MARIA S. MERIAN-Berichte

Investigating connectivity between Arctic freshwater outflow, Atlantic biogeochemistry and AMOC

Cruise No. MSM130

July 9 – August 14 2024

Reykjavik (Iceland) – Reykjavik (Iceland)

POLAR BEAST

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2024

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1 Cruise Summary

1.1 Summary in English

Cruise MSM130 on MARIA S. MERIAN took place in the high latitude North Atlantic Ocean, in the waters on the eastern side of Greenland. The cruise took place in the period July 9 to August 14, 2024. The high latitude North Atlantic and Arctic Oceans are visibly affected by anthropogenic climate change through ocean warming, freshening, acidification, increased cryosphere and river discharge, and rapid acceleration of sea ice loss. The changing dynamics at polar ice-ocean-atmosphere interfaces have far-reaching implications for the Earth's climate on diverse timescales through feedbacks on atmospheric circulation, oceanic mixing, circulation and carbon sequestration, and greenhouse gas sources and sinks. The overall goals of the POLAR BEAST cruise are achieved through observations and modelling, and are: (i) to investigate the role of Arctic sea ice loss as a driver of global change, (ii) to quantify chemical and physical processes at the ice-ocean-atmosphere interface that may constitute poorly-characterized climatic feedbacks in the Earth system. We investigated the key physical, chemical and biological factors determining salinity distribution, ocean productivity, greenhouse gas exchange and sediment carbon concentrations. The cruise sailed along the East Greenland coast and into fjord systems to capture land-ocean exchange, gradients in salinity, primary production and historical carbon export (from cores), with observations of water column biogeochemistry, ocean physics, in combination with satellite observations. Our improved understanding will be used to improve model projections of Arctic and low latitude systems under future climate scenarios.

1.2 Zusammenfassung

Die Fahrt MSM130 der MARIA S. MERIAN fand in den hohen Breiten des Nordatlantiks, in den Gewässern östlich von Grönland statt. Die Fahrt fand im Zeitraum vom 9. Juli bis 14. August 2024 statt. Der Nord Atlantik auf hohen Breitengraden und der Arktische Ozean sind sichtbar vom anthropogenen Klimawandel betroffen, der durch Erwärmung der Ozeane, Erfrischung, Versauerung, erhöhte Kryosphäre und Flussabflüsse sowie eine rasche Beschleunigung des Meereisverlusts verursacht wird. Die sich verändernde Dynamik an den polaren Grenzflächen zwischen Eis, Ozean und Atmosphäre hat weit reichende Auswirkungen auf das Erdklima auf verschiedenen Zeitskalen durch Rückkopplungen auf die atmosphärische Zirkulation, ozeanische Vermischung, Zirkulation und Kohlenstoffbindung sowie Treibhausgasquellen und -senken. Die Gesamtziele der Fahrt POLAR BEAST werden durch Beobachtungen und Modellierung erreicht: (i) die Rolle des arktischen Meereisverlusts als treibende Kraft des globalen Wandels zu untersuchen, (ii) chemische und physikalische Prozesse an der Schnittstelle Eis-Ozean-Atmosphäre zu quantifizieren, die möglicherweise schlecht charakterisierte klimatische Rückkopplungen im Erdsystem darstellen. Wir untersuchten die wichtigsten physikalischen, chemischen und biologischen Faktoren, die die Verteilung des Salzgehalts, die Produktivität der Ozeane, den Austausch von Sedimentkohlenstoff und Treibhausgasen bestimmen. Die Fahrt führte entlang der ostgrönländischen Küste und in die Fjordsysteme, um den Land-Ozean-Austausch, die Gradienten des Salzgehalts, die Primärproduktion und den historischen Kohlenstoffexport (aus Kernen) zu erfassen, mit Beobachtungen der Biogeochemie der Wassersäule, der Ozeanphysik, und Satellitenbeobachtungen. Unser verbessertes Verständnis wird genutzt werden, um Modellprojektionen von arktischen und niedrigbreiten Systemen unter zukünftigen Klimaszenarien zu verbessern.

2 Participants

2.1 Principal Investigators

Name	Institution
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2.2 Scientific Party

Name	Discipline	Institute
Prof. ACHTERBERG, Eric:	Mar. Biogeochem/ Chief Scientist	GEOMAR
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BOGNER, Boie	Marine Biogeochemistry	GEOMAR
WILSTERMANN, Carmen	Marine Biogeochemistry	GEOMAR
SCHREIBER, Lennart	Paleao Oceanography	GEUS
JIN, Xuewei	Marine Biogeochemistry	Shanghai
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Dr. TRUDNOWSKA; Emilia	Marine Biogeochemistry	IOPAN
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PATTERI VIJAYAN, Apsara	Marine Biogeochemistry	SUSTech
Dr. BRINKMANN, Inda	Paleo Oceanography	GEUS
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Dr. ZIMMERMANN, Heike Hildegard	Paleo Oceanography	GEUS
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Dr. STREUFF, Katharina	Paleo Oceanography	MARUM
TAENZER, Lukas	Physical Oceanography	WHOI
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2.3 Participating Institutions

GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel
Marum - Zentrum für Marine Umweltwissenschaften der Universität Bremen
Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research
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Woods Hole Oceanographic Institution, USA
Institute of Oceanology Polish Academy of Sciences (IOPAN), Poland
Geological Survey of Denmark and Greenland (GEUS), Denmark
LEMAR Laboratory, Brest, France
LEGOS Laboratory, Toulouse, France
Shanghai Jiao Tong University, China
University of South Florida, USA
Pontificia Universidad Católica de Valparaíso, Chile

3. Research Program

3.1 Description of the Work Area

The study region includes the high latitude North Atlantic Ocean and Greenland Sea. The cyclonic subpolar gyre of the North Atlantic flows through the Irminger and Iceland Basins. The North Atlantic Current (NAC) is part of the southern region of the subpolar gyre and flows as the main near-surface current northward into the central region of the high latitude North Atlantic (between ca. 10°W to 30°W). A branch of the NAC moves in the direction of the Faroe Islands and then into the Nordic Seas towards the Fram Strait (Hansen & Østerhus, 2000). The NAC feeds the Northern Icelandic Irminger Current (NIIC), which flows northwards past western Iceland. The NAC also feeds the Irminger Current, which is prominent in the east Irminger Basin, and turns west in the north Irminger Basin before moving south in the subpolar gyre flow. The western Irminger Basin features a fresh and cold western boundary current (East Greenland Current (EGC)) with a southerly flow, and salinity and temperature ranges of 30-34 and 3.5-5.5°C, respectively. The East Greenland System is strongly influenced by fresh, cold polar waters exiting the Arctic Ocean through the oceanic gateway of the Fram Strait, and flowing south to Cape Farewell in the EGC along, or inward of, the East Greenland shelf break. The EGC is the main freshwater exit route for the Arctic Ocean. In addition to transporting meteoric freshwater, the EGC transports sea ice southwards parallel to the coastline with ice melt accounting for approximately 1/3 of the EGC freshwater flux through the Fram Strait. Arctic-derived water masses in the East Greenland region can be classified as Polar Intermediate Water (PIW) and Polar Surface Water (PSW), with subsurface Atlantic Intermediate Water (AIW) and AIW modified by freshwater inputs (mAIW) flowing in northward directions. Freshwater in the EGC is primarily derived from Eurasian river waters advected across the Arctic Basin, with an additional contribution from sea ice melt, and an increasing component of runoff from Greenland as the current proceeds southward. South of Denmark Strait, a distinct inner-shelf current, the East Greenland Coastal Current (EGCC) has been identified with a faster velocity that appears to be an inner-branch of the EGC. The NAC recirculates in the Arctic and exits as cold/fresh surface waters via the EGC through the Fram Strait and along the East Greenland coastline. A branch of the EGC detaches from the shelf after Scoresby Sund (70 0°N) and becomes the East Iceland Current (EIC).

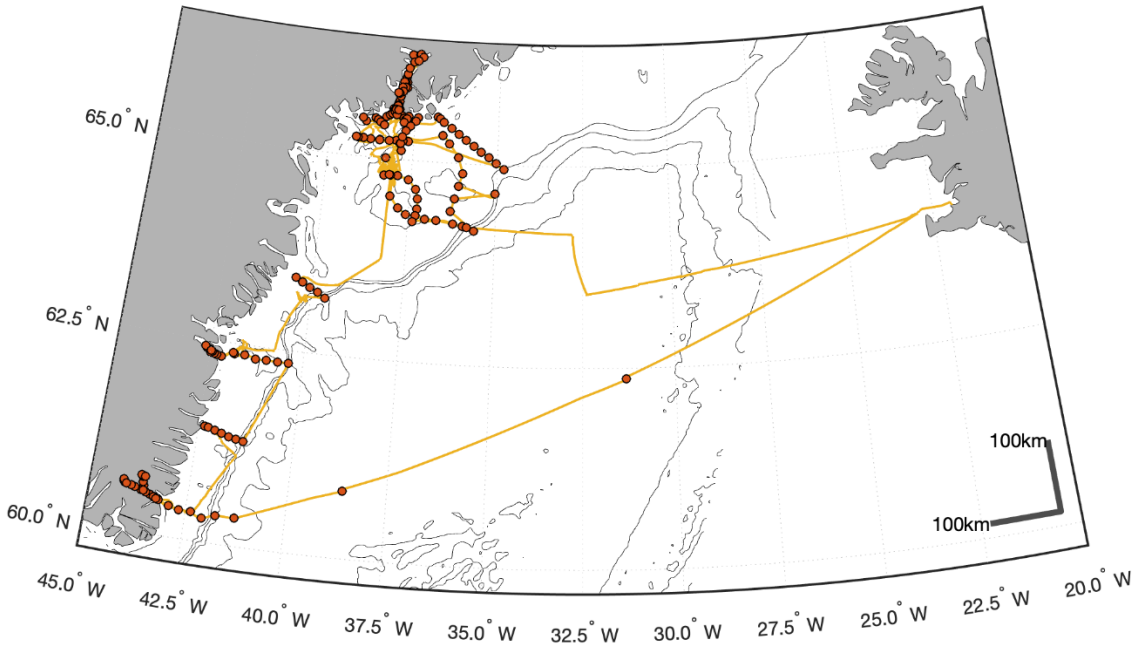


Fig. 3.1 Stations and cruise track for cruise MSM130.

3.2 Aims of the Cruise

Overall aims of the cruise:

Overall aim 1. We will conduct a salinity census of the East Greenland System with concurrent biogeochemical measurements to constrain the fate of freshwater and understand the effects of Arctic freshwater outflow on circulation and biogeochemistry in the North Atlantic.

Overall aim 2. We will conduct underway surface ocean and atmosphere measurements of trace gases (CO_2, CH_4) across the East Greenland system, alongside full depth profiles of nutrients, carbonate chemistry parameters (total alkalinity, dissolved inorganic carbon), CH_4, and intensive surveys of glacier-fjord systems (e.g. Kangerlussuatsiaq, Sermilik). These compliment prior early/late season inshore surveys of Sermilik – the only system in SE Greenland with prior data available- and moorings positioned in fjord mouths throughout the year.

Overall aim 3. We will collect sediment cores along the East Greenland shelf (complimenting GEUS cores already collected from further north in the Fram Strait). These will be used to reconstruct past climate variability and changes as a result of shifts in sea ice cover, salinity and productivity in the East Greenland system over the past 2000 years.

The specific objectives of the POLAR BEAST cruise are:

1. Conduct a census of low salinity waters across the East Greenland Current system (including the East Greenland Coastal Current) focusing on near-surface waters and inner-shelf waters, which are poorly captured in existing mooring and cruise work.
2. Determine the effects of shelf freshening on ocean biogeochemistry including climatically-active trace gases, carbonate chemistry, and nutrient availability.

3. Contribute to seasonal studies of physical/biogeochemical dynamics in east Greenland fjord systems complimenting earlier and later season work conducted by WHOI, NIOZ and SCRIPPS partners (which, to date, have focused on the OVIDE section and Sermilik).
4. Quantify past variations in blue carbon storage resulting from changing ocean properties at the ice-ocean interface in the East Greenland system by proxy reconstructions over the past 2000 years.

3.3 Agenda of the Cruise

The scientific group on MSM130 consisted of one technician, 10 senior scientists, and 8 PhD students, 1 MSc student and 3 HiWis. This group was made up by 12 females and 10 males with 11 different nationalities. The group embarked in Reykjavik (Iceland) on 8 July and we started our journey towards the study area in the region east of Greenland on 9 July. All scientists were eager to get started and spend the steaming time to prepare the laboratories and calibrate the scientific equipment. One test station was conducted in the Irminger Basin to test the CTD and other sampling equipment.

The cruise was conducted along the east coast of Greenland whereby fjord systems were accessed for detailed sampling, and cross sections were sampled in the East Greenland Current. The cruise captured land-ocean exchange, gradients in salinity, primary production and historical carbon export (from sediment cores), with observations of water column biogeochemistry, ocean physics, in combination with satellite observations.

On cruise MSM130, we have adhered to all ‘Measures to Conduct Responsible Marine Research’. We have carried out our research activities in the frame of the OSPAR Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area. Water samples were collected using a CTD rosette configuration with Niskin bottles attached. Sediments were collected using a mini multicorer and a gravity corer. The impact on the marine environment was hence negligible. There were no collections of zoological samples. No explosive or noise intensive measurements were conducted. All chemicals used onboard were be returned to home laboratories. In case we worked in the EEZ of a state, then all the additional measures prescribed measures were adhered to.

4 Narrative of the Cruise

Loading in Reykjavik and departure for east Greenland: The cruise participants arrived in Reykjavik (Iceland) on July 6 and 7 (2024), and mobilized the cruise MSM130. There were a total of 22 scientists participating in the cruise on RV MARIA S. MERIAN. We departed on Tuesday July 9 and set sail for the Kangerlussuatsiaq (otherwise known as Lindenow Fjord) which is the most southerly fjord in southeast Greenland that was studied on this expedition. The sea conditions during our transit from Reykjavik through the Irminger Basin to southeast Greenland were fine. We started sampling on the shelf on Thursday night (July 11) and conducted a detailed sampling campaign that reached the inner regions of Lindenow Fjord. The ice conditions in the Lindenow Fjord were fine with a relatively small amount of ice. The work included more than 20 stations and 2 short sampling expeditions with our Zodiac. At the stations we sampled for biological and

chemical variables using the standard stainless steel CTD rosette, which also has a UVP camera system and a range of biogeochemical sensors. In addition, we conducted casts for trace metal sampling using trace metal clean Niskin bottles on a plastic wire with the bottles being closed by deploying messengers. Then at a couple of the stations we deployed a mini MUC (multi corer) for collection short (ca. 30 cm) sediment cores. A gravity corer was also deployed at 3 to 4 stations in the fjord and on the shelf, to collect sediment cores of up to 5 m length. The further we moved into Lindenow Fjord, the more difficult the ice conditions became, and the vessel slowed down to about 2 knots to find a way through the ice. The work in Lindenow Fjord was finalised on Monday July 15 and we made our way towards Sikuijivitteq (otherwise known as Mogens Heinesens Fjord). The ice conditions on the shelf were favourable, but just before entering the fjord on July 18, we experienced difficult dense ice in front of the fjord. The next morning we managed to move through the ice and into the fjord, where the ice conditions were favourable. We managed to get a good distance into the fjord until the ice blocked us. We were able to successfully complete 8 stations with CTDs, MUC and gravity corer deployments, also very close to the glaciers. We had daily sightings of polar bears, even as far south as below 62°N.

We had an eventful week with cross-shelf sections in the region between Mogens Heinesens Fjord and Sermilik Fjord, and a lot of dense ice and thick fog which delayed our progress. The shelf work included more than 20 stations and additional geophysical surveys. Upon arrival in the shelf waters outside Sermilik Fjord on July 23, a wide and dense ice cover blocked our entry into the fjord. The ice situation this year were very difficult for the late July period. A French yacht of 22 m length had attempted to cross the dense ice region and reach Sermilik Fjord, but got stuck in the ice in thick fog. The skipper had no up to date ice charts and got into difficulties and had to send out a Mayday call. MARIA S. MERIAN moved to the area and positioned itself next to the dense ice region. The visibility and ice conditions were treacherous and prevented us from sailing into the ice. Fortunately, the ice broke up sufficiently to allow our vessel to escort the yacht out of the ice and into safety. They continued their voyage to Reykjavik, and we continued our shelf work until ice conditions improved later in the week.

On July 28th the ice conditions had improved sufficiently and we could sail into Sermilik Fjord and start operations with the CTD, trace metal clean Niskins on the Kevlar wire, multi-corer and gravity corer. We had a very successful week in Sermilik Fjord and conducted in-depth surveys in the fjord on physics, particle transport and biogeochemistry. We were able to sample right at the glacier edge, allowing us to collect valuable samples on particle release from glaciers. We endured a strong storm on July 30 whilst in the fjord (windforce 8 and above) which moved the ice and icebergs around the fjord and made operations difficult. We managed to sail from the northern part of the fjord towards the open waters of the outer fjord and occupied numerous stations for CTDs, trace metal sampling, MUCs and gravity cores. On August 3 we moved into the shelf waters outside of Sermilik Fjord to investigate the present and past transfer of material from Sermilik Fjord into the North Atlantic Ocean through CTD and coring operations. We also assessed the southward movement of polar waters in the East Greenland Current through cross shelf sections in the area.

The difficult wind, ice and fog conditions over the previous 2 weeks have slowed down our

progress. We therefore made the decision to use our remaining ship-time to study the region outside the Sermilik Fjord in more detail, and not move north to Kajser Franz Josef Fjord. We subsequently had a very successful week on the shelf near Sermilik Fjord and conducted in-depth surveys on the waters flowing in and out of Sermilik Fjord through different channel systems. The work involved detailed measurements of physics, particle transport and biogeochemistry. We had clear weather most of the week, but also periods with dense fog and moving ice fields, which made transits between the stations more difficult.

August 10 a strong storm developed (windforce 8 and above) on the shelf which moved the ice and iceberg at great speeds (more than 2 knots) and made our sampling challenging. We followed a deep channel in an off-shelf direction and reached the deep waters of the open North Atlantic on August 12. We finished our last station August 12 and transited to Reykjavik and arrived in port on Wednesday morning at 1210 h (August 14). A short detour occurred on the crossing back to Reykjavik to assist a yacht which had lost engine power and required escorting back to Iceland.

The cruise has been very successful, and we have been able to achieve our objectives, despite challenging ice, fog and wind conditions. The MARIA S. MERIAN encountered ice over 31 days of the cruise. The crew and captain of RV Maria S MERIAN have been wonderful in facilitating our research activities. The ice, fog and wind conditions required frequent changes to the cruise programme, which resulted in a very dynamic cruise. The multi-national and multi-disciplinary science team has done a wonderful job on this cruise. We managed to occupy 172 stations and take about 4400 samples for nutrients and more than 500 samples for trace elements, carbonate chemistry, POC, DOC ammonium etc. This has vastly improved the data paucity for the inshore waters off southeast Greenland which was previously among the least surveyed regions of the Greenland shelf. Only ~5 glacier fjord systems around Greenland have been previously characterized in terms of coordinated physical, chemical and biological oceanography (Hopwood et al., 2020), and few of these campaigns constrained benthic dynamics in parallel with water column observations. The inner shelf region south of Denmark Strait and north of Cape Farewell has also remained data deficient despite efforts to understand links between regional increases in freshwater discharge and AMOC. In providing two new regions of data (Kangerlussuatsiaq and Sikuijivitteq) and adding an additional year of summertime observations to the only relatively well studied site on the SE coastline (Sermilik), the cruise has made valuable contributions to data coverage around Greenland.

5 Preliminary Results

5.1 Hydroacoustic Operations

(K. Streuff, A. Burmester)

Knowledge of seabed topography and seafloor stratigraphy, obtained via hydroacoustic methods, is necessary to understand a range of marine processes. Specifically in glaciated regions, the hydroacoustic data offer insight into past ice sheet and glacier evolution. Bathymetry data often represent the first image of the seafloor, and particularly in sparsely covered areas ultimately

leading to the development of improved navigation charts. During MSM130, the hydroacoustic data were mainly used to select suitable sites for the deployment of gravity cores, but also helped uncover ~3165 nautical miles of previously mostly unchartered seafloor.

Hydroacoustic data acquisition was carried out throughout most of the cruise, starting on 09.07.2024 at 09:17 UTC, after leaving the port of Reykjavik. It ended on the 14.08.2024 at 07:00 UTC. In addition to the data acquired during transits between stations, selected surveys were conducted wherever possible, to map out observed features in greater detail. The MARIA S. MERIAN systems, comprising the two Kongsberg Maritime Simrad echosounders, EM122 and EM712, as well as the Atlas Parasound parametric sediment echosounder, were turned off only during station work and inside the narwhal protection zone designated by the Greenlandic authorities, when visibility was too poor for mammal observations (rough seas, darkness hours and fog). The systems were operational for a total of about 755 hours (EM122), 42 hours (EM712), and 590 hours (Parasound). Water column data were logged on Greenland continental shelf areas during 404 of these hours. Acquisition velocity ranged from 0.1 knots in areas with extensive sea ice to 10 knots during transit, weather permitting. Inside the narwhal zone and during designated survey time, data acquisition was carried out at a maximum speed of 5 knots.

Methodology

Multibeam bathymetry-All bathymetry was gathered using the EM122 and the EM712 systems installed on RV MARIA S. MERIAN, using the Kongsberg Seafloor Information System software to log and visualise the collected data. Bathymetric and backscatter data were stored as *.all and water column data as *.wcd files. Although the EM712 would have offered better resolution in the mostly shallow (<900 m) southeast Greenland shelf waters, the system interfered strongly with the Parasound and the acoustic doppler current profiler. As a result, the EM122 was used for most of the data acquisition, as it offers the better compromise when using multiple acoustic systems. The EM712 was only used during designated fjord surveys.

The EM122 is a deep-water system, operating in water depths between 20 and 11,000 m. In contrast, the EM712 is a shallow- to mid-water system, optimal for water depths between less than 3 and up to 3,500 m. Both systems use two linear transducer arrays that are configured in a Mills Cross alignment. The beam width configuration is 2° by 2° for the EM122 and 0.5° by 0.5° for the EM712. The EM122 operates with an acoustic frequency of about 12 kHz with a beam number of 576; the EM712 was set to operate with variable frequencies between 40 and 100 kHz and uses a beam number of 512. Beam spacing was set to in-between for the former, and to high-density quasi-equidistant for the latter, while the ping mode was set to automatic. Both systems were set to a dynamic dual-swath mode throughout, providing up to 864 (EM122) and up to 1600 soundings (EM712) per ping. To ensure maximum coverage, the opening angle was kept at the maximum of 150° for the EM122 and 140° for the EM712 during most of MSM130 – the port or starboard side angles were only adjusted manually when encountering particularly steep slopes.

