recovery	217,9	103	0	-1,6	-1,047	29,493	1016		2
4	RA43	Full	2024-09-17	15:23	79,081028	-69,451509	Boxcore geo	Recovery	218,7	201	0,9	-1,6	-1,069	29,427	1016		2
4	RA43	Full	2024-09-17	15:17	79,081070	-69,452053	Boxcore geo	Bottom	217,5	263	0,4	-1,6	-1,113	29,34	1016		2
4	RA43	Full	2024-09-17	15:13	79,081194	-69,452512	Boxcore geo	Deploymen	217,5	156	1,2	-1,6	-1,077	29,441	1016		2
4	RA43	Full	2024-09-17	15:09	79,081267	-69,452568	Boxcore geo	Recovery	217,2	20	1,1	-1,5	-1,062	29,489	1016		2
4	RA43	Full	2024-09-17	15:03	79,081373	-69,452412	Boxcore geo	Bottom	216,7	62	2,9	-1,3	-1,064	29,49	1016		2
4	RA43	Full	2024-09-17	14:58	79,081460	-69,452281	Boxcore geo	Deploymen	216,8	146	2,8	-1,3	-1,081	29,45	1016		2
4	RA43	Full	2024-09-17	14:44	79,081798	-69,451965	Boxcore bio	Recovery	216,3	182	0	-1,4	-1,092	29,414	1016		2
4	RA43	Full	2024-09-17	14:38	79,081941	-69,453015	Boxcore bio	Bottom	215,7	184	0,4	-1,3	-1,085	29,411	1016		2
4	RA43	Full	2024-09-17	14:34	79,082045	-69,453189	Boxcore bio	Deploymen	215,5	176	1,5	-1,2	-1,077	29,439	1016		2

4	RA43	Full	2024-09-17	14:20	79,082612	-69,453681	Rosette bio	Recovery	213,5	185	0	-1,6	-1,048	29,547	1016		2
4	RA43	Full	2024-09-17	13:52	79,083592	-69,462280	Rosette bio	Bottom	217,3	264	1,9	-1,3	-1,057	29,523	1016		2
4	RA43	Full	2024-09-17	13:48	79,083742	-69,463839	Rosette bio	Deploymen	217,8	262	1,6	-1,2	-1,062	29,501	1016		2
4	RA43	Full	2024-09-17	13:23	79,084157	-69,473411	Monster ne	Recovery	221,9	257	3,2	-2	-1,08	29,58	1016		2
4	RA43	Full	2024-09-17	13:15	79,084057	-69,476204	Monster ne	Bottom	222	251	2,1	-1,9	-1,08	29,57	1016		2
4	RA43	Full	2024-09-17	13:09	79,084027	-69,479142	Monster ne	Deploymen	222,6	248	2,4	-1,9	-1,149	29,243	1016		2
4	RA43	Full	2024-09-17	13:00	79,082411	-69,477777	Catamaran	Deploymen	221,4	237	0,9	-1,9	-1,171	29,209	1016		2
4	RA43	Full	2024-09-17	11:33	79,066487	-69,428781	Rosette bio	Recovery	251,3	254	4,4	-1,9	-1,168	29,231	1016		2
4	RA43	Full	2024-09-17	11:07	79,065501	-69,438862	Rosette bio	Bottom	251,2	251	3,3	-1,9			1016		2
4	RA43	Full	2024-09-17	11:02	79,065549	-69,441421	Rosette bio	Deploymen	249,9	261	4,4	-1,8			1016		2
4	RA42	Nutrient	2024-09-17	3:57	79,277577	-70,554311	CTD Rosette	Recovery	231,9	198	3,5	-3,1			1014		
4	RA42	Nutrient	2024-09-17	3:29	79,278036	-70,587617	CTD Rosette	Bottom	229,5	187	2,6	-2,9			1014		
4	RA42	Nutrient	2024-09-17	3:23	79,278241	-70,594537	CTD Rosette	Deploymen	236,5	115	1,7	-2,9			1014		
4	RA41	Full	2024-09-16	20:23	79,506686	-72,828623	Boxcore ge	Recovery	232,9	169	0,8	-2,4	-1,255	29,879	1013		3
4	RA41	Full	2024-09-16	20:17	79,506937	-72,825667	Boxcore ge	Bottom	232,2	187	0,2	-2,4	-1,224	29,974	1013		3
4	RA41	Full	2024-09-16	20:11	79,507230	-72,821812	Boxcore ge	Deploymen	232,9	187	0,4	-2,5	-1,228	29,988	1013		3
4	RA41	Full	2024-09-16	18:44	79,492573	-73,048641	Barge recov	Recovery	214,6	90	1,5	-2,5	-1,25	30,386	1013		3
4	RA41	Full	2024-09-16	18:28	79,494287	-73,041821	Catamaran	Recovery	212,8	112	2,8	-2,5	-1,24	30,465	1012		3
4	RA41	Full	2024-09-16	17:30	79,499172	-73,030127	Monster	Recovery	208,2	88	3,2	-2,7	-1,267	30,576	1012		3
4	RA41	Full	2024-09-16	17:24	79,499807	-73,027946	Monster	Bottom	208,5	106	2,4	-2,6	-1,267	30,506	1012		3
4	RA41	Full	2024-09-16	17:20	79,500079	-73,027967	Monster	Deploymen	207,7	107	1,7	-2,7	-1,287	30,387	1012		3
4	RA41	Full	2024-09-16	16:53	79,494660	-73,042929	Monster ne	Recovery	213,7	118	3,2	-2,5	-1,195	30,538	1012		3
4	RA41	Full	2024-09-16	16:44	79,495638	-73,039688	Monster ne	Bottom	212,3	119	3,6	-2,5	-1,18	30,52	1012		3
4	RA41	Full	2024-09-16	16:38	79,496394	-73,036392	Monster ne	Deploymen	212,4	112	3,4	-2,5	-1,211	30,497	1012		3
4	RA41	Full	2024-09-16	16:22	79,498120	-73,030379	Barge deply	Deploymen	210,6	60	2,1	-2,5	-1,219	30,49	1012		3
4	RA41	Full	2024-09-16	15:28	79,494899	-73,040753	Rosette bio	Recovery	213,5	85	3,8	-2,5	-1,194	30,525	1012		3
4	RA41	Full	2024-09-16	15:00	79,497892	-73,028297	Rosette bio	Bottom	213,1	95	4,6	-2,5	-1,199	30,575	1012		3
4	RA41	Full	2024-09-16	14:55	79,498215	-73,026876	Rosette bio	Deploymen	213,6	93	4,1	-2,5	-1,24	30,619	1012		3
4	RA41	Full	2024-09-16	14:24	79,495639	-73,081209	Tucker net	Recovery	206,2	87	1,1	-2	-1,267	30,338	1012		3
4	RA41	Full	2024-09-16	14:16	79,497134	-73,056404	Tucker net	Bottom	206,1	75	1,1	-1,9	-1,248	30,41	1012		3
4	RA41	Full	2024-09-16	14:07	79,499037	-73,029228	Tucker net	Deploymen	208,9	44	2,7	-1,8	-1,28	30,324	1012		3
4	RA41	Full	2024-09-16	13:45	79,497914	-73,039455	Catamaran	Deploymen	208,5	125	7	-2,4	-1,218	30,551	1012		3
4	RA41	Full	2024-09-16	13:30	79,498122	-73,035337	Rosette bio	Recovery	209	109	5,1	-2,5	-1,226	30,553	1012		3
4	RA41	Full	2024-09-16	13:01	79,497925	-73,023318	Rosette bio	Bottom	213,9	121	2,6	-2,4	-1,253	30,689	1012		3
4	RA41	Full	2024-09-16	12:55	79,498119	-73,021247	Rosette bio	Deploymen	213,5	61	4,7	-2,4	-1,268	30,367	1012		3
4	RA40	Nutrient	2024-09-16	10:56	79,459894	-72,404903	CTD Rosette	Recovery	248,1	113	5,8	-2,5	-1,341	30,565	1012		3
4	RA40	Nutrient	2024-09-16	10:23	79,462169	-72,376214	CTD Rosette	Bottom	246,7	94	7,2	-2,5	-1,431	30,485	1012		3
4	RA40	Nutrient	2024-09-16	10:18	79,462214	-72,372245	CTD Rosette	Deploymen	247,4	108	5,7	-2,5	-1,355	30,573	1012		3

4	RA39	Nutrient	2024-09-16	3:00	79,415812	-71,773091	CTD Rosett	Recovery	235,1	98	1,4	-2,6	-1,192	30,12	1011		3
4	RA39	Nutrient	2024-09-16	2:29	79,418422	-71,774730	CTD Rosett	Bottom	234,5	114	2,8	-2,7	-1,265	29,994	1011		3
4	RA39	Nutrient	2024-09-16	2:25	79,418836	-71,774081	CTD Rosett	Deploymen	235,3	109	2,5	-2,7	-1,288	29,964	1011		3
4	RA38	Basic	2024-09-15	23:10	79,444477	-71,036258	Gravity Cor	Recovery	224,4	259	5,8	-2	-1,383	30,167	1011		3
4	RA38	Basic	2024-09-15	23:05	79,444271	-71,037273	Gravity Cor	Bottom	224,1	264	4,8	-1,9	-1,375	30,192	1011		3
4	RA38	Basic	2024-09-15	22:59	79,443984	-71,037382	Gravity Cor	Deploymen	225	263	6,2	-1,9	-1,374	30,256	1011		3
4	RA38	Basic	2024-09-15	21:54	79,441393	-71,063816	Boxcore ge	Recovery	224,2	328	2	-1,8	-1,399	30,201	1012		3
4	RA38	Basic	2024-09-15	21:47	79,441163	-71,063103	Boxcore ge	Bottom	223,5	256	6	-1,9	-1,408	30,185	1012		3
4	RA38	Basic	2024-09-15	21:42	79,440647	-71,061997	Boxcore ge	Deploymen	222,8	261	2,3	-2	-1,402	30,12	1012		3
4	RA38	Basic	2024-09-15	21:27	79,441121	-71,067446	Boxcore ge	Recovery	224	275	4,6	-2,1	-1,403	30,113	1012		3
4	RA38	Basic	2024-09-15	21:21	79,440799	-71,067310	Boxcore ge	Bottom	223,1	254	3,2	-2,2	-1,407	30,152	1012		3
4	RA38	Basic	2024-09-15	21:16	79,440605	-71,067392	Boxcore ge	Deploymen	223	254	2,9	-2,1	-1,409	30,151	1012		3
4	RA38	Basic	2024-09-15	19:49	79,388375	-71,171881	Beamtrawl	Recovery	202,6	283	6,6	-1,7	-1,385	30,089	1012		
4	RA38	Basic	2024-09-15	19:29	79,380530	-71,133840	Beamtrawl	Bottom	192,8	279	3,4	-1,6	-1,365	30,084	1012		
4	RA38	Basic	2024-09-15	19:20	79,375815	-71,139023	Beamtrawl	Deploymen	191,5	263	3,8	-1,5	-1,369	30,072	1012		
4	RA37	Basic	2024-09-15	18:50	79,380734	-71,161851	Monster ne	Recovery	194,4	315	3,3	-1,8	-1,302	30,114	1012		
4	RA37	Basic	2024-09-15	18:47	79,380585	-71,163583	Monster ne	Bottom	195,7	314	3,6	-1,8	-1,334	30,126	1012		
4	RA37	Basic	2024-09-15	18:37	79,380279	-71,167369	Monster ne	Deploymen	191,7	305	4,5	-1,7	-1,329	30,176	1012		
4	RA37	Basic	2024-09-15	18:14	79,379590	-71,177479	Tucket net	Recovery	193,9	276	4	-1,8	-1,386	30,08	1012		
4	RA37	Basic	2024-09-15	18:06	79,382523	-71,193779	Tucket net	Bottom	199,5	248	4,7	-1,8	-1,397	30,083	1012		
4	RA37	Basic	2024-09-15	17:57	79,386446	-71,213180	Tucket net	Deploymen	198,3	284	3,6	-1,9	-1,406	30,095	1012		
4	RA38	Sea ice cori	2024-09-15	12:54	79,411967	-71,139224	Rosette bio	Recovery	212	337	2,1	-2,2	-1,416	30,111	1012		2
4	RA38	Sea ice cori	2024-09-15	12:20	79,410018	-71,146056	Rosette bio	Bottom	216,6	275	3,2	-2,1	-1,325	30,121	1012		2
4	RA38	Sea ice cori	2024-09-15	12:15	79,409593	-71,148108	Rosette bio	Deploymen	215,8	296	2,5	-2,1	-1,322	30,12	1012		2
4	RA38	Sea ice cori	2024-09-15	11:08	79,404688	-71,173262	Catamaran	Deploymen	207,3	300	2,1	-1,9	-1,417	30,151	1012		2
4	RA38	Sea ice cori	2024-09-15	10:46	79,403332	-71,180610	Rosette bio	Recovery	205,3	284	1,9	-1,9	-1,418	30,143	1013		2
4	RA38	Sea ice cori	2024-09-15	10:19	79,401192	-71,190122	Rosette bio	Bottom	203,7	260	1,3	-1,9	-1,412	30,103	1013		2
4	RA38	Sea ice cori	2024-09-15	10:14	79,400835	-71,191917	Rosette bio	Deploymen	203,6	258	0,8	-2	-1,41	30,107	1013		2
4	RA37		2024-09-14	21:13	79,936474	-70,330797	CTD Rosett	Recovery	187,2	44	5,7	-2	-1,293	29,871	1013		2
4	RA37		2024-09-14	20:46	79,942991	-70,300155	CTD Rosett	Bottom	192,7	59	4,4	-2	-1,325	30,04	1013		2
4	RA37		2024-09-14	20:43	79,944066	-70,296136	CTD Rosett	Deploymen	193,5	66	4,7	-2	-1,321	29,946	1013		4
4	RA36	Sea ice cori	2024-09-14	0:35	79,867995	-69,948012	Box core ge	Recovery	229,1	241	5,9	-1,4	-1,313	30,601	1012		4
4	RA36	Sea ice cori	2024-09-14	0:30	79,868363	-69,946340	Box core ge	Bottom	227,1		3,6	-1,4	-1,323	30,571	1012		4
4	RA36	Sea ice cori	2024-09-14	0:24	79,869042	-69,944396	Box core ge	Deploymen	226,6	255	3,6	-1,5	-1,36	30,506	1012		4
4	RA36	Sea ice cori	2024-09-14	0:06	79,869053	-69,952302	Box core ge	Recovery	228,8	212	3,9	-1,3	-1,343	30,468	1012		4
4	RA36	Sea ice cori	2024-09-14	0:01	79,869697	-69,950342	Box core ge	Bottom	224,8	199	3,2	-1,4	-1,349	30,46	1012		4
4	RA36	Sea ice cori	2024-09-13	23:55	79,870234	-69,948677	Box core ge	Deploymen	223,3	234	3,4	-1,5	-1,353	30,474	1012		4
4	RA36	Sea ice cori	2024-09-13	23:40	79,871657	-69,942821	Box core bi	Recovery	223	220	4,7	-1,4	-1,354	30,512	1012		4

4	RA36	Sea ice corir	2024-09-13	23:33	79,872110	-69,940573	Box core bio	Bottom	221	225	5,4	-1,6	-1,364	30,541	1012		4
4	RA36	Sea ice corir	2024-09-13	23:27	79,872872	-69,937924	Box core bio	Deploymen	220	195	4,7	-1,5	-1,36	30,573	1012		4
4	RA36	Sea ice corir	2024-09-13	23:00	79,878648	-69,917844	IKMT or Bea	Recovery	201	259	2,7	-2,2	-1,361	30,535	1012		4
4	RA36	Sea ice corir	2024-09-13	22:46	79,876976	-69,896472	IKMT or Bea	Bottom	221,3	224	1,4	-2,1	-1,375	30,474	1012		4
4	RA36	Sea ice corir	2024-09-13	22:34	79,880976	-69,916994	IKMT or Bea	Deploymen	206	282	2,1	-2,3	-1,353	30,451	1012		4
4	RA36	Sea ice corir	2024-09-13	21:28	79,914499	-69,757241	Sea ice sam	Recovery	234,5	247	5,3	-2	-1,39	30,486	1012		4
4	RA35	CTD	2024-09-13	11:26	80,024459	-69,529136	CTD Rosette	Recovery	247,3	230	2,3	-1,1	-1,405	30,587	1012		2
4	RA35	CTD	2024-09-13	11:17	80,025878	-69,525402	CTD Rosette	Bottom	247,7	163	2,5	-1,2	-1,431	30,545	1012		2
4	RA35	CTD	2024-09-13	11:11	80,026743	-69,524658	CTD Rosette	Deploymen	247,5	217	2,1	-1	-1,431	30,542	1012		2
4			2024-09-13	10:50	80,030413	-69,517349	Transit to R	Recovery	245,4	196	3,5	-0,7	-1,41	30,483	1012		2
4			2024-09-13	10:18	80,035646	-69,504313	Transit to R	Bottom	244,1	148	0,8	-1,6	-1,415	30,468	1012		2
4			2024-09-13	10:13	80,036385	-69,501902	Transit to R	Deploymen	245	208	1	-1,7	-1,426	30,471	1012		2
4			2024-09-13	3:36	80,372501	-69,214670	Transit to R	Recovery	301,9	34	1,7	-2,4	-1,25	29,983	1013		3
4			2024-09-13	3:28	80,373601	-69,215052	Transit to R	Bottom	303,7	33	2,2	-2,4	-1,297	30,186	1013		3
4			2024-09-13	3:22	80,374354	-69,214156	Transit to R	Deploymen	303,9	37	1,9	-2,3	-1,28	30,044	1013		3
4	helico	helico	2024-09-13	1:48	80,334373	-68,789656	helico	Recovery	697,9	221	4,1	-1,6	-1,208	30,062	1013		3
4	helico	helico	2024-09-13	1:08	80,331737	-68,779743	helico	Bottom	705,4	218	4,1	-0,6	-1,231	30,122	1013		3
4	helico	helico	2024-09-13	1:03	80,331596	-68,778213	helico	Deploymen	700,1	192	3,2	-0,6	-1,211	30,032	1013		3
4	RA33	CTD	2024-09-12	23:27	80,300884	-68,364018	CTD Rosette	Recovery	345,1	182	2,2	-1,3	-1,27	30,074	1014		3
4	RA33	CTD	2024-09-12	23:19	80,300644	-68,364583	CTD Rosette	Bottom	345,1	162	3,4	-1,3	-1,246	30,184	1014		3
4	RA33	CTD	2024-09-12	23:12	80,300512	-68,364879	CTD Rosette	Deploymen	345,5	170	3,1	-1,3	-1,281	30,262	1014		
4	RA32	CTD	2024-09-12	20:58	80,266185	-67,934424	CTD Rosette	Bottom	188,5	117	2,5	-1,2	-1,331	30,217	1014		
4	RA32	CTD	2024-09-12	20:54	80,266258	-67,933765	CTD Rosette	Deploymen	187,8	102	1,9	-1,2	-1,341	30,266	1014		
4	Ra31	Full	2024-09-12	19:11	80,254730	-67,807021	Gravity Cor	Deploymen	155,9	52	3,8	-1,1	-1,047	29,752	1015		3
4	Ra31	Full	2024-09-12	18:50	80,248303	-67,791510	Barge recov	Recovery	151,8	37	3,2	-1,1	-1,058	29,921	1015		3
4	Ra31	Full	2024-09-12	18:23	80,250013	-67,783410	Boxcore	Recovery	153,5	61	3,1	-1,2	-1,034	29,694	1015		3
4	Ra31	Full	2024-09-12	18:19	80,250345	-67,782904	Boxcore	Bottom	153,7	48	3,1	-1,2	-1,053	29,728	1015		3
4	Ra31	Full	2024-09-12	18:15	80,250665	-67,781695	Boxcore	Deploymen	152,5	53	3,5	-1,2	-1,047	29,718	1015		3
4	Ra31	Full	2024-09-12	18:02	80,251330	-67,774311	Boxcore	Recovery	150,2	63	2,7	-1,1	-1,031	29,709	1015		3
4	Ra31	Full	2024-09-12	17:58	80,251807	-67,772338	Boxcore	Bottom	153	62	2,6	-0,9	-1,011	29,78	1015		3
4	Ra31	Full	2024-09-12	17:54	80,251896	-67,770225	Boxcore	Deploymen	151,3	35	1,9	-0,7	-1,007	29,589	1015		3
4	Ra31	Full	2024-09-12	17:49	80,252177	-67,767423	Boxcore	Recovery	151,5	43	1,3	-0,6	-1,026	29,851	1015		3
4	Ra31	Full	2024-09-12	17:45	80,252641	-67,766589	Boxcore	Bottom	151,9	35	1,3	-0,5	-1,049	29,804	1016		3
4	Ra31	Full	2024-09-12	17:40	80,253436	-67,766340	Boxcore	Deploymen	152,4	270	1,1	-0,5	-1,006	29,332	1016		3
4	RA31	Full	2024-09-12	16:43	80,278809	-67,829439	Monster ne	Recovery	172,4	349	2,7	-0,7	-1,091	30,012	1016		3
4	RA31	Full	2024-09-12	16:37	80,278257	-67,828683	Monster ne	Bottom	173,4	293	0,4	-0,8	-1,119	30,112	1016		3
4	RA31	Full	2024-09-12	16:32	80,277904	-67,828243	Monster ne	Deploymen	172	300	0	-0,9	-1,124	30,009	1016		3
4	Ra31	Full	2024-09-12	14:15	80,276966	-67,746174	Rosette TM	Recovery	143,7	167	0,9	-1	-0,959	29,823	1017		3

4	Ra31	Full	2024-09-12	14:00	80,274719	-67,746448	Rosette TM	Bottom	145,2	151	0,4	-1	-1,011	29,839	1017		3
4	Ra31	Full	2024-09-12	13:56	80,274112	-67,746602	Rosette TM	Deploymen	146,7	141	1	-1	-1,034	29,858	1017		3
4	Ra31	Full	2024-09-12	12:48	80,262893	-67,752131	Rosette Bio	Recovery	141,7	343	4,4	-1,2	-1,064	29,655	1017		3
4	Ra31	Full	2024-09-12	12:26	80,259560	-67,755577	Rosette Bio	Bottom	149,2	335	3,2	-0,5	-1,04	29,786	1017		3
4	Ra31	Full	2024-09-12	12:23	80,258906	-67,756408	Rosette Bio	Deploymen	145,9	300	4,1	-0,5	-1,051	29,748	1017		3
4	Ra31	Full	2024-09-12	11:33	80,258515	-67,771887	Phytoplank	Recovery	153,1	260	2,6	-0,6	-1,104	29,738	1017		3
4	Ra31	Full	2024-09-12	11:25	80,256764	-67,771097	Phytoplank	Bottom	153,1	235	2,9	-0,6	-1,088	29,691	1017		3
4	Ra31	Full	2024-09-12	11:23	80,255948	-67,771135	Phytoplank	Deploymen	153,1	248	2,3	-0,6	-1,131	29,665	1017		3
4	Ra31	Full	2024-09-12	10:42	80,266017	-67,734975	Rosette Bio	Recovery	143	216	3,6	-0,8	-1,045	29,925	1018		3
4	Ra31	Full	2024-09-12	10:20	80,260219	-67,741535	Rosette Bio	Bottom	140,8	218	4,6	-0,9	-1,026	29,799	1018		3
4	Ra31	Full	2024-09-12	10:17	80,259288	-67,742574	Rosette Bio	Deploymen	139,5	228	4,9	-0,9	-1,018	29,768	1018		3
4	RA30	Nutrient	2024-09-12	3:28	80,296365	-68,185609	Nutrient Ro	Recovery	328	184	1,4	-1,4	-1,241	30,154	1018		
4	RA30	Nutrient	2024-09-12	2:56	80,290598	-68,178828	Nutrient Ro	Bottom	326,2	253	1,5	-1,2	-1,275	30,184	1018		
4	RA30	Nutrient	2024-09-12	2:49	80,289524	-68,178513	Nutrient Ro	Deploymen	325	95	0	-1,1	-1,272	30,184	1018		
4	RA29	Nutrient	2024-09-12	1:07	80,325504	-68,541673	Nutrient Ro	Recovery	359,6	307	0	-2,6	-1,303	30,428	1018		
4	RA29	Nutrient	2024-09-12	0:34	80,322467	-68,548937	Nutrient Ro	Bottom	359,8	138	2	-3,1	-1,248	30,422	1018		
4	RA29	Nutrient	2024-09-12	0:28	80,321982	-68,548952	Nutrient Ro	Deploymen	359,7				-1,272	30,423			
4	RA28	Full	2024-09-11	22:58	80,341644	-69,007944	Box Core	Recovery	336,9	87	1,2	-3,5	-1,358	30,506	1018		2
4	RA28	Full	2024-09-11	22:51	80,342910	-69,010053	Box Core	Bottom	337	70	2,8	-3,5	-1,362	30,531	1018		2
4	RA28	Full	2024-09-11	22:44	80,343524	-69,012429	Box Core	Deploymen	338,1	308	2	-3,4	-1,375	30,512	1018		2
4	RA28	Full	2024-09-11	22:30	80,344809	-69,017373	Box Core	Recovery	338,7	325	1,1	-3,6	-1,377	30,432	1018		2
4	RA28	Full	2024-09-11	22:20	80,345329	-69,016806	Box Core	Bottom	338,6	325	1,1	-3,7	-1,39	30,434	1018		2
4	RA28	Full	2024-09-11	22:13	80,345533	-69,016267	Box Core	Deploymen	338,9	346	1	-3,6	-1,38	30,44	1018		2
4	RA28	Full	2024-09-11	21:52	80,342988	-69,018554	Van veen	Recovery	338,1	297	0	-3,4	-1,352	30,471	1018		
4	RA28	Full	2024-09-11	21:44	80,344697	-69,017368	Van veen	Bottom	339,1	329	0	-3,5	-1,338	30,436	1018		
4	RA28	Full	2024-09-11	21:36	80,346312	-69,015859	Van veen	Deploymen	338,9	345	0	-3,6	-1,395	30,42	1018		
4	RA28	Full	2024-09-11	21:00	80,337654	-69,212270	Beam Trawl	Recovery	311,7	282	2,6	-3,5	-1,34	30,458	1018		
4	RA28	Full	2024-09-11	20:39	80,334157	-69,146409	Beam Trawl	Bottom	323	94	2,3	-3,4	-1,397	30,469	1018		
4	RA28	Full	2024-09-11	20:22	80,325646	-69,149545	Beam Trawl	Deploymen	321,6	110	3,3	-3,6	-1,345	30,44	1018		
4	RA28	Full	2024-09-11	19:46	80,311733	-69,127640	Barge recov	Recovery	321,8	82	1,9	-3,2	-1,326	30,569	1017		
4	RA28	Full	2024-09-11	19:15	80,317890	-69,112355	Catamaran	Recovery	325,1	112	1,3	-3,1	-1,294	30,562	1017		
4	RA28	Full	2024-09-11	18:57	80,321860	-69,102058	Phytoplank	Recovery	326,1	37	0,6	-2,4	-1,313	30,538	1017		
4	RA28	Full	2024-09-11	18:47	80,324195	-69,095571	Phytoplank	Bottom	327,7	197	0	-2,6	-1,313	30,547	1017		
4	RA28	Full	2024-09-11	18:45	80,324653	-69,094300	Phytoplank	Deploymen	327,6	357	0	-2,6	-1,313	30,552	1017		
4	RA28	Full	2024-09-11	17:56	80,332321	-69,063021	Barge deplo	Deploymen	334,9	61	0,4	-2,6	-1,292	30,52	1017		
4	RA28	Full	2024-09-11	16:58	80,344769	-69,027929	Monster	Recovery	337,4	278	0,8	-1,9	-1,273	30,581	1017		
4	RA28	Full	2024-09-11	16:49	80,347145	-69,021868	Monster	Bottom	335	259	0,8	-2	-1,288	30,566	1017		
4	RA28	Full	2024-09-11	16:44	80,348383	-69,018753	Monster	Bottom	335,2	200	0,2	-2,2	-1,272	30,594	1017		

4	RA28	Full	2024-09-11	16:38	80,349764	-69,015006	Monster	Deploymen	334,1	225	0,4	-2,3	-1,29	30,682	1017		
4	RA28	Full	2024-09-11	16:04	80,344270	-69,040911	Tucker	Recovery	336,5	73	4	-2,6	-1,332	30,635	1017		
4	RA28	Full	2024-09-11	15:56	80,341842	-69,051508	Tucker	Bottom	335,7	92	4	-2,6	-1,343	30,664	1017		
4	RA28	Full	2024-09-11	15:48	80,339834	-69,065243	Tucker	Deploymen	333,7	81	4	-2,5	-1,302	30,809	1017		
4	RA28	Full	2024-09-11	15:24	80,341710	-69,056959	Rosette TM	Recovery	335,1	54	1,3	-2,4	-1,254	30,979	1017		
4	RA28	Full	2024-09-11	15:05	80,343758	-69,044420	Rosette TM	Bottom	336,5	308	1,9	-2,4	-1,259	30,974	1017		
4	RA28	Full	2024-09-11	14:54	80,345670	-69,035849	Rosette TM	Deploymen	335,9	305	0,6	-2,4	-1,305	30,931	1017		
4	RA28	Full	2024-09-11	14:02	80,351158	-69,009905	Catamaran	Deploymen	334,4	283	1,3	-2,2	-1,333	30,922	1017		
4	RA28	Full	2024-09-11	13:35	80,339543	-69,040280	Rosette bio	Recovery	338,3	326	1,7	-2,2	-1,276	31,013	1016		
4	RA28	Full	2024-09-11	13:04	80,343798	-69,030543	Rosette bio	Bottom	336,5	25	2,3	-2,2	-1,307	31,048	1016		
4	RA28	Full	2024-09-11	12:55	80,345041	-69,028425	Rosette bio	Deploymen	337,4	4	2,5	-2,1	-1,286	31,044	1016		
4	RA28	Full	2024-09-11	11:57	80,349646	-69,022404	Rosette TM	Recovery	333,3	4	1,4	-2,2	-1,294	31,013	1016		
4	RA28	Full	2024-09-11	11:36	80,351966	-69,018610	Rosette TM	Bottom	332,1	44	3,6	-2,2	-1,3	31,015	1016		
4	RA28	Full	2024-09-11	11:25	80,353269	-69,014171	Rosette TM	Deploymen	331,5	30	0	-2,1	-1,306	30,912	1016		
4	RA28	Full	2024-09-11	11:00	80,355229	-69,007183	Rosette bio	Recovery	325,5	26	4,4	-2,1	-1,312	31,006	1016		
4	RA28	Full	2024-09-11	10:34	80,357778	-69,002202	Rosette bio	Bottom	321,8	28	5,8	-2,2	-1,309	30,961	1016		
4	RA28	Full	2024-09-11	10:28	80,358564	-69,001016	Rosette bio	Deploymen	326,2	25	4,5	-2,1	-1,31	30,99	1016		
4	RA27	Sea ice corir	2024-09-10	23:39	80,379732	-68,984583	Boxcore ged	Recovery	336,6	251	17,7	-0,6	-1,293	30,871	1015		1
4	RA27	Sea ice corir	2024-09-10	23:31	80,379704	-68,984246	Boxcore ged	Bottom	336,5	250	17,2	-0,7	-1,305	30,854	1015		1
4	RA27	Sea ice corir	2024-09-10	23:25	80,379695	-68,982518	Boxcore ged	Deploymen	337,6	250	16,5	-0,8	-1,311	30,852	1015		1
4	RA27	Sea ice corir	2024-09-10	23:10	80,385162	-68,960981	Boxcore ged	Recovery	335,1	260	14,8	-0,9	-1,281	30,927	1015		1
4	RA27	Sea ice corir	2024-09-10	23:01	80,385322	-68,961213	Boxcore ged	Bottom	334,8	253	12,2	-1,1	-1,272	30,876	1016		1
4	RA27	Sea ice corir	2024-09-10	22:54	80,385625	-68,958939	Boxcore ged	Deploymen	335,1	257	12,7	-1,1	-1,284	30,872	1016		1
4	RA27	Sea ice corir	2024-09-10	22:25	80,387959	-68,953962	Monster	Recovery	329,5	279	12,2	-1,1	-1,268	30,985	1016		1
4	RA27	Sea ice corir	2024-09-10	22:21	80,388266	-68,953894	Monster	Bottom	325,9	245	15,4	-1	-1,282	30,978	1016		1
4	RA27	Sea ice corir	2024-09-10	22:15	80,388618	-68,952108	Monster	Deploymen	323,6	242	18,5	-1	-1,296	30,847	1016		1
4	RA27	Sea ice corir	2024-09-10	21:20	80,389095	-68,834494	Hydrobios	Recovery	348,3	233	19,4	-0,9	-1,277	30,809	1016		1
4	RA27	Sea ice corir	2024-09-10	21:08	80,390366	-68,828992	Hydrobios	Bottom	355,8	241	19	-0,9	-1,284	30,847	1016		1
4	RA27	Sea ice corir	2024-09-10	20:58	80,390759	-68,826460	Hydrobios	Deploymen	357,3	233	18,2	-1	-1,299	30,779	1016		1
4	RA27	Sea ice corir	2024-09-10	20:27	80,406172	-68,813778	Tucker	Recovery	359,7	246	18,3	-0,9	-1,31	30,813	1016		1
4	RA27	Sea ice corir	2024-09-10	20:17	80,408273	-68,783661	Tucker	Bottom	365,7	233	14,9	-0,9	-1,313	30,791	1016		1
4	RA27	Sea ice corir	2024-09-10	20:07	80,404831	-68,759789	Tucker	Deploymen	368,2	241	13	-0,8	-1,322	30,769	1016		1
4	RA27	Sea ice corir	2024-09-10	19:34	80,398281	-68,734964	Sea ice corir	Recovery	373,5	234	16,7	-0,8	-1,391	30,578	1016		
4	RA27	Sea ice core	2024-09-10	12:51	80,501432	-68,434042	Rosette bio	Recovery	356,6	239	21,1	-0,5	-1,372	30,545	1017		3
4	RA27	Sea ice core	2024-09-10	12:21	80,504224	-68,423269	Rosette bio	Bottom	365,8	232	22,9	-0,5	-1,243	30,547	1018		3
4	RA27	Sea ice core	2024-09-10	12:12	80,504022	-68,416890	Rosette bio	Deploymen	367	225	21,2	-0,5	-1,223	30,52	1018		3
4	RA27	Sea ice corir	2024-09-10	11:05	80,518006	-68,412426	Rosette bio	Recovery	366,3	243	20	-0,9	-1,288	30,512	1018		3
4	RA27	Sea ice corir	2024-09-10	10:34	80,519589	-68,403839	Rosette bio	Bottom	369,7	232	17,9	-0,9	-1,244	30,474	1018		3

4	RA27	Sea ice corir	2024-09-10	10:27	80,519557	-68,402077	Rosette bio	Deploymen	371,4	242	20,1	-0,9	-1,243	30,47	1018		3
4	RA26	Sea ice corir	2024-09-10	3:02	80,899459	-66,671510	Tucker	Recovery	378,6	291	5,7	-0,9	-1,22	30,575	1020		3
4	RA26	Sea ice corir	2024-09-10	2:52	80,898222	-66,702694	Tucker	Bottom	381	265	3,8	-0,8	-1,176	30,568	1020		3
4	RA26	Sea ice corir	2024-09-10	2:42	80,901808	-66,728554	Tucker	Deploymen	376	294	8,5	-1	-1,25	30,6	1020		3
4	RA26	Sea ice corir	2024-09-10	2:20	80,906589	-66,722681	Rosette con	Recovery	377,9	276	9	-1,1	-1,218	30,602	1020		3
4	RA26	Sea ice corir	2024-09-10	1:50	80,907161	-66,714897	Rosette con	Bottom	377,6	288	9,5	-1,2	-1,218	30,614	1020		3
4	RA26	Sea ice corir	2024-09-10	1:41	80,907359	-66,714222	Rosette con	Deploymen	377,6	273	9,6	-1,2	-1,184	30,588	1020		3
4	RA26	Sea ice corir	2024-09-10	0:47	80,935333	-66,913665	IKMT	Recovery	364,3	260	4,9	-1,3	-1,222	30,744	1020		3
4	RA26	Sea ice corir	2024-09-10	0:17	80,932449	-66,844362	IKMT	Bottom	368,2	282	7,1	-1,5	-1,213	30,665	1020		3
4	RA26	Sea ice corir	2024-09-09	23:54	80,916797	-66,857952	IKMT	Deploymen	375,4	268	9,3	-1,3	-1,254	30,536	1020		3
4	RA26	Sea ice corir	2024-09-09	23:05	80,835488	-66,906070	Flamelite bu	Deploymen	451,9	276	10,5	-1,1	-1,324	30,242	1020		3
4	RA26	Sea ice corir	2024-09-09	22:38	80,814339	-66,788087	Flamelite bu	Recovery	444,5	278	14	-0,5	-1,326	30,287	1020		3
4	RA26	Sea ice corir	2024-09-09	21:00	80,825362	-66,761872	Rosette Nut	Deploymen	445,1	278	9,6	-0,9	-1,366	30,29	1020		3
4	RA26	Sea ice corir	2024-09-09	20:53	80,825887	-66,764497	Rosette Nut	Deploymen	444,1	271	9,4	-0,9	-1,272	30,288	1020		3
4	RA26	Sea ice corir	2024-09-09	20:51	80,826067	-66,765371	Rosette Nut	Deploymen	443,3	272	10	-0,9	-1,295	30,288	1020		3
4	Flamelit	transit	2024-09-09	10:18	80,900116	-66,339528	Flamelite bu	Deployment		277	16,6	-0,5	-1,488	30,338	1019		3
4	RA25 / F	Full	2024-09-09	0:42	81,404346	-64,252620	Boxcore geo	Recovery	511,7	282	15,7	-0,8	-1,532	30,414	1017		1
4	RA25 / F	Full	2024-09-09	0:32	81,403307	-64,257172	Boxcore geo	Bottom	509,8	284	19,7	-0,8	-1,526	30,489	1017		1
4	RA25 / F	Full	2024-09-09	0:20	81,402624	-64,267443	Boxcore geo	Deploymen	520,9	290	14,9	-0,8	-1,518	30,398	1017		1
4	RA25 / F	Full	2024-09-08	23:48	81,405764	-64,242262	Gravity Cor	Recovery	974,1	291	15,6	-0,9	-1,519	30,469	1017		1
4	RA25 / F	Full	2024-09-08	23:36	81,404955	-64,250072	Gravity Cor	Bottom	519,6	293	17,4	-0,9	-1,524	30,438	1017		1
4	RA25 / F	Full	2024-09-08	23:25	81,404756	-64,261935	Gravity Cor	Deploymen	533,5	309	13,6	-0,9	-1,48	30,6	1017		1
4	RA25 / F	Full	2024-09-08	21:51	81,405008	-64,239243	Boxcore bio	Recovery	506,8	298	16,5	-1,1	-1,478	30,63	1017		1
4	RA25 / F	Full	2024-09-08	21:40	81,404392	-64,248804	Boxcore bio	Bottom	516,4	291	13,9	-0,9	-1,484	30,589	1017		1
4	RA25 / F	Full	2024-09-08	21:26	81,403573	-64,264428	Boxcore bio	Deploymen	521,5	296	13,7	-1	-1,483	30,611	1017		1
4	RA25 / F	Full	2024-09-08	20:56	81,404544	-64,202648	Hydrobios	Recovery	540,2	291	18,5	-0,9	-1,486	30,56	1017		2
4	RA25 / F	Full	2024-09-08	20:40	81,403780	-64,212768	Hydrobios	Bottom	511,4	290	18,7	-0,8	-1,506	30,584	1017		2
4	RA25 / F	Full	2024-09-08	20:33	81,403507	-64,215644	Zodiac depl	Recovery	513,4	293	18,4	-0,8	-1,502	30,571	1017		2
4	RA25 / F	Full	2024-09-08	20:28	81,403397	-64,220154	Hydrobios	Deploymen	521,8	286	16,4	-0,8	-1,507	30,575	1017		2
4	RA25 / F	Full	2024-09-08	19:54	81,406279	-64,118826	Zodiac depl	Deploymen	539,8	276	24,1	-0,6	-1,519	30,519	1016		2
4	RA25 / F	Full	2024-09-08	18:36	81,419371	-64,106433	Tucker	Recovery	529,9	268	15,6	-0,7	-1,488	30,629	1016		2
4	RA25 / F	Full	2024-09-08	18:28	81,416422	-64,131502	Tucker	Bottom	554,2	277	19,2	-0,7	-1,491	30,61	1016		2
4	RA25 / F	Full	2024-09-08	18:18	81,413019	-64,163666	Tucker	Deploymen	534,7	282	16	-0,8	-1,494	30,566	1016		2
4	RA25 / F	Full	2024-09-08	17:51	81,408161	-64,239418	Phytoplankt	Recovery	536	292	18,2	-1,1	-1,483	30,575	1016		2
4	RA25 / F	Full	2024-09-08	17:42	81,408625	-64,247119	Phytoplankt	Bottom	560,1	291	14,6	-1,1	-1,5	30,504	1016		2
4	RA25 / F	Full	2024-09-08	17:39	81,408342	-64,249919	Phytoplankt	Deploymen	557,8	291	17,4	-1,1	-1,494	30,506	1016		2
4	RA25 / F	Full	2024-09-08	17:13	81,400053	-64,235927	TM-R #2	Recovery	518,8	290	17,1	-1	-1,54	30,293	1016		2
4	RA25 / F	Full	2024-09-08	16:55	81,403455	-64,238597	TM-R #2	Bottom	510,4	280	16,7	-1,1	-1,541	30,311	1016		2