Both systems were frequently calibrated, using the sound velocity profiles from CTD casts for all shelf work, and from the WOA13 Atlas Model during transit from and to Iceland.

Sediment echosounder (Parasound)-The ATLAS Parasound echosounder uses the principle of acoustic wave propagation to identify differences in sediment properties, such as density and sound velocity, through which lithological changes can be identified in the sediment column. Compared to conventional echo sounders, the Parasound system offers an improved lateral and vertical resolution of sedimentary structures because of the parametric effect on the one hand, and a much smaller opening angle (4° compared to 20°) on the other. The software programmes ATLAS Parastore and ATLAS Hydromap Control Center were used to modify the settings of the Parasound

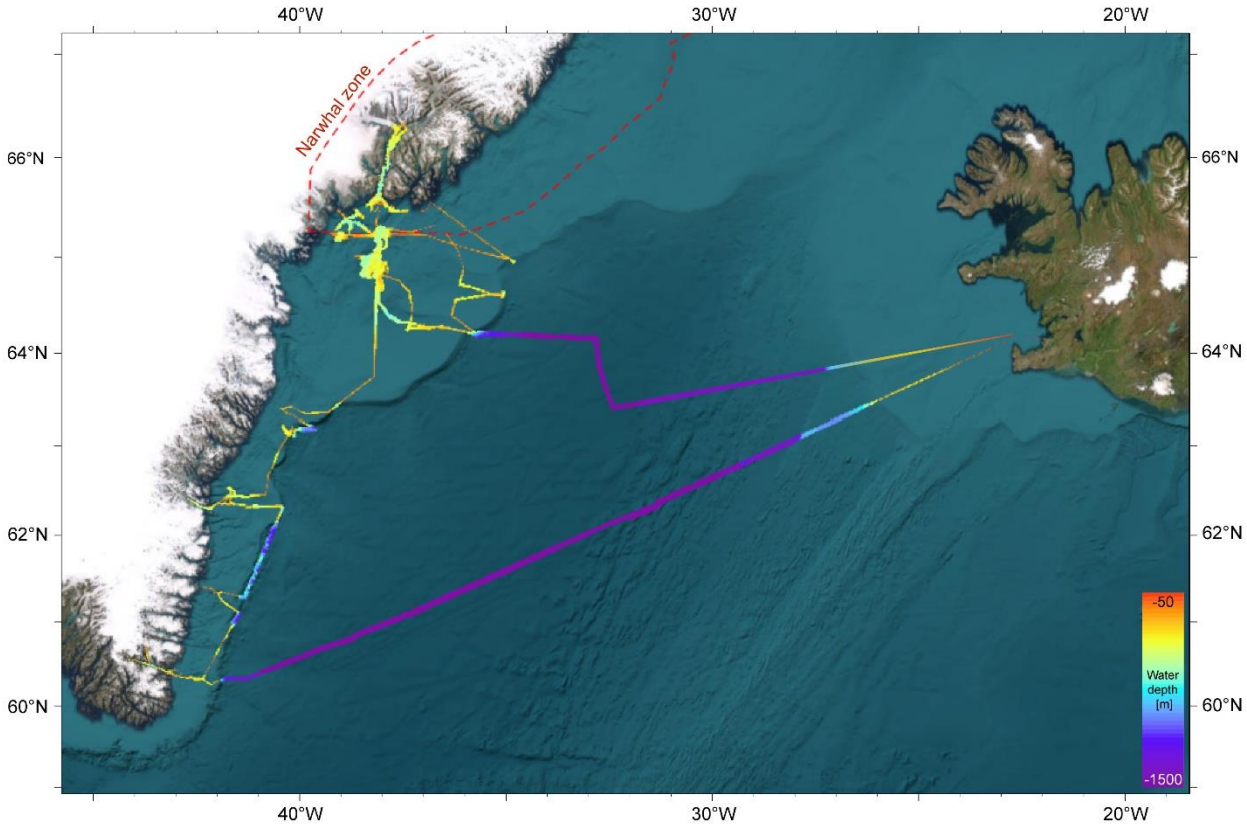


Fig. 5.1 Overview of the unprocessed bathymetry obtained during MSM130. Water depths are colour-coded according to the scale in the bottom right-hand corner. The narwhal zone is illustrated in red. As Parasound and multibeam were running simultaneously during the cruise, the extent of the bathymetry data displayed here also represents the lines, along which sediment echosounder data were acquired.

during MSM130. The system was operated at two main frequencies, a primary high (PHF, 18 kHz) and a secondary low frequency (SLF, 4kHz), in order to obtain information on the water column and seafloor stratigraphy, respectively. To achieve better resolution for the latter, which served as the main priority for core site identification, the transmission was set to quasi-equidistant throughout the entire cruise. The pulse type was set to continuous wave and the number of pulses to 1. Data storage occurred as raw .asd files, which were partially replayed in the Parastore software, and both, pre-processed .ps3 and .sgy files. Due to their superior quality, only the .ps3 files were used; they were converted into UTM-corrected envelope .sgy files with the software tool PS32SGY (courtesy of Hanno Keil, University of Bremen). The resulting output files were then imported into SMT The Kingdom Suite v. 2020 for visualisation and on-the-fly interpretation.

An overview of the data collected with the multibeam and sediment echosounders is given in Fig. 5.1.

5.2 SS-CTD System, Oxygen Measurements, and Calibration

(H. Oliver, L. Taenzer, B. Bogner)

5.2.1 SS-CTD-Rosette System

(H. Oliver, L. Taenzer, B. Bogner)

During MSM130 a total of 163 CTD-profiles were collected with the SBE 911 CTD rosette system provided by the RV MARIA S. MERIAN. The CTD system was installed in a Sea-Bird Rosette System frame for 24 Niskin bottles (Ocean Test Equipment). All casts were made with 24 bottles installed. Depth profiles up to a maximum pressure of 1540 dbar were performed. For most stations, the full water column was sampled. Data acquisition was done using Sea-Bird Seasave software version 7.22. Preprocessing was done with SBE Data Processing 7.26.7. The exact configuration of the CTD system can be found in **Table 5.2.1**.

At the first ship station the CTD data acquisition was corrupted as the calibration coefficients for the new CTDs had not yet been entered into the system. After we updated the CTD coefficients in Seasave data acquisition worked fine throughout the cruise. Therefore, the first CTD profile must be processed using the updated calibration coefficients. It was determined that all regular sensors (P, T, S, O_2) as well as the Chl-fluorescence sensor ECO-AFL/FL and turbidity sensor ECO-NTU manufactured by Wetlabs recorded data with sufficient accuracy and no errors were detected. These sensors provided high quality reliable data throughout the cruise. A full-depth PAR sensor was attached to the CTD and delivered good measurements throughout the cruise. A Sea-Bird Deep SUNA optical nitrate sensor was included on most casts shallower than 500 m, the pressure rating of its battery pack.

Processed preliminary CTD data, 1-m and 1-s binned, was provided in near real time to the scientists aboard MSM130 to inform adaptive sampling decisions. Sea-Bird program setup files for preliminary processing steps were provided by WHOI. After data conversion, the following processing steps were conducted: Wild Edit, Filter, Align CTD, Cell Thermal Mass, Loop Edit, Derive (using EOS-80 to derive thermodynamic properties). The resulting .cnv files were then bin averaged into both 1-m and 1-s files, and then the 1-m bin averaged files split into separate downcast (d*.cnv) and upcast (u*.cnv) files, with all final cnv files then converted into ascii files (*.asc).

Preliminary SUNA reprocessing was conducted onboard to remove the effects of bromide absorption, which is temperature and salinity dependent, following Sakamoto et al. (2009). We also apply the Plant et al. (2023) correction to account for nonlinear changes in seawater absorption with temperature. Reference spectra were collected and calibration coefficients were updated aboard MARIA S. MERIAN before the first deployment (8 July), midway through the cruise (4 August),

and upon removing the instrument from the rosette after the last deployment (12 August). Before the first The SUNA internal clock was re-synced to the ship clock five times throughout the cruise, approximately once per week. All SUNA data will be corrected using the bottle nitrate data when made available.

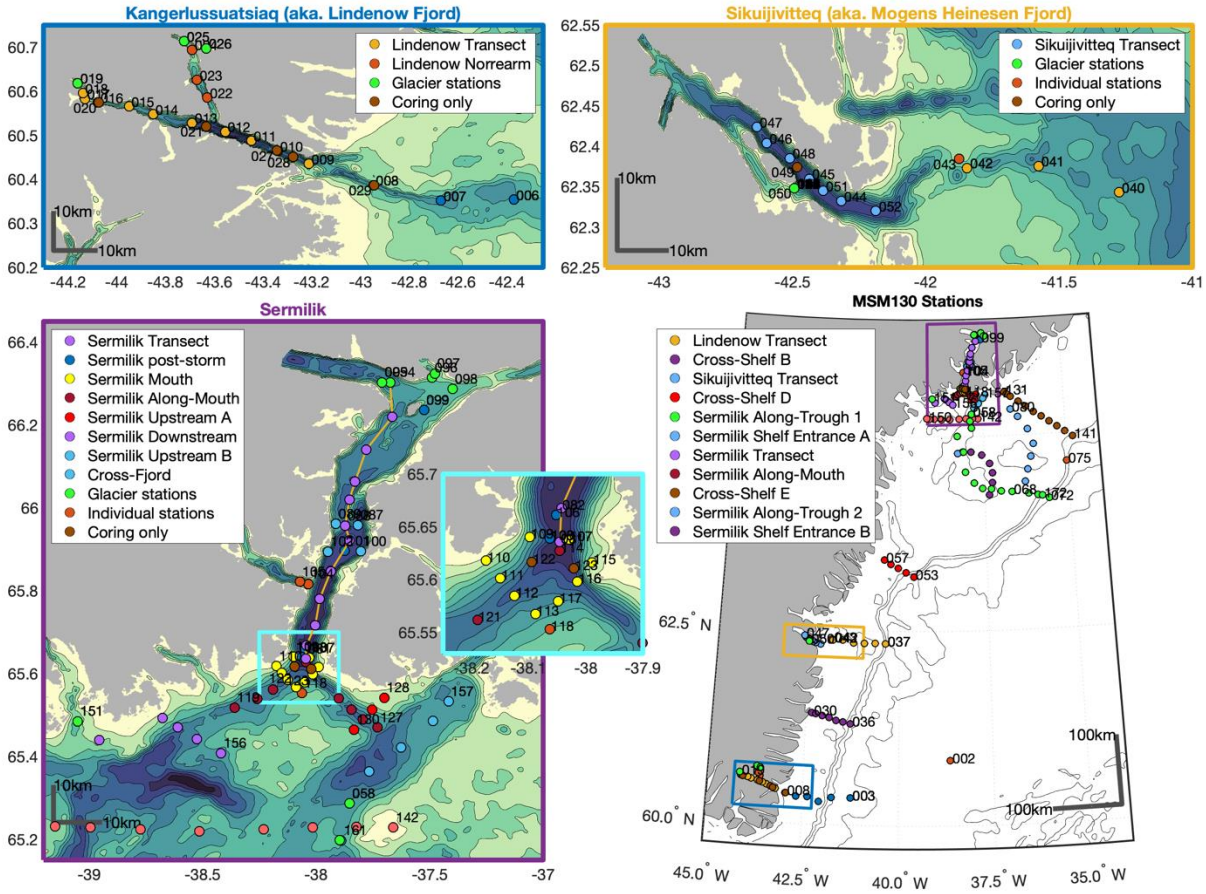


Fig . 5.2. Station map of MSM130, separated by transect.

The 172 individual stations can be grouped into 24 transects or types (**Table 5.2.1, Figure 5.2**). These include five cross shelf-transects, two transects associated with Kangerlussuantsiaq (also known as Lindenow fjord), one transect for Sikuijivitteq (also known as Mogens Heinesen Fjord), two transects along Sermilik, three transects across Sermilik, and ten associated with the shelf region in the vicinity of the mouth of Sermilik ("Sermilik Shelf"). Ten stations were "glacier" proximal stations, those stations as close as possible to the glacier fronts within the three fjords sampled. We also conducted eight repeat stations for comparison of changing conditions mainly over the shelf to evaluate the effects of a strong storm on ambient conditions.

Sensor	Serial Number	Calibration Date
Temperature 1	4442	07-Sep-23
Conductivity 1	2933	19-Sep-23
Pressure 1	0807	21-Nov-23
Temperature 2	4456	24-Nov-22
Conductivity 2	2941	21-Sep-23
Oxygen, SBE 43	0871	10-Oct-23
Oxygen, SBE 43, 2	0950	28-Nov-23
Altimeter	1187	07-May-22
PAR/Irradiance, Biospherical/Licor	4716	15-Aug-22
Fluorometer, WET Labs ECO-AFL/FL	1755	02-Nov-23
Turbidity Meter, WET Labs, ECO-NTU	1755	02-Nov-23
SPAR, Biospherical/Licor	20195	20-Oct-22

Table 5.2.1.1 CTD rosette sensors, serial numbers, and calibration dates.

NB.	NAME	STATION NUMBERS
1	Cross-Shelf A	3, 4, 5, 6, 7, 8
2	Lindenow Transect	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
3	Lindenow Nørrearm	22, 23, 24, 25, 26
4	Cross-Shelf B	30, 31, 32, 33, 34, 35, 36
5	Cross-Shelf C	37, 38, 39, 40, 41, 42
6	Sikuijivitteq Transect	37, 38, 39, 40, 41, 42, 52, 44, 51, 45, 48, 46
7	Cross-Shelf D	53, 54, 55, 56, 57
8	Sermilik Shelf Transect 1	58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72
9	Sermilik Shelf Entrance A	68, 73, 74, 76, 77, 78, 79, 80
10	Sermilik Transect	81, 82, 83, 84, 85, 86, 88, 90, 91, 92, 93, 94, 95
11	Sermilik post-storm	99, 101, 103, 106, 108
12	Sermilik Mouth	110, 111, 112, 113, 117, 116, 115, 107, 108, 109
13	Sermilik Along-Mouth	119, 120, 121, 112, 114, 116, 124, 125, 126, 127
14	Sermilik Upstream A	128, 129, 130
15	Cross-Shelf E	131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141
16	Sermilik Cross-Trough	142, 143, 144, 145, 146, 147, 148, 149, 150
17	Sermilik Downstream	151, 152, 153, 154, 155, 156
18	Sermilik Upstream B	157, 158, 159, 160, 161
19	Sermilik Shelf Transect 2	157, 158, 159, 160, 161, 162, 169, 171 172
20	Sermilik Shelf Entrance B	162, 163, 164, 165, 166, 167, 168, 169, 170
21	Cross-Fjord Transects	87, 88, 89 (Sermilik) 100, 101, 102 (Sermilik) 107, 108, 109 (Sermilik)
22	Glacier stations[1]	19, 25, 26, 50, 94+95, 96+97, 98, 151
23	Repeat stations	59 vs. 161, 62 vs. 163, 69 vs. 171, 71 vs. 172, 81 vs. 114, 82 vs. 106, 85 vs. 103, 93 vs. 99
24	Individual stations[2]	1, 2, 43, 50, 58, 75, 99, 104, 105
25	Coring only[3]	20, 21, 27, 28, 29, 49, 122, 123

Notes: [1] Stations in the vicinity of glacier fronts within fjords. [2] Individual stations do not belong to any transect, but may represent data for comparison. [3] No water sampling has been done at 'coring only' stations. Most 'coring only' stations coincide with the locations of previous station locations.

Table 5.2.1.2. All MSM130 station numbers categorized by transect and type.

5.2.2 CTD-conductivity Calibration

(E. Achterberg)

Overall, 155 calibration points were obtained by sampling for salinity. Salinity samples were taken by the CTD watch in 'Flensburger' bottles, which proved to be ideal for storing salinity samples over a long time. In order to calibrate the conductivity sensors of the CTD system, the conductivity of 155 water samples will be measured at GEOMAR. Therefore, we cannot give further

information on salinity and pressure downcast calibration for the CTD system used during MSM130.

5.2.3 Oxygen Calibration

(B. Bogner)

Dissolved Oxygen (DO) was determined by using the Winkler method with visual (starch) endpoint detection within a minimum of 48 min and maximum of 16 h after sampling, following standard protocols in Grasshoff et al. (1999, chap. 4: Determination of oxygen). Samples were taken with 100 mL wide-necked WOCE glass bottles with well-defined volumes (calibrated flasks with matched pair of flask and stopper). Oxygen samples were taken immediately after the CTD cast was finished. It was ensured that the sample bottles were flushed with at least 3 times its volume and the samples were free of air-bubbles. Immediately after sampling, the seawater samples were spiked from the bottom with the fixation solution (NaOH/NaI and $MnCl_2$) and shaken vigorously for at least 40 seconds. Some of the samples were taken as triplicates or duplicates in order to quantify sampling and titration uncertainties.

A total of 212 discrete water samples were taken from selected depths of 47 CTD casts.
The following reagents were used during this cruise:

- Sulfuric acid (50%)
- Zinc iodide starch solution (500 mL, Merck KGaA)
- Stock solution, pre-weighted: sodium thiosulfate pentahydrate 4,95 g/L
- Fixation solution, all pre-weighted:
  - manganese(II)chloride (600 g/L),
  - sodium iodide (600 g/L)
  - and sodium hydroxide (320 g/L)
- Standard solution, pre-weighted: potassium hydrogen diiodate (0,325 g/L)
- Standard Diiodatsolution OSIL

Titrations were performed within the WOCE bottles using a 20 mL Piston Burette (No. 10058872) TITRONIC universal from SI Analytics GmbH. The iodate standard was added with a 50 mL Piston Burette (No. 10058865) TITRONIC universal SI Analytics GmbH.
1 mL of the fixation solutions (NaI/NaOH and $MnCl_2$) were dispensed with a high precision bottle-top dispenser (0.4 - 2.0 mL, Ceramus classic,Hirschmann).
Every newly prepared standard solution (pre-weighted $KH(IO_3)_2$) was carefully validated against a standard solution (potassium iodate) from OSIL.
Titration procedure-The titration procedure for each measurement was as follows:

1. Switch on Piston Burettes and clear the system (dosing tubes) from air bubbles
2. Determine factor of the thiosulfate working solution by titrating the homemade standard 5 times on a daily basis
3. Measure the reagent blank
4. Measure the actual Winkler samples

A number of oxygen samples were rejected due to possible sampling (air bubble entry during fixation), storage (air bubble) and measurement errors. Results derived from those measurements were not considered in the final data evaluation. Thus a total of 196 samples were declared valid.

The relative difference of both sodium thiosulphate factors was 0.5% of the OSIL factor on average, and were between 0.9949 and 0.9874 (ideally 1). The reagent blank (resulted in a difference of ar = 0.007 mL (arithmetic mean). The thiosulphate factor determination on the first day of sample measurements was disturbed my problems with the MilliQ supply. For this reason the titrations were repeated in the following day and the new factor was used for calculations of the previous day.

DO concentrations were calculated according to Grasshoff et al. (1999) and varied between 275.994 µmol·L-1 (minimum) and 388.096 µmol·L-1 (maximum). The precision (arithmetical averages of all standard deviations per replicate) of the Winkler-titrated oxygen measurements was 0.377 µmol·L-1 based on 27 replicates (17 triplicates and 10 duplicates).

5.2.4 Thermosalinograph

(E. Achterberg)

Underway measurements of sea surface temperature (SST) and sea surface salinity (SSS) were continuously conducted by the ship's dual thermosalinograph (TSG). One inlet is located at the portside (TSG A) while the other thermosalinograph's inlet is at the starboard side (TSG B). The parallel system worked well throughout MSM130. SSS and SST measured by the TSG system will be calibrated with CTD measurements at 5 m as soon as the salinity of CTD system is calibrated.

5.3 Sample Collection From Trace Metal Clean Bottles and Tow-fish Surface Sampler

(A. Vijayan, C. Camin, Y. Guo, R. Cloete, E. Achterberg)

Water column sampling using trace metal clean bottles

Water column samples were collected using 6 Niskin bottles (6 L, Ocean Test Equipment) and 1 GoFlo bottle (12 L, General Oceanics) for a total of 7 depths. At each sampling location, the bottles were manually attached to a Kevlar wire fitted to one of the ship's winches. The bottles were attached with their ends open and triggered to close using a plastic coated messenger sent down the wire once all bottles were at their planned depths. Sampling depths were determined from physical and biological parameters measured during the preceding CTD cast. To verify the sampling depths and targeted water masses, pressure and salinity sensors were attached to selected bottles. Upon retrieval, bottles were transported to a metal free 'bubble', and attached to a custom built plastic rack where sub-sampling took place. The bottle taps were rinsed with deionised water prior to sampling. The bubble was constructed in one of the ship's laboratories using plastic sheeting and kept at positive air pressure via a High Efficiency Particulate Air (HEPA) filter with additional protection provided from a laminar flow hood inside the 'bubble'. Plastic overcoats and shoes were worn inside the bubble to minimize airborne contamination of samples.

Unfiltered seawater sampling

Unfiltered samples for total mercury (THg, 60 mL) and methyl-mercury (MeHg, 250 mL) were collected first after bottle retrieval (Table 1). The sample bottles were rinsed 3 times prior to

seawater collection which was done directly from the bottle tap ensuring no bubbles were present. Samples were then transferred to the laminar flow hood for acidification by hydrochloric acid (HCl, optima grade).

Filtered seawater sampling

For all filtered samples, a 0.8/0.2 µm cartridge filter (Acropak 500, Pall) was connected to the bottle taps and allowed to flush for 30 seconds prior to taking the first sample. All bottles were rinsed three times before collection. Filtered parameters included dissolved trace metals (dTM, 125 mL LDPE bottle), dissolved aluminium (dAl, 60 mL LDPE bottle), dissolved Barium (dBa, 60 mL LDPE bottle), dissolved iron (Fe) and lead (Pb) isotopes (1 L LDPE bottle) and ligands (500 mL LDPE bottle) (Table 1). All samples (except for ligands) were transferred to the laminar flow hood for acidification (HCl, optima grade, acidified to pH < 2). Ligand bottles were transferred to a freezer (-20°C).

At selected stations, filtered subsamples were collected for the analysis of the soluble fraction of trace metals. These samples were initially collected in 125 mL LDPE bottles, and then the seawater was further filtered through 0.02 µm filters (25 mm, Anapore, Whatmann) via a peristaltic pump under the laminar flow hood. The peristaltic tubings were first rinsed with 25 mL of dilute HCl, deionised water and seawater sample (as a bottle conditioning step) respectively.

All LDPE bottles used to collect respective trace metal clean samples were cleaned prior to the cruise in accordance with GEOTRACES cleaning approval. Further information on this is provided in the GEOTRACES cookbook (https://www.geotraces.org/methods-cookbook/.)

Filtered particles

After collection of filtered seawater, particulate trace metals (suspended marine particles) were collected by filtering seawater through acid cleaned filters (25 and 47 mm diameter, Supor, 0.45 and 5 µm pore size) placed inside swinnex filter holders connected directly to the Niskin bottle tap via tubing (Table 1). Between stations, swinnex filter holders and tubing were kept in a dilute HCl solution and rinsed thoroughly with deionised water before next use. Particles were only collected from the 6 Niskin bottles which were secured on either end using an adjustable Teflon clamp and pressurised using pure nitrogen gas (~0.5 bar; 99.999% Alphagaz). Prior to filtration, bottles were agitated by gently tipping from vertical to horizontal 3 times each. Measuring cylinders were placed below each swinnex holder to measure the volume of water filtered. Water volumes were variable depending on the depths and region, however typically 0.5-4.5 L would pass through each filter. A filter blank was done at each station by vertically stacking a filter in a separate swinnex holder below the sample filter. At selected stations, an additional set of filters (collected and stored in the same manner) was collected for speciation analysis. Filters were removed from swinnex holders with plastic forceps and sealed in acid cleaned petri dishes and stored in a -20°C freezer.

Surface water sampling

Surface water (approx. 2 m depth) samples were collected from a towfish deployed from the aft starboard winch when ice conditions permitted (largely in the offshore sections of the cruise free from icebergs and growlers). The towfish consists of a torpedo shaped steel frame (60 kg) with a

Teflon cap and acid cleaned tubing with an outflow into a basin within the metal free bubble. A Teflon bellow pump (Dellmeco) ensured a consistent outflow of roughly 1 L per minute. The pump was operated for minimum 15 minutes prior to collecting samples to flush and rinse the line, and the pump was turned off prior to stations to prevent contamination from the ship. A bubble trap was fitted to the outflow of water which was mounted alongside an EXO-1 (YSI, Sonde) to monitor temperature, salinity, turbidity and chlorophyll a in the water flow. When underway, regular samples were taken for measurement of dissolved trace metals, macronutrients and other parameters (Table 1) at 00:01, 08:00 and 16:00 daily, or at higher resolution when passing notable features (e.g. the shelf break). Filtered underway samples were obtained by fitting a flow-through filter to the towfish outflow (Acropak 0.8/0.2 µm). Under ice-free conditions, a towfish sample was collected immediately prior to stations.

Table 5.3. Details of sampled parameters.

Parameter	Collection method	Filtered/unfiltered	Acidified/unacidified	Type of storage
Total Mercury	Niskin/towfish	Unfiltered	Acidified	60 mL glass bottle
Methyl Mercury	Niskin/towfish	Unfiltered	Acidified	250 mL plastic bottle
Ammonia	Towfish	Unfiltered	Unacidified	15 mL Falcon tube, 4°C fridge
Macronutrients	Towfish	Filtered	Unacidified	15 mL Falcon tube, frozen
Dissolved TM's	Niskin/towfish	Filtered	Acidified	125 mL LDPE
dAl	Niskin/towfish	Filtered	Acidified	30 mL LDPE
dBa	Niskin	Filtered	Acidified	60 mL LDPE
Pb isotopes	Niskin/towfish	Filtered	Acidified	1 L LDPE
Fe isotopes	Niskin/towfish	Filtered	Acidified	1 L LDPE
Cd isotopes	towfish	Filtered	Acidified	4 L LDPE
Ligands	Niskin	Filtered	Unacidified	500 mL LDPE, frozen
pTM's	Niskin	0.45 & 5 µm pore size	-	Petri dish, frozen

5.4 POC Export Estimated From the $^{234}Th/^{238}U$ Disequilibria

(X. Jin)

Our main objective is to use the ^{234}Th tracer to provide a comprehensive understanding of vertical particulate organic carbon (POC) fluxes on the east Greenland shelf. Thorium-234 is widely used as a tracer for particle flux in the ocean. Thorium-234 has a short half-life ($\tau_{1/2}$ = 24.1 days). It is constantly produced by its radioactive parent ^{238}U ($\tau_{1/2}$ = 4.77 billion years), which is conservative in most of the ocean. Thorium-234 is particle-reactive and thus the deficit of ^{234}Th relative to ^{238}U in the upper ocean is used to quantify the export fluxes of ^{234}Th from the euphotic zone to the deeper waters. This ^{234}Th flux can be converted to POC flux when both POC and particulate ^{234}Th are measured for the same sample. When compared with surface primary production data, these estimates on carbon export allow one to quantify the biological carbon pump efficiency.

Methods

Samples of total ^{234}Th (dissolved ^{234}Th + particulate ^{234}Th), dissolved ^{238}U, and particulate ^{234}Th and POC were collected from Niskin bottles mounted on a stainless steel CTD-Rosette-system at 19 stations (station 4, 7, 9, 17, 36, 37, 42, 44, 47, 53, 58, 65, 71, 76, 82, 90, 95, 114 and 121). In

addition, one surface sample for each station was collected from the ship's underway system 30 minutes before ship arrived at each station. Sampling depths range from surface (underway seawater) to subsurface layers (400 - 600 m) (Table 1).

Four liters of total ^{234}Th per sample were collected unfiltered, and subsequently acidified to pH = 1.6 - 1.8 by adding 6 mL concentrated nitric acid. After more than 8 h of equilibrium, 7 mL of concentrated ammonia solution was added to raise the pH valves to 8.2 - 8.5. Subsequently, 50 µL of $KMnO_4$ solution (7.5 g/L) and 50 µL of $MnCl_2$ solution (8.9 g/L) were added to co-precipitate ^{234}Th with MnO_2. After more than 8 h of precipitation, particles were filtered onto 25 mm QMA filters (Whatman®, 2.2 µm pore size) and dried at 50°C overnight.

Particulate ^{234}Th and POC samples were collected and immediately filtered onto the 25 mm QMA filters. After filtration, filters were dried at 50°C overnight. All sampling bottles were rinsed with cleaning solution (1M HCl/H_2O_2 solution) and three times with Milli-Q water and three times with seawater samples before sampling. Corresponding to each total ^{234}Th samples, ^{238}U samples were collected by filtering seawater through syringe filters (0.22 µm pore size). After filtration, the ^{238}U samples were acidified and stored at room temperature.

Total and particulate ^{234}Th samples will be counted for beta activities at a monthly interval using the Risø low-level beta GM multicounter at Shanghai Jiao Tong University and Xiamen University, China, to determine ^{234}Th activities at time of filtration, for total ^{234}Th, or sampling, for particulate ^{234}Th. After the final counting, total ^{234}Th samples will be dismounted, dissolved in a mixture of H_2O_2 and HNO_3 and analyzed on an ICP-MS to determine chemistry yield, following Pike et al. (2005). For particulate ^{234}Th samples, they will be dismounted and POC and PON content will be concurrently measured to determine the POC/^{234}Th or PON/^{234}Th ratios. Dissolved uranium seawater samples will be analyzed for ^{238}U concentrations on the ICP-MS at GEOMAR, following Xie et al. (2020).

Table 5.4. Sampling depth of total ^{234}Th, dissolved ^{238}U, and particulate ^{234}Th and POC samples.

Stations	Sampling depth (m)	
	Total ^{234}Th and dissolved ^{238}U	Particulate ^{234}Th and POC
4	11, 25, 43, 97, 139, 396, Underway	43, 139
7	5, 11, 23, 52, 102, 170, 400	52, 170
9	10, 13, 50, 100, 109, 399, Underway	50, 113
17	20, 40, 100, 200, 301, 350, Underway	20,100
36	20, 50, 150, 300, 500, Underway	50, 150, 300
37	25, 50, 150, 300, 450, 780, Underway	50, 300
42	10, 50, 100, 150, 200, 500, Underway	50, 150

44	10, 50, 100, 175, 200, 600	50, 175
47	10, 50, 100, 150, 200, 550	50, 150
53	15, 30, 40, 125, 300, 450	40, 125
58	10, 50, 100, 150, 200, 400	50, 150
65	20, 23, 50, 150, 250, 400, Underway	50, 150
71	20, 25, 50, 150, 250, 400, Underway	50, 150
76	20, 50, 100, 150, 300, 550, Underway	50, 150
82	25, 40, 150, 250, 350, 600, Underway	40, 150
90	25, 40, 100, 150, 250, 350, Underway	40, 150
95	15, 40, 150, 250, 325, 425, 600, Underway	40, 150
114	15, 50, 125, 150, 250, 450, Underway	50, 150
121	15, 40, 80, 150, 250, 550, Underway	40, 150

5.5 Underwater Vision Profiler

(E. Trudnowska)

The concentrations of particles and images of marine plankton & aggregates were assessed by the Underwater Vision Profiler (UVP), instrument belonging to GEOMAR, version UVP6-HF (serial number 000169HF). UVP is a compact and autonomous underwater imaging system developed at the Laboratoire d'Oceanographie de Villefranche-sur-Mer (LOV) and manufactured by Hydroptic (http://www.hydroptic.com/). The UVP is the only intercalibrated camera-based counter for counting particles in the size range between 80 and 2000 µm, and for imaging aggregates of the size > 700 µm. The objects imaged by the camera (5 Mpixels CMOS monochrome image sensor - Sony IMX264) are illuminated by a lateral collimated light beam created in front of the lens, therefore, all imaged particles within this fixed volume (0.7 l per frame) are in focus and at the same distance from the camera, thus enabling reliable size measurements as well as accurate determinations of particle concentrations.

During the cruise, the UVP was mounted at the base of the CTD rosette, and this way it was collecting data from vertical profiles at 161 stations (Fig 5.5.1), in which particles abundances were processed and analyzed immediately after each section, and by which more than 2 million images were collected (Fig. 5.5.1), and their morphology and composition will be analyzed afterwards.

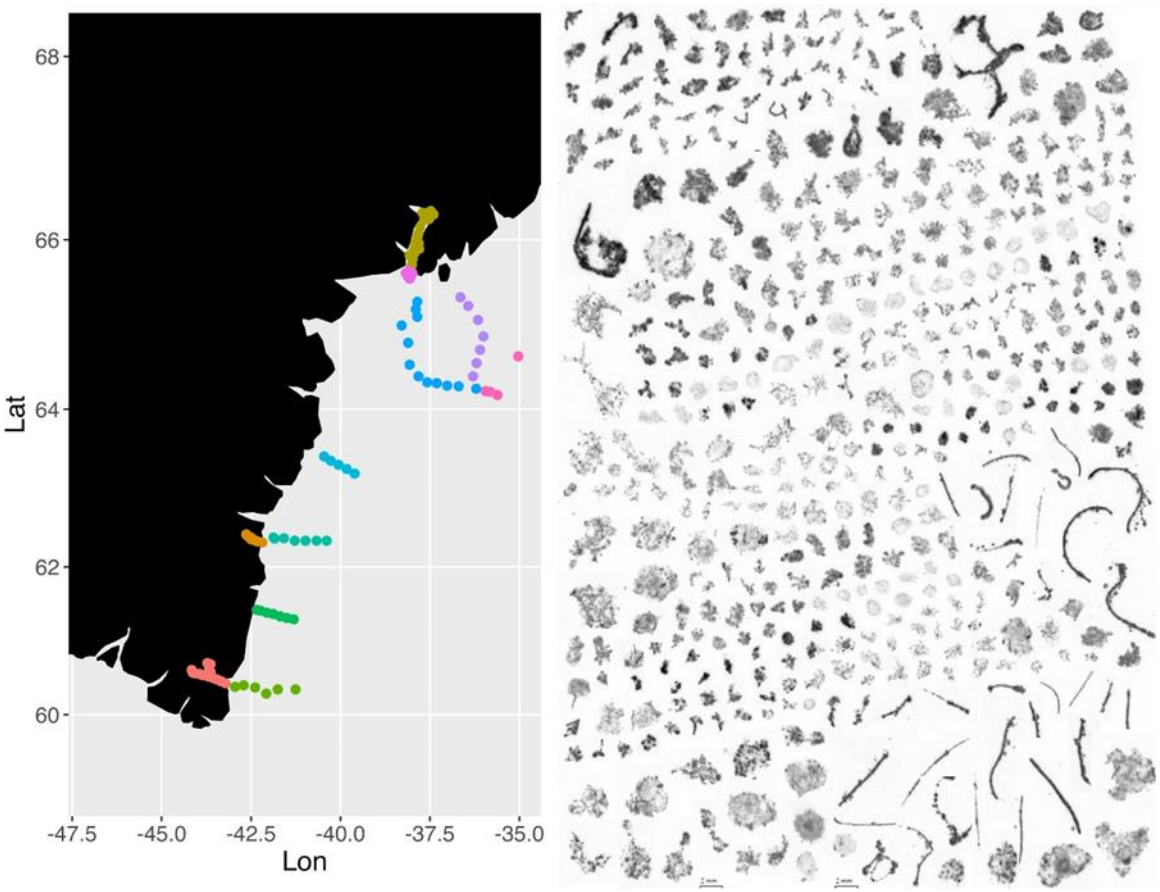


Fig. 5.5.1. Map with sampling stations (left) and examples of collected images of marine aggregates (right).

In general, we observed very high concentrations of particles in the fjords compared to shelf waters, with surface concentration peaks in Lindenow fjord, sub-surface peaks in Mogens (at ~200 m depth) and extreme plumes both in terms of particle concentrations and broad depth ranges in Sermilik (Fig. 2). Whilst surveying Sermilik we experienced a storm, which resulted in a downward shift of the observed particle plumes.

The preliminary analysis of shelf transects showed that the further north we surveyed, the higher the concentration of particles on the shelf (Fig. 5.5.2). Particles typically were concentrated only within the surface layers in the more southern locations, while their high abundances were observed also deeper in the northern parts of the shelf.

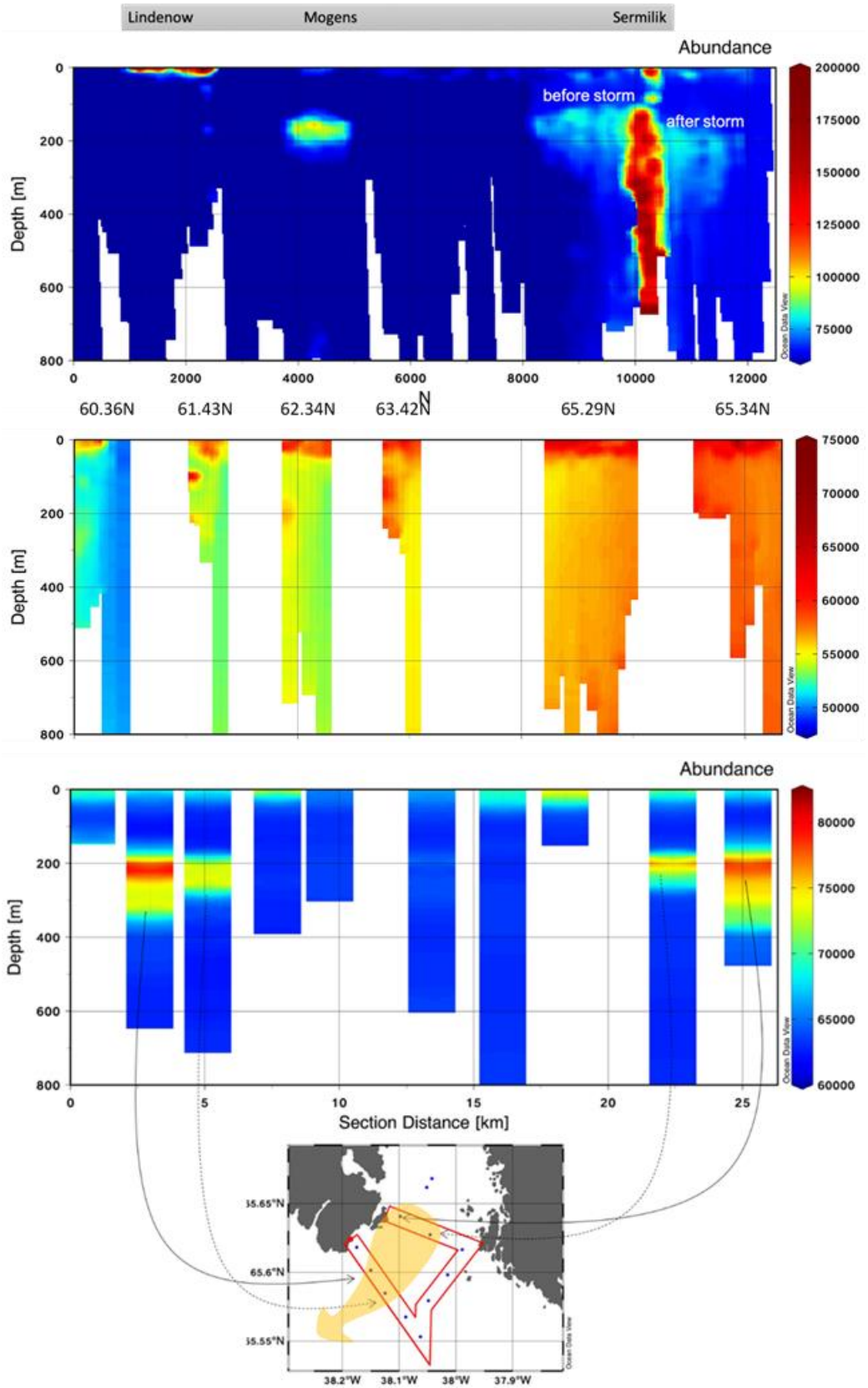


Fig. 5.5.2 Top: Vertical profiles of particle concentration (colors) at shelf stations grouped across latitudinal locations and arranged from land to open sea. Centre: vertical profiles of particle concentration from south to north over shelf. Bottom: Section of profiles constraining inflow/outflow dynamics at entrance to Sermilik showing outflow of particles was through SE part of the mouth, while the western part remains clear.

5.6 Nutrient Analysis

(B. Bogner)

The distribution of nutrients in seawater is key for understanding the biogeochemical processes, and their signatures allow the differentiation between the various water masses in the ocean. They also play a major role in the stimulation of primary production by phytoplankton in the ocean. Especially the lack of nitrogen and phosphorus can have a limiting effect on phytoplankton growth. Around Greenland, dissolved silicic acid (dSi) concentrations may be enriched in inshore waters from fjord-scale processes (Meire et al., 2016), and Arctic outflow may also impart a strong regional signature in the East Greenland Current (Torres-Valdés et al., 2013).

Each Niskin bottle from each CTD cast was sampled for nutrients. For DOP/DON, 4 to 10 bottles were sampled depending on depth and downcast features. Additionally, outside of station work as condition permitted a tow fish pumped by Teflon membrane pump was deployed from which a sample for nutrients and DON/DOP was drawn 3 times daily. Sample vials and caps were cleaned in 10% by volume hydrochloric acid baths prior and during the cruise. During sampling they were rinsed three times with the water of the sample before the actual sampling. All samples to be frozen were filtered through a "AcroPak 500 Supor Membrane 0.8/0.2 µm" filter membrane and were placed in the freezer directly after sampling.

Sampling vials

- 15 mL polypropylene vial with cap for freezing at -20°C and subsequent measurement of nutrients in the GEOMAR laboratory
- 50 mL polypropylene vial with screw-on cap for freezing at -20°C and subsequent measurement of DOP/DON in the GEOMAR laboratory.

Samples frozen for analysis at GEOMAR

sample type	sample count	processing
Macro nutrients (CTD, GO-Flow, underway)	4400	frozen @ -20°C
DON / DOP	500	frozen @ -20°C

The frozen samples will be measured in the lab by segmented flow injection analysis using a QUAATRO (Seal Analytical) auto-analyzer including a XY2-autosampler unit. The system set-up included 4 channels for nitrate + nitrite (TON), silicic acid, nitrite, and phosphate. The analytical methods followed during the MS130 cruise correspond to those described by QuAAtro Applications Method No.:

- Q-068-05 Rev. 11 for TON, Q-066-05 Rev. 5 for Silicic acid, Q-070-05 Rev. 6 for Nitrite and Q-064-05 Rev. 8 for Phosphate.

Certified Reference Material for Nutrients in Seawater (RMNS) (KANSO CRM, Lot-No. to be determined) will be used for every analytical run. Duplicate samples were collected from 50 samples over the cruise duration to further quality control nutrient analyses.

5.7 Sampling and Onboard Analysis of Dissolved Aluminium

(Y. Guo)

Introduction

A high abundance of aluminium (Al) in continentally derived mineral aerosols and a short residence time (typically, a few weeks to 5 years, Orians and Bruland, 1986) of dissolved Al (dAl) in surface waters render the surface ocean dAl distribution sensitive to atmospheric mineral dust deposition, particularly in the open ocean regions (Measures and Vink, 2000). Other important external sources of dAl to the ocean include suspended sediments from continental shelf/slope and the seafloor, and riverine discharges of lithogenic sediments and freshwater. Dissolved Al distributions have been used to trace the mixing of water masses, carrying the dAl-rich signatures of their source regions (e.g. of high dust input) and/or that acquired along the advective pathways via interaction with Al-rich sediments over the continental shelf/slope and abyssal plain (Measures and Edmond, 1988).

Prior work in SE Greenland suggests dAl may be a useful tracer of local lithogenic inputs, potentially associated with outflow from Greenland's fjords (Barraqueta et al., 2018). Along the MSM130 cruise transect, the dAl distribution will therefore be potentially useful to track the external supply of trace metals from lithogenic material input at different interfaces along the east Greenland coast.

Sampling and Analysis of aluminium

Shipboard measurements of dissolved aluminium

Dissolved Al concentrations were analyzed onboard in acidified samples taken from the 1 Go-Flo bottle, 6 Niskin bottles, boat sampling, Sermilik grab sampling, rain sampling, and underway Tow-fish sampling system (Tabe 5.3). A modified analytical method based on the aluminum-lumogallion complex detection proposed by Ren et al. (2001) was adopted, and the fluorescence signal of the complex was measured using a Carey Eclipse fluorimeter. A running eight-point external standards (0, 1, 2, 4, 10, 20, 50, 100 nM Al standard additions), prepared by spiking low-Al acidified surface seawater samples with different proportions of ~500 nM stock standard solution. For each sample batch, the blank contributions from both the manifold and reagent addition were evaluated, which were determined separately as the manifold blank and the reagent blank. The manifold blank was assessed by the average counts of acidified surface seawater samples (used for standard preparation) without reagents. The reagent blank was determined using two different methods. The first method used three acidified seawater samples spiked with 1x, 2x, and 3x volumes of reagent. The second method used two sets of calibration curves, each prepared with 1x and 2x volumes of reagent. The reagent blank was evaluated based on the difference between the intercepts of these two calibration curves. Some seawater samples were run after a dilution factor of 1-20 to reduce Al concentrations to within the linear response range of the method. Standards showed a linear relationship up to 100 nM, so samples with dAl concentrations >100 nM were re-analyzed after dilution.