4	RA25 / F	Full	2024-09-08	16:16	81,408964	-64,227022	TM-R #2	Deploymen	518,5	280	19,4	-0,9	-1,512	30,384	1016		2
4	RA25 / F	Full	2024-09-08	16:12	81,408873	-64,227397	TM-R #2	Deploymen	517,6	284	21,7	-0,9	-1,479	30,385	1016		2
4	RA25 / F	Full	2024-09-08	15:44	81,408692	-64,256507	CTD-R #2	Recovery	561,8	273	5,9	2,3	-1,551	30,264	1015		2
4	RA25 / F	Full	2024-09-08	15:08	81,411886	-64,237334	CTD-R #2	Bottom	561,4	269	25	1,5	-1,488	30,291	1016		2
4	RA25 / F	Full	2024-09-08	14:54	81,413292	-64,227824	CTD-R #2	Deploymen	537	279	13	3,8	-1,537	30,306	1016		2
4	RA25 / F	Full	2024-09-08	14:07	81,393891	-64,222251	TM-R #1	Recovery	507,9	272	23,4	-0,6	-1,502	30,248	1015		2
4	RA25 / F	Full	2024-09-08	13:44	81,396557	-64,223565	TM-R #1	Bottom	537,1	280	28,5	-0,7	-1,557	30,263	1015		2
4	RA25 / F	Full	2024-09-08	13:23	81,396871	-64,234941	TM-R #1	Deploymen	538,1	282	20,7	-0,8	-1,569	30,228	1015		2
4	RA25 / F	Full	2024-09-08	12:09	81,408641	-64,232466	CTD-R #1	Recovery	517,3	258	11,9	4,2	-1,566	30,274	1015		1
4	RA25 / F	Full	2024-09-08	11:37	81,406926	-64,236716	CTD-R #1	Bottom	512,5	270	24,4	-0,7	-1,51	30,305	1015		1
4	RA25 / F	Full	2024-09-08	11:27	81,406643	-64,237389	CTD-R #1	Deploymen	513	276	12	0,4	-1,569	30,265	1015		1
4	RA25 / F	Full	2024-09-08	10:47	81,409258	-64,431529	Flamelite bu	Deploymen	887,2	294	18,9	-0,8	-1,495	30,558	1015		1
Leg 5																	
5	JACS-02		2024-10-28	14:16	50,150041	-63,417794	Rosette/UV	Recovery	93,51	316	11,6		4,952	31,482	1013		
5	JACS-02		2024-10-28	14:07	50,149690	-63,418962	Rosette/UV	Bottom	86,03	302	13,6		4,93	31,506	1013		
5	JACS-02		2024-10-28	14:00	50,149524	-63,419654	Rosette/UV	Deploymen	84,73	302	15,8		4,884	31,527	1013		
5	JACS-01		2024-10-28	12:30	49,981905	-63,103811	Rosette/UV	Recovery	102,9	239	13,5		8,074	31,11	1012		
5	JACS-01		2024-10-28	12:19	49,980842	-63,105060	Rosette/UV	Bottom	103	311	19,5		8,124	31,108	1012		
5	JACS-01		2024-10-28	12:12	49,980375	-63,105856	Rosette/UV	Deploymen	101,5	309	18,1		8,134	31,107	1012		
5	BIS-02		2024-10-27	12:06	51,196906	-57,039573	Rosette/UV	Recovery	64,61	260	14,9		4,981	31,557	997		
5	BIS-02		2024-10-27	12:00	51,195434	-57,039461	Rosette/UV	Bottom	64,66	254	16,2		4,929	31,567	997		
5	BIS-02		2024-10-27	11:52	51,194041	-57,039174	Rosette/UV	Deploymen	59,85	246	13,6		4,845	31,583	997		
5	BIS-1		2024-10-27	10:49	51,320962	-56,981992	Rosette/UV	Recovery	98,21	240	11,4		5,213	31,328	997		
5	BIS-1		2024-10-27	10:38	51,320448	-56,980147	Rosette/UV	Bottom	99,09	255	20		5,191	31,334	997		
5	BIS-1		2024-10-27	10:31	51,320072	-56,980880	Rosette/UV	Deploymen	95,55	246	16,4		5,148	31,355	997		
5	TCAT1_(	Full	2024-10-26	18:47	53,666553	-55,529004	Beam Trawl	Recovery	151,8	117	2,5		3,588	31,86	1000		
5	TCAT1_(	Full	2024-10-26	18:28	53,663910	-55,543983	Beam Trawl	Bottom	148	23	11,2		3,429	31,896	1000		
5	TCAT1_(	Full	2024-10-26	18:19	53,668736	-55,548403	Beam Trawl	Deploymen	147,5	24	8,8		3,49	31,884	1000		
5	TCAT1_(	Full	2024-10-26	17:54	53,676412	-55,541111	CTD Rosette	Recovery	154,5	329	0,8		3,549	31,874	1000		
5	TCAT1_(	Full	2024-10-26	17:32	53,678468	-55,544642	CTD Rosette	Bottom	155,9	13	10,6		3,6	31,88	1000		
5	TCAT1_(	Full	2024-10-26	17:24	53,679783	-55,545003	CTD Rosette	Deploymen	157,3	359	0,9		3,538	31,877	1000		
5			2024-10-26	16:38	53,763237	-55,478851	MVP	Recovery		38	3,3		3,667	31,776	1000		
5	TCAT1_(	Nutrient	2024-10-26	14:37	53,980293	-55,262728	MVP	Deploymen	148,4	22	14,9		3,711	32,3	1002		
5	TCAT1_(	Nuterient	2024-10-26	14:27	53,985894	-55,255298	CTD Rosette	Recovery	150,3	13	9,9		3,714	32,3	1002		
5	TCAT1_(	Nuterient	2024-10-26	14:05	53,987677	-55,253743	CTD Rosette	Bottom	149	24	17,2		3,717	32,298	1002		
5	TCAT1_(	Nuterient	2024-10-26	13:56	53,988490	-55,251825	CTD Rosette	Deploymen	149,4	36	14,9		3,698	32,298	1002		
5	TCAT1_(	Nuterient	2024-10-26	13:55	53,988659	-55,251575	CTD Rosette	Deploymen	149,5	21	16,5		3,708	32,297	1002		
5	TCAT1_(	Basic	2024-10-26	11:16	54,487211	-54,753617	Monster ne	Recovery	198,2	51	12,5		3,222	31,957	1005		

5	TCAT1_(	Basic	2024-10-26	11:10	54,487283	-54,754011	Monster ne	Bottom	198,2	55	19,9		3,278	31,957	1005		
5	TCAT1_(	Basic	2024-10-26	11:06	54,487708	-54,754092	Monster ne	Deploymen	197,6	59	11,9		3,25	31,956	1005		
5	TCAT1_(	Basic	2024-10-26	10:48	54,486728	-54,757317	CTD Rosett	Recovery	196,2	72	9,8		3,261	31,934	1005		
5	TCAT1_(	Basic	2024-10-26	10:22	54,490287	-54,760106	CTD Rosett	Bottom	192,5	71	17,3		3,251	31,938	1006		
5	TCAT1_(	Basic	2024-10-26	10:11	54,491884	-54,758009	CTD Rosett	Deploymen	193,6	63	18		3,246	31,936	1005		
5	GR24-17	Basic	2024-10-24	14:29	58,882014	-66,285064	Tucker	Recovery	26,37	272	26,7	33,1	3,686	29,903	1000		
5	GR24-17	Basic	2024-10-24	14:23	58,882010	-66,293372	Tucker	Bottom	32,92	283	24,1	4,3	3,704	29,867	1000	54,4	
5	GR24-17	Basic	2024-10-24	14:15	58,885297	-66,304930	Tucker	Deploymen	57,48	293	11,7		3,71	29,848	1000		
5	GR24-17	Basic	2024-10-24	13:35	58,883108	-66,307504	Boxcore	Recovery	62,13	258	17,8	14,2	3,693	29,835	1000	71,2	
5	GR24-17	Basic	2024-10-24	13:07	58,883610	-66,308325	Boxcore	Bottom	63,38	305	31,7		3,717	29,855	998	65,5	
5	GR24-17	Basic	2024-10-24	13:04	58,884073	-66,308523	Boxcore	Deploymen	64,03	305	31,7	51,7	3,696	29,83	998		
5	GR24-17	Basic	2024-10-24	12:33	58,883461	-66,308300	CTD Rosett	Recovery	63,12	334	16,6		3,685	29,787	998		
5	GR24-17	Basic	2024-10-24	12:21	58,884076	-66,311461	CTD Rosett	Bottom	61,54	245	22,9		3,705	29,81	998		
5	GR24-17	Basic	2024-10-24	12:15	58,884590	-66,312740	CTD Rosett	Deploymen	61,85	324	15,9		3,744	29,828	998		
5	UNG--3	Basic	2024-10-23	13:14	59,424519	-67,457139	Boxcore 2	Recovery		48	16,1	4	1,843	32,094	986	96,5	
5	UNG--3	Basic	2024-10-23	13:06	59,425579	-67,456533	Boxcore 2	Bottom	182,9	85	17,3	-2,3	1,835	32,096	986	67,8	
5	UNG--3	Basic	2024-10-23	12:58	59,426224	-67,455620	Boxcore 2	Deploymen	10,75	81	21,7	-2,3	1,84	32,095	986	41	
5	UNG--3	Basic	2024-10-23	12:33	59,424871	-67,456710	Boxcore	Recovery	129,4	80	19,7		1,825	32,096	986		
5	UNG--3	Basic	2024-10-23	12:22	59,425504	-67,454441	Boxcore	Bottom		90	18,3		1,831	32,097	986		
5	UNG--3	Basic	2024-10-23	12:15	59,425920	-67,453955	Boxcore	Deploymen	12,13	89	19,8		1,825	32,095	986		
5	UNG--3	Basic	2024-10-23	11:28	59,415758	-67,472977	tucker	Recovery	191	99	19,9		1,796	32,118	987		
5	UNG--3	Basic	2024-10-23	11:18	59,421460	-67,472117	tucker	Bottom	173	87	17,7		1,804	32,107	987		
5	UNG--3	Basic	2024-10-23	11:05	59,427048	-67,459310	tucker	Deploymen	181	98	18,8		1,827	32,096	987		
5	UNG--3	Basic	2024-10-23	10:52	59,427373	-67,458309	CTD Rosett	Recovery	181,9	88	13,7		1,825	32,095	988		
5	UNG--3	Basic	2024-10-23	10:17	59,427258	-67,456182	CTD Rosett	Bottom	17,24	99	13,4		1,819	32,091	988		
5	UNG--3	Basic	2024-10-23	10:06	59,427527	-67,455107	CTD Rosett	Deploymen	173,6	98	14,3		1,827	32,094	989		
5	LR24-04	Basic	2024-10-22	21:14	59,082898	-68,749835	Grab/Boxco	Recovery	93,49	157	14,8		3,415	31,229	1005		
5	LR24-04	Basic	2024-10-22	21:09	59,081419	-68,749738	Grab/Boxco	Bottom	93,47	252	15,5		3,426	31,214	1005		
5	LR24-04	Basic	2024-10-22	21:05	59,080018	-68,750541	Grab/Boxco	Deploymen	85,9	255	14,9		3,476	31,21	1005		
5	LR24-04	Basic	2024-10-22	20:27	59,097410	-68,728348	Tuker	Recovery	99,02	256	14,2		3,349	31,268	1005		
5	LR24-04	Basic	2024-10-22	19:59	59,079006	-68,748325	Tuker	Deploymen	76,93	250	7,4		3,408	31,203	1006		
5	LR24-04	Basic	2024-10-22	19:39	59,086097	-68,740592	CTD Rosett	Recovery	96,51	272	17,5		3,31	31,342	1005		
5	LR24-04	Basic	2024-10-22	19:24	59,083115	-68,748693	CTD Rosett	Bottom	97,68	274	19,8		3,303	31,357	1006		
5	LR24-04	Basic	2024-10-22	19:16	59,081783	-68,752778	CTD Rosett	Deploymen	94,41	265	21		3,298	31,367	1005		
5	LR24-05	Basic	2024-10-22	18:27	58,969650	-68,904790	Grad/Boxco	Recovery	139,4	265	21,1		3,438	31,261	1006		
5	LR24-05	Basic	2024-10-22	18:20	58,969086	-68,908641	Grad/Boxco	Bottom	132,9	270	19		3,376	31,266	1006		
5	LR24-05	Basic	2024-10-22	18:14	58,968045	-68,910593	Grad/Boxco	Deployment		281	18,4		3,391	31,261	1006		
5	LR24-05	Basic	2024-10-22	17:25	58,984867	-68,857339	Tucker	Recovery	131,6	277	17,1		3,438	31,139	1006		

5	LR24-05	Basic	2024-10-22	17:09	58,976147	-68,871575	Tucker	Bottom	145,7	260	18,9		3,396	31,243	1006		
5	LR24-05	Basic	2024-10-22	16:56	58,971360	-68,886126	Tucker	Deploymen	153,8	274	20,5		3,454	31,172	1006		
5	LR24-05	Basic	2024-10-22	16:21	58,976148	-68,927633	CTD Rosett	Recovery	75,41	291	22,3		3,402	31,227	1006		
5	LR24-05	Basic	2024-10-22	16:09	58,971778	-68,923672	CTD Rosett	Bottom	96,1	237	11,4		3,381	31,258	1006		
5	LR24-05	Basic	2024-10-22	16:02	58,970188	-68,923633	CTD Rosett	Deploymen	106,1	278	6,1		3,383	31,256	1006		
5	AR24-17	Baisc	2024-10-21	21:54	60,015521	-69,546726	Tucker	Recovery	55,05	291	18,4		2,823	30,431	993		
5	AR24-17	Baisc	2024-10-21	21:46	60,011734	-69,561442	Tucker	Bottom	31,41	295	18,4		2,843	30,376	993		
5	AR24-17	Baisc	2024-10-21	21:40	60,011535	-69,571885	Tucker	Deploymen	54,5	293	15,3		2,84	30,336	993		
5	AR24-17	Basic	2024-10-21	21:13	60,016428	-69,581829	CTD Rosett	Recovery	90,91	279	22,5		2,809	30,306	992		
5	AR24-17	Basic	2024-10-21	20:58	60,013071	-69,593102	CTD Rosett	Bottom	77,64	299	26,6		2,915	30,162	992		
5	AR24-17	Basic	2024-10-21	20:52	60,012133	-69,599037	CTD Rosett	Deployment		206	28,7		2,818	31,312	993		
5	AR24-19	Basic	2024-10-21	18:20	59,987681	-69,351266	Tucker	Bottom	76,93	296	20,6		2,53	31,75	990		
5	AR24-19	Basic	2024-10-21	18:13	59,983967	-69,359534	Tucker	Deploymen	78,74	293	18,4		2,531	31,75	990		
5	AR24-19	Basic	2024-10-21	17:20	59,985511	-69,388169	Grab	Recovery	92,52	294	29,9		2,536	31,748	989		
5	AR24-19	Basic	2024-10-21	17:15	59,985461	-69,388750	Grab	Bottom	92,79	290	26,9		2,532	31,75	988		
5	AR24-19	Basic	2024-10-21	17:10	59,985082	-69,389168	Grab	Deploymen	91,48	293	27,8		2,528	31,748	989		
5	AR24-19	Basic	2024-10-21	16:43	59,982858	-69,389175	CTD Rosett	Recovery		291	35,9		2,515	31,751	988		
5	AR24-19	Basic	2024-10-21	16:20	59,982327	-69,394195	CTD Rosett	Bottom	92,54	12	25,3		2,526	31,748	989		
5	AR24-19	Basic	2024-10-21	16:11	59,980625	-69,395652	CTD Rosett	Deploymen	88,87	280	31,5		2,596	31,751	988		
5	AR24-20	Basic	2024-10-21	14:19	60,002795	-69,228618	Box Core	Recovery	78,06	278	25,7		2,429	31,692	989		
5	AR24-20	Basic	2024-10-21	14:15	60,002898	-69,228456	Box Core	Bottom	79,1	280	29		2,438	31,692	989		
5	AR24-20	Basic	2024-10-21	14:12	60,002895	-69,228766	Box Core	Deploymen	77,23	276	33,2		2,453	31,692	989		
5	AR24-20	Basic	2024-10-21	13:44	60,001844	-69,227479	CTD Rosett	Recovery	76,84	263	21,6		2,413	31,713	989		
5	AR24-20	Basic	2024-10-21	13:33	60,002274	-69,228531	CTD Rosett	Bottom	76,69	237	19,9		2,405	31,721	989		
5	AR24-20	Basic	2024-10-21	13:26	60,001800	-69,230505	CTD Rosett	Deploymen	77,89	265	19,2		2,406	31,73	989		
5	AR24-20	Rosette	2024-10-21	13:26	60,001815	-69,230700	CTD Rosett		76,89	260	22,3		2,405	31,729	989		
5	AR24-20	Rosette	2024-10-21	13:24	60,001888	-69,230883	CTD Rosett		76,42	297	15,9		2,405	31,731	989		
5	TCAT6-0	Full	2024-10-18	11:05	66,606518	-61,175767	Hydrobios	Recovery	125,2	12	28		1,36	30,719	1008		
5	TCAT6-0	Full	2024-10-18	11:01	66,605593	-61,177579	Hydrobios	Bottom	673	14	28,7		1,425	30,707	1008		
5	TCAT6-0	Full	2024-10-18	10:53	66,605506	-61,184265	Hydrobios	Deploymen	1010	285	33,6		1,287	30,814	1008		
5	TCAT6-0	Full	2024-10-18	9:47	66,594697	-61,161055	Classic Rose	Recovery	151,2	22	19,8		1,435	30,805	1007		
5	TCAT6-0	Full	2024-10-18	9:24	66,598523	-61,175189	Classic Rose	Bottom	129,8	12	30,9		1,546	30,747	1007		
5	TCAT6-0	Full	2024-10-18	9:16	66,600690	-61,181665	Classic Rose	Deploymen	119	12	26,1		1,562	30,721	1007		
5			2024-10-18	7:50	66,587784	-61,188490	Classic rose	Recovery	114,6	24	16,3		1,601	30,612	1006		
5			2024-10-18	7:29	66,597745	-61,193396	Classic rose	Bottom	105,5	341	14,5		1,63	30,601	1005		
5			2024-10-18	7:20	66,601605	-61,194235	Classic rose	Deploymen	103,3	2	23,3		1,658	30,576	1005		
5	TCAT6-0	Rosette	2024-10-18	5:06	66,659742	-60,441523	Classic rose	Recovery	519	28	13,1		1,055	31,213	1003		
5	TCAT6-0	Rosette	2024-10-18	4:23	66,668506	-60,454025	Classic rose	Bottom	522,2	1	21,6		1,001	31,221	1002		

5	TCAT6-0	Rosette	2024-10-18	4:07	66,670705	-60,458722	Classic rose	Deploymen	522,1	357	19,7		0,974	31,22	1002		
5	TCAT6-0	Full	2024-10-18	1:24	66,730590	-59,610563	Box Core	Recovery	868,2	34	6,3		1,589	31,209	1000		
5	TCAT6-0	Full	2024-10-18	1:03	66,730414	-59,611077	Box Core	Bottom	868,2	2	10,8		1,649	31,193	999		
5	TCAT6-0	Full	2024-10-18	0:42	66,730044	-59,612061	Box Core	Deploymen	868	341	5,8		1,569	31,224	999		
5	TCAT6-0	Full	2024-10-18	0:22	66,728554	-59,610094	TM Rosette	Recovery	865,6	78	1,9		1,538	31,187	999		
5	TCAT6-0	Full	2024-10-18	0:08	66,728590	-59,609958	TM Rosette	Bottom	866	346	1,9		1,498	31,184	999		
5	TCAT6-0	Full	2024-10-17	23:56	66,728624	-59,610240	TM Rosette	Deploymen	866,3	3	2,4		1,53	31,194	998		
5	TCAT6-0	Full	2024-10-17	23:41	66,728739	-59,611091	Classic Rose	Recovery	865,9	358	3,2		1,539	31,211	998		
5	TCAT6-0	Full	2024-10-17	23:30	66,728688	-59,611059	Classic Rose	Bottom	865,9	360	3,2		1,508	31,216	998		
5	TCAT6-0	Full	2024-10-17	23:23	66,728725	-59,611034	Classic Rose	Deploymen	866	337	1,3		1,48	31,222	998		
5	TCAT6-0	Full	2024-10-17	23:04	66,729071	-59,610746	Hydrobios	Recovery	866	271	0,6		1,456	31,277	997		
5	TCAT6-0	Full	2024-10-17	22:35	66,726871	-59,608888	Hydrobios	Bottom	867,7	235	1,1		1,393	31,246	997		
5	TCAT6-0	Full	2024-10-17	22:12	66,726767	-59,608015	Hydrobios	Deploymen	869,2	63	1,5		1,411	31,241	997		
5	TCAT6-0	Full	2024-10-17	21:43	66,721855	-59,613026	Tucker	Recovery	864,3	146	1,1		1,557	31,214	996		
5	TCAT6-0	Full	2024-10-17	21:35	66,721969	-59,604894	Tucker	Bottom	868,1	67	6,5		1,559	31,198	996		
5	TCAT6-0	Full	2024-10-17	21:27	66,723908	-59,604518	Tucker	Deploymen	868,5	72	1,6		1,547	31,211	996		
5	TCAT6-0	Full	2024-10-17	21:03	66,714274	-59,602945	IKMT	Recovery	864,5	59	3,8		1,546	31,217	996		
5	TCAT6-0	Full	2024-10-17	20:11	66,721524	-59,629277	IKMT	Bottom	854,9	106	3,2		1,57	31,168	995		
5	TCAT6-0	Full	2024-10-17	19:48	66,729486	-59,607493	IKMT	Deploymen	871	71	7,1		1,573	31,184	995		
5	TCAT6-0	Full	2024-10-17	19:34	66,728571	-59,611522	Classic rose	Recovery	865,7	118	3,4		1,587	31,186	994		
5	TCAT6-0	Full	2024-10-17	18:45	66,730039	-59,611477	Classic rose	Bottom	867,2	129	5,9		1,571	31,25	994		
5	TCAT6-0	Full	2024-10-17	18:25	66,731298	-59,610610	Classic rose	Deploymen	869	342	1,1		1,584	31,281	993		
5	TCAT6-0	Full	2024-10-17	18:13	66,727794	-59,605786	TM Rosette	Recovery	870,1	271	0,4		1,586	31,299	993		
5	TCAT6-0	Full	2024-10-17	17:45	66,729641	-59,604587	TM Rosette	Bottom	871	127	2,1		1,747	31,277	993		
5	TCAT6-0	Full	2024-10-17	17:23	66,731687	-59,599415	TM Rosette	Deploymen	872,8	147	5,2		1,917	31,401	992		
5	TCAT6-0	Rosette	2024-10-17	15:30	66,803493	-58,763827	Classic rose	Recovery	904	136	3,6		1,786	31,379	992		
5	TCAT6-0	Rosette	2024-10-17	14:43	66,803876	-58,764621	Classic rose	Bottom	905,4	99	6,5		1,875	31,41	991		
5	TCAT6-0	Rosette	2024-10-17	14:21	66,802909	-58,762658	Classic rose	Deploymen	903,6	98	4		1,816	31,419	991		
5	TCAT6-0	Full	2024-10-17	12:32	66,872367	-57,967675	Box Core	Recovery	821,7	224	1,3		2,062	31,434	990		
5	TCAT6-0	Full	2024-10-17	12:15	66,871051	-57,959624	Box Core	Bottom	819,3	191	3,8		2,123	31,418	990		
5	TCAT6-0	Full	2024-10-17	12:00	66,870923	-57,957192	Box Core	Deploymen	819,4	184	5,3		2,172	31,438	990		
5	TCAT6-0	Full	2024-10-17	11:37	66,870559	-57,952812	Hydrobios	Recovery	817,8	206	4,4		2,209	31,439	990		
5	TCAT6-0	Full	2024-10-17	11:11	66,871066	-57,951821	Hydrobios	Bottom	817,8	135	3,5		2,22	31,44	990		
5	TCAT6-0	Full	2024-10-17	10:49	66,870259	-57,951065	Hydrobios	Deploymen	817,1	176	5,4		2,215	31,43	990		
5	TCAT6-0	Full	2024-10-17	10:35	66,870309	-57,952008	Classic Rose	Recovery	817,3	161	2,9		2,202	31,434	990		
5	TCAT6-0	Full	2024-10-17	10:15	66,870853	-57,951510	Classic Rose	Bottom	818	132	5,9		2,189	31,445	990		
5	TCAT6-0	Full	2024-10-17	10:04	66,871366	-57,949837	Classic Rose	Deploymen	816,9	144	4,2		2,174	31,438	990		
5	TCAT6-0	Full	2024-10-17	9:52	66,870651	-57,942268	Tucker	Recovery	815,8	132	4,7		2,161	31,438	990		

5	TCAT6-0	Full	2024-10-17	9:40	66,874577	-57,948644	Tucker	Bottom	819,7	169	6,1		2,176	31,437	990		
5	TCAT6-0	Full	2024-10-17	9:30	66,873889	-57,936916	Tucker	Deploymen	816,6	119	3,4		2,089	31,443	990		
5	TCAT6-0	Full	2024-10-17	9:08	66,882395	-57,917771	IKMT	Recovery	823,2	226	6		2,219	31,436	989		
5	TCAT6-0	Full	2024-10-17	8:45	66,873402	-57,906022	IKMT	Bottom	809,5	7	0,2		2,217	31,434	989		
5	TCAT6-0	Full	2024-10-17	8:00	66,872788	-57,948720	IKMT	Deploymen	817,4	183	5,4		1,934	31,448	989		
5	TCAT6-0	Full	2024-10-17	7:32	66,866213	-57,923028	Classic rose	Recovery	808,3	198	6,4		2,285	31,433	989		
5	TCAT6-0	Full	2024-10-17	6:42	66,870777	-57,937045	Classic rose	Bottom	815,4	192	5,5		2,407	31,44	989		
5	TCAT6-0	Full	2024-10-17	6:23	66,872284	-57,943748	Classic rose	Deploymen	816,5	152	4,9		2,376	31,438	989		
5	TCAT6-0	Full	2024-10-17	6:04	66,870036	-57,942847	TM Rosette	Recovery	813,1	131	9,8		2,359	31,43	989		
5	TCAT6-0	Full	2024-10-17	5:35	66,871919	-57,945830	TM Rosette	Bottom	815,1	153	8,2		2,356	31,429	989		
5	TCAT6-0	Full	2024-10-17	5:12	66,872930	-57,946748	TM Rosette	Deploymen	816,1	156	8,2		2,354	31,432	990		
5	TCAT6-0	Rosette	2024-10-17	2:55	66,898716	-56,926211	Classic rose	Recovery	658,2	176	0,9		2,42	31,671	991		
5	TCAT6-0	Rosette	2024-10-17	2:04	66,896579	-56,923434	Classic rose	Bottom	654,9	163	1,3		2,63	31,68	991		
5	TCAT6-0	Rosette	2024-10-17	1:47	66,895310	-56,920490	Classic rose	Deploymen	654,6	136	5,6		2,708	31,674	991		
5	TCAT6-0	Full	2024-10-16	23:35	66,983014	-56,069224	Monster (Z	Recovery	132,6	134	4,7		3,232	31,559	992		
5	TCAT6-0	Full	2024-10-16	23:28	66,982880	-56,068807	Monster (Z	Bottom	133,1	117	4,8		3,223	31,557	992		
5	TCAT6-0	Full	2024-10-16	23:25	66,982861	-56,068464	Monster (Z	Deploymen	133,1	141	3,8		3,224	31,556	992		
5	TCAT6-0	Full	2024-10-16	23:05	66,987941	-56,063489	Tucker	Recovery	132,3	154	2,4		3,177	31,553	992		
5	TCAT6-0	Full	2024-10-16	22:56	66,983795	-56,059135	Tucker	Bottom	133	133	3,6		3,189	31,551	992		
5	TCAT6-0	Full	2024-10-16	22:46	66,983424	-56,066831	Tucker	Deploymen	131,4	156	2,1		3,181	31,551	992		
5	TCAT6-0	Full	2024-10-16	22:29	66,984546	-56,058890	Hydrobios	Recovery	133,1	147	4,7		3,196	31,564	992		
5	TCAT6-0	Full	2024-10-16	22:25	66,984473	-56,058960	Hydrobios	Bottom	133	141	6,7		3,198	31,563	992		
5	TCAT6-0	Full	2024-10-16	22:20	66,984472	-56,059332	Hydrobios	Deploymen	133,1	63	2,3		3,203	31,564	992		
5	TCAT6-0	Full	2024-10-16	22:00	66,983984	-56,059513	Classic Rose	Recovery	133,2	193	1,5		3,188	31,561	992		
5	TCAT6-0	Full	2024-10-16	21:30	66,983031	-56,062703	Classic Rose	Bottom	126,9	131	2,6		3,207	31,549	992		
5	TCAT6-0	Full	2024-10-16	21:22	66,982921	-56,063530	Classic Rose	Deploymen	126,7	108	3,6		3,228	31,548	992		
5	TCAT6-0	Full	2024-10-16	21:09	66,982685	-56,061282	TM Rosette	Recovery	127,7	90	2		3,252	31,543	993		
5	TCAT6-0	Full	2024-10-16	20:58	66,982843	-56,061671	TM Rosette	Bottom	127,8	89	3,1		3,289	31,549	993		
5	TCAT6-0	Full	2024-10-16	20:50	66,982887	-56,062462	TM Rosette	Deploymen	127,5	89	3,8		3,32	31,566	993		
5	TCAT6-0	Rosette	2024-10-16	18:40	67,043266	-55,079445	Classic rose	Recovery	66,16	68	6,5		3,321	31,833	994		
5	TCAT6-0	Rosette	2024-10-16	18:25	67,043826	-55,078905	Classic rose	Bottom	65,99	92	6,8		3,328	31,838	994		
5	TCAT6-0	Rosette	2024-10-16	18:18	67,043921	-55,079413	Classic rose	Deploymen	66,41	73	5,8		3,343	31,836	994		
5	TCAT6-0	Full	2024-10-16	16:18	67,092860	-54,267718	Box Core	Recovery	76,79	105	5,4		3,428	31,922	995		
5	TCAT6-0	Full	2024-10-16	16:15	67,093103	-54,268767	Box Core	Bottom	76,3	95	7,3		3,429	31,922	995		
5	TCAT6-0	Full	2024-10-16	16:11	67,093225	-54,270616	Box Core	Deploymen	75,86	89	6,2		3,397	31,92	995		
5	TCAT6-0	Full	2024-10-16	15:52	67,086824	-54,261316	Beam Trawl	Recovery	79,83	79	10,2		3,385	31,918	995		
5	TCAT6-0	Full	2024-10-16	15:36	67,092200	-54,285754	Beam Trawl	Bottom	79,49	90	7,6		3,369	31,917	995		
5	TCAT6-0	Full	2024-10-16	15:31	67,094378	-54,280342	Beam Trawl	Deploymen	82,19	90	6,9		3,38	31,918	995		

5	TCAT6-0	Full	2024-10-16	14:58			Classic rose	Recovery									
5	TCAT6-0	Full	2024-10-16	14:41	67,095710	-54,267370	Classic rose	Bottom	76,87	77	12,4		3,367	31,918	996		
5	TCAT6-0	Full	2024-10-16	14:34	67,096769	-54,270254	Classic rose	Deploymen	76,9	59	5,5		3,371	31,918	996		
5	TCAT6-0	Full	2024-10-16	14:20			Zodiac laun										
5	TCAT6-0	Full	2024-10-16	14:07	67,081178	-54,258522	Tucker	Recovery	77,15	80	13		3,329	31,92	996		
5	TCAT6-0	Full	2024-10-16	13:58	67,083174	-54,270316	Tucker	Bottom	75,66	68	12,4		3,315	31,919	996		
5	TCAT6-0	Full	2024-10-16	13:47	67,086693	-54,282651	Tucker	Bottom	77,63	82	12,2		3,384	31,916	996		
5	TCAT6-0	Full	2024-10-16	13:40	67,090296	-54,279991	Tucker	Deploymen	81,98	74	4,9		3,368	31,919	996		
5	TCAT6-0	Full	2024-10-16	13:36	67,091341	-54,276061	Tucker	Deploymen	80,11	57	6,5		3,34	31,918	997		
5	TCAT6-0	Full	2024-10-16	13:24	67,093148	-54,270687	Monster	Recovery	77,21	349	11,5		3,406	31,921	997		
5	TCAT6-0	Full	2024-10-16	13:20	67,093285	-54,270095	Monster	Bottom	77,16	69	10,8		3,501	31,981	997		
5	TCAT6-0	Full	2024-10-16	13:15	67,092624	-54,270126	Monster	Deploymen	77,19	69	11,7		3,399	31,929	997		
5	TCAT6-0	Full	2024-10-16	12:56	67,096874	-54,278790	TM Rosette	Recovery	83,34	70	10,5		3,341	31,92	997		
5			2024-10-16	12:55	67,096909	-54,278576			83,07	83	11,7		3,348	31,921	997		
5	TCAT6-0	Full	2024-10-16	12:47	67,096334	-54,277484	TM Rosette	Bottom	83,95	67	12		3,348	31,922	997		
5	TCAT6-0	Full	2024-10-16	12:38	67,096581	-54,275782	TM Rosette	Deploymen	84,14	87	10,4		3,362	31,922	997		
5	TCAT6-0	Full	2024-10-16	12:23	67,096348	-54,274850	Classic Rose	Recovery	84,43	123	5,6		3,336	31,923	997		
5	TCAT6-0	Full	2024-10-16	12:06	67,095552	-54,274198	Classic Rose	Bottom	84,34	57	8,6		3,312	31,928	997		
5	TCAT6-0	Full	2024-10-16	11:59	67,095134	-54,274116	Classic Rose	Deploymen	83,87	88	7,5		3,302	31,924	997		
5	C4-23	Mooring	2024-10-15	22:28	67,983550	-60,656791	Hydrobios	Recovery	1600	89	3,8		1,689	31,146	1006		
5	C4-23	Mooring	2024-10-15	21:37	67,982196	-60,654304	Hydrobios	Bottom	1600	36	7		1,625	31,14	1006		
5	C4-23	Mooring	2024-10-15	20:57	67,980379	-60,644870	Hydrobios	Deploymen	1600	36	7,7		1,604	31,139	1006		
5	C4-23	Mooring	2024-10-15	20:37	67,980776	-60,643099	Classic rose	Recovery	1599	38	5,4		1,67	31,147	1006		
5	C4-23	Mooring	2024-10-15	19:42	67,980349	-60,640374	Classic rose	Bottom	1600	72	11,6		1,686	31,147	1006		
5	C4-23	Mooring	2024-10-15	19:09	67,981411	-60,640229	Classic rose	Deploymen	1599	64	11,2		1,602	31,143	1006		
5	C4-23	Mooring	2024-10-15	17:51	67,962929	-60,608027	Tucker	Recovery	1598	24	1		1,649	31,146	1006		
5	C4-23	Mooring	2024-10-15	17:43	67,959942	-60,607810	Tucker	Bottom	1595	44	15,4		1,645	31,139	1006		
5	C4-23	Mooring	2024-10-15	17:35	67,960416	-60,617267	Tucker	Deployment		30	10,3		1,607	31,133	1006		
5	C4-23	Mooring	2024-10-15	17:31	67,962557	-60,616226	Morring rec	Deploymen	1597	131	2,1		1,629	31,141	1006		
5	C4-23	Mooring	2024-10-15	12:11	67,926158	-60,648198	Classic Rose	Bottom	1595	275	13,7		1,881	30,997	1006		
5	C4-23	Mooring	2024-10-15	11:39	67,923414	-60,653276	Classic Rose	Deploymen	1595	112	1		1,897	30,986	1007		
5	TCAT3-1	Full	2024-10-13	2:30	75,820367	-66,486280	Box Core	Recovery	594,6	60	6,1		-0,688	29,304	1009		
5	TCAT3-1	Full	2024-10-13	2:16	75,820178	-66,484998	Box Core	Bottom	594,7	88	6,5		-0,864	29,108	1009		
5	TCAT3-1	Full	2024-10-13	2:02	75,819825	-66,485673	Box Core	Deploymen	594,8	88	6,3		-0,861	29,049	1009		
5	TCAT3-1	Full	2024-10-13	1:44	75,821611	-66,473320	Classic Rose	Recovery	598,4	56	1,7		-0,412	29,403	1009		
5	TCAT3-1	Full	2024-10-13	1:34	75,822140	-66,468238	Classic Rose	Bottom	599,4	73	10,8		-0,418	29,426	1009		
5	TCAT3-1	Full	2024-10-13	1:26	75,822532	-66,462477	Classic Rose	Deploymen	599,7	72	9,3		-0,111	29,532	1009		
5	TCAT3-1	Full	2024-10-13	0:32	75,798773	-66,511680	IKMT	Recovery	586,8	105	7,6		-0,555	29,37	1010		

5	TCAT3-1	Full	2024-10-13	0:11	75,797316	-66,527534	IKMT	Bottom	577,5	123	10,1		-0,566	29,308	1010		
5	TCAT3-1	Full	2024-10-12	23:26	75,826828	-66,572336	IKMT	Deploymen	484,2	122	8,1		-0,427	29,058	1010		
5	TCAT3-1	Full	2024-10-12	23:02	75,829555	-66,525247	Classic Rose	Recovery	526	121	11,3		-0,284	29,393	1011		
5	TCAT3-1	Full	2024-10-12	22:31	75,830089	-66,525230	Classic Rose	Bottom	522,1	108	12,3		-0,224	29,169	1011		
5	TCAT3-1	Full	2024-10-12	22:16	75,830863	-66,520629	Classic Rose	Deploymen	515,8	120	11,2		-0,429	29,023	1011		
5	TCAT3-1	Full	2024-10-12	21:56	75,831589	-66,514637	TM Rosette	Recovery	514,2	124	9,8		-0,356	29,11	1011		
5	TCAT3-1	Full	2024-10-12	21:27	75,831585	-66,514497	TM Rosette	Bottom	515,6	115	10,6		-0,218	29,102	1011		
5	TCAT3-1	Full	2024-10-12	21:11	75,832191	-66,509998	TM Rosette	Deploymen	510,5	118	6,8		-0,281	29,319	1011		
5	TCAT3-1	Full	2024-10-12	20:57	75,832684	-66,523767	Tucker	Recovery	491,7	113	10,2		-0,488	28,762	1011		
5	TCAT3-1	Full	2024-10-12	20:46	75,830387	-66,495285	Tucker	Bottom	539,9	113	12,5		-0,51	28,946	1011		
5	TCAT3-1	Full	2024-10-12	20:34	75,834063	-66,502240	Tucker	Deploymen	481,6	62	8,7		-0,529	28,818	1012		
5	TCAT3-1	Full	2024-10-12	19:51	75,831313	-66,520583	Hydrobios	Recovery	512,9	154	13,8		-0,179	29,213	1012		
5	TCAT3-1	Full	2024-10-12	19:33	75,830494	-66,518728	Hydrobios	Bottom	524,5	106	14,6		-0,318	28,844	1011		
5	TCAT3-1	Full	2024-10-12	19:18	75,830553	-66,516241	Hydrobios	Deploymen	525,8	36	7,8		-0,248	29,073	1011		
5	TCAT3-1	Full	2024-10-12	18:50	75,832035	-66,499289	Classic Rose	Recovery	520,8	80	5,9		-0,366	28,958	1012		
5	TCAT3-1	Full	2024-10-12	18:13	75,833630	-66,496144	Classic Rose	Bottom	493,9	97	12,3		-0,089	29,025	1011		
5	TCAT3-1	Full	2024-10-12	17:52	75,834162	-66,488714	Classic Rose	Deploymen	480	75	6,1		-0,055	29,18	1011		
5	TCAT3-1	Nutrient	2024-10-12	15:46	75,494326	-66,484644	Classic Rose	Recovery	344,7	28	9,5		1,175	31,545	1012		
5	TCAT3-1	Nutrient	2024-10-12	15:15	75,494235	-66,488887	Classic Rose	Bottom	348,4	323	10,1		1,177	31,539	1012		
5	TCAT3-1	Nutrient	2024-10-12	15:00	75,494134	-66,489668	Classic Rose	Deploymen	348,9	280	11		1,131	31,533	1013		
5	TCAT3-1	Basic	2024-10-12	13:03	75,156042	-66,539719	Tucker	Recovery	473,1	31	9,6		1,171	31,511	1014		
5	TCAT3-1	Basic	2024-10-12	12:56	75,155907	-66,554548	Tucker	Bottom	473,4	38	9,2		1,175	31,515	1014		
5	TCAT3-1	Basic	2024-10-12	12:49	75,158823	-66,550992	Tucker	Deploymen	473	70	4,3		1,156	31,513	1014		
5	TCAT3-1	Basic	2024-10-12	12:30	75,158217	-66,555832	TM Rosette	Recovery	474,1	16	9,9		1,146	31,515	1014		
5	TCAT3-1	Basic	2024-10-12	12:15	75,159485	-66,555440	TM Rosette	Bottom	474,1	28	10,2		1,215	31,522	1014		
5	TCAT3-1	Basic	2024-10-12	12:00	75,159536	-66,552096	TM Rosette	Deploymen	474	27	11,5		1,137	31,516	1014		
5	TCAT3-1	Basic	2024-10-12	11:32	75,157301	-66,553559	Classic rose	Recovery	472,8	22	10,3		1,15	31,523	1014		
5	TCAT3-1	Basic	2024-10-12	10:57	75,157472	-66,551733	Classic rose	Bottom	473,4	19	8,2		1,166	31,528	1015		
5	TCAT3-1	Basic	2024-10-12	10:42	75,157536	-66,552353	Classic rose	Deploymen	474,5	21	7,7		1,238	31,539	1015		
5	TCAT3-1	Nutrient	2024-10-12	8:46	74,835625	-66,642217	Nutrient ro	Recovery	1384	64	6,9		1,282	31,807	1016		
5	TCAT3-1	Nutrient	2024-10-12	7:43	74,835589	-66,632801	Nutrient ro	Bottom	1382	73	5,4		1,166	31,816	1016		
5	TCAT3-1	Nutrient	2024-10-12	7:13	74,835394	-66,626681	Nutrient ro	Deploymen	1382	41	7		1,283	31,814	1016		
5	TCAT3-1	Full	2024-10-12	3:58	74,323851	-66,703002	Box Core	Recovery	2188	193	2,7		1,028	32,007	1017		
5	TCAT3-1	Full	2024-10-12	3:08	74,322486	-66,717800	Box Core	Bottom	2187	148	4,5		0,993	32,016	1017		
5	TCAT3-1	Full	2024-10-12	2:15	74,321814	-66,728662	Box Core	Deploymen	2186	183	5,5		0,822	32,031	1018		
5	TCAT3-1	Full	2024-10-12	1:54	74,320476	-66,733909	Monster (Z	Recovery	2186	180	7,2		1,093	31,994	1018		
5	TCAT3-1	Full	2024-10-12	1:47	74,320173	-66,736952	Monster (Z	Bottom	2185	124	7,4		1,041	31,992	1018		
5	TCAT3-1	Full	2024-10-12	1:41	74,319947	-66,739290	Monster (Z	Deploymen	2185	180	8,6		1,004	32,001	1018		

5	TCAT3-1	Full	2024-10-12	1:22	74,319327	-66,751450	Tucker	Recovery	2184	181	4,7		1,031	31,991	1018		
5	TCAT3-1	Full	2024-10-12	1:18	74,319020	-66,758498	Tucker	Bottom	2183	183	9,1		1,03	31,992	1018		
5	TCAT3-1	Full	2024-10-12	1:03	74,321962	-66,744257	Tucker	Deploymen	2186	182	6,3		1,022	31,993	1018		
5	TCAT3-1	Full	2024-10-12	0:44	74,315180	-66,739695	TM Rosette	Recovery	2183	185	8,8		1,029	31,992	1018		
5	TCAT3-1	Full	2024-10-12	0:22	74,314187	-66,740408	TM Rosette	Bottom	2185	164	5,4		1,162	31,994	1018		
5	TCAT3-1	Full	2024-10-12	0:06	74,314917	-66,741807	TM Rosette	Deploymen	2184	80	10,4		1,093	31,995	1018		
5	TCAT3-1	Full	2024-10-11	23:36	74,313354	-66,742932	Classic Rose	Recovery	2183	190	11,5		1,037	32	1018		
5	TCAT3-1	Full	2024-10-11	23:11	74,312756	-66,741773	Classic Rose	Bottom	2183	190	10		1,011	32,009	1018		
5	TCAT3-1	Full	2024-10-11	22:59	74,312839	-66,742266	Classic Rose	Deploymen	2182	180	10,2		0,986	32,081	1019		
5	TCAT3-1	Full	2024-10-11	22:31	74,310852	-66,737600	Hydrobios	Recovery	2185	81	12,6		0,976	32,024	1018		
5	TCAT3-1	Full	2024-10-11	21:27	74,311076	-66,738891	Hydrobios	Bottom	2184	181	9,2		0,875	32,073	1019		
5	TCAT3-1	Full	2024-10-11	20:32	74,311204	-66,737313	Hydrobios	Deploymen	2183	195	12,2		0,838	32,102	1018		
5	TCAT3-1	Full	2024-10-11	20:08	74,299269	-66,784269	IKMT	Recovery	2185	186	10,5		0,807	32,108	1018		
5	TCAT3-1	Full	2024-10-11	19:10	74,317001	-66,794369	IKMT	Bottom	2180	190	12,1		0,789	32,127	1018		
5	TCAT3-1	Full	2024-10-11	18:48	74,315862	-66,758088	IKMT	Deploymen	2181	201	3,8		0,792	32,121	1018		
5	TCAT3-1	Full	2024-10-11	18:34	74,311695	-66,758184	Classic Rose	Recovery	2182	187	11		0,803	32,113	1018		
5	TCAT3-1	Full	2024-10-11	17:30	74,312462	-66,745470	Classic Rose	Bottom	2182	141	10,1		0,806	32,108	1018		
5	TCAT3-1	Full	2024-10-11	16:45	74,312945	-66,733174	Classic Rose	Deploymen	2182	202	9,3		0,823	32,098	1019		
5	TCAT3-1	Full	2024-10-11	16:14	74,313374	-66,727115	TM Rosette	Recovery	2182	202	7,7		0,802	32,12	1019		
5	TCAT3-1	Full	2024-10-11	15:24	74,313280	-66,722549	TM Rosette	Bottom	2183	193	12		0,847	32,068	1019		
5	TCAT3-1	Full	2024-10-11	14:40	74,313138	-66,722563	TM Rosette	Deploymen	2184	192	12,9		0,966	32,027	1019		
5	TCAT3-1	Full	2024-10-11	14:26	74,315002	-66,723046	Classic Rose	Recovery	2184	195	10,7		0,961	32,023	1019		
5	TCAT3-1	Full	2024-10-11	12:58	74,314105	-66,723462	Classic Rose	Bottom	2184	185	10,7		1,026	31,994	1019		
5	TCAT3-1	Full	2024-10-11	12:15	74,313183	-66,720874	Classic Rose	Deploymen	2185	116	10,4		1,046	31,996	1019		
5	TCAT3-1	Basic	2024-10-11	9:27	73,784059	-66,844459	TM Rosette	Recovery	2284	149	21,6		1,409	31,939	1018		
5	TCAT3-1	Basic	2024-10-11	9:04	73,783795	-66,837761	TM Rosette	Bottom		201	19,5		1,36	31,936	1018		
5	TCAT3-1	Basic	2024-10-11	8:47	73,784153	-66,827729	TM Rosette	Deploymen	1785	195	14,1		1,476	31,937	1018		
5	TCAT3-1	Basic	2024-10-11	8:20	73,786396	-66,887723	Classic Rose	Recovery	2281	176	11,7		1,359	31,924	1018		
5	TCAT3-1	Basic	2024-10-11	7:00	73,784349	-66,847555	Classic Rose	Bottom		147	17		1,307	32,003	1018		
5	TCAT3-1	Basic	2024-10-11	6:12	73,784113	-66,827864	Classic Rose	Deploymen	2286	185	11,1		1,346	31,931	1018		
5	TCAT3-1	Basic	2024-10-11	5:25	73,796519	-66,845832	Tucker	Recovery	2281	191	16,5		1,394	31,908	1018		
5	TCAT3-1	Basic	2024-10-11	5:16	73,793840	-66,830734	Tucker	Bottom	2282	196	15,9		1,395	31,913	1018		
5	TCAT3-1	Basic	2024-10-11	5:07	73,788074	-66,832017	Tucker	Deploymen	2285	189	7,6		1,383	31,918	1018		
5	TCAT3-1	Basic	2024-10-11	4:15	73,788077	-66,858108	TM Rosette	Recovery	2282	191	20,1		1,407	31,91	1018		
5	TCAT3-1	Basic	2024-10-11	3:22	73,789012	-66,844103	TM Rosette	Bottom	2284	154	18,4		1,407	31,91	1019		
5	TCAT3-1	Basic	2024-10-11	2:32	73,787849	-66,833366	TM Rosette	Deploymen	2284	200	14,4		1,393	31,913	1019		
5	TCAT3-1	Basic	2024-10-11	2:00	73,794911	-66,820441	Classic Rose	Recovery	2283	138	5,2		1,327	31,922	1019		
5	TCAT3-1	Basic	2024-10-11	0:25	73,790797	-66,832307	Classic Rose	Bottom	2285	112	15,7		1,399	31,93	1020		