Preliminary Results

Results for stations in the fjord and shelf regions along east Greenland are shown in Figure 5.7.3, and show enhanced concentrations in surface waters associated with supply of lithogenic material to the fresher polar waters. The highest concentrations were observed within fjords reaching values of up to 200 nM which were clearly elevated compared to a more constant concentration across the shelf. Shelf profiles showed decreasing concentrations with depth in the Atlantic derived waters to about 200 m depth followed by more constant concentrations in deeper waters.

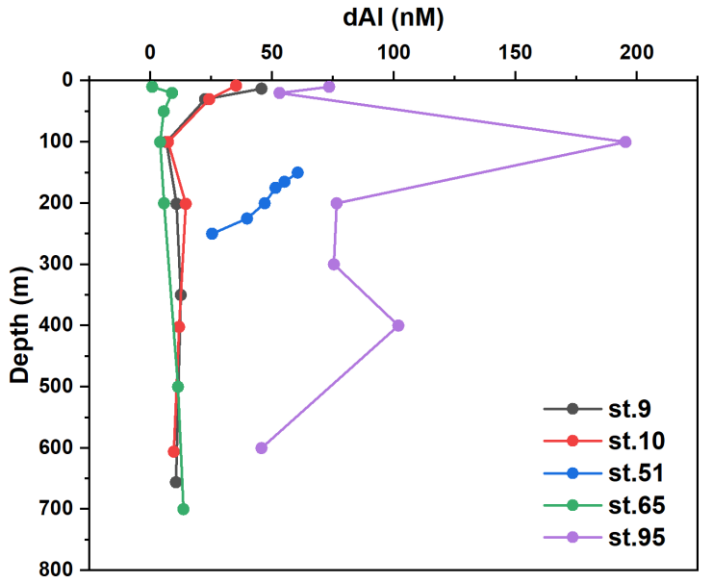


Fig. 5.7. **(A)** Dissolved aluminum (dAl) concentrations in Lindenow fjord (station 9 and station 10), near Sikuijivitteq fjord (station 51), shelf break (station 65) and Sermilik fjord (station 95 with particle plume) in East Greenland.

5.8 Sampling and Analysis of Ammonium

(E. Achterberg)

Samples for ammonium analysis were taken from Niskin bottles deployed on the SS-CTD. At all stations, samples were taken with varying resolution depending on depths which were sampled with the SS-CTD. Additionally, samples were taken from the tow fish.

Analysis of ammonium was conducted using the OPA method. After sampling, either the fluorescent OPA reagent was added to the samples immediately or stored in the fridge for maximum 7 h period before the addition of the reagent. Thereafter, the samples were incubated for 24 h at room temperature and kept in the dark with tightly closed caps.

Subsequent detection of ammonium was performed on a Carey Eclipse fluorimeter. Calibration was carried out using the external standard addition method using ammonium-free deep ocean waters (> 600 m). Blanks were prepared with ammonium-free deep ocean water.

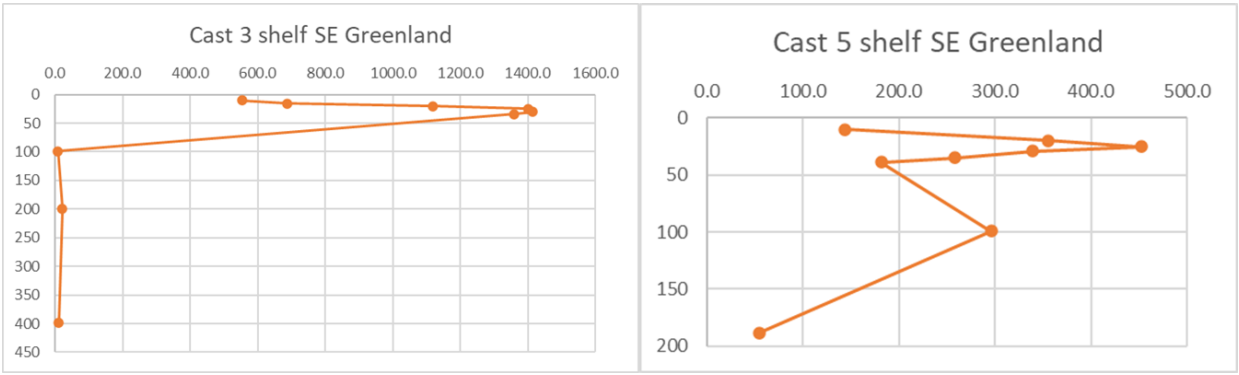


Fig. 5.8 Ammonium profiles for casts 3 (60°21.11 N 41°15.39 W) and 5 (60°17.83 N 42°4.25 W) in the SE Greenland shelf

5.9 Sampling of Underway Samples, Rainwater Collection and Small Boat Sample Collection

(M. Hopwood)

5.9.1 Underway Sample Measurements

The ship's seawater inflow line (from approximately 5 m depth) was cleaned with bleach at the start of the cruise to ensure a clean flow of seawater into the hanger deck. Two flows of identical water were used throughout the cruise, one was used to fill a sensor package with inflowing seawater, the other was used to conduct underway measurements. At regular intervals (00:01, 08:00 and 16:00 on days without stations) or immediately before stations (on days with transects), surface water was collected from the underway system to provide samples from the uppermost water column where a freshwater film was expected in inshore waters. The sampling routine was designed to capture gradients, particularly moving from fjord to coastal waters, and from shelf to offshore waters across the shelf break. Primary production incubations were timed to start at 00:01 to tie the data together with the underway sampling program. A total of 141 underway samples were collected over the cruise duration.

5.9.2 Rain Water Measurements

(M. Hopwood)

A rain water collector was deployed alongside the high volume aerosol collector on the uppermost deck. During rain events a large (c 30 cm) plastic funnel collected rainfall in a 2 L acid cleaned LDPE bottle. After rain events, the water was processed in the clean room. Syringe filtered (0.2 µm PTFE Millipore) samples were retained for macronutrients, dAl and dissolved trace metals. Unfiltered water was retained for ammonium and O^{18} analysis. Filters and syringes for trace metal clean sampling were pre-cleaned with dilute (1 M) HCl and rinsed with deionised water. Two rain events were encountered and sampled (12.07.2024 and 31.07.2024).

Fig. 5.9.2 The rainwater collector used on the cruise.

5.9.3 Inshore Water Sample Collection

(M. Hopwood)

In Kangerlussuatsiaq (Lindenow fjord), the ship's motor boat was deployed twice to collect inshore samples in shallow waters around the fjord's periphery which were too shallow for the MARIA S. MERIAN. Four scientific persons were deployed on the motor boat which operated within line of sight of the main vessel while coring operations were conducted. Two L LDPE bottles (Nalgene) were pre-cleaned with 1 M HCl and deionized water. The bottles were filled upstream and upwind of the motor boat. Water properties were determined with a EXO-1 (YSI, Sonde) in situ (temperature, salinity, turbidity, chlorophyll a) and the position of the motor boat was logged with a GPS system (Garmin Solar). Water bottles were returned to the ship for processing. Ice samples were collected from ice slicks randomly and boxed in large plastic boxes which had been precleaned with deionized water. Because of the strong heterogeneity expected in individual ice pieces, each box was treated as one homogenized sample. Upon return to the ship, boxes were sealed with cable ties and tape, then allowed to melt at the ambient temperature of the hanger (ca. 10°C) for two days before sampling.

In Sermilik fjord, the motor boat could not be deployed due to heavy ice cover and strong winds. On exiting the fjord, some surface grab samples were collected using an extended plastic pole loaded with trace metal clean 2 L LDPE bottles. The pole was extended ca, 2 m from the ship (similar to the tow fish) and used to collect samples whilst the ship moved at low speeds downs fjord.

Low salinity freshwater and ice samples were processed in the trace metal clean room. Samples were retained for O^{18} and ammonium. Syringe filtered (0.2 µm PTFE Millipore) samples were retained for macronutrients. For low salinity samples collected under trace metal clean conditions, additional samples were syringe filtered for dAl, dissolved trace metals, Hg and Me-Hg. Filters and syringes for trace metal clean sampling were pre-cleaned with dilute (1 M) HCl and rinsed with deionized water. Over the cruise duration we were able to cover the full salinity gradient from 35 to 0.1. Particularly in inshore regions, tow fish and underway samples were notably often 3-4 psu units fresher than the shallowest sampled CTD depth (typically 10 m) evidencing the presence of a thin, fresh film of low salinity water at the surface.

Location	Date	Sample details
Kangerlussuatsiaq (Lindenow fjord)	14.07.2024	21 water samples and 1 ice sample collected for nutrients, dTMs, dAl, O^{18} and dBa analyses.
Kangerlussuatsiaq (Lindenow fjord)	15.07.2024	3 ice samples collected for nutrients, dTMs, dAl, O^{18} and dBa analyses.
Sermilik	1.08.2024	14 grab samples collected for nutrients, dTMs, dAl, O^{18} and dBa analysis
E Greenland shelf	12&31.07.2024	2 rain water samples collected for nutrients, dTMs, dAl and O^{18} analyses.

Table 5.9.3 Low salinity samples collected during the cruise.

5.9.4 Bulk Suspended Glacier Particles Collection

(M. Hopwood)

In Sermilik fjord an intense turbidity plume was encountered in the inner fjord (turbidity off-scale, >25 NTU) with water from the CTD casts at the innermost stations (especially station 93) visibly turbid. After sampling from the CTD cast for standard parameters, the excess water from plume depths was retained in large 5 L bottles which were allowed to stand in the fridge for two days. Excess water was then decanted and the remaining particle-rich water filtered to provide some bulk samples of (re)suspended glacier rock flour which could be used for incubation experiments and mineralogy tests upon return to our home laboratories. These samples were frozen at -20°C and returned to SUSTech for analysis.

5.10 ^{18}O Sampling

(M. Hopwood)

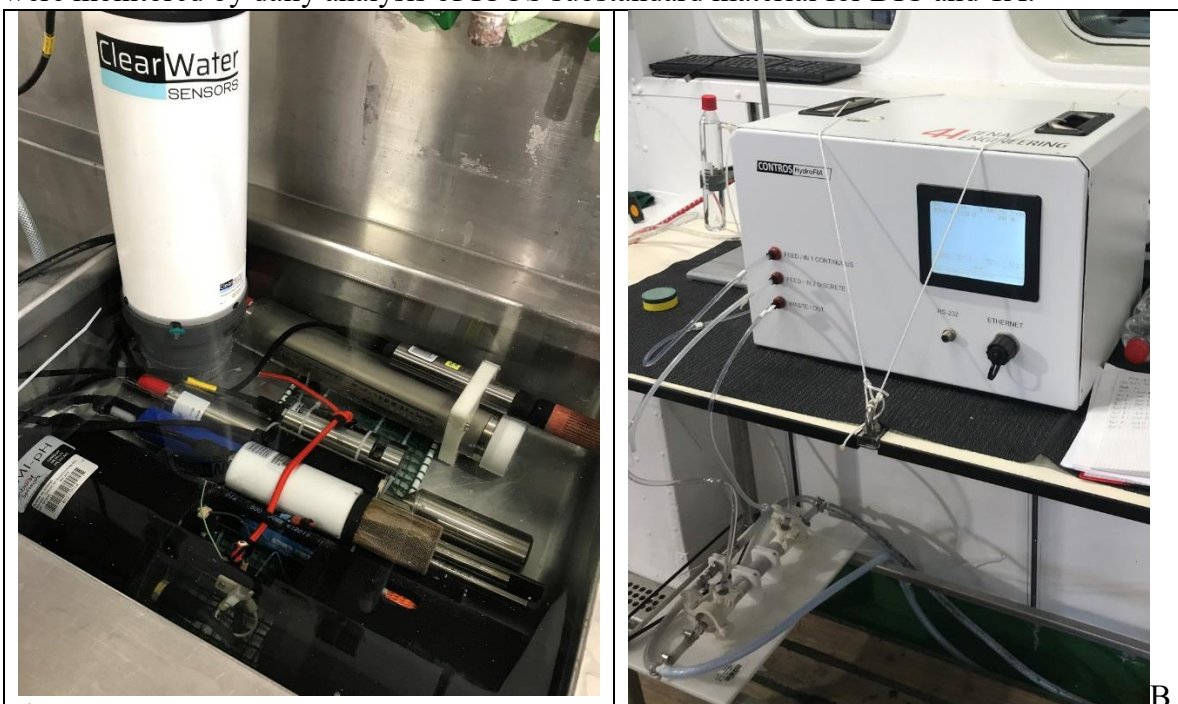
^{18}O, a natural stable isotope of oxygen, may be of use in water mass tracing (Benetti et al., 2019). Numerous sources of meteoric water around the Greenland shelf have similar salinity/temperature dynamics and thus additional tracers are required to distinguish different fresh water sources which include subglacial discharge, runoff, ice melt, precipitation and sea ice melt. ^{18}O samples were collected across the salinity gradient focusing on areas with particularly diverse fresh water inputs and close to endmembers. 400 samples were collected in total. ^{18}O samples were collected as per O_2 and DIC samples, with an overflow of vials through a bubble free tube, retained in sealed in air-tight glass vials (4 mL) and stored refrigerated (4°C) in the dark until analysis. Samples were transferred to SUSTech for analysis using an L2130-I Picarro.

5.11 Sensors on Ship's Underway Water Supply

(M. Esposito)

A set of 9 commercial sensors were immersed into a sink supplied with seawater from 5 m depth from the ship underway system (Figure 5.11). Prior to the start of the measurements, 10 L of 10 % bleach was used to wash the ship's flow lines and tubing by pumping the solution through the underway system for at least 20 minutes. For underway measurements, the water flow rate was fixed at 10 L/min with a water turnover time of about 2 minutes. The suite of sensors included an

Exo1 Sonde (YSI, Xylem brand) equipped with probes for measurements of conductivity, temperature, oxygen, turbidity and fDOM; three different sensors – SAMI (SunBurst), AquapHOx-L (Pyroscience) and AQ5 (ANB sensors) – were used for colorimetric, optical and transconductance measurements of pH, respectively; an HydroC (4H-Jena engineering GmbH, CONTROS) sensor for pCO_2 measurements; a mini CH_4 (ProOceanus) sensor for measurements of dissolved methane; a VLux AlgaePro (Chelsea Technologies) multiparameter fluorometer for turbidity and chlorophyll-a measurements; two sensors – Opus (Trios) and PO_4 analyser (ClearWater) for measurements of inorganic nutrients of nitrate and phosphate, respectively. A second tap from the same underway water supply system was connected to the bench top HydroFIA TA analyser (4H-Jena engineering GmbH) via a cross-flow-filter module and a custom made de-bubbler. The flow rate was fixed at 5 L/min. Measurement accuracy was determined by the analysis of certified reference material (supplied by A. Dickson Laboratory, Scripps Institution of Oceanography) at the start and end of the cruise while precision and instrument performance were monitored by daily analysis of ICOS substandard material for DIC and TA.



A B

Figure 5.11. Sensors setup (A) and total alkalinity unit (b) connected to the underway system during MSM130 cruise.

Sensors configuration

The 9 sensors were powered by a common power supply and connected via a multiport USB hub to a computer screen in order to display measurements in real-time. Data were stored both internally on the individual sensors and externally on the laptop via serial communication logging. The frequency of the sampling was defined according to individual sensor performances (Table 5.11.1).

For quality control of cruise data, the EXO-1 sensor units used on the tow fish inflow were intercalibrated with the underway sensors by deploying them alongside the main sensor packages for time periods of 6-12 hours at regular intervals during the cruise (total >4 days of intercalibration time). Following quality check and inter-calibration analysis with the ship's measurements,

measurements from all sensors will be merged and reported at one minute interval, when possible.

Sensor	Parameter	Sample frequency
Exo01 sonde	conductivity temperature oxygen turbidity fDOM	10 s
AquapHOx-L	pH temperature	30 s
AQ5	pH temperature	15 s
SAMI	pH temperature	15 min
HydroC	pCO2	10 s
Mini CH4	methane	2 s
VLux AlgaePro	turbidity chlorophyll-a chlorophyll-b temperature	1 s
Trios	inorganic nitrate	30 s
ClearWater PO4	inorganic phosphate	1 h
HydroFIA TA	total alkalinity	20 min

Table 5.11.1. Sensors type and configuration used for measurements of surface water (5 m) from the ship underway system during MSM130 cruise.

Table 5.11.2 Sensors and measurement intervals.

Parameter	Sensor	Sampling interval	Details
pH	AquapHOx-L-pH (PyroScience GmbH, Aachen, Germany)	1 min	External pump
pCO_2	CONTROS HydroC (-4H- JENA engineering GmbH, Jena, Germany)	1 min	External pump
nitrate	OPUS (TriOS Mess- und Datentechnik GmbH, Rastede, Germany)	1 min	
alkalinity	Li et al. (2013)	Approx. 7 min	

5.12 DIC, TA and Methane Sampling in Bottles

(M- Esposito)

A variable number of Niskin bottles were selected from vertical CTD casts for sampling of dissolved inorganic carbon (DIC), total alkalinity (TA) and dissolved methane (CH_4) (Table 5.12.1). Regular sampling for salinity and TA/DIC from the on-board underway water supply system was also undertaken (Table 5.12.2).

Dissolved inorganic carbon and total alkalinity sampling

The 24 x 10 L Niskin bottles rosette mounted on the frame of the CTD system was used for discrete water sampling. Samples for TA/DIC were drawn directly from the Niskin bottles into 250 mL Pyrex borosilicate glass bottles. Bottles were rinsed with the sample water before filling. While filling, the bottles were rotated to ensure no bubbles accumulate inside and to avoid the persistence of any minute bubbles. Overflowing for at least three times the bottle volume was allowed. After removal of 2.5 mL of sampled seawater for headspace, samples were preserved by addition of 100 µL of 50% saturated $HgCl_2$ solution (Dickson et al. 2007). A thin layer of silicone grease was applied around the glass stoppers and after ensuring appropriate labelling, the bottles were sealed and stored in the dark for later analysis at GEOMAR. The same sampling procedure was applied to underway water samples. Analysis will be performed on an Apollo analyser.

Dissolved methane sampling

Samples for CH_4 were drawn directly from the Niskin bottles into 120 mL glass bottles. Bottles were rinsed with the sample water before filling. Sample bottles were filled from the bottom using a silicone tubing and care was taken to avoid the formation or accumulation of bubbles. Overflowing for at least three times the bottle volume was allowed. Bottles were closed immediately after sampling with a crimp cap and septum. Following appropriate labelling, samples were preserved by addition of about 200 µL of 50% saturated $HgCl_2$ solution by using a needle syringe. The collected CH_4 water samples will be analysed at AWI by gas chromatography.

Table 5.12.1. List of samples collected from Niskin bottles on CTD casts

Date	Station Number	DIC/TA samples	CH4 Samples	Date	Station	DIC/TA samples	CH4 Samples
12.07.2024	3	10	10	29.07.2024	91	7	7
12.07.2024	5	10	11	29.07.2024	92	3	-
12.07.2024	6	10	-	29.07.2024	93	3	-
12.07.2024	8	10	11	29.07.2024	94	3	-
13.07.2024	10	10	10	30.07.2024	95	7	8
13.07.2024	11	10	-	30.07.2024	96	3	-
13.07.2024	13	9	10	30.07.2024	97	3	9
13.07.2024	14	10	-	30.07.2024	98	3	9
13.07.2024	15	10	10	01.08.2024	99	3	7
14.07.2024	16	10	10	02.08.2024	104	11	8
14.07.2024	18	9	-	04.08.2024	119	3	7
14.07.2024	19	6	7	04.08.2024	120	3	-
15.07.2024	23	7	-	04.08.2024	124	-	7
15.07.2024	24	6	10	05.08.2024	127	3	7
15.07.2024	26	4	8	05.08.2024	131	6	6
17.07.2024	30	3	-	05.08.2024	133	6	6
17.07.2024	32	3	-	05.08.2024	134	6	6
17.07.2024	33	3	-	06.08.2024	135	6	6
17.07.2024	36	3	-	06.08.2024	137	7	6
18.07.2024	38	3	9	06.08.2024	138	6	6
18.07.2024	39	3	-	06.08.2024	140	7	6

18.07.2024	40	3	10	06.08.2024	141	7	7
18.07.2024	41	3	-	07.08.2024	150	3	-
18.07.2024	43	10	-	08.08.2024	151	8	8
19.07.2024	45	9	10	08.08.2024	152	7	7
19.07.2024	46	3	-	08.08.2024	153	3	-
20.07.2024	50	3	-	08.08.2024	154	4	-
22.07.2024	53	4	-	08.08.2024	155	9	9
22.07.2024	55	4	-	08.08.2024	156	9	9
22.07.2024	56	3	-	10.08.2024	161	7	7
28.07.2024	82	7	7	11.08.2024	163	9	9
28.07.2024	83	4	4	11.08.2024	169	10	10
28.07.2024	84	7	7				
29.07.2024	86	7	7				
29.07.2024	90	7	7	TOTAL		392	335

Table 5.12.2. List of underway samples collected during MSM130 cruise

Date	Time (UTC)	Salinity sample	DIC/TA sample
10.07.2024	16:10		x
16.07.2024	16:00		x
24.07.2024	23:59	x	x
25.07.2024	23:59	x	x
26.07.2024	23:59	x	x
27.07.2024	23:59	x	x
28.07.2024	23:59	x	x
29.07.2024	23:59	x	x
30.07.2024	23:59	x	x
31.07.2024	23:59	x	x
01.08.2024	23:59	x	x
03.08.2024	00:40	x	x
03.08.2024	23:59	x	x
04.08.2024	23:40	x	x
05.08.2024	23:59	x	x
06.08.2024	23:59	x	x
07.08.2024	23:59	x	x
09.08.2024	00:20	x	x
10.08.2024	00:20	x	x
10.08.2024	23:59	x	x
11.08.2024	23:59	x	x
TOTAL		18	21

5.13 Filtration of Samples for Biological Variables

5.13.1 HPLC Pigments

(E. Trudnowska)

Samples for the analysis of phytoplankton pigment composition through HPLC (high-pressure

liquid chromatography) method were collected at selected depths at 43 stations (Fig. 5.13.1). Overall 340 filters were assessed by filtration of 650 liters of water.