5	TCAT3-1	Basic	2024-10-10	23:38	73,788915	-66,833782	Classic Rose	Deploymen	2267	173	12		1,415	31,928	1020		
5	TCAT3-2	Nutrient	2024-10-10	20:51	73,273919	-66,927096	Classic Rose	Recovery	2332	191	18,1		1,151	32,005	1020		
5	TCAT3-2	Nutrient	2024-10-10	19:23	73,272199	-66,926694	Classic Rose	Bottom	2333	174	16,8		1,171	31,997	1021		
5	TCAT3-2	Nutrient	2024-10-10	18:35	73,272183	-66,911115	Classic Rose	Deploymen	2333	191	16,5		1,198	31,996	1021		
5	TCA-BB2		2024-10-10	15:45	72,747817	-67,017688	Classic Rose	Recovery	2343	161	9		2,088	31,755	1021		
5	TCA-BB2		2024-10-10	15:36	72,747070	-67,011940	Classic Rose	Bottom	2344	194	15,7		2,09	31,76	1021		
5	TCA-BB2		2024-10-10	15:34	72,746881	-67,010935	Classic Rose	Deploymen	2343	196	21,8		2,055	31,786	1021		
5	TCA-BB2	Full	2024-10-10	15:07	72,746365	-67,008729	Box Core	Recovery	2342	192	18,5		1,893	31,82	1022		
5	TCA-BB2	Full	2024-10-10	14:31	72,746617	-67,007088	Box Core	Bottom	2343	195	16,3		2,107	31,752	1022		
5	TCA-BB2	Full	2024-10-10	13:41	72,746869	-67,005208	Box Core	Deploymen	2343	111	18,3		2,099	31,743	1022		
5	TCA-BB2	Full	2024-10-10	13:20	72,746739	-67,014799	Classic Rose	Recovery	2343	178	16,3		2,099	31,745	1022		
5	TCA-BB2	Full	2024-10-10	12:19	72,746646	-67,001996	Classic Rose	Bottom	2344	214	11,6		2,087	31,764	1022		
5	TCA-BB2	Full	2024-10-10	11:32	72,746626	-66,995240	Classic Rose	Deploymen	2343	95	16,4		2,115	31,748	1023		
5	TCA-BB2	Full	2024-10-10	11:12	72,746545	-66,999263	TM Rosette	Recovery	2343	191	14,1		2,121	31,739	1023		
5	TCA-BB2	Full	2024-10-10	10:19	72,746165	-67,007086	TM Rosette	Bottom	2346	287	11,8		2,125	31,736	1023		
5	TCA-BB2	Full	2024-10-10	9:35	72,747044	-66,996918	TM Rosette	Deploymen	2342	224	10,9		2,019	31,846	1024		
5	TCA-BB2	Full	2024-10-10	9:17	72,748066	-66,987231	Classic Rose	Recovery	2344	174	9,9		2,137	31,734	1023		
5	TCA-BB2	Full	2024-10-10	8:51	72,747978	-66,988359	Classic Rose	Bottom	2344	168	10,6		2,12	31,733	1024		
5	TCA-BB2	Full	2024-10-10	8:43	72,747084	-66,990170	Classic Rose	Deploymen	2344	198	20		2,139	31,731	1024		
5	TCA-BB2	Full	2024-10-10	8:11	72,755094	-66,993783	Hydrobios	Recovery	2344	178	12,3		2,127	31,738	1024		
5	TCA-BB2	Full	2024-10-10	6:55	72,750123	-67,002761	Hydrobios	Bottom	2344	109	17,2		2,136	31,736	1024		
5	TCA-BB2	Full	2024-10-10	6:00	72,747994	-67,006471	Hydrobios	Deploymen	2344	280	10,3		2,353	31,739	1025		
5	TCA-BB2	Full	2024-10-10	5:29	72,749984	-67,006310	Monster (Zo	Recovery	2344	179	8		2,198	31,748	1025		
5	TCA-BB2	Full	2024-10-10	5:24	72,750002	-67,006056	Monster (Zo	Bottom	2343	183	16,9		2,156	31,785	1025		
5	TCA-BB2	Full	2024-10-10	5:18	72,749592	-67,003685	Monster (Zo	Deploymen	2343	189	17,7		2,083	31,75	1024		
5	TCA-BB2	Full	2024-10-10	4:24	72,749516	-67,092692	Classic rose	Recovery		195	16,5		2,148	31,741	1025		
5	TCA-BB2	Full	2024-10-10	3:04	72,745661	-67,040650	Classic rose	Bottom	2344	201	9,6		1,843	31,753	1025		
5	TCA-BB2	Full	2024-10-10	2:13	72,747610	-67,002657	Classic rose	Deploymen	2343	161	17,4		2,147	31,743	1026		
5	TCA-BB2	Full	2024-10-10	1:31	72,753251	-67,043674	IKMT	Recovery	2344	169	20,8		2,163	31,739	1026		
5	TCA-BB2	Full	2024-10-10	0:43	72,753784	-67,028735	IKMT	Bottom	2344	167	19,5		2,166	31,739	1027		
5	TCA-BB2	Full	2024-10-10	0:23	72,758499	-67,006393	IKMT	Deploymen	2344	116	5,2		2,155	31,738	1027		
5	TCA-BB2	Full	2024-10-09	23:55	72,748122	-67,018381	TM Rosette	Recovery	2344	199	7,7		2,155	31,74	1027		
5	TCA-BB2	Full	2024-10-09	23:34	72,747031	-67,005863	TM Rosette	Bottom	2344	200	12,1		2,145	31,741	1027		
5	TCA-BB2	Full	2024-10-09	23:15	72,747374	-66,998671	TM Rosette	Deployment		134	9,8		2,151	31,741	1027		
5	TCA-BB2	Full	2024-10-09	22:55	72,743865	-67,021618	Classic Rose	Recovery	2344	269	1,2		2,097	31,758	1027		
5	TCA-BB2	Full	2024-10-09	21:24	72,747585	-67,006262	Classic Rose	Bottom	2345	199	11,1		2,154	31,74	1028		
5	TCA-BB2	Full	2024-10-09	20:37	72,747396	-67,003275	Classic Rose	Deploymen	2345	176	10		2,188	31,736	1028		
5	TCA-BB2	Full	2024-10-09	19:53	72,754370	-67,025199	Tucker	Recovery	2345	179	14,9		2,191	31,736	1028		

5	TCA-BB2	Full	2024-10-09	19:44	72,756865	-67,016365	Tucker	Bottom	2345	163	9,3		2,188	31,734	1028		
5	TCA-BB2	Full	2024-10-09	19:36	72,753104	-67,009732	Tucker	Deploymen	2345	133	2,1		2,189	31,736	1028		
5	TCAT3-1	Nutrient	2024-10-09	17:01	72,723896	-68,484299	Classic Rose	Recovery	2169	205	6,6		1,302	31,316	1028		
5	TCAT3-1	Nutrient	2024-10-09	15:34	72,724064	-68,471502	Classic Rose	Bottom	2171	203	10,2		1,355	31,322	1028		
5	TCAT3-1	Nutrient	2024-10-09	14:49	72,723322	-68,466510	Classic Rose	Deploymen	2174	193	11,5		1,462	31,648	1028		
5	TCAT3-0	Basic	2024-10-09	11:53	72,687591	-70,114264	TM Rosette	Recovery	1728	172	11		0,84	30,505	1027		
5	TCAT3-0	Basic	2024-10-09	11:44	72,687618	-70,109806	TM Rosette	Bottom	1729	170	10,6		0,864	30,548	1027		
5	TCAT3-0	Basic	2024-10-09	11:34	72,688478	-70,108654	TM Rosette	Deploymen	1729	169	10,5		0,826	30,502	1027		
5	TCAT3-0	Basic	2024-10-09	11:16	72,684406	-70,120969	Classic rose	Recovery	1727	158	8,5		0,755	30,503	1027		
5	TCAT3-0	Basic	2024-10-09	10:11	72,687792	-70,109708	Classic rose	Bottom	1729	178	8,4		0,811	30,545	1027		
5	TCAT3-0	Basic	2024-10-09	9:36	72,689796	-70,095841	Classic rose	Deploymen	1731	169	2,7		0,775	30,503	1027		
5	TCAT3-0	Basic	2024-10-09	9:09	72,690170	-70,123233	Tucker	Recovery	1725	188	7,9		0,71	30,501	1027		
5	TCAT3-0	Basic	2024-10-09	9:01	72,693407	-70,111365	Tucker	Bottom	1726	180	7,6		0,728	30,494	1027		
5	TCAT3-0	Basic	2024-10-09	8:52	72,691980	-70,097494	Tucker	Deploymen	1729	147	2,6		0,709	30,51	1027		
5	TCAT3-0	Basic	2024-10-09	8:31	72,688584	-70,110576	TM Rosette	Recovery	1728	160	1,3		0,705	30,534	1028		
5	TCAT3-0	Basic	2024-10-09	7:48	72,688200	-70,101452	TM Rosette	Bottom	1730	174	3,2		0,716	30,555	1027		
5	TCAT3-0	Basic	2024-10-09	7:09	72,689970	-70,093639	TM Rosette	Deploymen	1732	230	3		0,71	30,58	1027		
5	TCAT3-0	Basic	2024-10-09	6:41	72,680345	-70,095449	Classic Rose	Recovery	1733	232	2,8		0,667	30,651	1027		
5	TCAT3-0	Basic	2024-10-09	5:23	72,685368	-70,092384	Classic Rose	Bottom	1733	258	5,5		0,68	30,728	1026		
5	TCAT3-0	Basic	2024-10-09	4:45	72,689661	-70,093326	Classic Rose	Deploymen	1731	253	6,1		0,649	30,734	1026		
5	TCAT3-0	Full	2024-10-09	2:00	72,634093	-71,583408	Box Core	Recovery	1130	292	9,2		0,804	30,699	1025		
5	TCAT3-0	Full	2024-10-09	1:34	72,636905	-71,574204	Box Core	Bottom	1131	287	9,1		0,644	30,529	1025		
5	TCAT3-0	Full	2024-10-09	1:04	72,639174	-71,571417	Box Core	Deploymen	1131	291	7,9		0,929	30,804	1025		
5	TCAT3-0	Full	2024-10-09	0:37	72,637160	-71,548700	Classic Rose	Recovery	1132	283	7		0,757	30,618	1025		
5	TCAT3-0	Full	2024-10-08	23:44	72,639683	-71,556102	Classic Rose	Bottom	1134	250	3,7		0,903	30,79	1024		
5	TCAT3-0	Full	2024-10-08	23:19	72,640480	-71,557369	Classic Rose	Deploymen	1134	274	6,5		0,833	30,724	1024		
5	TCAT3-0	Full	2024-10-08	22:56	72,639186	-71,570162	Monster (Z	Recovery	1132	274	7		0,942	30,84	1023		
5	TCAT3-0	Full	2024-10-08	22:49	72,639042	-71,570128	Monster (Z	Bottom	1132	310	8		0,949	30,75	1023		
5	TCAT3-0	Full	2024-10-08	22:44	72,639121	-71,566936	Monster (Z	Deploymen	1131	246	7,8		0,951	30,915	1023		
5	TCAT3-0	Full	2024-10-08	22:09	72,646000	-71,585202	Hydrobios	Recovery	1131	246	8,5		0,93	30,753	1023		
5	TCAT3-0	Full	2024-10-08	21:33	72,643418	-71,582814	Hydrobios	Bottom	1131	291	4,2		0,772	30,663	1023		
5	TCAT3-0	Full	2024-10-08	21:03	72,640943	-71,577729	Hydrobios	Deploymen	1131	271	3,8		0,86	30,669	1022		
5	TCAT3-0	Full	2024-10-08	20:31	72,648344	-71,580750	Tucker	Recovery	1133	285	11,6		0,709	30,426	1022		
5	TCAT3-0	Full	2024-10-08	20:22	72,646293	-71,565548	Tucker	Bottom	1135	301	7,3		0,714	30,43	1022		
5	TCAT3-0	Full	2024-10-08	20:10	72,640231	-71,569131	Tucker	Deploymen	1131	323	5,4		0,704	30,518	1021		
5	TCAT3-0	Full	2024-10-08	19:51	72,628760	-71,576044	IKMT	Recovery	1134	302	6,8		0,924	30,749	1021		
5	TCAT3-0	Full	2024-10-08	18:58	72,648758	-71,562587	IKMT	Bottom	1137	321	10,6		0,755	30,38	1020		
5	TCAT3-0	Full	2024-10-08	18:34	72,639243	-71,547162	IKMT	Deploymen	1134	338	2,3		0,721	30,436	1020		

5	TCAT3-0	Full	2024-10-08	18:02	72,641216	-71,561960	Classic Rose	Recovery	1133	333	5,8		0,713	30,535	1020		
5	TCAT3-0	Full	2024-10-08	16:59	72,637469	-71,563646	Classic Rose	Bottom	1132	313	7		0,926	30,765	1019		
5	TCAT3-0	Full	2024-10-08	16:26	72,637335	-71,568249	Classic Rose	Deploymen	1133	331	10,1		0,926	30,758	1018		
5	TCAT3-0	Full	2024-10-08	15:51	72,639377	-71,578676	TM Rosette	Recovery	1131	171	3,6		0,86	30,646	1018		
5	TCAT3-0	Full	2024-10-08	15:21	72,639320	-71,579648	TM Rosette	Bottom	1131	337	4,2		0,866	30,627	1018		
5	TCAT3-0	Full	2024-10-08	14:50	72,638759	-71,578614	TM Rosette	Deploymen	1131	316	11,4		0,91	30,675	1017		
5	TCAT3-0	Full	2024-10-08	14:34	72,639917	-71,584257	Classic Rose	Recovery	1130	337	9,9		0,889	30,676	1017		
5	TCAT3-0	Full	2024-10-08	13:30	72,639359	-71,575471	Classic Rose	Bottom	1131	285	8,3		0,866	30,627	1016		
5	TCAT3-0	Full	2024-10-08	13:04	72,639456	-71,575145	Classic Rose	Deploymen	1131	296	8,9		0,85	30,605	1016		
5	TCAT3-0	Nutrient	2024-10-08	11:18	72,588726	-72,486074	Classic Rose	Recovery	869,1	284	8,2		1,21	30,361	1015		
5	TCAT3-0	Nutrient	2024-10-08	10:27	72,605127	-72,477068	Classic Rose	Bottom	869,1	316	6,5		1,137	30,354	1014		
5	TCAT3-0	Nutrient	2024-10-08	10:07	72,610221	-72,475182	Classic Rose	Deploymen	868,7	289	8,6		1,137	30,355	1014		
5	TCAT3-0	Basic	2024-10-08	8:09	72,590009	-73,539848	Classic Rose	Recovery	728,3	249	2,8		0,803	30,273	1013		
5	TCAT3-0	Basic	2024-10-08	7:16	72,579278	-73,513212	Classic Rose	Bottom	718,9	293	10,8		0,823	30,271	1012		
5	TCAT3-0	Basic	2024-10-08	6:59	72,575375	-73,509649	Classic Rose	Deploymen	709,4	298	11,5		0,787	30,271	1012		
5	TCAT3-0	Basic	2024-10-08	6:25	72,583819	-73,548923	Monster	Recovery	714,1	287	12,7		0,742	30,237	1011		
5	TCAT3-0	Basic	2024-10-08	6:01	72,581103	-73,536496	Monster	Bottom	712,9	181	9,8		0,744	30,253	1012		
5	TCAT3-0	Basic	2024-10-08	5:43	72,577226	-73,524332	Monster	Deploymen	708,6	271	9,9		0,748	30,248	1011		
5	TCAT3-0	Basic	2024-10-08	5:04	72,582838	-73,510535	Tucker	Recovery	724,4	284	8,1		0,718	30,266	1011		
5	TCAT3-0	Basic	2024-10-08	4:56	72,578173	-73,501217	Tucker	Bottom	717,6	272	10,4		0,712	30,267	1011		
5	TCAT3-0	Basic	2024-10-08	4:48	72,574587	-73,507085	Tucker	Deploymen	709,5	320	6,5		0,767	30,261	1011		
5	TCAT3-0	Basic	2024-10-08	3:57	72,576707	-73,537437	TM Rosette	Recovery	698,3	14	0,9		0,783	30,204	1011		
5	TCAT3-0	Basic	2024-10-08	3:33	72,575230	-73,528171	TM Rosette	Bottom	701,7	259	10,8		0,715	30,206	1011		
5	TCAT3-0	Basic	2024-10-08	3:09	72,576211	-73,518881	TM Rosette	Deploymen	705,9	242	13,5		0,714	30,224	1010		
5	TCAT3-0	Basic	2024-10-08	2:35	72,584288	-73,542729	Classic Rose	Recovery	715,4	217	12,1		0,828	30,224	1011		
5	TCAT3-0	Basic	2024-10-08	1:44	72,578562	-73,518736	Classic Rose	Bottom	714,7	185	9,4		0,836	30,214	1011		
5	TCAT3-0	Basic	2024-10-08	1:27	72,577065	-73,515502	Classic Rose	Deploymen	26,47	193	11,5		0,828	30,241	1011		
5	TCAT3-0	Nutrient	2024-10-07	23:51	72,543134	-74,334932	Classic Rose	Recovery	207,8	190	2,6		1,331	30,275	1011		
5	TCAT3-0	Nutrient	2024-10-07	23:23	72,541405	-74,325480	Classic Rose	Bottom	14,28	136	5,5		1,367	30,235	1012		
5	TCAT3-0	Nutrient	2024-10-07	23:11	72,540697	-74,321056	Classic Rose	Deploymen	16,55	120	7,4		1,401	30,217	1012		
5	TCAT3-0	Full	2024-10-07	21:04	72,502619	-75,024294	Box Core	Recovery	72,13	192	6,6		0,785	30,506	1012		
5	TCAT3-0	Full	2024-10-07	21:00	72,502520	-75,024788	Box Core	Bottom	73,5	189	9,1		0,642	30,396	1012		
5	TCAT3-0	Full	2024-10-07	20:57	72,502454	-75,024642	Box Core	Deploymen	74,71	195	6,4		0,915	30,265	1012		
5	TCAT3-0	Full	2024-10-07	20:30	72,502471	-75,024156	Zodiac laun	Deploymen	75,12	162	6,9		0,946	30,262	1012		
5	TCAT3-0	Full	2024-10-07	19:41	72,506651	-75,039239	Beam trawl	Recovery	54,57	246	5		0,905	30,278	1012		
5	TCAT3-0	Full	2024-10-07	19:30	72,506206	-75,019154	Beam trawl	Bottom	67,73	179	7		0,949	30,2	1012		
5	TCAT3-0	Full	2024-10-07	19:24	72,501928	-75,022013	Beam trawl	Deploymen	79,5	170	14,8		0,954	30,202	1012		
5	TCAT3-0	Full	2024-10-07	19:03	72,500448	-75,030698	Classic Rose	Recovery	74,95	218	0,4		0,979	30,155	1012		

5	TCAT3-0	Full	2024-10-07	18:47	72,501124	-75,025231	Classic Rose	Bottom	82,5	222	2,5		0,971	30,16	1013		
5	TCAT3-0	Full	2024-10-07	18:40	72,501289	-75,023642	Classic Rose	Deploymen	80,09	55	1,7		0,972	30,148	1013		
5	TCAT3-0	Full	2024-10-07	18:23	72,501093	-75,018547	Monster	Recovery	84,97	216	1,2		0,925	30,331	1013		
5	TCAT3-0	Full	2024-10-07	18:19	72,501482	-75,019060	Monster	Bottom	84,28	239	2,2		0,912	30,154	1013		
5	TCAT3-0	Full	2024-10-07	18:15	72,501641	-75,019062	Monster	Deploymen	82,69	215	4,7		0,919	30,159	1013		
5	TCAT3-0	Full	2024-10-07	17:50	72,504056	-75,055316	Tucker	Recovery	41,84	184	6,5		0,954	30,223	1013		
5	TCAT3-0	Full	2024-10-07	17:32	72,502628	-75,026921	Tucker	Deploymen	71,9	177	2,6		0,93	30,168	1013		
5	TCAT3-0	Full	2024-10-07	17:09	72,496341	-75,013904	TM Rosette	Recovery	88,26	174	8,5		0,951	30,147	1013		
5	TCAT3-0	Full	2024-10-07	17:00	72,497423	-75,014437	TM Rosette	Bottom	90	167	2,9		0,975	30,155	1013		
5	TCAT3-0	Full	2024-10-07	16:51	72,498339	-75,014233	TM Rosette	Deploymen	89,89	187	7		0,932	30,155	1013		
5	TCAT3-0	Full	2024-10-07	16:26	72,500297	-75,014754	Classic Rose	Recovery	86,72	155	4,6		0,925	30,177	1014		
5	TCAT3-0	Full	2024-10-07	16:08	72,502564	-75,020203	Classic Rose	Bottom	74,42	160	7,2		0,896	30,186	1013		
5	TCAT3-0	Full	2024-10-07	16:02	72,502579	-75,018173	Classic Rose	Deploymen	76,84	97	2,7		0,892	30,174	1014		
5			2024-10-07	2:44	73,710449	-80,934926	Refueling	Recovery		64	7,8		0,52	30,145	1012		
5			2024-10-07	2:44	73,710443	-80,934897	Refueling	Bottom		67	5,3		0,518	30,147	1012		
5	Wol1	Boxcore	2024-10-06	18:30	73,814898	-81,107876	Box Core	Recovery	646,8	134	7,9		0,246	31,891	1010		
5	Wol1	Boxcore	2024-10-06	18:17	73,816758	-81,114382	Box Core	Bottom	649,5	131	11,5		-0,011	32,158	1009		
5	Wol1	Boxcore	2024-10-06	18:01	73,819395	-81,117812	Box Core	Deploymen	653,7	76	4,9		0,337	31,855	1009		
5	TCA-S3	Full	2024-10-06	14:41	73,740391	-78,634332	Classic Rose	Recovery	908,2	135	9,3		0,175	30,38	1010		
5	TCA-S3	Full	2024-10-06	13:51	73,740769	-78,668107	Classic Rose	Bottom	877,5	169	4,9		0,335	30,206	1010		
5	TCA-S3	Full	2024-10-06	13:32	73,740633	-78,684412	Classic Rose	Deploymen	863,3	90	1,5		0,33	30,19	1010		
5	TCA-S3	Full	2024-10-06	13:02	73,733643	-78,637914	Hydrobios	Recovery	870,2	164	7,6		0,436	30,099	1010		
5	TCA-S3	Full	2024-10-06	12:32	73,737536	-78,655540	Hydrobios	Bottom	876,6	157	6,7		0,365	30,091	1010		
5	TCA-S3	Full	2024-10-06	12:09	73,738141	-78,674564	Hydrobios	Deploymen	862,6	153	6		0,377	30,101	1010		
5	TCA-S3	Full	2024-10-06	11:16	73,734130	-78,665474	Tucker	Recovery	859,8	139	7		0,418	30,066	1010		
5	TCA-S3	Full	2024-10-06	11:09	73,737460	-78,678051	Tucker	Bottom	869,8	150	6,3		0,414	30,063	1009		
5	TCA-S3	Full	2024-10-06	11:00	73,739449	-78,675146	Tucker	Deploymen	868,4	149	3,6		0,406	30,073	1009		
5	TCA-S3	Full	2024-10-06	10:37	73,732832	-78,628740	Classic Rose	Recovery	871,2	151	2,5		0,41	30,073	1009		
5	TCA-S3	Full	2024-10-06	9:40	73,736299	-78,659883	Classic Rose	Bottom	880,4	152	4,8		0,332	30,264	1009		
5	TCA-S3	Full	2024-10-06	9:19	73,737767	-78,675563	Classic Rose	Deploymen	863,7	112	0		0,31	30,08	1009		
5	TCA-S3	Full	2024-10-06	8:59	73,731922	-78,675168	TM Rosette	Recovery	840,6	181	2		0,182	30,227	1009		
5	TCA-S3	Full	2024-10-06	8:25	73,737543	-78,676292	TM Rosette	Bottom	866,5	173	2,9		-0,243	31,066	1009		
5	TCA-S3	Full	2024-10-06	7:58	73,738297	-78,676183	TM Rosette	Deploymen	19,21	74	0		-0,245	31,338	1009		
5	TCA-S3	Full	2024-10-06	7:26	73,738667	-78,659938	Classic Rose	Recovery	30,68	201	4,2		-0,159	30,742	1009		
5	TCA-S3	Full	2024-10-06	7:22	73,738684	-78,663256	Classic Rose	Bottom	29,48	179	3,8		-0,182	31,38	1009		
5	TCA-S3	Full	2024-10-06	7:14	73,738366	-78,671592	Classic Rose	Deploymen	23,41	171	4,1		-0,19	31,053	1008		
5	Keb-S1	CTD	2024-10-05	14:34	74,048065	-91,158572	CTD only (n	Recovery	49,18	102	12,4		-0,211	30,873	1006		
5	Keb-S1	CTD	2024-10-05	14:31	74,048075	-91,158239	CTD only (n	Bottom	50,01	94	12,1		-0,224	30,863	1006		

5	Keb-S1	CTD	2024-10-05	14:25	74,048271	-91,156342	CTD only (n	Deploymen	49	102	12,2		-0,211	30,855	1006		
5	Keb-S2	CTD	2024-10-05	14:06	74,066204	-91,128067	CTD only (n	Recovery	103,8	201	14,7		-0,027	30,542	1007		
5	Keb-S2	CTD	2024-10-05	14:02	74,065896	-91,128752	CTD only (n	Bottom	103,5	90	14,4		-0,07	30,395	1007		
5	Keb-S2	CTD	2024-10-05	13:54	74,066240	-91,127068	CTD only (n	Deploymen	104,3	79	10,6		0,016	30,383	1007		
5	Keb/TCA	Basic	2024-10-05	12:17	74,094648	-91,093222	Classic Rose	Recovery	147,3	127	9,3		-0,057	30,365	1008		
5	Keb/TCA	Basic	2024-10-05	11:49	74,096020	-91,087756	Classic Rose	Bottom	150,6	114	14,3		-0,058	30,355	1008		
5	Keb/TCA	Basic	2024-10-05	11:40	74,096964	-91,085814	Classic Rose	Deploymen	150,7	103	9,2		0,07	30,495	1008		
5	Keb/TCA	Basic	2024-10-05	10:25	74,095413	-91,097440	Monster	Recovery	147,6	108	15,4		-0,125	30,48	1008		
5	Keb/TCA	Basic	2024-10-05	10:19	74,095433	-91,095771	Monster	Bottom	148,3	116	13,4		-0,163	30,567	1008		
5	Keb/TCA	Basic	2024-10-05	10:08	74,095363	-91,093367	Monster	Deploymen	147,9	60	17,5		-0,046	30,413	1008		
5	Keb/TCA	Basic	2024-10-05	9:42	74,092201	-91,107612	Classic Rose	Recovery	142,7	125	12,1		-0,03	30,436	1008		
5	Keb/TCA	Basic	2024-10-05	9:16	74,094969	-91,096082	Classic Rose	Bottom	149,1	128	10,9		-0,039	30,398	1008		
5	Keb/TCA	Basic	2024-10-05	9:07	74,095648	-91,092323	Classic Rose	Deploymen	150,1	118	18,3		-0,05	30,403	1008		
5	Keb/TCA	Basic	2024-10-05	7:49	74,098010	-91,107345	Classic Rose	Recovery	150,4	92	12,8		-0,042	30,411	1009		
5	Keb/TCA	Basic	2024-10-05	7:36	74,098155	-91,102405	Classic Rose	Bottom	152,4	91	9,6		-0,056	30,43	1009		
5	Keb/TCA	Basic	2024-10-05	7:25	74,097743	-91,098445	Classic Rose	Deploymen	151,9	117	11,2		-0,061	30,454	1009		
5	Keb-S4	Rosette	2024-10-05	6:45	74,143244	-91,031135	Rosette for	Recovery	216,2	99	8,1		-0,101	29,987	1009		
5	Keb-S4	Rosette	2024-10-05	6:36	74,143520	-91,029153	Rosette for	Bottom	217,4	125	10,8		-0,093	29,981	1009		
5	Keb-S4	Rosette	2024-10-05	6:26	74,143760	-91,024592	Rosette for	Deploymen	215,4	132	10,1		-0,078	29,989	1009		
5	Keb-S5	Full	2024-10-05	5:17	74,222207	-91,023955	Beam trawl	Recovery	325,8	123	20,5		-0,104	29,709	1008		
5	Keb-S5	Full	2024-10-05	4:56	74,223813	-90,974140	Beam trawl	Bottom	328,2	120	14,5		-0,225	29,531	1009		
5	Keb-S5	Full	2024-10-05	4:38	74,222180	-90,928918	Beam trawl	Deploymen	310,3	152	14,3		-0,249	29,518	1009		
5	Keb-S5	Full	2024-10-05	3:54	74,218246	-91,040842	Classic Rose	Recovery	323,1	109	16,2		-0,012	29,843	1009		
5	Keb-S5	Full	2024-10-05	3:14	74,222112	-90,986403	Classic Rose	Bottom	327,7	59	8,3		-0,211	29,512	1009		
5	Keb-S5	Full	2024-10-05	3:01	74,224199	-90,964524	Classic Rose	Deploymen	326,3	131	5,1		-0,24	29,492	1009		
5	Keb-S6	Rosette	2024-10-05	1:29	74,270615	-90,888021	Rosette for	Recovery	288,7	142	3,5		-0,357	29,734	1008		
5	Keb-S6	Rosette	2024-10-05	1:16	74,274003	-90,866833	Rosette for	Bottom	265,4	89	10,4		-0,352	29,658	1009		
5	Keb-S6	Rosette	2024-10-05	1:02	74,276662	-90,840375	Rosette for	Deploymen	235,2	357	0,8		-0,348	29,72	1009		
5	Keb-S7	CTD	2024-10-05	0:01	74,337120	-90,769004	CTD only (n	Recovery	203,2	147	12,2		-0,231	29,327	1009		
5	Keb-S7	CTD	2024-10-04	23:54	74,338550	-90,765535	CTD only (n	Bottom	205,6	90	13		-0,233	29,292	1009		
5	Keb-S7	CTD	2024-10-04	23:42	74,339713	-90,741529	CTD only (n	Deploymen	212,6	96	8,2		-0,234	29,282	1009		
5	Keb-S8	Full	2024-10-04	22:00	74,410475	-90,870999	Box Core	Recovery	166	120	20		0,195	29,343	1009		
5	Keb-S8	Full	2024-10-04	21:53	74,409731	-90,865781	Box Core	Bottom	170,4	114	29,4		0,184	29,293	1009		
5	Keb-S8	Full	2024-10-04	21:46	74,409739	-90,860861	Box Core	Deploymen	172	61	9,5		0,173	28,805	1009		
5	Keb-S8	Full	2024-10-04	21:23	74,403517	-90,773762	Beam trawl	Recovery	183,6	70	20,6		0,189	28,672	1010		
5	Keb-S8	Full	2024-10-04	20:06	74,398044	-90,684351	Classic Rose	Recovery	199,8	138	14,7		0,173	28,625	1010		
5	Keb-S8	Full	2024-10-04	19:39	74,398503	-90,656139	Classic Rose	Bottom	194,7	100	17		0,179	28,606	1010		
5	Keb-S8	Full	2024-10-04	19:29	74,399935	-90,641363	Classic Rose	Deploymen	194	122	13		0,276	28,584	1010		

5	Keb-S8	Full	2024-10-04	18:12	74,403304	-90,680145	Tucker	Bottom	195,2	121	22,9		0,034	28,615	1009		
5	Keb-S8	Full	2024-10-04	18:00	74,402435	-90,640546	Tucker	Deploymen	195	123	22		0,046	28,573	1010		
5	Keb-S8	Full	2024-10-04	17:23	74,402046	-90,638481	Hydrobios	Recovery		104	11,7		0,108	28,891	1010		
5	Keb-S8	Full	2024-10-04	17:14	74,401393	-90,639107	Hydrobios	Bottom	194,9	132	17,9		0,092	28,626	1009		
5	Keb-S8	Full	2024-10-04	17:08	74,401323	-90,638432	Hydrobios	Deploymen	193,6	120	15,1		0,064	28,625	1010		
5	Keb-S9	CTD	2024-10-04	15:18	74,466505	-90,543685	CTD only (n	Recovery	262,5	131	20,6		0,143	28,795	1010		
5	Keb-S9	CTD	2024-10-04	15:09	74,466560	-90,542650	CTD only (n	Bottom	263,5	148	12,5		0,147	28,89	1010		
5	Keb-S9	CTD	2024-10-04	14:57	74,466460	-90,535977	CTD only (n	Deploymen	262	115	11,3		0,262	28,904	1010		
5	Keb-S10	Rosette	2024-10-04	13:59	74,541815	-90,413174	Classic Rose	Recovery	189,7	142	12,1		0,335	29,599	1010		
5	Keb-S10	Rosette	2024-10-04	13:27	74,543368	-90,409809	Classic Rose	Bottom		135	14		0,367	29,544	1010		
5	Keb-S10	Rosette	2024-10-04	13:18	74,543351	-90,408157	Classic Rose	Deploymen	182,6	140	11,6		0,36	29,634	1010		
5	Keb-S11	CTD	2024-10-04	12:42	74,570581	-90,392139	CTD only (n	Recovery	105,8	144	18,1		0,414	29,324	1010		
5	Keb-S11	CTD	2024-10-04	12:37	74,570351	-90,389116	CTD only (n	Bottom		137	18		0,448	29,314	1009		
5	Keb-S11	CTD	2024-10-04	12:28	74,570172	-90,384105	CTD only (n	Deploymen	109,3	135	19,3		0,477	29,306	1010		
5			2024-10-03	13:45	74,682705	-94,859542	Crew Chang			100	12,5		0,467	29,049	1002		

Appendix 3: CTD Logbook for the 2024 Amundsen Expedition

Leg	cast	station	date	Time	latitude	longitude	depth	bottom	Type
			(UTC)	(UTC)	(N)	(W)	(m)	(m)	
2	1	Hopedale Saddle	2024-07-13	21:44	56.0539	-57.41186	649	668	Classic
2	2	Hopedale Saddle	2024-07-14	12:55	56.05106	-57.4266	503	512	Classic
2	3	ASL Makkovik IPS5	2024-07-14	17:26	55.41066	-58.06528	93	102	Classic
2	4	ASL Makkovik IPS5	2024-07-14	22:38	55.40648	-58.06408	93	103	Classic
2	5	MAK-2024-M2	2024-07-15	1:59	55.51424	-58.93744	662	710	Classic
2	6	MAK-2024-M2	2024-07-15	4:01	55.51658	-58.94332	673	682	Classic
2	7	MAK-2024-M1	2024-07-15	8:34	55.4358	-58.94642	694	704	Classic
2	8	MAK-2024-M1	2024-07-15	23:13	55.43432	-58.94234	693	702	Classic
2	9	MAK-2024-M1	2024-07-16	2:14	55.43402	-58.93674	676	686	Classic
2	10	MAK-2024-M1	2024-07-16	17:46	55.43208	-58.94598	689	698	Classic
2	11	Hopedale Shelf	2024-07-17	12:12	55.71742	-59.3937	193	205	Classic
2	12	Sentinel	2024-07-19	2:35	56.31904	-59.83764	562	570	Classic
2	13	Sentinel	2024-07-19	12:52	56.31626	-59.83842	540	549	Classic
2	14	entinel North - Moa	2024-07-19	17:54	56.69192	-60.26068	483	491	Classic
2	15	Okak Bay	2024-07-20	13:47	57.56978	-62.04974	79	90	Classic
2	16	Nachvak Fjord	2024-07-22	12:41	59.0853	-63.46894	198	207	Classic
2	17	Ramah Shelf	2024-07-23	2:33	58.88758	-62.49112	190	199	Classic
2	18	Kangalaksiorvik Shel	2024-07-23	12:16	59.53422	-63.28752	170	179	Classic
2	19	Killinik 2	2024-07-24	1:15	60.84862	-64.06516	397	407	Classic
2	20	Davis Strait 2024	2024-07-25	8:15	64.54624	-58.51838	685	694	Classic
2	21	DS_500_B2	2024-07-26	4:55	65.53454	-59.61004	484	495	Classic
2	22	DS_500_B1	2024-07-26	12:51	65.4508	-58.43706	489	497	Classic
2	23	DS_600_A1	2024-07-27	0:25	66.20242	-58.21828	616	625	Classic
2	24	BB1_A	2024-07-27	23:27	67.76928	-59.04206	572	583	Classic
2	25	SV_1	2024-07-30	4:40	67.32656	-64.52256	251	260	Classic
2	26	TCA-QFC1	2024-07-30	9:29	67.35342	-64.75494	108	117	Classic
2	27	TCA-QFC2	2024-07-30	18:33	67.3125	-64.374	205	214	Classic
2	28	SV_2	2024-07-30	23:38	67.17294	-64.27596	351	361	Classic
2	29	TCA-QFA2	2024-07-31	4:15	67.23866	-64.36634	311	321	Classic
2	30	TCA-QFA1	2024-07-31	6:35	67.22098	-64.7224	182	192	Classic
2	31	TCA-QF3	2024-07-31	18:18	67.27148	-63.88004	509	516	Classic
2	32	TCA-QF3	2024-07-31	23:43	67.27264	-63.8798	90	536	Classic
2	33	TCA-QFB2	2024-08-01	2:39	67.16824	-64.29268	348	358	Classic
2	34	TCA-QFB1	2024-08-01	7:32	67.09614	-64.65764	151	162	Classic
2	35	TCA-QF4	2024-08-01	18:13	67.37122	-63.77106	446	456	Classic
2	36	D1	2024-08-01	20:23	67.47306	-63.691	649	659	Classic
2	37	TCA-D1B	2024-08-02	4:01	67.67592	-63.4493	515	524	Classic
2	38	D2	2024-08-02	6:28	67.85704	-63.15004	258	267	Classic
2	39	D3	2024-08-02	15:17	68.23552	-62.5973	69	1545	Classic
2	40	D3	2024-08-02	18:00	68.24128	-62.60272	1540	1548	Classic
2	41	D4	2024-08-03	2:16	68.62566	-61.97932	1794	1803	Classic
2	42	C4-24	2024-08-03	19:43	67.93914	-60.1614	1523	1532	Classic
2	43	C5	2024-08-04	2:36	68.1514	-59.97764	1351	1361	Classic
2	44	C3	2024-08-04	16:47	67.73898	-61.26512	1546	1555	Classic

2	45	C3	2024-08-04	21:17	67.74786	-61.26718	70	1555	Classic
2	46	C2	2024-08-05	2:09	67.55066	-61.92156	432	438	Classic
2	47	C1	2024-08-05	5:09	67.3476	-62.51858	123	133	Classic
2	48	B1	2024-08-05	12:11	67.05972	-61.50816	105	114	Classic
2	49	B3	2024-08-05	20:27	67.32392	-60.27504	1065	1075	Classic
2	50	B4	2024-08-06	2:30	67.46808	-59.65088	1420	1429	Classic
2	51	B5	2024-08-06	6:47	67.5839	-59.02274	1191	1200	Classic
3	1	Test	2024-08-10	20:08	67.76862	-61.31476	101	193	TM
3	2	RA01	2024-08-12	15:35	72.88022	-75.64908	429	439	Classic
3	3	RA01	2024-08-12	17:18	72.88014	-75.65062	423	432	TM
3	4	RA01	2024-08-12	18:31	72.88166	-75.65516	402	411	Classic
3	5	RA01	2024-08-12	22:23	72.8692	-75.64702	517	527	TM
3	6	RA02	2024-08-14	10:35	77.2335	-79.10784	461	471	Classic
3	7	RA02	2024-08-14	12:17	77.23888	-79.12106	479	490	TM
3	8	RA02	2024-08-14	13:33	77.24064	-79.12108	510	521	Classic
3	9	RA03	2024-08-15	10:12	77.2926	-80.73814	451	461	Classic
3	10	RA03	2024-08-15	12:53	77.29212	-80.75888	421	431	TM
3	11	RA03	2024-08-15	14:03	77.2923	-80.74918	438	449	Classic
3	12	RA03	2024-08-15	17:26	77.29064	-80.74382	451	461	Classic
3	13	RA04	2024-08-16	10:14	77.36114	-81.08076	187	197	Classic
3	14	RA04	2024-08-16	11:56	77.36256	-81.06622	194	204	TM
3	15	RA04	2024-08-16	13:06	77.36254	-81.07292	192	203	Classic
3	16	RA02	2024-08-17	2:49	77.23464	-79.1472	364	375	TM
3	17	RA05	2024-08-17	16:17	78.31344	-74.77946	601	611	Classic
3	18	RA06	2024-08-18	10:19	79.68316	-73.08722	235	246	Classic
3	19	RA06	2024-08-18	12:01	79.68352	09047833333	220	251	TM
3	20	RA06	2024-08-18	12:58	79.68438	-73.0968	241	252	Classic
3	21	RA06	2024-08-18	14:00	79.6843833	09242333333	228	252	TM
3	22	RA07	2024-08-19	10:13	79.78534	-73.55754	220	230	Classic
3	23	RA07	2024-08-19	11:46	79.78508	-73.5621	219	229	TM
3	24	RA07	2024-08-19	12:40	79.7852	-73.569	220	230	Classic
3	25	RA07	2024-08-19	13:54	79.78596	-73.56208	205	222	TM
3	26	RA08	2024-08-20	10:45	79.82894	-74.0989	247	256	Classic
3	27	RA08	2024-08-20	12:14	79.82792	-74.10246	238	250	TM
3	28	RA08	2024-08-20	13:11	79.82882	-74.11702	246	256	Classic
3	29	RA08	2024-08-20	14:18	79.82806	-74.1092	238	253	TM
3	30	RA09	2024-08-22	10:42	82.3988	-60.84702	126	135	Classic
3	31	RA09	2024-08-22	12:12	82.39568	-60.86318	125	145	TM
3	32	RA09	2024-08-22	12:57	82.39166	-60.8652	129	140	Classic
3	33	RA09	2024-08-22	14:10	82.38582	-60.8097	119	160	TM
3	34	RA10	2024-08-23	0:40	82.1255	-61.22272	485	497	Classic
3	35	RA11	2024-08-23	13:08	81.53702	-64.95392	111	121	Classic
3	36	RA12	2024-08-23	18:24	81.57012	-67.6115	285	295	Classic
3	37	RA12	2024-08-23	19:34	81.56874	-67.61346	238	286	TM
3	38	RA12	2024-08-23	20:27	81.56784	-67.62054	282	293	Classic
3	39	RA12	2024-08-23	22:09	81.5704	-67.63852	268	289	TM
3	40	RA13	2024-08-25	10:11	81.28692	-68.39964	405	414	Classic