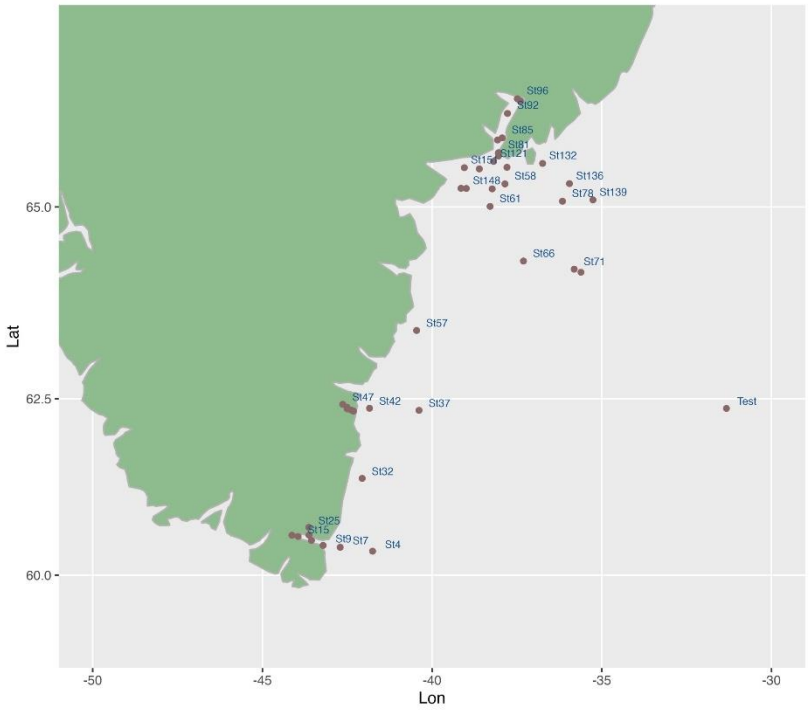


Fig. 5.13.1 Bio-profiles where HPLC concentrations were collected.

Sampling bottles were all triple rinsed with filtered target water from the rosette prior to final sampling. Then, the sampled water was immediately transported to the lab and was filtered onto glass-microfibre filters (grade GF/F, Whatman), with volumes ranging from 400 ml to 4 000 ml (1 900 ml on average), depending on the color intensity of the filter (Fig. 5.13.1.2). After the filtration, the filter was rinsed with pH 9 MilliQ water. Each filter was separately folded in aluminium foil, marked with a sticker with a unique number, supplemented by small card inside with station and depth metadata, and deep frozen (-80°C) for further laboratory HPLC analyses. The results will be processes by CHEMTAX – a program for estimating class abundances from chemical markers. This will be done to assess the relations between dominating phytoplankton taxa and the morphotypes of marine snow.

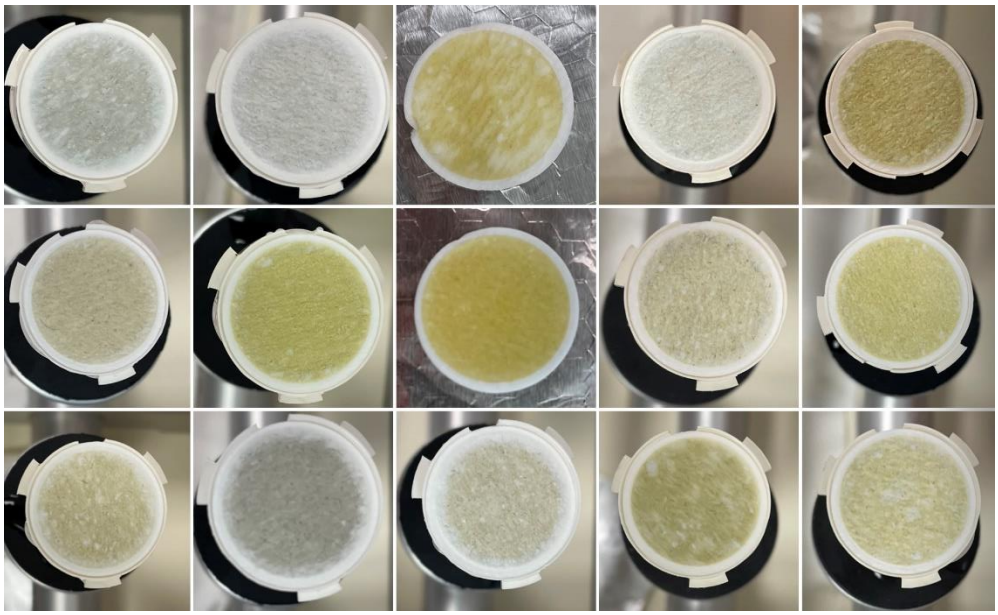


Fig. 5.13.1.2 Filters after sample collection for HPLC showing a range of biogenic and lithogenic particle types.

Moreover, the underway samples from 5 m depth were collected daily to assist primary production experiment, to provide also surface layer at the sampled stations, as well as to resolve finer spatial distribution, resulting in additional 87 surface data points.

5.13.2 Chlorophyll a Sampling

(L. Frankholz)

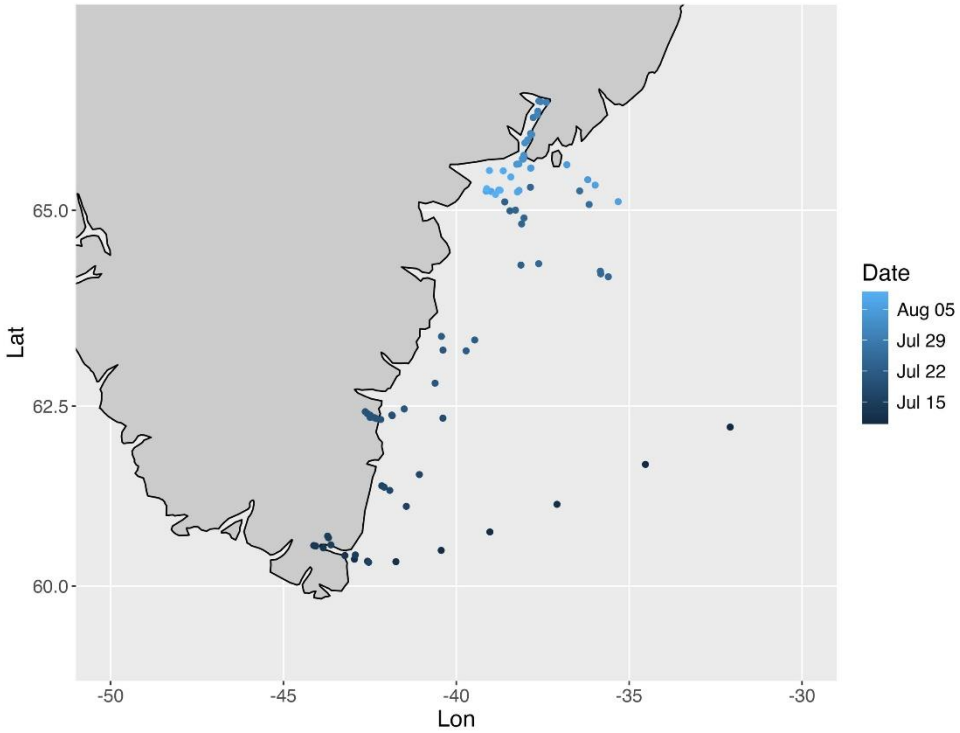


Fig. 5.13.2 Sample locations for chlorophyll

Water samples were collected from Niskin bottles mounted on the CTD rosette. Each 4 L container was rinsed thrice with target water before collection of the sample. All water samples were kept in the dark until processing by filtration onto Fisher MF300 glass-fibre filters (25 mm diameter). Filtered volumes ranged between 500 – 2000 ml (and recorded), depending on water and time availability, were filtered with a vacuum pump at 200 bar. Filtration columns and filters were rinsed with pH 9 MilliQ water after processing of each sample. Filters were folded in half, packaged into aluminium foil bags with a sample ID sticker (MSM130_####), and stored at -20°C. In addition to station samples, a midnight sample was taken each night from the ship's underway supply, to supplement a collaborating primary production experiment.

Approximately 500 L water was filtered in total onto 450 filters. The glass fibre filters will be extracted at GEOMAR for 12-24 h in 10 mL 90% acetone in a -20°C freezer in the dark before measurement on a Turner Designs trilogy fluorometer following Welschmeyer (1994). Chlorophyll concentrations will be used to calibrate the fluorescence sensor data from the CTD profiles.

5.13.3 Particulate Organic Carbon (POC) and Organic Matter

(L. Frankholz)

Water samples for the determination of POC, PON, particulate amino sugars (AS) and particulate amino acids (AA) were collected in the same containers as samples for Chl a filtration, thereby collected and treated in the same manner as described above. Water volumes ranging between 2000 – 4000 ml were filtered onto previously combusted Fisher MF300 glass-fibre filters (25 mm diameter) at 200 mbar. Zooplankton that were found on filters were not removed, but their presence was recorded after visually inspecting filters. Filters were folded in half, wrapped in aluminium foil bags with the corresponding sample ID sticker (MSM130_####), and stored at -20°C in small zip-lock bags. Additionally to station samples, a midnight sample was taken each night from the ship's underway supply (5 m depth) , to supplement a collaborating primary production experiment.

Approximately 900 L water were filtered onto 373 filters.

Samples for POC, PN and bulk $\delta^{13}C$ and $\delta^{15}N$ determination will be fumigated with hydrochloric acid (HCl) to remove inorganic carbonate followed by oven-drying at 60°C for 24 h, and analyzed using a Flash EA IsoLink CN elemental analyzer coupled with a MAT 253 plus IRMS (Thermo Fisher Scientific, Germany). Pretreatment of AS samples will follow acid leaching. GF/F filters will be hydrolyzed using 6 M HCl at 105°C for 8 h. The hydrolysates will be then neutralized with 6 M potassium hydroxide (KOH) to a pH ~6.8 and centrifuged immediately. The supernatant will be taken through solid phase extraction (SPE) cartridges to remove salts, and then eluted with methanol and dichloromethane. The eluent containing AS will be concentrated under nitrogen and then redissolved in Milli-Q water for concentration and stable carbon isotope analysis. Individual AS concentrations will be quantified using an ion chromatograph (IC, Dionex ICS-5000+ SP) coupled with an electrochemical detector.

Concentrations of D- and L-amino acids will be hydrolyzed using 6 M hydrochloric acid and then separated as *o*-phthaldialdehyde derivatives using a Thermo Fisher Scientific U3000 ultrahigh performance liquid chromatography (UPLC) system equipped with a Poroshell 120 EC-C18 column (4.6×100 mm, 2.7 μm particles).

5.13.4 Biogenic Silica (BSi)

(X. Huang)

The silicon cycles in terrestrial-oceanic system are coupled with the carbon cycles. Over long-term time-scales, weathering of rock minerals produces dSi which is delivered to the ocean via runoff. In the ocean, biological uptake by phytoplankton, burial in sediment, remineralization and upwelling to surface waters are the main processes affecting silicon distributions in the ocean and linking them to the carbon biogeochemical cycle. Alongside dissolved silicic acid measurements, we filtered water for biogenic silica to help better understand the silicon cycles in Greenlandic coastal system. "Biogenic' silica is more strictly referred to as 'amorphous' silica in these environments as chemical leaches cannot directly distinguish between the amorphous silica incorporated into diatoms (biogenic silica) and labile particulate silica delivered by runoff into the ocean around Greenland (lithogenic silica), concentrations of which may be elevated in fjords from glacier inputs (e.g. Meire et al., 2016). In order to distinguish these components we additionally

measured dAl at sea, as a tracer of lithogenic particles, and will additionally measure dAl on leached BSi samples to quantitatively distinguish lithogenic and biogenic labile particulate Si phases.

Two liter (2 L) seawater samples were collected in 2 L HDPE brown bottles from Niskin bottles mounted on CTD rosette. Exactly 1 L of seawater was filtered through Whatman 47 mm 0.8 µm Nuclepore Track-Etch membrane filters (vacuum pressure at 60 kPa). For high turbidity samples (a few layers from station 93 to station 99, Sermilik Fjord, were visibly turbid), likely with higher BSi loading, filtration volumes were reduced to 0.5 L per sample. Filters were folded twice and wrapped in aluminium foil and stored at – 20ºC with labels in a zip-log bag. Sampling bottles and filtration units were cleaned three times with fresh water and rinsed three times with MilliQ water between samples.

More than 700 samples were collected from 83 stations. For each station, samples from underway and depths of 10, 20, 30 and 50 m were collected. Other sampling layers were determined via real time turbidity profile from a sensor mounted on the CTD rosette. For non-station days, underway samples were taken at 08:00, 16:00 and 23:59 h (midnight) UTC. During the cruise, midnight BSi samples were always taken in parallel with other biological measurements. 10 blanks (MilliQ water collected in same 2 L HDPE brown bottles) and 5 triplicates samples were also collected for assessing sampling quality control.

5.13.5 Particulate Lipids

(X. Huang)

1.5 liter (1.5 L) seawater samples were collected from Niskin bottles mounted on CTD rosette. Duplicates of 0.5 L seawater sample were filtered through Merck 47 mm 0.22 µm Durapore PVDF membrane filters (vacuum pressure at 60 kPa). Filters were folded twice and wrapped in aluminium foil and stored at – 80ºC with labels in zip-log bags. Sampling bottles and filtration units were cleaned three times with fresh water.

200 samples were collected from 21 stations. For each station, samples from depths of 10, 20, 50 and 100 m were mostly collected. Samples will be analysed at GEOMAR by Dr. Kevin Becker.

5.13.6 Virus Counting (CV), Micro-DNA and Viruses

(X. Huang)

About 20 L seawater samples were collected from the Niskin bottles mounted on the CTD rosette. Seawater samples were passed through a pre-cleaned 200-mesh screen (mounted on the outlet of the sampling tube which was connected to the Niskin bottles) to remove large particles before collected in 20 L plastic folding buckets. During the whole process of sampling collection and filtration, folding buckets were always covered with black bags to minimize light.

Virus Counting-Triplicates of 4.5 mL samples (filtrate from 200-mesh screen) were collected into 5 mL preservation tubes with labels and stored at -80ºC (zip-log bag).

A DNA Filtration-Sample was then filtered through Merck 142 mm 0.22 µm Durapore GV membrane filters (142 mm large disc filtration system, peristaltic pump at 90 rpm). Filtrate from this process was stored in another 20 L folding buckets (also covered with black bags to minimize light). Filters were folded four times and kept in 15 mL centrifuge tubes with labels at -80°C (zip-log bag).

Virus Filtration-Filtrate from DNA filtration were reacted with 1 mL 10 g/L $FeCl_3$ stock (2.415 g pre-weighted $FeCl_3$-$6H_2O$ solid dissolved in 50 mL MilliQ, then filtered through 0.22 µm Millex PES syringe filter and 0.02 µm Whatman Anotop 25 syringe filter, stored at 4 °C). Immediately after addition, vials were shaken for 1 minute to mix. Another 1 mL 10 g/L $FeCl_3$ stock was then added with another 1 min shaking. 1 hour at room temperature with repeated shaking every 10 minutes, the mixture was filtered through Merck 142 mm 0.8 µm Isopore ATTP membrane filters (142 mm large disc filtration system, peristalic pump at 90 rpm). Using PALL 142 mm 0.8 µm Supor PES membrane filters as holder (ATTP membrane on upper layer, PES membrane at lower layer). ATTP filters were folded thrice and kept in 50 mL centrifuge tubes with labels. Centrifuge tubes were then seal with parafilm and stored at -80°C (zip-log bag).

The volume of remaining water of the DNA filtrate and Virus filtrate was used to calculate the actual filtration volume of DNA and Virus. Folding sample containers were cleaned thrice with fresh water and rinsed three times with MilliQ. 142 mm large disc filtration system were cleaned with MilliQ thrice only. Sampling tubes (with 200-mesh screen mounted on) were cleaned thrice with fresh water and rinsed with MilliQ.
79 samples from 20 stations of Micro-DNA and Virus samples were collected in total.

5.13.7 Primary Production Incubations

(C. Arias)

For the primary production incubations, an on-deck incubator covered with a UV filter was used to protect the phytoplankton from excess light. A Fibox 4 sensor and glass bottles with a spot were used to carry out the oxygen measurements In each incubation, there were 10 glass bottles, of which 5 were darkened in order to achieve oxygen consumption and production conditions.

The samples came from the underway supply at 5 m depth, at 00:01 h UTC the water sample was taken in a darkened canister to maintain sample conditions. In addition, this sampling was accompanied by other parameters, for example, HPLC pigment, biogenic silica, chlorophyll, cytometry, etc.

From the canister, the sample was taken in each bottle, first the material was resuspended by shaking the canister, the bottle was primed and it was filled without bubbles. The initial oxygen was measured once the bottle was filled. Depending on the condition of the bottle, it was then darkened with a bag or not. Once the 10 samples were ready, they were taken in a transparent plastic box to the incubator on the port side. After approximately 23 h, the incubation was finished, and the final oxygen in each bottle measured. Then, the bottles were cleaned and left ready for the next incubation.

5.13.8 Flow Cytometry

(C. Arias)

At each sampling depth, 50 mL of seawater was taken. After that, 3 aliquots/replicates were made, using 1350 µl of seawater and the samples fixed with 150 µl of Glutaraldehyde. They were then stored at -80°C. From cryotube 730, one of the replicas had 150 ul of glutaraldehyde and the other two had 75 µl to expand the amount of sampling.

In addition to the station samples, a midnight sample was taken for the primary production experiment along with other biological parameters. The total number of cryotubes sampled was 918, corresponding to 306 depths. 34 of these were samples from midnight incubations carried out from waters from the underway supply, 5 depths were samples taken in the zodiac in the first fjord and the rest corresponded to station samples.

5.14 Sediment Sampling

(C. Wilstermann, L. Schreiber, I. Brinkmann, H. Zimmermann, M. Stry)

Sediment cores were targeted at 26 sites (Fig. 5.15.1) for several purposes: (1) to provide a longer-term perspective on cryosphere-biosphere interactions and their impact on carbon dynamics, (2) to obtain surface sediments to investigate contemporary environmental conditions (including living foraminifera), and (3) to investigate microbial processes with a focus on iron cycling as an important anaerobic respiration pathway.

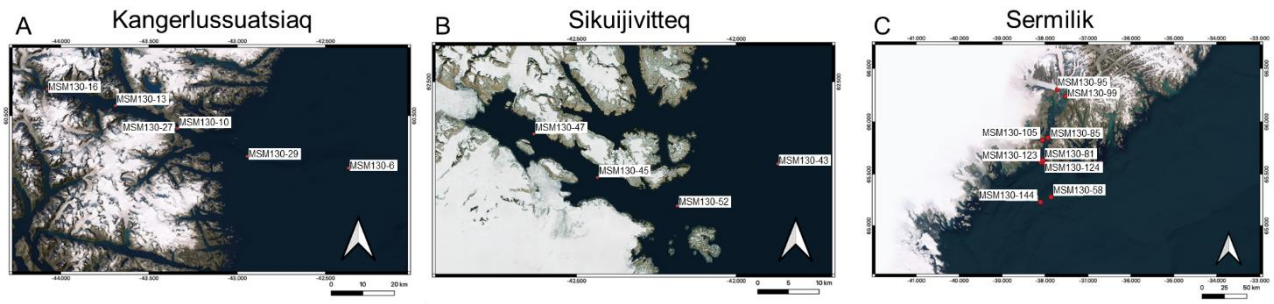


Fig. 5.14.1 Overview maps showing the station locations where sediment coring was carried out.

Sediment sampling was carried out using two devices: a gravity corer for longer sediment cores (3-5m; Fig. 5.15.2 A, B) and the mini-Multicorer (MUC; Fig. 5.16 2A, 2C) to retrieve the undisturbed surface of the seafloor (< 0.6 m). We deployed a total of 15 gravity cores (resulting in 9 successful long cores; Table 1) and 32 MUCs (resulting in 94 successful short sediment cores) during the expedition. For some attempted coring sites, we did not recover a sediment core due to (1) hitting a layer of coarser material (pebbles and sand in core catcher) or (2) soupy, sandy sediments potentially lost during recovery.

5.14.1 Gravity Coring

(L. Schreiber, I. Brinkmann, H. Zimmermann)

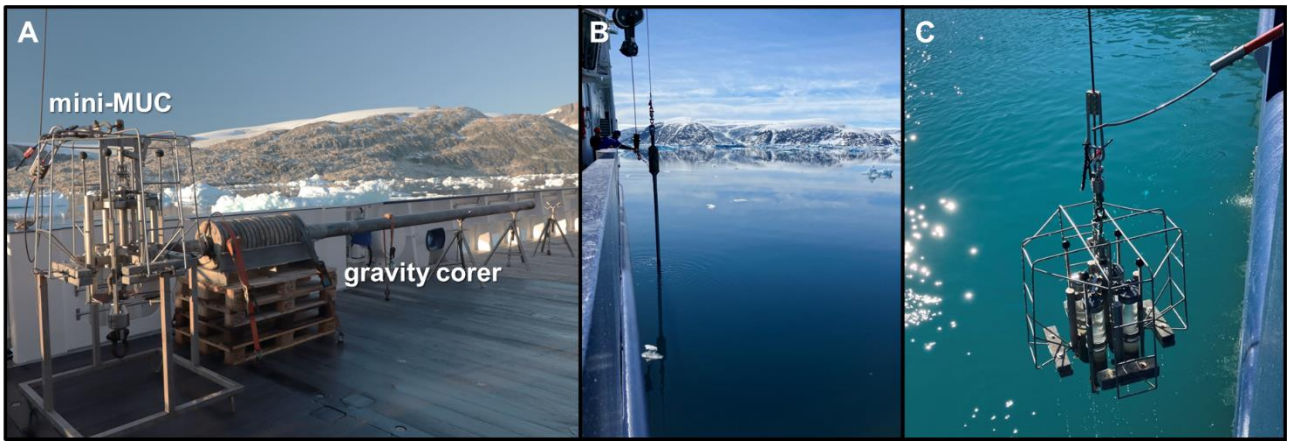


Fig. 5.14.2 Equipment used for sediment coring. (A) The GEOMAR mini-Multicorer (MUC) and gravity corer. (B) Deployment of the gravity corer. (C) Successful recovery of the mini-MUC.

A gravity corer consisting of a 3 m- or 5 m-long interchangeable steel barrel was used to recover soft Holocene sediments (Table 5.15.1). Besides the steel barrel, the gravity corer includes a core catcher, and lead plates making up a total weight of about 1 - 1.4 t. Before each deployment a PVC liner was inserted into the steel barrel (outer/inner diameter of 120/110 mm). The gravity corer was deployed at the starboard side of the ship using the ships cranes. Descent rate was 1 m/s until approximately 100 m above the seafloor. For the final 100 m, the speed was reduced to 0.3 – 1 m/s (Table 5.15.1) velocity depending on the sediment surface. At bottom contact, indicated by a sharp decline in rope tension, the winch was stopped instantly in very soupy inner fjord sediments or after releasing approximately 5 m extra rope for penetration of more dense sediments. We slowly heaved (0.3 m/s) the core out of the sediments and then increased the velocity to 1 m/s until reaching the surface. After returning to the water surface, the gravity corer was cleaned and then recovered onboard. The core catcher, which prevents the liner with sediments from sliding out of the barrel, was carefully removed and we collected any visible organic material suitable for radiocarbon dating. However, most core catchers were devoid of any suitable material. The liner was cut into maximum 1 m long sections, which were labelled, capped on both ends, sealed with tape, and stored in the refrigerated container for return to Kiel (4 °C).

Table 5.14.1 List of gravity core deployments.