3	41	RA13	2024-08-25	11:23	81.2883	-68.39386	377	407	TM
3	42	RA13	2024-08-25	12:30	81.28746	-68.39538	402	412	Classic
3	43	RA13	2024-08-25	13:40	81.28786	-68.39448	376	407	TM
3	44	RA14	2024-08-26	10:10	81.58874	-65.92776	522	532	Classic
3	45	RA14	2024-08-26	11:15	81.58858	-65.93186	494	526	TM
3	46	RA14	2024-08-26	12:30	81.58614	-65.94142	496	507	Classic
3	47	RA14	2024-08-26	14:29	81.58716	-65.90696	495	533	TM
3	48	RA15	2024-08-27	10:08	81.70052	-64.088	502	517	Classic
3	49	RA15	2024-08-27	11:16	81.69854	-64.06602	495	525	TM
3	50	RA15	2024-08-27	12:38	81.69884	-64.11636	535	545	Classic
3	51	RA15	2024-08-27	13:59	81.69336	-64.12152	475	512	TM
3	52	RA16	2024-08-28	10:09	81.72102	-59.22874	107	117	Classic
3	53	RA16	2024-08-28	11:08	81.71974	-59.22764	99	111	TM
3	54	RA16	2024-08-28	12:21	81.72026	-59.23202	106	116	Classic
3	55	RA16	2024-08-28	13:17	81.71964	-59.22842	99	112	TM
3	56	RA16	2024-08-28	13:55	81.71954	-59.21872	99	110	TM
3	57	RA17	2024-08-29	0:04	81.63096	-58.91662	82	92	Classic
3	58	RA17	2024-08-29	0:59	81.62936	-58.92744	80	92	TM
3	59	RA17	2024-08-29	1:45	81.62988	-58.91	82	92	Classic
3	60	RA18	2024-08-29	22:02	81.9397	-60.35682	289	299	Classic
3	61	RA18	2024-08-29	23:03	81.93828	-60.35902	288	292	TM
3	62	RA18	2024-08-30	0:01	81.9382	-60.36346	287	298	Classic
3	63	RA19	2024-08-30	10:15	81.25384	-64.31272	475	484	Classic
3	64	RA20	2024-09-02	12:50	75.57008	-78.86066	512	522	Classic
3	65	RA21	2024-09-02	21:05	76.03008	-83.119	643	654	Classic
3	66	RA22	2024-09-03	20:11	78.3194	-73.18534	249	257	Classic
3	67	RA23	2024-09-04	0:23	78.32198	-74.84318	477	487	Classic
3	68	RA24	2024-09-04	10:19	78.03256	-75.60156	232	253	Classic
3	69	RA24	2024-09-04	11:20	78.03274	-75.604	206	214	TM
3	70	RA24	2024-09-04	12:12	78.03202	-75.60572	208	222	Classic
4	71	RA25	2024-09-08	11:27	81.4067	-64.23718	523	531	Classic
4	72	RA25	2024-09-08	13:31	81.39672	-64.22654	543	553	TM
4	73	RA25	2024-09-08	14:55	81.41328	-64.22818	565	577	Classic
4	74	RA25	2024-09-08	16:15	81.40896	-64.22706	505	516	TM
4	75	RA26	2024-09-10	1:42	80.90738	-66.7138	361	371	Classic
4	76	RA27	2024-09-10	10:27	80.51954	-68.40216	353	360	Classic
4	77	RA27	2024-09-10	12:12	80.50402	-68.41716	348	357	Classic
4	78	RA28	2024-09-11	10:28	80.35854	-69.00104	313	322	Classic
4	79	RA28	2024-09-11	11:26	80.35316	-69.01478	325	334	TM
4	80	RA28	2024-09-11	12:55	80.345	-69.02856	328	337	Classic
4	81	RA28	2024-09-11	14:55	80.34552	-69.03664	328	338	TM
4	82	RA29	2024-09-12	0:27	80.32188	-68.54928	352	361	Classic
4	83	RA30	2024-09-12	2:49	80.28954	-68.1785	320	330	Classic
4	84	RA31	2024-09-12	10:17	80.2593	-67.74256	134	145	Classic
4	85	RA31	2024-09-12	12:23	80.25886	-67.75646	139	147	Classic
4	86	RA31	2024-09-12	13:57	80.27426	-67.74654	135	146	TM
4	87	RA32	2024-09-12	20:54	80.2663	-67.93376	178	188	Classic

4	88	RA33	2024-09-12	23:12	80.30052	-68.36488	336	347	Classic
4	89	RA34	2024-09-13	1:03	80.3316	-68.7782	345	355	Classic
4	90	RA35	2024-09-13	3:23	80.37434	-69.21416	295	305	Classic
4	91	RA36	2024-09-13	10:13	80.03628	-69.50222	236	246	Classic
4	92	RA37	2024-09-14	20:42	79.94404	-70.29614	184	193	Classic
4	93	RA38	2024-09-15	10:15	79.40086	-71.19184	194	204	Classic
4	94	RA38	2024-09-15	12:15	79.40958	-71.14812	208	217	Classic
4	95	RA39	2024-09-16	2:25	79.41884	-71.77408	225	235	Classic
4	96	RA40	2024-09-16	10:18	79.46218	-72.37258	239	247	Classic
4	97	RA41	2024-09-16	12:56	79.4981	-73.02146	204	212	Classic
4	98	RA41	2024-09-16	14:56	79.49818	-73.02708	203	213	Classic
4	99	RA42	2024-09-17	3:23	79.27824	-70.5944	223	231	Classic
4	100	RA43	2024-09-17	11:02	79.06556	-69.44142	242	251	Classic
4	101	RA43	2024-09-17	13:47	79.08378	-69.46416	208	217	Classic
4	102	RA44	2024-09-17	17:17	79.13006	-69.89636	293	303	Classic
4	103	RA45	2024-09-18	10:30	78.32964	-74.78136	490	498	Classic
4	104	RA46	2024-09-19	0:42	78.29714	-74.34146	531	541	Classic
4	105	RA47	2024-09-19	2:42	78.29966	-73.99856	610	621	Classic
4	106	RA48	2024-09-19	10:13	78.31406	-74.73922	613	620	Classic
4	107	RA48	2024-09-19	11:30	0858333333	-74.7594	297	612	TM
4	108	RA48	2024-09-19	13:23	78.30838	-74.79908	572	581	Classic
4	109	RA48	2024-09-19	18:13	78.30568	-74.76826	610	621	TM
4	110	RA49	2024-09-20	2:23	78.28232	-73.19778	374	383	Classic
4	111	RA50	2024-09-20	10:13	78.29078	-73.61482	664	674	Classic
4	112	RA50	2024-09-20	11:29	78.2818	-73.644	716	727	TM
4	113	RA50	2024-09-20	13:07	78.29338	-73.59428	600	610	Classic
4	114	RA50	2024-09-20	14:24	78.29504	-73.60178	631	641	TM
4	115	RA51	2024-09-21	13:29	78.3806	-73.38478	360	370	Classic
4	116	RA52	2024-09-22	15:04	77.19308	-71.06904	857	868	Classic
4	117	RA53/116	2024-09-23	10:12	76.38068	-70.52588	129	138	Classic
4	118	RA54/115	2024-09-23	12:14	76.33386	-71.2066	660	669	Classic
4	119	RA54/115	2024-09-23	13:28	76.33436	-71.20562	643	653	TM
4	120	RA54/115	2024-09-23	14:35	76.33398	-71.20884	649	658	Classic
4	121	RA54/115	2024-09-23	16:08	76.33152	-71.20168	663	672	TM
4	122	RA54/115	2024-09-23	22:44	76.33388	-71.20036	99	652	TM
4	123	RA55/114	2024-09-24	10:11	76.3248	-71.77828	604	614	Classic
4	124	RA56/113	2024-09-24	11:22	76.31944	-72.217	540	549	Classic
4	125	RA57/112	2024-09-24	13:08	76.31628	-72.70072	550	560	Classic
4	126	RA58/111	2024-09-24	14:29	76.30592	-73.21428	579	589	Classic
4	127	RA58/111	2024-09-24	15:32	76.307	-73.21486	581	596	TM
4	128	RA58/111	2024-09-24	17:07	76.30796	-73.21836	580	588	Classic
4	129	RA59/110	2024-09-24	23:36	76.29972	-73.63716	518	526	Classic
4	130	RA60/109	2024-09-25	1:20	76.28998	-74.1119	440	450	Classic
4	131	RA61/107	2024-09-25	3:07	76.28104	-74.98558	428	437	Classic
4	132	RA62/108	2024-09-25	10:17	76.263	-74.6033	436	446	Classic
4	133	RA62/108	2024-09-25	11:17	76.2632	-74.60054	437	449	TM
4	134	RA62/108	2024-09-25	12:41	76.26382	-74.59932	436	446	Classic

4	135	RA62/108	2024-09-25	13:52	76.26418	-74.6002	436	449	TM
4	136	RA63/106	2024-09-25	23:09	76.30672	-75.35568	371	380	Classic
4	137	RA64/104	2024-09-26	0:41	76.3429	-76.17214	180	190	Classic
4	138	RA65/103	2024-09-26	1:41	76.35322	-76.57694	138	147	Classic
4	139	RA66/102	2024-09-26	2:54	76.37458	-76.98824	239	246	Classic
4	140	RA67/101	2024-09-26	10:11	76.37554	-77.39544	351	361	Classic
4	141	RA67/101	2024-09-26	11:09	76.37112	-77.41974	383	391	TM
4	142	RA67/101	2024-09-26	12:45	76.38696	-77.39612	333	342	Classic
4	143	RA67/101	2024-09-26	13:47	76.37876	-77.42066	377	387	TM
4	144	RA68/100	2024-09-26	20:53	76.40754	-77.95964	222	232	Classic
4	145	RA69/105	2024-09-27	0:29	76.31518	-75.75982	315	324	TM
4	146	RA69/105	2024-09-27	1:09	76.31628	-75.75936	316	327	Classic
4	147	RA69/105	2024-09-27	2:23	76.31812	-75.76028	318	327	Classic
4	148	RA70/TCA-S3	2024-09-27	18:39	73.73506	-78.61746	914	921	Classic
4	149	RA70/TCA-S3	2024-09-27	20:40	73.7383	-78.63318	903	916	Classic
4	150	RA71	2024-09-30	12:14	74.46482	-90.56652	254	263	Classic
4	151	RA72	2024-09-30	16:06	74.14014	-91.056	209	219	Classic
4	152	RA73/TCAT2-305D	2024-09-30	21:40	74.2216	-93.51458	147	155	Classic
4	153	RA74/TCAT2-305C	2024-09-30	23:09	74.3516	-93.58348	152	162	Classic
4	154	RA75/TCAT2-305B	2024-10-01	0:44	74.48278	-93.64104	159	169	Classic
4	155	RA76/TCAT2-305A	2024-10-01	2:03	74.60236	-93.70926	113	123	Classic
5	1	Keb-S11	2024-10-04	12:34	74.57024	-90.38708	99	109	Classic
5	2	Keb-S10	2024-10-04	13:23	74.54348	-90.41062	171	182	Classic
5	3	Keb-S9	2024-10-04	15:03	74.46664	-90.5414	255	262	Classic
5	4	Keb-S8	2024-10-04	19:35	74.39918	-90.64932	186	194	Classic
5	5	Keb-S7	2024-10-04	23:48	74.33926	-90.75472	198	205	Classic
5	6	Keb-S6	2024-10-05	1:07	74.2754	-90.85064	257	261	Classic
5	7	Keb-S5	2024-10-05	3:07	74.2233	-90.97548	317	328	Classic
5	8	Keb-S4	2024-10-05	6:31	74.14362	-91.02816	206	216	Classic
5	9	Keb/TCA-S3	2024-10-05	7:32	74.09806	-91.10124	142	151	Classic
5	10	Keb/TCA-S3	2024-10-05	9:12	74.09514	-91.0951	138	147	Classic
5	11	Keb/TCA-S3	2024-10-05	11:45	74.09652	-91.08684	140	149	Classic
5	12	Keb-S2	2024-10-05	13:59	74.06596	-91.12762	94	102	Classic
5	13	Keb-S1	2024-10-05	14:30	74.0481	-91.15752	36	48	Classic
5	14	TCA-S3	2024-10-06	7:18	73.73866	-78.66668	60	880	Classic
5	15	TCA-S3	2024-10-06	8:11	73.73824	-78.6763	868	870	TM
5	16	TCA-S3	2024-10-06	9:25	73.73732	-78.67112	878	888	Classic
5	17	TCA-S3	2024-10-06	13:36	73.74048	-78.68064	875	884	Classic
5	18	TCAT3-01	2024-10-07	16:06	72.50264	-75.01992	63	74	Classic
5	19	TCAT3-01	2024-10-07	16:56	72.49776	-75.01446	77	87	TM
5	20	TCAT3-01	2024-10-07	18:39	72.5013	-75.02358	71	82	Classic
5	21	TCAT3-03	2024-10-07	23:16	72.54082	-74.32286	194	206	Classic
5	22	TCAT3-05	2024-10-08	1:31	72.57688	-73.51584	709	717	Classic
5	23	TCAT3-05	2024-10-08	3:19	72.57626	-73.5232	700	708	TM
5	24	TCAT3-05	2024-10-08	7:03	72.57628	-73.50994	710	720	Classic
5	25	TCAT3-07	2024-10-08	10:11	72.6091	-72.47654	864	873	Classic
5	26	TCAT3-08	2024-10-08	13:09	72.63958	-71.57598	1130	1139	Classic

5	27	TCAT3-08	2024-10-08	14:57	72.63882	-71.57804	1131	1140	TM
5	28	TCAT3-08	2024-10-08	16:30	72.63758	-71.56826	1132	1140	Classic
5	29	TCAT3-08	2024-10-08	23:23	72.64058	-71.55664	1134	1143	Classic
5	30	TCAT3-09	2024-10-09	4:51	72.6889	-70.09242	1744	1753	Classic
5	31	TCAT3-09	2024-10-09	7:14	72.68974	-70.09404	1733	1754	Tm
5	32	TCAT3-09	2024-10-09	9:40	72.68958	-70.09808	1743	1750	Classic
5	33	TCAT3-09	2024-10-09	11:40	72.6878	-70.10888	159	1744	Tm
5	34	TCAT3-10	2024-10-09	14:54	72.72362	-68.46672	2187	2196	Classic
5	35	TCA-BB2	2024-10-09	20:41	72.74764	-67.00376	2358	2367	Classic
5	36	TCA-BB2	2024-10-09	23:24	72.74724	-67.003	396	2365	TM
5	37	TCA-BB2	2024-10-10	2:35	72.74708	-67.02126	2349	2366	Classic
5	38	TCA-BB2	2024-10-10	8:48	72.74786	-66.98918	100	2365	Classique
5	39	TCA-BB2	2024-10-10	9:39	72.74702	-66.99782	2360	2370	TM
5	40	TCA-BB2	2024-10-10	11:37	72.74718	-66.99582	2346	2366	Classic
5	41	TCA-BB2	2024-10-10	15:33	72.74688	-67.01068	50	2365	Classic
5	42	TCAT3-20	2024-10-10	18:41	73.2728	-66.91528	2342	2361	Classic
5	43	TCAT3-19	2024-10-10	23:43	73.78968	-66.83498	2291	2311	Classic
5	44	TCAT3-19	2024-10-11	3:20	73.78896	-66.84352	2293	2314	Tm
5	45	TCAT3-19	2024-10-11	6:18	73.78422	-66.83082	2301	2310	Classic
5	46	TCAT3-19	2024-10-11	8:55	73.78356	-66.83304	416	2306	TM
5	47	TCAT3-17	2024-10-11	12:18	74.31352	-66.72124	2201	2210	Classic
5	48	TCAT3-17	2024-10-11	14:44	74.31332	-66.72212	2194	2215	TM
5	49	TCAT3-17	2024-10-11	16:50	74.3125	-66.7331	2189	2210	Classic
5	50	TCAT3-17	2024-10-11	23:04	74.31288	-66.74264	149	2210	Classic
5	51	TCAT3-17	2024-10-12	0:13	74.31492	-66.7404	415	2207	TM
5	52	TCAT3-16	2024-10-12	7:19	74.83554	-66.62802	1371	1392	Classic
5	53	TCAT3-15	2024-10-12	10:47	75.15748	-66.55222	467	476	Classic
5	54	TCAT3-15	2024-10-12	12:07	75.15964	-66.55336	466	475	TM
5	55	TCAT3-13	2024-10-12	15:08	75.4943	-66.489	339	351	Classic
5	56	TCAT3-11	2024-10-12	17:57	75.83338	-66.4915	503	511	Classic
5	57	TCAT3-11	2024-10-12	21:17	75.8316	-66.51618	520	525	TM
5	58	TCAT3-11	2024-10-12	22:21	75.8304	-66.52404	517	528	Classic
5	59	TCAT3-11	2024-10-13	1:30	75.82202	-66.46614	119	520	Classic
5	60	C4-23	2024-10-15	11:43	67.9241	-60.6526	1598	1606	Classic
5	61	C4-23	2024-10-15	19:14	67.981	-60.64012	1601	1611	Classic
5	62	TCAT6-09 (A9)	2024-10-16	12:04	67.09548	-54.27398	73	84	Classic
5	63	TCAT6-09 (A9)	2024-10-16	12:42	67.09634	-54.2769	72	83	TM
5	64	TCAT6-09 (A9)	2024-10-16	14:39	67.09608	-54.26794	67	76	Classic
5	65	TCAT6-08 (A8)	2024-10-16	18:23	67.04394	-55.07912	55	65	Classic
5	66	TCAT6-07 (A7)	2024-10-16	20:55	66.98278	-56.06186	117	126	TM
5	67	TCAT6-07 (A7)	2024-10-16	21:26	66.98296	-56.0633	117	127	Classic
5	68	TCAT6-06 (A6)	2024-10-17	1:52	66.89588	-56.92062	650	659	Classic
5	69	TCAT6-05 (A5)	2024-10-17	5:19	66.87296	-57.9471	795	815	TM
5	70	TCAT6-05 (A5)	2024-10-17	6:27	66.87222	-57.94214	806	815	Classic
5	71	TCAT6-05 (A5)	2024-10-17	10:08	66.8712	-57.95056	149	815	Classic
5	72	TCAT6-04 (A4)	2024-10-17	14:26	66.8032	-58.7631	898	909	Classic
5	73	TCAT6-03 (A3)	2024-10-17	17:31	66.7307	-59.60206	854	874	TM

5	74	TCAT6-03 (A3)	2024-10-17	18:30	66.73098	-59.61092	860	870	Classic
5	75	TCAT6-03 (A3)	2024-10-17	23:29	66.7287	-59.61106	60	870	Classic
5	76	TCAT6-03 (A3)	2024-10-18	0:04	66.72868	-59.60986	188	865	TM
5	77	TCAT6-02 (A2)	2024-10-18	4:13	66.6697	-60.45676	513	523	Classic
5	78	TCAT6-01 (A1)	2024-10-18	7:25	66.59912	-61.19346	94	104	Classic
5	79	TCAT6-01 (A1)	2024-10-18	9:21	66.59904	-61.17794	119	128	Classic
5	80	AR24-20	2024-10-21	13:30	60.00206	-69.22922	66	75	Classic
5	81	AR24-19	2024-10-21	16:17	59.98194	-69.39408	82	92	Classic
5	82	AR24-17	2024-10-21	20:56	60.01254	-69.59514	67	76	Classic
5	83	LR24-05	2024-10-22	16:06	58.97114	-68.92346	85	94	Classic
5	84	LR24-04	2024-10-22	19:21	59.08254	-68.75038	86	100	Classic
5	85	UNG-3	2024-10-23	10:12	59.42722	-67.4557	252	261	Classic
5	86	GR24-17	2024-10-24	12:19	58.88432	-66.31184	50	60	Classic
5	87	TCAT1_05	2024-10-26	10:18	54.49048	-54.76016	182	191	Classic
5	88	TCAT1_03	2024-10-26	14:00	53.98798	-55.25306	138	147	Classic
5	89	TCAT1_01	2024-10-26	17:28	53.67906	-55.54486	144	154	Classic
5	90	BIS-1	2024-10-27	10:35	51.32034	-56.97994	91	96	Classic
5	91	BIS-02	2024-10-27	11:57	51.19494	-57.0394	58	63	Classic
5	92	JACS-01	2024-10-28	12:17	49.9806	-63.105	96	101	Classic
5	93	JACS-02	2024-10-28	14:04	50.14956	-63.41922	78	83	Classic

Appendix 4: List of participants on the 2024 Amundsen Expedition

Leg	Name (Family, First)	Position	Affiliation	Project Investigator/ Supervisor	Embark place	Embark date	Disembark place	Disembark date
Leg 2a								
2a	Laing, Rodd	Chief Scientist	Nunatsiavut Government	Rodd Laing	St. John's	11-Jul-2024	Nain	20-Jul-2024
2a	Cote, David	Chief Scientist	Department of Fisheries	David Cote	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Bartlett, James	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Nain	20-Jul-2024
2a	Bender, Aidan	BSc Student	University of Calgary	Casey Hubert	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Bennett, James Robert (Ro	Research Staff	Natural Resources Canad	Alexandre Normandeau	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Bentley, Jeremy	Research Staff	Natural Resources Canad	Alexandre Normandeau	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Bisiach, Francesco	MSc Student	University of Calgary	Casey Hubert	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Broom, Laura	Research Staff	Natural Resources Canad	Alexandre Normandeau	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Champigny, Alfred	PhD Student	Université du Québec à R	André Rochon	Nain	20-Jul-2024	Iqaluit	8-Aug-2024
2a	Chen, Letitia Ye Pao	MSc Student	Memorial University	David Cote/Paul Snelgrove	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Danzinger, Amelia	PhD Student	University of Calgary	Casey Hubert	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Dwyer-Samuel, Frédéric	Research Staff	Nunatsiavut Government	Rodd Laing	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Edinger, Evan	Researcher/Professor	Department of Fisheries	Evan Edinger	Nain	20-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Fountain, Christopher Tyle	PhD Student	Memorial University	Barbara Neves	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Geizer, Haley	PhD Student	Dalhousie University	Christopher Algar	St. John's	11-Jul-2024	Iqaluit	29-Jul-2024
2a	Girard, Luke	Professional	Canadian Scientific Subm	Keith Shepherd	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Guillot, Pascal	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Harker, Brayden	MSc Student	University of New Brunsv	Audrey Limoges	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Hayward, Scott	Research Staff	Natural Resources Canad	Alexandre Normandeau	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Higdon, Jennifer Joan	Research Staff	Department of Fisheries	Jennica Seiden	Nain	20-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Jones, Silas	Research Staff	Memorial University	Christopher Algar	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Jones, Simon	Professional	Canadian Scientific Subm	Keith Shepherd	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Kasraian, Ali	Postdoctoral Fellow	University of Calgary	Casey Hubert	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Kilgour Prevost, Rhys Samu	Professional	Canadian Scientific Subm	Keith Shepherd	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Lahaye, Quentin	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Laing, Janelle	Research Staff	Department of Fisheries	John O'Brien	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Lalor, Kathleen	Research Staff	Department of Fisheries	Jennica Seiden	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	MacMillan-Kenny, Zach	Professional	Amundsen Science	Alexandre Forest	Nain	20-Jul-2024	Iqaluit	8-Aug-2024
2a	Neves, Barbara	Researcher/Professor	Department of Fisheries	Barbara Neves	St. John's	11-Jul-2024	Nain	20-Jul-2024
2a	Nickoloff, Gina	PhD Student	University of Calgary	Brent Else	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Oates, Ashley	MSc Student	Memorial University	Maxime Geoffroy/Christine	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	O'Brien, John	Researcher/Professor	Department of Fisheries	John O'Brien	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Patel, Nidhiben	BSc Student	University of Calgary	Casey Hubert	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Pietri, Mélody	Professional	Université Laval	Frédéric Maps	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024

2a	Poitrimol, Camille	Postdoctoral Fellow	Université Laval	Philippe Archambault	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Porter, Gibson	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Roul, Sheena	Research Staff	Department of Fisheries	Dave Cote	St. John's	11-Jul-2024	Nain	20-Jul-2024
2a	Seiden, Jennica	Researcher/Professor	Department of Fisheries	Jennica Seiden	St. John's	11-Jul-2024	Nain	20-Jul-2024
2a	Shepherd, Trevor	Professional	Canadian Scientific Subm	Keith Shepherd	St. John's	11-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	Thériault, Myriam	MSc Student	Université Laval	Patrick Lajeunesse	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Van Dijk, Joshua	MSc Student	University of New Brunsv	Ian Church	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Vilgrain, Laure	Postdoctoral Fellow	Memorial University	Maxime Geoffroy	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	Wilmotte, Louis	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2a	TBD (NG)		Nunatsiavut Government	Rodd Laing	Nain	20-Jul-2024	Qikiqtarjuaq	29-Jul-2024
2a	SSI		Canadian Ice Service		St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
Leg 2b								
2b	Desmarais, Amélie	Chief Scientist	Amundsen Science	Alexandre Forest	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Ashevak,Lerena	Professional	Environment and Climate	Carina Gjerdrum	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Belko, Alexis	PhD Student	Université Laval	Patrick Lajeunesse	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Bennett, James Robert (Ro	Research Staff	Natural Resources Canad	Alexandre Normandeau	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Bentley, Jeremy	Research Staff	Natural Resources Canad	Alexandre Normandeau	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Broom, Laura	Research Staff	Natural Resources Canad	Alexandre Normandeau	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Burgers, Tonya	Research Staff	Department of Fisheries	David Capelle	Qikiqtarjuaq	29-Jul-2024	Pituffik Space	5-Sep-2024
2b	Cai, Huiwen	Postdoctoral Fellow	Université Laval	Julien Gigault	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Cantelo, Julia	MSc Student	Dalhousie University	Erin Bertrand	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Champigny, Alfred	PhD Student	Université du Québec à R	André Rochon	Nain	20-Jul-2024	Iqaluit	8-Aug-2024
2b	Chartrand, Elliott	MSc Student	Université du Québec à R	Jean-Eric Tremblay et Saulnier-Talbot, Emilie	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Ciastek, Stephen	Research Staff	University of Manitoba -	Zou Zou Kuzyk	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Corlett, Hilary	Researcher/Professor	Memorial University	Hillary Corlett	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Dumoulin, Laury-Ann	PhD Student	Université du Québec à R	Stephanie Kusch	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Fraisse, Antoine	MSc Student	Université Laval	Julien Gigault	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Friesen, Stephen	PhD Student	University of Manitoba -	Kristina Brown	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Geizer, Haley	PhD Student	Dalhousie University	Chris Algar/Carly Buchwald	St. John's	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Glowa, Sarah	Research Staff	Department of Fisheries	Neil Fisher/Lisa Matthes	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Guillot, Pascal	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Harker, Brayden	MSc Student	University of New Brunsv	Audrey Limoges	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Hayward, Scott	Research Staff	Natural Resources Canad	Alexandre Normandeau	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Kelly, Brendan	Research Staff	Environment and Climate	Carina Gjerdrum	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Kitching, Elizabeth	Research Staff	Department of Fisheries	Lisa Matthes	Qikiqtarjuaq	29-Jul-2024	Pituffik Space	5-Sep-2024
2b	Lahaye, Quentin	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Lee, Megan	Research Staff	Department of Fisheries	Lisa Matthes	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	MacMillan-Kenny, Zach	Professional	Amundsen Science	Alexandre Forest	Nain	20-Jul-2024	Iqaluit	8-Aug-2024

2b	Mandryk, Rachel	Research Staff	Department of Fisheries	David Capelle	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Nakashuk, Charlie	Research Staff	Department of Fisheries	Lisa Matthes	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Oates, Ashley	MSc Student	Memorial University	Maxime Geoffroy/Christine	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Pietri, Mélody	Professional	Université Laval	Frédéric Maps	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Poitrimol, Camille	Postdoctoral Fellow	Université Laval	Philippe Archambault	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Porter, Gibson	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Pucko, Monika	Research Staff	Department of Fisheries	Lisa Matthes	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Saulnier-Talbot, Emilie	Researcher/Professor	Université Laval	Emilie Saulnier-Talbot	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Soucy-Giguère, Eleonore	BSc Student	Université Laval	Emilie Saulnier-Talbot	Qikiqtarjuaq	29-Jul-2024	Iqaluit	8-Aug-2024
2b	Thériault, Myriam	MSc Student	Université Laval	Patrick Lajeunesse	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Van Dijk, Joshua	MSc Student	University of New Brunsw	Ian Church	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Vilgrain, Laure	Postdoctoral Fellow	Memorial University	Maxime Geoffroy	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	Wilmotte, Louis	Professional	Amundsen Science	Alexandre Forest	St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
2b	SSI				St. John's	11-Jul-2024	Iqaluit	8-Aug-2024
Leg 3								
3	Ardyna, Mathieu	Chief Scientist	Université Laval	Mathieu Ardyna	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Limoges, Audrey	Chief Scientist	University of New Brunsw	Audrey Limoges	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Amirault, Daniel	Professional	Amundsen Science	Alexandre Forest	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Barut, Guillaume	PhD Student	Université Laval	Christine Michel/Mathieu A	Iqaluit	8-Aug-2024	Resolute Bay	3-Oct-2024
3	Belhadj-Senini, Moustafa	Research Staff	LEGOS	Catherine Jeandel/Mélanie	Iqaluit	8-Aug-2024	Resolute Bay	3-Oct-2024
3	Blais, Guillaume	PhD Student	Université Laval	Philippe Archambault	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Bonnin, Jérôme	Researcher/Professor	Université de Bordeaux	Audrey Limoges/Philippe M	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Boutôt, Christian	Professional	Amundsen Science	Alexandre Forest	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Bracquart, Élodie	PhD Student	Université du Québec à R	Jean Carlos Montero-Serra	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Brembach, Kerstin	PhD Student	Université Laval	Patrick Lajeunesse	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Bruyant, Flavienne	Research Staff	Université Laval	Mathieu Ardyna	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Burgers, Tonya	Research Staff	Department of Fisheries	David Capelle	Qikiqtarjuaq	29-Jul-2024	Pituffik Space	5-Sep-2024
3	Cossa, Daniel	Researcher/Professor	Université Grenoble Alpe	Daniel Cossa	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Cullen, Jay	Researcher/Professor	University of Victoria	Jay Cullen	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Dhifallah, Fatma	Professional	Amundsen Science	Alexandre Forest	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Doxaran, David	Researcher/Professor	Laboratoire d'Océanogra	David Doxaran	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Drouet, Antonin	Professional	Amundsen Science	Alexandre Forest	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Ferreira, Eva	PhD Student	LSCE	Bruno Lansard	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Furey, Tony	Professional	Amundsen Science	Alexandre Forest	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Gagnon, Jonathan	Research Staff	Québec-Océan	Jean-Éric Tremblay	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Galand, Pierre	Researcher/Professor	Observatoire Océanologi	Pierre Galand	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Jaouen, Emmanuelle	PhD Student	Station biologique de Ro	A.C. Baudoux/D. Demory/S	Iqaluit	8-Aug-2024	Resolute Bay	3-Oct-2024
3	Jeandel, Catherine	Researcher/Professor	LEGOS	Catherine Jeandel	Iqaluit	8-Aug-2024	Resolute Bay	3-Oct-2024
3	Kitching, Elizabeth	Research Staff	Freshwater Institute	Lisa Matthes	Qikiqtarjuaq	29-Jul-2024	Pituffik Space	5-Sep-2024

3	Leymarie, Edouard	Researcher/Professor	Laboratoire d'Océanogra	Edouard Leymarie	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Lopes dos Santos, Adriana	Researcher/Professor	University of Oslo	Ardyna/Michel/Amiraux/O	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Maps, Frederic	Researcher/Professor	Université Laval	Frederic Maps	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Marie, Barbara	Research Staff	LOMIC	Eva Ortega-Retuerta	Iqaluit	8-Aug-2024	Pituffik Space	3-Oct-2024
3	Mercier, Florence	MSc Student	Université Laval	Raoul-Marie Couture	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Morisset, Simon	Professional	Amundsen Science	Alexandre Forest	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Nault, Nathan	PhD Student	Laboratoire d'océanogra	Ortega-Retuerta/Galand/Jo	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Ohrling, Sofie	MSc Student	University of Victoria	Jay Cullen	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Provencher, Juliette	Research Staff	Université Laval	Mathieu Ardyna	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Reimer, Jillian	Research Staff	Department of Fisheries a	Lisa Matthes	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Sandbank, Einat	PhD Student	Memorial University	Maxime Geoffroy	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Segur, Theo	PhD Student	Géosciences Environnem	Jeroen Sonke	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Vilgrain, Laure	Postdoctoral Fellow	Memorial University	Maxime Geoffroy	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Waelbroeck, Claire	Researcher/Professor	LOCEAN	Claire Waelbroeck	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	Zanon, Arturo	PhD Student	Université du Québec à R	Philippe Archambault	Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
3	ISS				Iqaluit	8-Aug-2024	Pituffik Space	5-Sep-2024
Leg 4								
4	Babin, Marcel	Chief Scientist	Université Laval	Marcel Babin	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Anderlini, Tia	PhD Student	University of Victoria	Jay Cullen	Pituffik Space	5-Sep-2024	Kuujjuaq	3-Oct-2024
4	Barut, Guillaume	PhD Student	Université Laval	Mathieu Ardyna	Iqaluit	8-Aug-2024	Resolute Bay	3-Oct-2024
4	Belko, Alexis	Professional	Amundsen Science	Alexandre Forest	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Blais, Clémence	PhD Student	Université Laval	Marcel Babin	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Bodiguel, Léna	PhD Student	Université Laval	Mathieu Ardyna	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024
4	Bourreau, Lucie	PhD Student	Université Laval	Frédéric Maps	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Carson, Thomas	Research Staff	Natural Resources Canad	Audrey Limoges/Philippe N	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Combaz, Thibaud	PhD Student	Université Laval	Philippe Archambault	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024
4	Deslongchamps, Gabrièle	Research Staff	Université Laval	Jean-Éric Tremblay	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Desmarais, Amélie	Professional	Amundsen Science	Alexandre Forest	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Ehn, Jens	Professional	University of Manitoba -	Dorthe Dahl-Jensen	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Garmirian, Zoé	PhD Student	Université Laval	Mathieu Ardyna/Maxime G	Pituffik Space	5-Sep-2024	Quebec City (	30-Oct-2024
4	Gourvil, Priscilla	Research Staff	RCC	A. Lopes dos Santos/I. Prob	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Gouzien, Corentin	PhD Student	L2SN	Mathieu Ardyna	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Grenier, Mélanie	Researcher/Professor	LEGOS	Melanie Grenier	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Guérin, Sébastien	Postdoctoral Fellow	Université Laval	Mathieu Ardyna	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024
4	Hamon, Michel	Research Staff	IFREMER	Pether Sutherland	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Heimbürger, Lars Eric	Researcher/Professor	Institut Méditerranéen d	Lars-Eric Heimburger	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Huot, Matthieu	Postdoctoral Fellow	Université Laval	Mathieu Ardyna	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Jaouen, Emmanuelle	PhD Student	Station biologique de Ros	AC.Baudoux/D.Demory/ S.\	Iqaluit	8-Aug-2024	Resolute Bay	3-Oct-2024
4	Jeandel, Catherine	Researcher/Professor	LEGOS	Jeandel Catherine	Iqaluit	8-Aug-2024	Resolute Bay	3-Oct-2024

4	Jensen, Mads Kristian Rein	Postdoctoral Fellow	UiT The Arctic University	Maxime Geoffroy	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Kuchly, Sébastien	PhD Student	ESPCI	Peter Sutherland	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Kvorning, Anna	PhD Student	Geological Survey of Den	Audrey Limoges/Philippe M	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Lahaye, Quentin	Professional	Amundsen Science	Alexandre Forest	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Lansard, Bruno	Researcher/Professor	LSCE	Bruno Lansard	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Michel, Elisabeth	Researcher/Professor	LSCE	Audrey Limoges/Philippe M	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Ortega-Retuerta, Eva	Researcher/Professor	LOMIC	Eva Ortega-Retuerta	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Pagé, Sonia	Research Staff	Université Laval	Philippe Archambault	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Plassart, Arthur	PhD Student	Université Laval	Marcel Babin	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Raulier, Bastian	PhD Student	Université Laval	Marcel Babin	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Rochefort, Véronique	Professional	Amundsen Science	Alexandre Forest	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Sellet, Hugo	Research Staff	IFREMER	Peter Sutherland	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Sonke, Jeroen	Researcher/Professor	Géosciences Environnem	Jeron Sonke	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Sutherland, Peter	Researcher/Professor	IFREMER	Peter Sutherland	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Thil, François	Researcher/Professor	LSCE	Bruno Lansard	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Villefer, Antoine	Postdoctoral Fellow	IFREMER	Peter Sutherland	Pituffik Space	5-Sep-2024	Resolute Bay	3-Oct-2024
4	Wilmotte, Louis	Professional	Amundsen Science	Alexandre Forest	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024
Leg 5a								
5a	Tremblay, Jean-Éric	Chief Scientist	Université Laval	Jean-Eric Tremblay	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Anderlini, Tia	PhD Student	University of Victoria	Jay Cullen	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024
5a	Bisson, Laurence	MSc Student	Université Laval	Jean-Eric Tremblay	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Bodiguel, Léna	PhD Student	Université Laval	Mathieu Ardyna	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024
5a	Bourgouin, Andeol	PhD Student	Université Laval	Frédéric Maps	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Bruggmann, Sylvie	Postdoctoral Fellow	Université Lausanne	Jean-Eric Tremblay/Samue	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Bruzac, Indiana	PhD Student	Université Laval	Julien Gigault	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Cantelo, Julia	MSc Student	Dalhousie University	Erin Bertrand	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Capelle, David	Researcher/Professor	Department of Fisheries a	David Capelle	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Combaz, Thibaud	PhD Student	Université Laval	Philippe Archambault	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024
5a	Crispi, Olivier	Research Staff	Observatoire Océanologi	Mathieu Ardyna	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Cron, Daniel	Research Staff	Université Laval	Julien Gigault	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Drouet, Antonin	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Ferrand, Paco	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Forget, Marie-Helene	Research Staff	Université Laval	Jean-Eric Tremblay	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Gagnon, Elodie	Research Staff		Mathieu Ardyna	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Gagnon, Jonathan	Research Staff	Université Laval	Jean-Eric Tremblay	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Garmirian, Zoé	PhD Student	Université Laval	Maxime Geoffroy/Frederic	Pituffik Space	5-Sep-2024	Quebec City (	30-Oct-2024
5a	Goudreau, Maryse	Media/Artist	Université du Québec à R	Baptiste Grison	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Guay, Carole-Anne	MSc Student	Université du Québec à R	Gwénaëlle Chaillou/Philipp	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Guérin, Sébastien	Postdoctoral Fellow	Université Laval	Mathieu Ardyna	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024

5a	Guillot, Pascal	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Guilmette, Caroline	Research Staff	Université Laval	Julien Gigault	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Hieronimus, Emmy Gabrie	MSc Student	University of Zurich (ETH	Jean-Eric Tremblay	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Iqualla, Damien	Research Staff	Department of Fisheries	Lisa Matthes	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Jacobsen, Eugenie	PhD Student	Memorial University	Maxime Geoffroy/Dave Co	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Jaffrès, Simon	PhD Student	Université Laval	Jean-Eric Tremblay/Rémi A	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Kitching, Elizabeth	Research Staff	Department of Fisheries	Lisa Matthes	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Lee, Megan	Research Staff	Department of Fisheries	Lisa Matthes	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Mandryk, Rachel	Research Staff	Department of Fisheries	David Capelle	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Morrissey, Christopher	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Normandeau, Claire	Research Staff	Dalhousie University	Doug Wallace	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Pearson, Marcia	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Perugini, Gabrielle	MSc Student	Memorial University	Maxime Geoffroy	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Pradel, Alice	Postdoctoral Fellow	Université Laval	Julien Gigault	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Pucko, Monika	Research Staff	Department of Fisheries	Lisa Matthes	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Reader, Heather Erin	Researcher/Professor	Memorial University	Reader, Heather Erin	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Schiliro, Vanessa	MSc Student	Dalhousie University	Erin Bertrand/Carolyn Buch	Resolute Bay	3-Oct-2024	Kuujjuaq	20-Oct-2024
5a	Wickens, Arthur	Professional	Canadian Hydrographic S	John Mercuri	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5a	Wilmotte, Louis	Professional	Amundsen Science	Alexandre Forest	Pituffik Space	5-Sep-2024	Kuujjuaq	20-Oct-2024
Leg 5b								
5b	Archambault, Philippe	Chief Scientist	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Akyildiz, Ayse	PhD Student	The Pennsylvania State U	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Bartenstein, Kristin	Researcher/Professor	Université Laval	Bartenstein, Kristin	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Bisson, Laurence	MSc Student	Université Laval	Maxime Geoffroy	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5b	Boucher, Nadine	PhD Student	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Bourgouin, Andeol	PhD Student	Université Laval	Frédéric Maps	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5b	Charette, Manuel	MSc Student	University of Ottawa	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Cohen, Jacob	MSc Student	University of Alaska Fairb	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Cooper, Isabelle	PhD Student	University of Southampto	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Dempsey, Britton	PhD Student	Dalhousie University	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Drouet, Antonin	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5b	Dubos, Véronique	Postdoctoral Fellow	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Duhaime, Gérard	Researcher/Professor	Université Laval	Gérard Duhaime	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Everett, Karen	Professional	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Falardeau, Marianne	Researcher/Professor	TELUQ	Marianne Falardeau	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Farquhar, Samantha	PhD Student	East Carolina University	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Gagnon, Jonathan	Research Staff	Université Laval	Jean-Eric Tremblay	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5b	Gagnon, Judith	MSc Student	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Gallais, Sophie	Professional	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024

5b	Garmirian, Zoé	PhD Student	Université Laval	Maxime Geoffroy/Frederic	Pituffik Space	5-Sep-2024	Quebec City (	30-Oct-2024
5b	Gélinas, Vicky	MSc Student	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Gellé, Alexandra	Postdoctoral Fellow	Université de Sherbrooke	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Genest, François	Media/Artist	Radio Canada	Sylvie Mallard	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Godbold, Jasmin	Researcher/Professor	University of Southampto	TBD	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Graham, Myrah	Professional	Amundsen Science	Alexandre Forest	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Guillot, Pascal	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5b	Hadria Gondry, Karima	MSc Student	Institut National de la Re	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Holen, Davin	Researcher/Professor	University of Alaska Fairb	Davin Holen	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Jacobsen, Eugenie	PhD Student	Memorial University	Maxime Geoffroy/Dave Co	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5b	Jamal, Meral	Media/Artist	Independant	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Johansen, Malou Platou	MSc Student	UiT The Arctic University	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Karlsdóttir, Anna	Researcher/Professor	University of Iceland	TBD	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Lebel, Tobie	Media/Artist	Radio Canada	Sylvie Mallard	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Morrissey, Christopher	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5b	Ollila, Mirkka	PhD Student	University of Helsinki	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Pearson, Marcia	Professional	Amundsen Science	Alexandre Forest	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024
5b	Serrano Burbano, Natalia	PhD Student	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Tokpanou, Sonagnon Olivi	PhD Student	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Vachon, Geneviève	MSc Student	Université Laval	Philippe Archambault	Kuujjuaq	20-Oct-2024	Quebec City (	30-Oct-2024
5b	Wickens, Arthur	Professional	Canadian Hydrographic S	John Mercuri	Resolute Bay	3-Oct-2024	Quebec City (	30-Oct-2024