Core name	Latitude (degree)	Longitude (degree)	Water depth (m)	Event time	Core length (cm)	Barrel length (m)	Deployment velocity (m/s)	Notes
MSM130-20-1GC	60.574128	-44.073026	426	7/14/2024 17:10	395	5	0.7	lead plates amount to 1.15 t
MSM130-21-1GC	60.520487	-43.633189	816	7/14/2024 20:25	490	5	0.7	overshot
MSM130-28-1GC	60.450776	-43.276588	791	7/15/2024 20:51	442	5	0.7	overshot
MSM130-47-5GC	62.424261	-42.632106	742	7/20/2024	224	5	0.7	removed 300kg; sediment

				8:36				very watery in bottom and in top
MSM130-48-1GC	62.374423	-42.480873	799	7/20/2024 13:22	0	5	0.7	no recovery
MSM130-48-2GC	62.374423	-42.480873	800	7/20/2024 14:25	0	5	0.3	no recovery
MSM130-52-3GC	62.320509	-42.187026	815	7/20/2024 23:40	485	5	0.7	overshot
MSM130-81-5GC	65.633799	-38.051527	918	7/28/2024 9:02	462	5	0.7	oasis added (~4cm) to top; top of the core was soupy and got disturbed during recovery
MSM130-86-1GC	65.921854	-37.851437	610	7/28/2024 23:42	~100	3	0.7	lead plates adjusted to 600kg weight; only ca. 1m in sediment and did not fill out the whole tube, disturbed from recovery
MSM130-90-3GC	66.017325	-37.844491	512	7/29/2024 10:18	0	3	0.7	no recovery; very coarse material (pebbles, sand) in core catcher
MSM130-103-3GC	65.846774	-37.937002	873	8/2/2024 8:49	0	5	0.7	core did not penetrate deep into sediment; lead plates adjusted to 800kg, stopped at bottom contact
MSM130-103-4GC	65.846861	-37.937163	873	8/2/2024 9:30	0	5	0.8	at bottom contact 5m extra given; core fell over, some pebbles in core catcher
MSM130-123-3GC	65.615842	-38.095513	783	8/4/2024 16:19	405	5	1	4 full sections, 5cm at top collected in whirlpak (was disturbed)
MSM130-124-3GC	65.610656	-38.020595	904	8/4/2024 19:48	505	5	1	5 full sections, 5cm at top collected in whirlpak
MSM130-144-3GC	65.231544	-38.103476	807	8/7/2024 6:32	500	5	1	winch driver did not react to stop command, so about 10m extra rope let down until it was heaved; overshot; top of core outside PVC liner but collected in short liner segment and filled with oasis (8-12cm uneven)

5.14.2. Mini Multi-Corer (MUC)

(C. Wilstermann, L. Schreiber, I. Brinkmann, H. Zimmermann, M. Stry)

The mini-MUC allows for the simultaneous retrieval of four short sediment cores via custom-made acryl tubes (Fig. 5.15.2). We deployed the MUC once per station for Kangerlussuatsiaq, and twice for Sikuijivitteq and Sermilik to collect enough material for additional incubation experiments (Fig. 5.15.2, Table 5.15.1). Deployments usually followed after CTD and trace metal operations at super stations. Generally, MUC deployments on the shelf did not collect any soft sediments but recovered pebbles/gravel and some faunal remains (e.g. a piece of coral and a piece of a large encrusting sponge) which indicated hard bottom substrates at these sites. The only shelf site for which sediments were retrieved was located in a trough. For each deployment, the cores were dedicated to a range of experiments (Fig. 5.15.2).

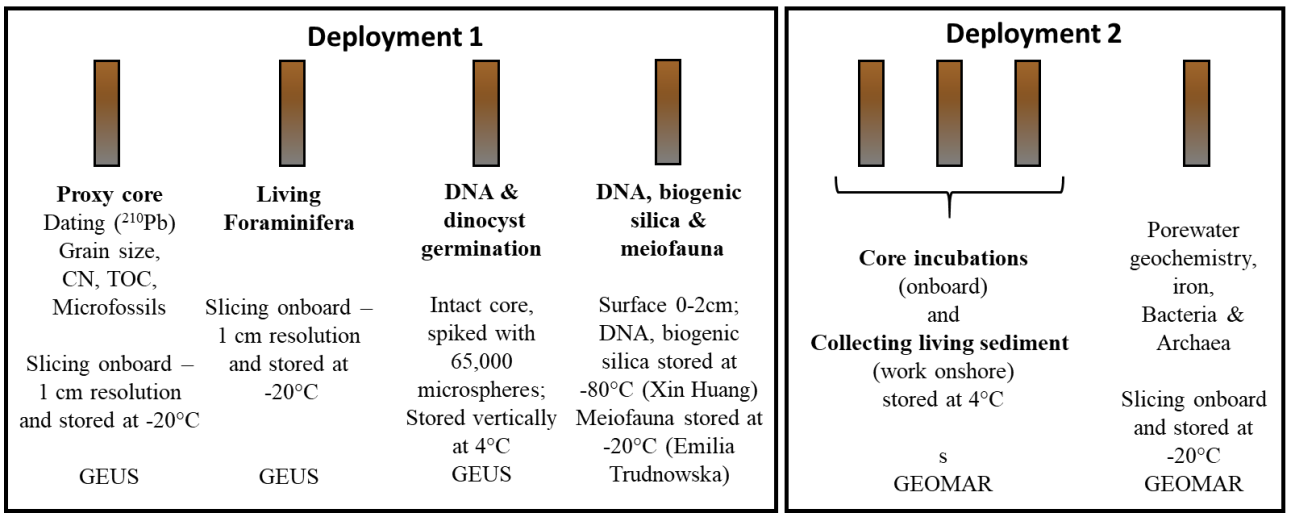


Figure 5.14.2 Overview of dedicated work packages for each of the four short MUC cores per deployment.

5.14.2.1 Proxy Core

(L. Schreiber, I. Brinkmann, H. Zimmermann)

The longest core was collected as proxy core to carry out dating and analyze several sedimentological parameters such as grain size, total organic carbon (TOC), carbon to nitrogen (CN) ratio, and microfossil analysis. Onboard, we sliced this core in 1 cm resolution, placed each sample in a Whirlpak and stored the samples frozen (-20°C).

5.14.2.2 Living Foraminifera From Fjord Surface Sediments by Marine-terminating Glaciers

(L. Schreiber, I. Brinkmann, H. Zimmermann)

Chemical preparation: CTG/DMSO solution

Add 1 ml of DMSO (Dimethyl Sulfoxide; by MedChemTronica) to each 1µg tube of Green CMFDA (5-Chloromethylfluorescein Diacetate; by MedChemTronica). Freeze at -20ºC.

Sample preparation:

Sediment samples (Table 5.15.2) were processed as soon as possible after recovery and stored at ambient temperature until then (0–6 h). The top 2–3 cm of the core were sliced into 1-cm intervals, and placed in HDPE containers each (approx. 80 ml sediment). Bottom-water collected from the same site by Niskin bottles was added, bringing the volume up to about 120 ml. 72 µl of stock Green CMFDA + DMSO solution was added to the samples (i.e., 6 µl per 10 ml volume sediment + seawater). The samples were incubated at 4ºC in darkness for 11–17 h (minimum of 8-12 h required at 4 ºC). Following incubation, c. 80 ml ethanol were added and samples stored at -20ºC.

Table 5.14.2 Sample details for the living foraminifera experiments of the top 2-4 cm of sediments from short multicores.

Fjord	Site	Sample	Sediment	Water	CTG + DMSO	Ethanol (96%)	Incubation time
Kangerlussuatsiaq / Lindelow Fjord	outer fjord	MSM130-10-3MUC1	3 cm ~80 ml	To ~120 ml	72 µl (13/07/24 18:37)	~80 ml (14/07/24 07:47)	~13 h
	mid fjord	MSM130-13-3MUC2	3 cm ~80 ml	To ~120 ml	72 µl (14/07/24 00:45)	~80 ml 14/07/24 12:55)	~12 h
	inner fjord	MSM130-16-3MUC4	3 cm ~80 ml	To ~120 ml	72 µl (14/07/24 13:58)	~80 ml (15/07/24 6:48)	~17 h
Sermilik Fjord	shelf through	MSM130-58-4MUC3	3 cm ~80 ml	To ~120 ml	72 µl (24/07/24 19:42)	~80 ml (25/07/24 07.19)	~12 h
	outer fjord	MSM130-81-2MUC1	4 cm ~80 ml	To ~120 ml	72 µl (27/07/24 13:23)	~80 ml (28/07/24 00.35)	~11 h
	mid fjord	MSM130-85-4MUC2	3 cm ~80 ml	To ~120 ml	72 µl (28/07/24 22:57)	~80 ml 29/07/24 13:54)	~15 h
	side arm	MSM130-105-4MUC2	3 cm ~80 ml	To ~120 ml	72 µl (02/08/24 19:28)	~80 ml (03/08/24 07.35)	~12 h
	fjord mouth	MSM130-123-1MUC3	2 cm ~80 ml	To ~120 ml	72 µl (04/08/24 20:46)	~80 ml (05/08/24 10:14)	~13 h
	fjord mouth	MSM130-124-2MUC1	2 cm ~80 ml	To ~120 ml	72 µl (04/08/2420:46)	~80 ml (05/08/24 10:14)	~13 h

5.14.2.3 Core for DNA and Dinocyst Germination Experiments

(L. Schreiber, I. Brinkmann, H. Zimmermann)

A total of 12 cores were collected for DNA and germination experiments of dinoflagellate cysts (dinocysts). To trace potential downward mixing of younger dinocysts and DNA through core

transport, we added microspheres in approximately the size of the expected dinocysts (10 µm size). The bottom water on top of the sediments was removed using a bleached and ethanol rinsed hose until only about 150 mL of water was left to which ~65,000 polybead, polystyrene, blue-died microspheres were added. After at least 2 hours of settling, the water was carefully removed with a sterile syringe, and the sediment surface was secured by floral foam (oasis) in a bleached and ethanol rinsed plastic bag. A further layer of floral foam was added on top to soak up excess water and stabilize the top of the core for transport. The core liners were sealed with rubber plugs and tape and stored and transported standing upright in a refrigerated container (4°C).

5.14.2.4.1. Processing of MUC Cores for Geochemical and Microbiological Analysis

(C. Wilstermann, L. Schreiber, I. Brinkmann, H. Zimmermann, M. Stry)

A total of 12 MUC cores were used for geochemical and microbial analysis (Table 5.15.2.4). The MUC core for geochemical and microbiological analysis was sliced under anoxic conditions at ambient temperature inside a glovebag filled with nitrogen. The used plasticware was made anoxic (at least 24h before sampling) by placing it in an anaerogen pack (containing an oxygen-consuming pouch (AnaeroGen, ThermoFischer)). The core was sliced in sections of 1 cm from 0-4 cm sediment depth, 2 cm from 4-10 cm sediment depth, and 3 cm intervals below. From each slice subsamples were taken for, DNA/RNA analysis (stored at -80 °C), sequential HCL extractions (FeHCL) and determination of the porosity of the sediment (both stored at -20 °C). To investigate the porewater of the sediment of each slice, sediment-filled falcon tubes were connected to rhizons that pulled out the porewater into 10 ml syringes. The rhizons were made anoxic by placing them in a Schott bottle filled with MilliQ and bubbling them with N_2 for 20 min. The porewater was pipetted into separate vials for various parameters and fixed as described in Table 5.15.2.4.

Table 5.14.2.4: List of parameters and preparation for porewater sampling.

Parameter	
dFe/dMn	1.5 ml vial + 100 µl 6M HCl
Sulfate	1.5 ml vial
Sulfide	1.5 ml vial + 500 µl 5 % ZnAc
Ammonium	1.5 ml vial
DIC	1.8 ml glass vial
NO_2^-/NO_3^-	1.5 ml vial
Phosphate	1.5 ml vial
Silic acid	1.5 ml vial
Alkalinity	1.8 ml glass vial

5.14.3 Incubation Experiments

(C. Wilstermann, M. Stry)

To study the flux of Fe from the fjord sediments into the overlying water, incubation experiments were carried out in triplicates for the second and third fjord transects. For the incubation experiment, three cores from the same MUC cast were processed onboard as soon as possible by

subsampling them with a 6 cm diameter core liner (push core). The remaining sediment was collected in plastic bags and stored at 4 °C. They were acclimated for 24 hours at in-situ temperature (4 °C), and the bottom water was kept oxic by installing aquarium pumps. Then, the overlying water was removed and replaced by fresh bottom water. After 3 hours, T0 was sampled by filtering the overlying water through syringe filters. For Fe sampling, 14 ml was collected in acid-cleaned bottles, to which 40 µl of 6 M HCL were added before .1 ml was sampled for each parameter: NO_3^-, PO_4, and Si. For the dissolved inorganic carbon (DIC) samples, 1.8 ml was pipetted into glass vials prepared with 10 µl mercury chloride solution. The sampling of T1 followed after 24 hours, and the incubation was terminated. Samples were stored at 4°C and –20°C. For the quantification of the remaining supernatant volume, 2 ml of the supernatant was taken without treatment, and then bromide was added (5 mM of bromide from 1.25 M stock solution). The overlying water was stirred for 10 minutes, and another 2 ml was taken and stored at 4 °C.

5.15 Polar Bear Spotting

(E. Achterberg)

In addition to a dedicated mammal watch within the designated narwhal protection zone, a record was kept of polar bear sittings during the cruise. Four bear sightings were made along the cruise track.

Date	Latitude	Longitude	Notes
17.07.2024	61° 23.79’ N	042° 4.82’ W	A medium sized bear swimming between sea ice flows. After swimming away from the shop, paused on an ice flow to watch us pass.
17.07.2024	61° 23.08’ N	042° 3.09’ W	A medium sized bear moving between ice floes
19.07.2024	62° 22.15’ N	041° 56.48’ W	A large bear walking on sea ice
19.07.2024	62° 21.24’ N	042° 29.08’ W	A bear was spotting swimming in between ice mélange close to the glacier front

Table 5.16 Polar Bear sightings.

6 Ship’s Meteorological Station

Not relevant to this cruise.

7 Station List MSM130

7.1 Overall Station List

EM122: Deep-Sea Multibeam Echosounder; EM712; Shallow-water Multibeam Echosounder

Station No.	[UTC]	Gear	Activity	Latitude N	Longitude W	Water depth [m]
MSM130_1-1	10/07/2024 13:25	CTD	max depth/on ground	62° 22,107	031° 19,694	2638
MSM130_2-!	11/07/2024 13:07	CTD	max depth/on ground	60° 50,511	038° 38,153	2813
MSM130_2-2	11/07/2024 14:17	Go-Flo Sampler	max depth/on ground	60° 50,510	038° 38,153	2809
MSM130_3-1	12/07/2024 05:18	CTD	max depth/on ground	60° 21,105	041° 15,392	1728
MSM130_3-2	12/07/2024 06:25	Go-Flo Sampler	max depth/on ground	60° 21,106	041° 15,392	1731
MSM130_4-1	12/07/2024 09:45	CTD	max depth/on ground	60° 21,077	041° 45,215	1528
MSM130_5-1	12/07/2024 13:06	CTD	max depth/on ground	60° 17,647	042° 04,428	420
MSM130_5-2	12/07/2024 13:59	Go-Flo Sampler	max depth/on ground	60° 17,083	042° 05,025	485
MSM130_6-1	12/07/2024 17:37	CTD	max depth/on ground	60° 21,232	042° 22,247	432
MSM130_6-2	12/07/2024 18:25	Multi Corer	max depth/on ground	60° 21,233	042° 22,247	431
MSM130_7-1	12/07/2024 20:48	CTD	max depth/on ground	60° 21,112	042° 40,135	574
MSM130_8-1	13/07/2024 00:03	CTD	max depth/on ground	60° 23,197	042° 56,781	565
MSM130_8-2	13/07/2024 00:57	Go-Flo Sampler	max depth/on ground	60° 23,198	042° 56,782	577
MSM130_8-3	13/07/2024 01:24	Parasound P70	profile start	60° 23,199	042° 56,855	562
MSM130_8-4	13/07/2024 01:24	EM122	profile start	60° 23,199	042° 56,855	564
MSM130_8-3	13/07/2024 09:37	Parasound P70	profile end	60° 26,127	043° 12,697	672
MSM130_8-4	13/07/2024 09:37	EM122	profile end	60° 26,127	043° 12,697	672
MSM130_9-1	13/07/2024 09:59	CTD	max depth/on ground	60° 26,127	043° 12,699	674
MSM130_9-2	13/07/2024 10:58	Go-Flo Sampler	max depth/on ground	60° 26,128	043° 12,697	675
MSM130_10-1	13/07/2024 12:57	CTD	max depth/on ground	60° 27,858	043° 20,356	787
MSM130_10-2	13/07/2024 13:52	Go-Flo Sampler	max depth/on ground	60° 27,858	043° 20,355	786
MSM130_10-3	13/07/2024 14:54	Multi Corer	max depth/on ground	60° 27,888	043° 20,287	785
MSM130_11-1	13/07/2024 16:49	CTD	max depth/on ground	60° 29,266	043° 26,863	841
MSM130_12-1	13/07/2024 18:31	CTD	max depth/on ground	60° 30,494	043° 33,273	879
MSM130_13-1	13/07/2024 20:23	CTD	max depth/on ground	60° 31,686	043° 41,444	725
MSM130_13-2	13/07/2024 21:33	Go-Flo Sampler	max depth/on ground	60° 31,687	043° 41,443	727
MSM130_13-3	13/07/2024 22:26	Multi Corer	max depth/on ground	60° 31,687	043° 41,442	728

MSM130_14-1	14/07/2024 00:33	CTD	max depth/on ground	60° 32,885	043° 51,018	570
MSM130_15-1	14/07/2024 02:04	CTD	max depth/on ground	60° 33,906	043° 56,968	503
MSM130_15-3	14/07/2024 02:17	EM122	profile start	60° 33,893	043° 57,003	500
MSM130_15-2	14/07/2024 02:17	Parasound P70	profile start	60° 33,893	043° 57,004	502
MSM130_15-4	14/07/2024 04:54	EM712	profile start	60° 37,194	044° 09,137	240
MSM130_15-2	14/07/2024 04:54	Parasound P70	profile end	60° 37,193	044° 09,133	233
MSM130_15-3	14/07/2024 04:54	EM122	profile end	60° 37,193	044° 09,130	232
MSM130_15-4	14/07/2024 08:40	EM712	profile end	60° 34,472	044° 04,660	416
MSM130_16-1	14/07/2024 08:57	CTD	max depth/on ground	60° 34,472	044° 04,660	417
MSM130_16-2	14/07/2024 09:50	Go-Flo Sampler	max depth/on ground	60° 34,473	044° 04,659	418
MSM130_16-3	14/07/2024 10:41	Multi Corer	max depth/on ground	60° 34,467	044° 04,671	418
MSM130_17-1	14/07/2024 12:02	CTD	max depth/on ground	60° 34,974	044° 07,807	367
MSM130_18-1	14/07/2024 13:19	CTD	max depth/on ground	60° 35,756	044° 08,299	346
MSM130_18-2	14/07/2024 14:03	Go-Flo Sampler	max depth/on ground	60° 35,755	044° 08,300	346
MSM130_19-1	14/07/2024 15:16	CTD	max depth/on ground	60° 37,105	044° 09,562	218
MSM130_20-1	14/07/2024 16:59	Water Sampler	information	60° 34,437	044° 04,398	426
MSM130_20-2	14/07/2024 17:10	Gravity Corer	max depth/on ground	60° 34,448	044° 04,382	426
MSM130_21-1	14/07/2024 20:25	Gravity Corer	max depth/on ground	60° 31,229	043° 37,991	816
MSM130_21-2	14/07/2024 21:09	EM712	profile start	60° 31,284	043° 38,490	788
MSM130_21-2	15/07/2024 05:35	EM712	profile end	60° 31,904	043° 35,750	484
MSM130_21-3	15/07/2024 05:35	EM122	profile start	60° 31,912	043° 35,752	480
MSM130_21-4	15/07/2024 05:35	Parasound P70	profile start	60° 31,913	043° 35,753	480
MSM130_21-3	15/07/2024 06:28	EM122	profile end	60° 35,158	043° 37,682	482
MSM130_21-4	15/07/2024 06:28	Parasound P70	profile end	60° 35,157	043° 37,681	482
MSM130_22-4	15/07/2024 06:53	CTD	max depth/on ground	60° 35,148	043° 37,670	482
MSM130_23-1	15/07/2024 08:40	CTD	max depth/on ground	60° 37,533	043° 40,248	433
MSM130_23-2	15/07/2024 09:32	Go-Flo Sampler	max depth/on ground	60° 37,533	043° 40,248	434
MSM130_24-1	15/07/2024 11:38	CTD	max depth/on ground	60° 41,644	043° 41,422	361
MSM130_25-1	15/07/2024 13:39	CTD	max depth/on ground	60° 42,815	043° 43,362	172
MSM130_26-1	15/07/2024 15:13	CTD	max depth/on ground	60° 41,839	043° 37,923	222
MSM130_27-1	15/07/2024 19:00	Water Sampler	station start	60° 27,916	043° 20,558	786
MSM130_27-2	15/07/2024 19:19	Multi Corer	max depth/on ground	60° 27,916	043° 20,550	787
MSM130_28-1	15/07/2024 20:51	Gravity Corer	max depth/on ground	60° 27,047	043° 16,595	791

MSM130_29-1	16/07/2024 02:25	Multi Corer	max depth/on ground	60° 23,211	042° 56,606	557
MSM130_30-1	17/07/2024 06:29	CTD	max depth/on ground	61° 25,860	042° 20,306	136
MSM130_31-1	17/07/2024 08:45	CTD	max depth/on ground	61° 25,275	042° 14,335	212
MSM130_32-1	17/07/2024 12:55	CTD	max depth/on ground	61° 23,765	042° 03,621	225
MSM130_33-1	17/07/2024 16:19	CTD	max depth/on ground	61° 22,591	041° 52,789	312
MSM130_33-2	17/07/2024 17:01	Go-Flo Sampler	max depth/on ground	61° 22,137	041° 53,060	362
MSM130_34-1	17/07/2024 18:24	CTD	max depth/on ground	61° 20,673	041° 41,112	192
MSM130_35-1	17/07/2024 19:48	CTD	max depth/on ground	61° 19,489	041° 30,120	204
MSM130_36-1	17/07/2024 21:21	CTD	max depth/on ground	61° 18,358	041° 18,310	1209
MSM130_37-1	18/07/2024 06:38	CTD	max depth/on ground	62° 20,525	040° 23,116	802
MSM130_38-1	18/07/2024 08:28	CTD	max depth/on ground	62° 20,564	040° 40,252	508
MSM130_38-2	18/07/2024 09:18	Go-Flo Sampler	max depth/on ground	62° 20,565	040° 40,251	504
MSM130_39-1	18/07/2024 11:29	CTD	max depth/on ground	62° 20,565	040° 58,663	669
MSM130_40-1	18/07/2024 13:16	CTD	max depth/on ground	62° 20,583	041° 16,548	503
MSM130_40-2	18/07/2024 14:06	Go-Flo Sampler	max depth/on ground	62° 20,583	041° 16,550	501
MSM130_41-1	18/07/2024 16:21	CTD	max depth/on ground	62° 22,483	041° 34,686	454
MSM130_42-1	18/07/2024 20:36	CTD	max depth/on ground	62° 22,314	041° 50,684	697
MSM130_43-1	18/07/2024 22:11	CTD	max depth/on ground	62° 23,055	041° 52,464	216
MSM130_43-2	18/07/2024 22:53	Go-Flo Sampler	max depth/on ground	62° 23,004	041° 52,451	219
MSM130_43-3	18/07/2024 23:31	Multi Corer	max depth/on ground	62° 22,923	041° 52,328	228
MSM130_43-4	18/07/2024 23:54	Multi Corer	max depth/on ground	62° 22,892	041° 52,232	229
MSM130_44-1	19/07/2024 15:37	CTD	max depth/on ground	62° 19,924	042° 18,975	816
MSM130_45-1	19/07/2024 18:41	CTD	max depth/on ground	62° 21,578	042° 26,116	810
MSM130_45-2	19/07/2024 19:35	Go-Flo Sampler	max depth/on ground	62° 21,636	042° 26,113	809
MSM130_45-3	19/07/2024 20:30	Multi Corer	max depth/on ground	62° 21,708	042° 26,071	809
MSM130_45-4	19/07/2024 21:20	Multi Corer	max depth/on ground	62° 21,705	042° 26,097	808
MSM130_46-1	20/07/2024 01:03	CTD	max depth/on ground	62° 24,222	042° 35,746	766
MSM130_47-1	20/07/2024 03:37	CTD	max depth/on ground	62° 25,453	042° 38,004	743
MSM130_47-2	20/07/2024 04:46	Go-Flo Sampler	max depth/on ground	62° 25,496	042° 38,059	743
MSM130_47-3	20/07/2024 05:42	Multi Corer	max depth/on ground	62° 25,496	042° 38,058	740

MSM130_47-4	20/07/2024 06:37	Multi Corer	max depth/on ground	62° 25,483	042° 38,007	741
MSM130_47-5	20/07/2024 08:36	Gravity Corer	max depth/on ground	62° 25,456	042° 37,926	742
MSM130_48-1	20/07/2024 11:06	CTD	max depth/on ground	62° 23,111	042° 30,580	794
MSM130_48-2	20/07/2024 11:50	Go-Flo Sampler	max depth/on ground	62° 23,111	042° 30,581	794
MSM130_49-1	20/07/2024 13:22	Gravity Corer	max depth/on ground	62° 22,465	042° 28,852	799
MSM130_49-2	20/07/2024 14:25	Gravity Corer	max depth/on ground	62° 22,436	042° 28,950	800
MSM130_50-1	20/07/2024 16:30	CTD	max depth/on ground	62° 20,884	042° 29,560	402
MSM130_51-1	20/07/2024 18:48	CTD	max depth/on ground	62° 20,704	042° 23,085	812
MSM130_51-2	20/07/2024 19:29	Go-Flo Sampler	max depth/on ground	62° 20,735	042° 23,082	812
MSM130_52-1	20/07/2024 22:07	CTD	max depth/on ground	62° 19,223	042° 11,190	815
MSM130_52-2	20/07/2024 22:54	Multi Corer	max depth/on ground	62° 19,222	042° 11,182	816
MSM130_52-3	20/07/2024 23:40	Gravity Corer	max depth/on ground	62° 19,231	042° 11,222	815
MSM130_52-4	21/07/2024 00:35	Multi Corer	max depth/on ground	62° 19,242	042° 11,105	816
MSM130_53-1	22/07/2024 06:49	CTD	max depth/on ground	63° 11,994	039° 36,284	1328
MSM130_54-1	22/07/2024 08:52	CTD	max depth/on ground	63° 15,490	039° 49,686	315
MSM130_55-1	22/07/2024 10:35	CTD	max depth/on ground	63° 18,600	040° 03,153	229
MSM130_56-1	22/07/2024 13:12	CTD	max depth/on ground	63° 21,684	040° 16,182	259
MSM130_56-2	22/07/2024 13:53	Go-Flo Sampler	max depth/on ground	63° 21,335	040° 16,332	255
MSM130_57-1	22/07/2024 17:16	CTD	max depth/on ground	63° 24,976	040° 27,443	238
MSM130_58-1	24/07/2024 13:31	CTD	max depth/on ground	65° 17,166	037° 51,179	666
MSM130_58-2	24/07/2024 14:31	Go-Flo Sampler	max depth/on ground	65° 16,853	037° 51,396	668
MSM130_58-3	24/07/2024 15:26	Multi Corer	max depth/on ground	65° 16,853	037° 51,396	668
MSM130_58-4	24/07/2024 16:03	Multi Corer	max depth/on ground	65° 16,854	037° 51,395	668
MSM130_59-1	24/07/2024 17:57	CTD	max depth/on ground	65° 11,862	037° 53,687	708
MSM130_60-1	24/07/2024 19:29	CTD	max depth/on ground	65° 06,588	037° 51,241	622
MSM130_61-1	24/07/2024 21:58	CTD	max depth/on ground	65° 00,427	038° 17,491	813
MSM130_62-1	25/07/2024 00:40	CTD	max depth/on ground	64° 48,062	038° 06,475	645
MSM130_63-1	25/07/2024 03:40	CTD	max depth/on ground	64° 32,374	038° 04,108	706
MSM130_64-1	25/07/2024 05:52	CTD	max depth/on ground	64° 24,049	037° 49,226	926
MSM130_65-1	25/07/2024 07:48	CTD	max depth/on ground	64° 19,699	037° 34,620	797

MSM130_65-2	25/07/2024 08:52	Go-Flo Sampler	max depth/on ground	64° 19,699	037° 34,620	797
MSM130_66-1	25/07/2024 10:44	CTD	max depth/on ground	64° 19,038	037° 18,508	601
MSM130_67-1	25/07/2024 12:29	CTD	max depth/on ground	64° 17,226	037° 01,098	464
MSM130_68-1	25/07/2024 14:11	CTD	max depth/on ground	64° 16,779	036° 41,862	415
MSM130_69-1	25/07/2024 16:34	CTD	max depth/on ground	64° 14,973	036° 12,343	384
MSM130_70-1	25/07/2024 18:16	CTD	max depth/on ground	64° 13,256	035° 56,668	380
MSM130_71-1	25/07/2024 19:35	CTD	max depth/on ground	64° 12,778	035° 48,819	785
MSM130_71-2	25/07/2024 20:30	Go-Flo Sampler	max depth/on ground	64° 12,668	035° 49,730	783
MSM130_72-1	25/07/2024 22:35	CTD	max depth/on ground	64° 10,441	035° 36,789	1483
MSM130_73-1	26/07/2024 02:07	CTD	max depth/on ground	64° 24,020	036° 17,729	291
MSM130_74-1	26/07/2024 04:06	CTD	max depth/on ground	64° 33,584	036° 11,869	485
MSM130_75-1	26/07/2024 09:29	CTD	max depth/on ground	64° 38,437	035° 01,867	656
MSM130_76-1	26/07/2024 15:33	CTD	max depth/on ground	64° 43,071	036° 06,009	573
MSM130_76-2	26/07/2024 16:22	Go-Flo Sampler	max depth/on ground	64° 43,070	036° 06,010	573
MSM130_77-1	26/07/2024 18:26	CTD	max depth/on ground	64° 52,737	036° 00,407	191
MSM130_78-1	26/07/2024 20:45	CTD	max depth/on ground	65° 04,363	036° 09,543	205
MSM130_79-1	26/07/2024 23:25	CTD	max depth/on ground	65° 14,178	036° 25,802	203
MSM130_79-2	26/07/2024 23:58	Go-Flo Sampler	max depth/on ground	65° 14,174	036° 25,981	201
MSM130_80-1	27/07/2024 02:44	CTD	max depth/on ground	65° 20,286	036° 38,861	192
MSM130_81-1	28/07/2024 04:33	Multi Corer	max depth/on ground	65° 38,073	038° 03,142	917
MSM130_81-2	28/07/2024 05:25	Multi Corer	max depth/on ground	65° 38,073	038° 03,180	917
MSM130_81-3	28/07/2024 06:29	CTD	max depth/on ground	65° 38,129	038° 02,734	917
MSM130_81-4	28/07/2024 07:36	Go-Flo Sampler	max depth/on ground	65° 38,127	038° 02,856	917
MSM130_81-5	28/07/2024 09:02	Gravity Corer	max depth/on ground	65° 38,028	038° 03,092	918
MSM130_82-1	28/07/2024 11:31	CTD	max depth/on ground	65° 40,062	038° 02,613	918
MSM130_83-1	28/07/2024 13:44	CTD	max depth/on ground	65° 42,971	038° 00,192	915
MSM130_84-1	28/07/2024 16:25	CTD	max depth/on ground	65° 46,862	037° 59,013	909
MSM130_85-1	28/07/2024 18:57	CTD	max depth/on ground	65° 50,814	037° 56,091	892
MSM130_85-2	28/07/2024 19:54	Go-Flo Sampler	max depth/on ground	65° 50,859	037° 55,969	894
MSM130_85-3	28/07/2024 20:47	Multi Corer	max depth/on ground	65° 50,887	037° 56,057	874

MSM130_85-4	28/07/2024 21:34	Multi Corer	max depth/on ground	65° 50,890	037° 56,109	873
MSM130_86-1	28/07/2024 23:42	Gravity Corer	max depth/on ground	65° 55,311	037° 51,086	610
MSM130_86-2	29/07/2024 00:36	CTD	max depth/on ground	65° 55,265	037° 51,098	604
MSM130_87-1	29/07/2024 02:23	CTD	max depth/on ground	65° 57,491	037° 48,901	816
MSM130_88-1	29/07/2024 03:50	CTD	max depth/on ground	65° 57,393	037° 52,290	675
MSM130_89-1	29/07/2024 05:06	CTD	max depth/on ground	65° 57,673	037° 54,724	566
MSM130_90-1	29/07/2024 07:53	CTD	max depth/on ground	66° 01,210	037° 51,210	702
MSM130_90-2	29/07/2024 09:11	Go-Flo Sampler	max depth/on ground	66° 01,095	037° 51,125	611
MSM130_90-3	29/07/2024 10:18	Gravity Corer	max depth/on ground	66° 01,040	037° 50,669	512
MSM130_91-1	29/07/2024 12:15	CTD	max depth/on ground	66° 03,775	037° 49,686	684
MSM130_92-1	29/07/2024 15:51	CTD	max depth/on ground	66° 08,416	037° 46,753	632
MSM130_93-1	29/07/2024 19:28	CTD	max depth/on ground	66° 13,201	037° 39,814	588
MSM130_93-2	29/07/2024 20:23	Go-Flo Sampler	max depth/on ground	66° 13,218	037° 39,832	586
MSM130_94-1	30/07/2024 06:10	CTD	max depth/on ground	66° 18,168	037° 40,442	657
MSM130_95-1	30/07/2024 07:46	CTD	max depth/on ground	66° 18,188	037° 42,557	652
MSM130_95-2	30/07/2024 08:36	Go-Flo Sampler	max depth/on ground	66° 18,204	037° 42,615	665
MSM130_95-3	30/07/2024 09:32	Multi Corer	max depth/on ground	66° 18,189	037° 42,582	658
MSM130_95-4	30/07/2024 10:15	Multi Corer	max depth/on ground	66° 18,159	037° 42,469	656
MSM130_96-1	30/07/2024 12:55	CTD	max depth/on ground	66° 18,846	037° 29,352	293
MSM130_97-1	30/07/2024 14:20	CTD	max depth/on ground	66° 19,439	037° 28,623	229
MSM130_97-2	30/07/2024 15:02	Go-Flo Sampler	max depth/on ground	66° 19,381	037° 28,620	230
MSM130_98-1	30/07/2024 18:27	CTD	max depth/on ground	66° 17,216	037° 23,980	402
MSM130_99-1	01/08/2024 09:51	CTD	max depth/on ground	66° 14,165	037° 31,491	507
MSM130_99-2	01/08/2024 10:35	Go-Flo Sampler	max depth/on ground	66° 14,193	037° 31,629	511
MSM130_99-3	01/08/2024 11:20	Multi Corer	max depth/on ground	66° 14,199	037° 31,536	512
MSM130_99-4	01/08/2024 11:54	Multi Corer	max depth/on ground	66° 14,520	037° 31,140	500
MSM130_100-1	02/08/2024 00:58	CTD	max depth/on ground	65° 53,691	037° 48,126	485
MSM130_101-1	02/08/2024 02:30	CTD	max depth/on ground	65° 53,770	037° 52,419	857
MSM130_102-1	02/08/2024 04:07	CTD	max depth/on ground	65° 53,675	037° 56,857	753
MSM130_103-1	02/08/2024 06:24	CTD	max depth/on ground	65° 50,858	037° 56,108	874

MSM130_103-2	02/08/2024 07:22	Go-Flo Sampler	max depth/on ground	65° 50,803	037° 56,152	873
MSM130_103-3	02/08/2024 08:49	Gravity Corer	max depth/on ground	65° 50,806	037° 56,220	873
MSM130_103-4	02/08/2024 09:30	Gravity Corer	max depth/on ground	65° 50,812	037° 56,230	873
MSM130_104-1	02/08/2024 11:38	CTD	max depth/on ground	65° 48,978	038° 02,051	478
MSM130_105-1	02/08/2024 14:43	CTD	max depth/on ground	65° 49,339	038° 04,290	575
MSM130_105-2	02/08/2024 15:31	Go-Flo Sampler	max depth/on ground	65° 49,502	038° 04,133	576
MSM130_105-3	02/08/2024 16:17	Multi Corer	max depth/on ground	65° 49,590	038° 03,878	542
MSM130_105-4	02/08/2024 16:52	Multi Corer	max depth/on ground	65° 49,610	038° 03,921	530
MSM130_106-1	02/08/2024 21:06	CTD	max depth/on ground	65° 39,562	038° 03,247	898
MSM130_107-1	02/08/2024 22:37	CTD	max depth/on ground	65° 38,278	038° 01,780	897
MSM130_108-1	03/08/2024 00:16	CTD	max depth/on ground	65° 38,269	038° 03,916	829
MSM130_109-1	03/08/2024 01:33	CTD	max depth/on ground	65° 38,343	038° 05,946	442
MSM130_110-1	03/08/2024 03:09	CTD	max depth/on ground	65° 37,077	038° 10,480	118
MSM130_111-1	03/08/2024 04:19	CTD	max depth/on ground	65° 36,078	038° 08,993	610
MSM130_112-1	03/08/2024 05:28	CTD	max depth/on ground	65° 35,078	038° 07,483	674
MSM130_113-1	03/08/2024 06:34	CTD	max depth/on ground	65° 34,055	038° 05,294	373
MSM130_114-1	03/08/2024 09:20	CTD	max depth/on ground	65° 37,620	038° 02,749	905
MSM130_114-2	03/08/2024 10:33	Go-Flo Sampler	max depth/on ground	65° 37,549	038° 02,918	909
MSM130_115-1	03/08/2024 12:08	CTD	max depth/on ground	65° 36,979	037° 59,328	128
MSM130_116-1	03/08/2024 13:24	CTD	max depth/on ground	65° 35,876	038° 00,866	758
MSM130_117-1	03/08/2024 14:57	CTD	max depth/on ground	65° 34,762	038° 02,895	565
MSM130_118-1	03/08/2024 16:05	CTD	max depth/on ground	65° 33,179	038° 03,767	268
MSM130_119-1	04/08/2024 07:22	CTD	max depth/on ground	65° 31,079	038° 21,556	540
MSM130_120-1	04/08/2024 09:47	CTD	max depth/on ground	65° 32,367	038° 15,578	563
MSM130_120-2	04/08/2024 10:37	Go-Flo Sampler	max depth/on ground	65° 32,343	038° 15,611	561
MSM130_121-1	04/08/2024 12:13	CTD	max depth/on ground	65° 33,708	038° 11,376	633
MSM130_122-1	04/08/2024 14:40	Multi Corer	max depth/on ground	65° 36,973	038° 05,879	780
MSM130_122-2	04/08/2024 15:30	Multi Corer	max depth/on ground	65° 37,007	038° 05,686	782
MSM130_122-3	04/08/2024 16:19	Gravity Corer	max depth/on ground	65° 36,950	038° 05,731	783
MSM130_123-1	04/08/2024 18:07	Multi Corer	max depth/on ground	65° 36,640	038° 01,237	902

MSM130_123-2	04/08/2024 18:57	Multi Corer	max depth/on ground	65° 36,639	038° 01,235	904
MSM130_123-3	04/08/2024 19:48	Gravity Corer	max depth/on ground	65° 36,639	038° 01,236	904
MSM130_124-1	04/08/2024 22:45	CTD	max depth/on ground	65° 32,414	037° 54,026	588
MSM130_125-1	05/08/2024 00:10	CTD	max depth/on ground	65° 30,766	037° 50,670	727
MSM130_125-2	05/08/2024 01:08	Go-Flo Sampler	max depth/on ground	65° 30,711	037° 51,543	630
MSM130_126-1	05/08/2024 03:28	CTD	max depth/on ground	65° 29,357	037° 47,730	650
MSM130_127-1	05/08/2024 05:30	CTD	max depth/on ground	65° 28,192	037° 43,842	529
MSM130_128-1	05/08/2024 07:48	CTD	max depth/on ground	65° 32,504	037° 42,032	162
MSM130_129-1	05/08/2024 09:16	CTD	max depth/on ground	65° 30,702	037° 45,391	395
MSM130_130-1	05/08/2024 10:39	CTD	max depth/on ground	65° 27,868	037° 50,051	279
MSM130_131-1	05/08/2024 17:09	CTD	max depth/on ground	65° 33,684	036° 49,457	117
MSM130_132-1	05/08/2024 18:21	CTD	max depth/on ground	65° 32,208	036° 44,680	205
MSM130_132-2	05/08/2024 18:56	Go-Flo Sampler	max depth/on ground	65° 32,209	036° 44,680	206
MSM130_133-1	05/08/2024 20:17	CTD	max depth/on ground	65° 30,126	036° 37,848	167
MSM130_134-1	05/08/2024 22:33	CTD	max depth/on ground	65° 25,840	036° 24,038	247
MSM130_135-1	06/08/2024 00:40	CTD	max depth/on ground	65° 21,868	036° 10,316	207
MSM130_136-1	06/08/2024 02:47	CTD	max depth/on ground	65° 17,346	035° 57,253	215
MSM130_136-2	06/08/2024 03:28	Go-Flo Sampler	max depth/on ground	65° 16,962	035° 58,566	200
MSM130_137-1	06/08/2024 05:29	CTD	max depth/on ground	65° 13,566	035° 42,928	217
MSM130_138-1	06/08/2024 06:49	CTD	max depth/on ground	65° 09,420	035° 29,230	248
MSM130_139-1	06/08/2024 08:08	CTD	max depth/on ground	65° 05,270	035° 15,642	257
MSM130_140-1	06/08/2024 09:39	CTD	max depth/on ground	65° 01,138	035° 01,756	312
MSM130_140-2	06/08/2024 10:16	Go-Flo Sampler	max depth/on ground	65° 01,118	035° 01,841	312
MSM130_141-1	06/08/2024 11:52	CTD	max depth/on ground	64° 56,996	034° 48,050	599
MSM130_142-1	06/08/2024 20:03	CTD	max depth/on ground	65° 13,717	037° 39,575	176
MSM130_143-1	06/08/2024 21:06	CTD	max depth/on ground	65° 13,799	037° 49,316	510
MSM130_144-1	07/08/2024 06:32	Gravity Corer	max depth/on ground	65° 13,893	038° 06,209	807
MSM130_144-2	07/08/2024 07:48	CTD	max depth/on ground	65° 13,751	038° 00,973	753
MSM130_144-3	07/08/2024 09:04	Go-Flo Sampler	max depth/on ground	65° 13,761	038° 01,781	751
MSM130_145-1	07/08/2024 10:32	CTD	max depth/on ground	65° 13,451	038° 13,876	425

MSM130_146-1	07/08/2024 11:48	CTD	max depth/on ground	65° 13,166	038° 30,855	282
MSM130_147-1	07/08/2024 13:28	CTD	max depth/on ground	65° 13,441	038° 46,432	274
MSM130_147-2	07/08/2024 14:06	Go-Flo Sampler	max depth/on ground	65° 13,365	038° 46,615	251
MSM130_148-1	07/08/2024 16:30	CTD	max depth/on ground	65° 13,709	038° 59,662	598
MSM130_149-1	07/08/2024 18:35	CTD	max depth/on ground	65° 13,868	039° 08,935	217
MSM130_150-1	07/08/2024 20:16	CTD	max depth/on ground	65° 14,027	039° 12,927	194
MSM130_150-2	07/08/2024 20:52	Go-Flo Sampler	max depth/on ground	65° 13,970	039° 13,063	183
MSM130_151-1	08/08/2024 08:29	CTD	max depth/on ground	65° 29,099	039° 02,976	339
MSM130_151-2	08/08/2024 09:04	Go-Flo Sampler	max depth/on ground	65° 29,098	039° 02,977	336
MSM130_152-1	08/08/2024 11:06	CTD	max depth/on ground	65° 26,377	038° 57,279	161
MSM130_153-1	08/08/2024 14:11	CTD	max depth/on ground	65° 29,573	038° 40,555	86
MSM130_154-1	08/08/2024 15:35	CTD	max depth/on ground	65° 28,241	038° 36,565	730
MSM130_154-2	08/08/2024 16:36	Go-Flo Sampler	max depth/on ground	65° 28,240	038° 36,564	730
MSM130_155-1	08/08/2024 18:10	CTD	max depth/on ground	65° 26,527	038° 31,589	557
MSM130_156-1	08/08/2024 19:40	CTD	max depth/on ground	65° 24,433	038° 25,174	460
MSM130_157-1	10/08/2024 01:04	CTD	max depth/on ground	65° 31,976	037° 25,017	477
MSM130_157-2	10/08/2024 01:53	Go-Flo Sampler	max depth/on ground	65° 31,976	037° 25,016	476
MSM130_158-1	10/08/2024 03:37	CTD	max depth/on ground	65° 29,142	037° 29,077	479
MSM130_159-1	10/08/2024 05:24	CTD	max depth/on ground	65° 25,329	037° 37,486	605
MSM130_160-1	10/08/2024 07:08	CTD	max depth/on ground	65° 21,816	037° 45,915	582
MSM130_161-1	10/08/2024 10:36	CTD	max depth/on ground	65° 11,900	037° 53,615	704
MSM130_161-2	10/08/2024 11:39	Go-Flo Sampler	max depth/on ground	65° 12,018	037° 55,179	705
MSM130_162-1	10/08/2024 16:49	CTD	max depth/on ground	64° 47,194	038° 17,825	676
MSM130_163-1	10/08/2024 18:12	CTD	max depth/on ground	64° 48,061	038° 08,635	565
MSM130_163-2	10/08/2024 18:55	Go-Flo Sampler	max depth/on ground	64° 48,088	038° 08,670	556
MSM130_164-1	11/08/2024 07:49	CTD	max depth/on ground	64° 48,052	037° 53,537	339
MSM130_165-1	11/08/2024 09:46	CTD	max depth/on ground	64° 45,298	037° 34,089	294
MSM130_166-1	11/08/2024 11:22	CTD	max depth/on ground	64° 38,873	037° 20,650	414
MSM130_167-1	11/08/2024 12:52	CTD	max depth/on ground	64° 31,723	037° 15,951	354
MSM130_168-1	11/08/2024 14:18	CTD	max depth/on ground	64° 24,057	037° 16,150	386

MSM130_169-1	11/08/2024 15:43	CTD	max depth/on ground	64° 19,016	037° 18,527	600
MSM130_169-2	11/08/2024 16:30	Go-Flo Sampler	max depth/on ground	64° 18,998	037° 18,553	601
MSM130_170-1	11/08/2024 17:58	CTD	max depth/on ground	64° 14,500	037° 22,157	552
MSM130_171-1	12/08/2024 04:21	CTD	max depth/on ground	64° 14,966	036° 12,361	382
MSM130_172-1	12/08/2024 06:29	CTD	max depth/on ground	64° 12,787	035° 48,649	786
MSM130_172-2	12/08/2024 07:35	Go-Flo Sampler	max depth/on ground	64° 12,686	035° 49,253	788

8 Data and Sample Storage and Availability

A cruise summary report (CSR) has been compiled and submitted to DOD (Deutsches Ozeanographisches Datenzentrum), BSH, Hamburg, immediately after the cruise. Part of the cruise was performed in waters under jurisdiction of Denmark, Greenland and Iceland. As requested, the corresponding data and this cruise report have been transferred to the respective authorities.

All hydrographic data acquired during the cruise will be made available to the PANGAEA data base. All nutrient and trace metal and isotope data to be acquired will also be fed into these data bases and will be made publicly available within 3 years after cruise end (3rd quarter of 2027). All water and particulate and sediment samples are stored at the respective laboratories, where the measurements will be carried out. The Kiel Data Management Team (KDMT) provides an information and data archival system where metadata of the onboard DSHIP-System are collected and are made publicly available. This Ocean Science Information System (OSIS-Kiel) is accessible for all project participants and can be used to share and edit field information (https://portal.geomar.de/metadata/).

Availability of metadata in OSIS, 2 weeks after completion of the cruise and related experiments. Availability of data in OSIS (https://portal.geomar.de/osis): 6 months after completion of the cruise and related experiments.

Table 8.1 lists the target data bases, tentative availability times and responsible scientists.

Hydrography CTD and ADCP and multibeam data are held at DAM and GEOMAR Helmholtz Centre for Ocean Research Kiel and are publicly available immediately after cruise (responsible: Prof. E. Achterberg).

Dissolved trace metals - samples and data are held at GEOMAR, Kiel (responsible: Prof. E. Achterberg).

Particulate trace metals - samples and data are held at The University of Brest, France (responsible: Dr Hélène Planquette).

Trace element isotopes (Fe and Pb isotopes) - samples and data are held at GEOMAR, Kiel (responsible: Prof. E. Achterberg).

Phytoplankton/productivity – samples and data are held at IOPAN, Poland (responsible Dr. E. Trudnowska).

Gravity core samples - samples and data are held at GEUS (responsible Dr. S. Ribeiro).

Multi core samples - samples and data are held at GEOMAR, Kiel (responsible: Dr. K. Laufer-

Meiser).

Nutrients, DOC, DOC, alkalinity, carbon cycle - samples and data are held at GEOMAR, Kiel (responsible Prof. E. Achterberg).

Table 8.1 Overview of data availability

Type	Database	Available	Contact
Hydrography	PANGAEA	August 2026	eachterberg@geomar.de
Nutrients	PANGAEA	August 2026	eachterberg@geomar.de
Dissolved trace metals	PANGAEA	August 2027	eachterberg@geomar.de
Particulate trace metals	PANGAEA	August 2027	Helene.planquette@uni-brest.fr
Stable Fe and Pb isotopes	PANGAEA	August 2027	eachterberg@geomar.de
Phytoplankton/productivity	PANGAEA	August 2026	emilia.trudnowska@gmail.com
Carbonate chemistry, DOC, DON/DOP	PANGAEA	August 2026	eachterberg@geomar.de
Sediment core profiles	PANGAEA	August 2027	sri@geus.dk
Biogenic/amorphous silica	PANGAEA	August 2026	mark@sustech.edu.cn
O^{18}	PANGAEA	August 2026	mark@sustech.edu.cn

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11 Abbreviations

ADCP	Acoustic Doppler Current Profiler
BCP	Biological Carbon Pump
BSi	Biogenic Silica
Chl	Chlorophyll
CRM	Certified Reference Material

CSR	Cruise Summary Report
CTD	Conductivity, Temperature, and Depth
DIC	Dissolved Inorganic Carbon
DOC	Dissolved Organic Carbon
DOD	Deutsches Ozeanographisches Datenzentrum
EEZ	Exclusive Economic Zone
EGC	East Greenland Current
EGCC	East Greenland Coastal Current
FEP	Fluorinated ethylene propylene
FRRf	Fast repetition rate fluorometry
GFF	Glass Fibre Filter
HgT	Total Hg
HPLC	High Performance Liquid Chromatography
KDMT	Kiel Data Management Team
LDPE	Low-density Polyethylene
MC-ICPMS	Multi-Collector Inductively Coupled Plasma Mass Spectrometry
OPA	o-Phtaladiadehyde
OTE	Ocean Test Equipment
PAR	Photosynthetically Active Radiation
PC	Polycarbonate
PES	Polyethersulfone
PET	Polyethylene terephthalate
PFA	Perfluoroalkoxy Alkane
PN	Particulate Nitrogen
POC	Particulate Organic Carbon
POM	Particulate Organic Matter
PON	Particulate Organic Nitrogen
QMA	Quartz Microfiber
RMS	Root Mean Squared
RMNS	Reference Material for Nutrients in Seawater
SPE	Solid Phase Extraction
SS	Stainless Steel
SSS	Sea Surface Salinity
SS-CTD	Stainless Steel CTD
SST	Sea Surface Temperature
TA	Total Alkalinity
TEIs	Trace Elements and Isotopes
TON	Total Oxidized Nitrogen
TRIS	tris(hydroxymethyl)aminomethane
TSG	Thermosalinograph
UVP	Underwater Vision Profiler

12 Appendices

12.1 Sediment Work

Table 12.1 List of collected, sampled and processed short multicores.

Core name	Latitude (deg)	Longitude (deg)	Water depth (m)	Event time	Length (cm)	Dedicated work	Notes	Core processing
MSM130-6-3MUC1	60.353879	-42.370791	431	7/12/2024 18:25	10	Geochem	only one core recovered a bit of sediment; pebbles	80ml of the first 2cm of sediments were collected and stored at -20?
MSM130-6-3MUC1	60.353879	-42.370791	431	7/12/2024 18:25	10	meiofauna		upper 0-2 cm in 1cm resolution
MSM130-10-3MUC1	60.464794	-43.338121	785	7/13/2024 14:54	25	Geochem	only 2 cores recovered in this deployment;	
MSM130-10-3MUC2	60.464794	-43.338121	785	7/13/2024 14:54	25.5	Foraminifera, proxy	0-3cm for foraminifera, for rest each cm homogenized and then half sample stored frozen, other half cold	spliced 1cm resolution stored at 4°C and -20°C
MSM130-13-3MUC1	60.528119	-43.690705	728	7/13/2024 22:26	23.5	Geochem		Supsampling as described for, Geochem and mircobial analysis
MSM130-13-3MUC2	60.528119	-43.690705	728	7/13/2024 22:26	24	Foraminifera		spliced 1cm resolution
MSM130-13-3MUC3	60.528119	-43.690705	728	7/13/2024 22:26	23.5	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-13-3MUC4	60.528119	-43.690705	728	7/13/2024 22:26	21	proxy		spliced 1cm resolution, stored at -20°C
MSM130-16-3MUC1	60.574457	-44.077842	418	7/14/2024 10:41	21	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-16-3MUC2	60.574457	-44.077842	418	7/14/2024 10:41	21.5	Geochem		Supsampling as described for, Geochem and mircobial analysis
MSM130-16-3MUC3	60.574457	-44.077842	418	7/14/2024 10:41	18	proxy		3 foram samples stored at -20°C, rest spliced 1cm resolution, stored at 4°C
MSM130-16-3MUC4	60.574457	-44.077842	418	7/14/2024 10:41	20	Foraminifera		spliced 1cm resolution
MSM130-27-1MUC1	60.465259	-43.342506	787	7/15/2024 19:19	22	DNA	recorded as MSM130_27-2 in action log; repetition of station 10 MUC to get full proxy and DNA core; extra samples to Emilia	intact core spiked with microspheres; stored at 4°C
MSM130-27-1MUC2	60.465259	-43.342506	787	7/15/2024 19:19	22.5	proxy		spliced 1cm resolution, stored at -20°C
MSM130-29-1MUC	60.386847	-42.943435	557	7/16/2024 2:25	NA	no recovery	MUC placed at ~1 cable distance from station 8; st.6 too far away, st.8 site was at a slope so we are not exactly under superstation, but MUC hit hard bottom and came up with a piece of coral and a stone with Bryozoans	no sediment recovery

MSM130-43-3MUC	62.382044	-41.872132	228	7/18/2024 23:31	NA	no recovery	yellow sponge recovered, hard-bottom substrate	
MSM130-43-4MUC	62.381527	-41.870537	229	7/18/2024 23:54	NA	no recovery	hard-bottom substrate	
MSM130-45-3MUC1	62.361799	-42.434509	809	7/19/2024 20:30	29	Geochem		Supsampling as described for, Geochem and mircobial analysis
MSM130-45-3MUC2	62.361799	-42.434509	809	7/19/2024 20:30	30	Geochem		Sampling as described for incubation experiment
MSM130-45-3MUC3	62.361799	-42.434509	809	7/19/2024 20:30	26	Geochem		Sampling as described for incubation experiment
MSM130-45-3MUC4	62.361799	-42.434509	809	7/19/2024 20:30	24	Geochem		Sampling as described for incubation experiment
MSM130-45-4MUC1	62.361746	-42.434951	808	7/19/2024 21:20	28	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-45-4MUC2	62.361746	-42.434951	808	7/19/2024 21:20	28	proxy		spliced 1cm resolution, stored at -20°C
MSM130-45-4MUC3	62.361746	-42.434951	808	7/19/2024 21:20	27	DNA/RNA, biogenic silica	0-2 cm surface sediments collected for DNA/RNA (3tubes) and BiSi (1 Tube)	0-2cm, stored at -80°C
MSM130-45-4MUC4	62.361746	-42.434951	808	7/19/2024 21:20	27	meiofauna		upper 0-2 cm; stored at -20°C
MSM130-47-3MUC1	62.424928	-42.634305	740	7/20/2024 5:42	25-26	DNA/RNA, biogenic silica	0-2 cm surface sediments collected for DNA/RNA (3tubes) and BiSi (1 Tube) stored at -80°C; surface uneven	0-2cm, stored at -80°C
MSM130-47-3MUC2	62.424928	-42.634305	740	7/20/2024 5:42	22-23	meiofauna	surface uneven	upper 0-2 cm; stored at -20°C
MSM130-47-3MUC3	62.424928	-42.634305	740	7/20/2024 5:42	23.5	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-47-3MUC4	62.424928	-42.634305	740	7/20/2024 5:42	25.5	proxy		spliced 1cm resolution, stored at -20°C
MSM130-47-4MUC1	62.424721	-42.633445	741	7/20/2024 6:37	25	Geochem		Supsampling as described for, Geochem and mircobial analysis
MSM130-47-4MUC2	62.424721	-42.633445	741	7/20/2024 6:37	22	Geochem		Sampling as described for incubation experiment
MSM130-47-4MUC3	62.424721	-42.633445	741	7/20/2024 6:37	23	Geochem		Sampling as described for incubation experiment
MSM130-47-4MUC4	62.424721	-42.633445	741	7/20/2024 6:37	25	Geochem		Sampling as described for incubation experiment
MSM130-52-2MUC1	62.32036	-42.186369	816	7/20/2024 22:54	22	Geochem		Supsampling as described for, Geochem and mircobial analysis
MSM130-52-2MUC2	62.32036	-42.186369	816	7/20/2024 22:54	20	Geochem		Sampling as described for incubation

								experiment
MSM130-52-2MUC3	62.32036	-42.186369	816	7/20/2024 22:54	22	Geochem		Sampling as described for incubation experiment
MSM130-52-2MUC4	62.32036	-42.186369	816	7/20/2024 22:54	19	Geochem		Sampling as described for incubation experiment
MSM130-52-4MUC1	62.320706	-42.185077	816	7/21/2024 0:35	24	DNA	GC was not allowed after darkness so 2nd MUC deployment after GC	intact core spiked with microspheres; stored at 4°C
MSM130-52-4MUC2	62.320706	-42.185077	816	7/21/2024 0:35	21	DNA/RNA, biogenic silica		0-2cm, stored at -80°C
MSM130-52-4MUC3	62.320706	-42.185077	816	7/21/2024 0:35	23	proxy		spliced 1cm resolution, stored at -20°C
MSM130-52-4MUC4	62.320706	-42.185077	816	7/21/2024 0:35	22	meiofauna		upper 0-2 cm; stored at -20°C
MSM130-58-3MUC1	65.28089	-37.856599	668	7/24/2024 15:26	21	Geochem	lots of organics in the top; brown top layer, then gray, sandy bottom layer; siliceous sponge ooze	Supsampling as described for, Geochem and mircobial analysis
MSM130-58-3MUC2	65.28089	-37.856599	668	7/24/2024 15:26	14	Geochem		Sampling as described for incubation experiment
MSM130-58-3MUC3	65.28089	-37.856599	668	7/24/2024 15:26	21	Geochem		Sampling as described for incubation experiment
MSM130-58-3MUC4	65.28089	-37.856599	668	7/24/2024 15:26	19	Geochem		Sampling as described for incubation experiment
MSM130-58-4MUC1	65.280901	-37.856585	668	7/24/2024 16:03	14	DNA	lots of organics in the top; brown top layer, then gray, sandy bottom layer; siliceous sponge ooze	intact core spiked with microspheres; stored at 4°C
MSM130-58-4MUC2	65.280901	-37.856585	668	7/24/2024 16:03	15.5	proxy		spliced 1cm resolution, stored at -20°C
MSM130-58-4MUC3	65.280901	-37.856585	668	7/24/2024 16:03	5.5	Foraminifera		surface 0-4cm spliced 1cm resolution
MSM130-58-4MUC4	65.280901	-37.856585	668	7/24/2024 16:03	NA	no recovery		
MSM130-81-1MUC1	65.634543	-38.052364	917	7/28/2024 4:33	40	Geochem		Supsampling as described for, Geochem and mircobial analysis
MSM130-81-1MUC2	65.634543	-38.052364	917	7/28/2024 4:33	41	Geochem		Sampling as described for incubation experiment
MSM130-81-1MUC3	65.634543	-38.052364	917	7/28/2024 4:33	42	Geochem		Sampling as described for incubation experiment
MSM130-81-1MUC4	65.634543	-38.052364	917	7/28/2024 4:33	44	Geochem		Sampling as described for incubation experiment
MSM130-81-2MUC1	65.634545	-38.053002	917	7/28/2024 5:25	40	Foraminifera		surface 0-4cm spliced 1cm

								resolution
MSM130-81-2MUC2	65.634545	-38.053002	917	7/28/2024 5:25	42	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-81-2MUC3	65.634545	-38.053002	917	7/28/2024 5:25	44.5	DNA/RNA, biogenic silica, meiofauna		stone inside; not for proxy core used;upper 0-2 cm; stored at -20°C / -80C
MSM130-81-2MUC4	65.634545	-38.053002	917	7/28/2024 5:25	42	proxy		spliced 1cm resolution, stored at -20°C
MSM130-85-3MUC1	65.848121	-37.934279	874	7/28/2024 20:47	24	Geochem		
MSM130-85-3MUC2	65.848121	-37.934279	874	7/28/2024 20:47	28	Geochem		
MSM130-85-3MUC3	65.848121	-37.934279	874	7/28/2024 20:47	26	Geochem		
MSM130-85-3MUC4	65.848121	-37.934279	874	7/28/2024 20:47	29.5	Geochem		
MSM130-85-4MUC1	65.84817	-37.935154	873	7/28/2024 21:34	25.5	proxy		spliced 1cm resolution, stored at -20°C
MSM130-85-4MUC2	65.84817	-37.935154	873	7/28/2024 21:34	25	Foraminifera		surface 0-4cm spliced 1cm resolution
MSM130-85-4MUC3	65.84817	-37.935154	873	7/28/2024 21:34	26.5	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-85-4MUC4	65.84817	-37.935154	873	7/28/2024 21:34	21.5	DNA/RNA, biogenic silica, meiofauna		upper 0-2 cm; stored at -20°C / -80C
MSM130-95-3MUC1	66.303152	-37.709701	658	7/30/2024 9:32	NA	Geochem	sediments very soupy, dripped out during recovery; for one core the content wass saved into a plastic bag	full content collected in bag; stored at 4°C
MSM130-95-4MUC1	66.302645	-37.707817	656	7/30/2024 10:15	NA	no recovery	sediments very soupy, dripped out during recovery	
MSM130-99-3MUC1	66.236651	-37.5256	512	8/1/2024 11:20	51.5	proxy	sediments very soupy, MUC sank in even though we instantly stopped winch at bottom contact; 2 cores recovered full of sediment; 2 cores bottom water retained but leaked through the sediment before the rubber plug got inserted and were lost	spliced 1cm resolution, stored at -20°C
MSM130-99-3MUC2	66.236651	-37.5256	512	8/1/2024 11:20	55	Geochem	sediments very soupy, MUC sank in despite stopping winch at bottom contact; 2 MUCs recovered full of sediment, surface not recovered	packed in plastic bag without slicing; stored at 4°C
MSM130-99-3MUC3	66.236651	-37.5256	512	8/1/2024 11:20	NA	no recovery	lost during recovery	
MSM130-99-3MUC4	66.236651	-37.5256	512	8/1/2024 11:20	NA	no recovery	lost during recovery	
MSM130-99-4MUC1	66.242004	-37.519007	500	8/1/2024 11:54	NA	no recovery	sediments very soupy, MUC sank in despite stopping winch at bottom contact; 2 MUCs recovered full of sediment, surface not recovered	
MSM130-99-4MUC2	66.242004	-37.519007	500	8/1/2024 11:54	NA	no recovery	lost during recovery	

MSM130-99-4MUC3	66.242004	-37.519007	500	8/1/2024 11:54	NA	no recovery	lost during recovery	
MSM130-99-4MUC4	66.242004	-37.519007	500	8/1/2024 11:54	NA	no recovery	lost during recovery	
MSM130-105-3MUC1	65.826501	-38.06463	542	8/2/2024 16:17	32	Geochem		Supsampling as described for, Geochem and mircobial analysis
MSM130-105-3MUC2	65.826501	-38.06463	542	8/2/2024 16:17	26	Geochem		Sampling as described for incubation experiment
MSM130-105-3MUC3	65.826501	-38.06463	542	8/2/2024 16:17	27	Geochem		Sampling as described for incubation experiment
MSM130-105-3MUC4	65.826501	-38.06463	542	8/2/2024 16:17	34	Geochem		Sampling as described for incubation experiment
MSM130-105-4MUC1	65.826834	-38.065348	530	8/2/2024 16:52	21	proxy	4th MUC lost during recovery	spliced 1cm resolution, stored at -20°C
MSM130-105-4MUC2	65.826834	-38.065348	530	8/2/2024 16:52	14	Foraminifera		
MSM130-105-4MUC3	65.826834	-38.065348	530	8/2/2024 16:52	23	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-123-1MUC1	65.616219	-38.097984	780	8/4/2024 14:40	19.5	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-123-1MUC2	65.616219	-38.097984	780	8/4/2024 14:40	20.5	proxy	bags wrongly labelled with MUC1 but actually MUC2	spliced 1cm resolution, stored at -20°C
MSM130-123-1MUC3	65.616219	-38.097984	780	8/4/2024 14:40	16.5	Foraminifera		
MSM130-123-1MUC4	65.616219	-38.097984	780	8/4/2024 14:40	NA	DNA/RNA, biogenic silica, meiofauna	MUC had to be wrapped in tape and length could not be measured	upper 0-2 cm; stored at -20°C / -80C
MSM130-123-2MUC1	65.616777	-38.094763	782	8/4/2024 15:30	24	Geochem	stone with lots of organisms (Tunicates, Bryozoa, forams, tube worms) recovered and stored extra frozen	Supsampling as described for, Geochem and mircobial analysis
MSM130-123-2MUC2	65.616777	-38.094763	782	8/4/2024 15:30	22	Geochem		Sampling as described for incubation experiment
MSM130-123-2MUC3	65.616777	-38.094763	782	8/4/2024 15:30	18	Geochem		Sampling as described for incubation experiment
MSM130-123-2MUC4	65.616777	-38.094763	782	8/4/2024 15:30	24	Geochem		Sampling as described for incubation experiment
MSM130-124-1MUC1	65.610671	-38.020617	902	8/4/2024 18:07	34	Geochem		Supsampling as described for, Geochem and mircobial analysis
MSM130-124-1MUC2	65.610671	-38.020617	902	8/4/2024 18:07	29	Geochem		Sampling as described for incubation experiment
MSM130-124-1MUC3	65.610671	-38.020617	902	8/4/2024 18:07	36	Geochem		Sampling as described for incubation experiment

MSM130-124-1MUC4	65.610671	-38.020617	902	8/4/2024 18:07	26	Geochem		Sampling as described for incubation experiment
MSM130-124-2MUC1	65.610654	-38.020589	904	8/4/2024 18:57	NA	Foraminifera	only 3 liners left for deployment; MUC had to be wrapped in tape and length could not be measured	surface 0-3cm spliced 1cm resolution
MSM130-124-2MUC2	65.610654	-38.020589	904	8/4/2024 18:57	34	DNA		intact core spiked with microspheres; stored at 4°C
MSM130-124-2MUC3	65.610654	-38.020589	904	8/4/2024 18:57	31	proxy		spliced 1cm resolution, stored at -20°C