
CAGE - Centre for Arctic Gas Hydrate Environment and Climate Report Series, Volume 8 (2020)

To be cited as: Ferré, B. et al. (2023). CAGE20-7 Cruise Report: Sediment and water column analyses around flares at Norskebanken, Hinlopen and offshore Prins Karls Forland. CAGE - Centre for Arctic Gas Hydrate Environment and Climate Report Series, Volume 8. https://doi.org/10.7557/cage.6916
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ISSN: 2703-9625
Publisher: Septentrio Academic Publishing Tromsø Norway

# Cruise report

# CAGE 20-7

Sediment and water column analyses around flares at Norskebanken, Hinlopen and offshore Prins Karls Forland

Longyearbyen – Longyearbyen 02-16/11/2020

Participants: Bénédicte Ferré (chief scientist), Giuliana Panieri, Dimitri Kalenitchenko, Claudio Argentino, Manuel Moser, Knut Ola Dølven, Fatih Sert, Marie Stetzler, Alessandra Savini, Matteus Lindgren, Eleonore Jones, Tim de Groot, Jenny Friedrich, Stormer Jensen and the ROV team: Stig Vågenes, Jörn Patrick Meyer, Marco Micheel and Eyvind Erntsen

Centre for Arctic Gas Hydrate, Environment and Climate (CAGE)
Department of Geology
UiT – The Arctic University of Norway
N-9037 Tromsø, Norway

# Contents

## 1 PARTICIPANTS LIST

| Name | Expertise | Assoc. WP |
|---|---|---|
| Bénédicte Ferré | cruise leader – Physical oceanographer | CAGE/UiT – WP4 |
| Fatih Sert | Biogeochemist – Water column | CAGE/UiT – WP4 |
| Jenny Friedrich | Msc student – Water column / help | CAGE/UiT – WP4 |
| Knut Ola Dølven | Physical oceanographer – WC | CAGE/UiT – WP4 |
| Manuel Moser | Geophysicist – multibeam/EK80 | CAGE/UiT – WP4 |
| Marie Stetzler | Water column / help | CAGE/UiT – WP4 |
| Tim De Groot | Microbiologist | NOIZ/CAGE/UiT – WP3/4 |
| Dimitri Kalenitchenko | Microbiologist | CAGE/UiT – WP3 |
| Eleanor Jones | Microbiologist | CAGE/UiT – WP3 |
| Giuliana Panieri | Micropaleontologist –geochemistry | CAGE/UiT – WP5 |
| Claudio Argentino | Sedimentology / geochemistry | CAGE/UiT – WP1 |
| Matteus Lindgren | Pore water geochemistry | CAGE/UiT – WP5 |
| Alessandra Savini | Photomosaic | UniMib – WP5 |
| Stormer Jensen | UiT engineer | UiT/IG |
| Stig Vågenes | ROV | UiB |
| Jörn Patrick Meyer | ROV engineer | UiB |
| Eyvind Ernstsen | ROV engineer | UiB |
| Marco Micheel | ROV engineer - multibeam | UiB |

## 2 CRUISE OBJECTIVES

The overall objective of the cruise was to observe and investigate a large active methane seepage area south from the Yermak plateau (Northern Svalbard), and in particular to characterize the water column and the sediment near known flares in Norskebanken (Geissler et al., 2016). In addition, we planned to target some flares for gas composition, DNA and bubble size distribution. The cruise was conducted from November 2$^{nd}$ to 16$^{th}$ 2020 as part of the Centre of Excellence for Arctic Gas Hydrate, Environment and Climate (CAGE) at UiT – The Arctic University of Norway. The combination of the R/V Kronprins Haakon and the ROV ÆGIR 6000 from the Norwegian Marine Robotics Laboratory at the University of Bergen allowed this investigation to happen in this rough environment, while collecting invaluable data from the ROV. The instrumentation and the aim of each topic is described in the following sections.

## 3 INVESTIGATED AREA

The survey was initially guided by methane seepages reported by Geissler et al. (2016) on Norskebanken, a bank offshore northern Svalbard at the south of the Yermak plateau with an average depth of less than 300m (Fig. 1). We also investigated the Hinlopen Trough further east (Fig. 2), and spent a few days at the shelf edge offshore Prins Karls Forland (Fig. 3).

A giant submarine landslide at the mouth of the Hinlopen Trough remobilized ~1350 km$^3$ of sediment (Vanneste et al., 2006). Seismic data highlights a bottom-simulated reflector (BSR) revealing the presence of gas hydrate a few kilometers north of the megaslide, as well as free gas within the sediment (Geissler et al., 2006). Numerous flares were reported by Geissler et al. (2016) at Norskebanken and in the Hinlopen Trough, mostly shallower than 300 m depth. They found methane

concentrations up to 218 nmol/L from water sampling and multicorer. They state that these seepage are diffuse and that no gas hydrate sealing exist. Platt et al. (2016) further reported higher atmospheric methane concentrations at 80.4 N, 12.8 E, unexplained by wetlands or anthropogenic activities. They infer this anomaly from ocean-atmosphere flux.

The circulation in the area is characterized by the North Svalbard Current (NSC) resulting from the West Spitsbergen Current (WSC) and carrying warm Atlantic Water (AW) in the Arctic. Modeling shows that AW flows southward along the western side from the mouth, as well as after recirculating on Norskebanken and entering southward in the south part of the Trough. The water exits the Trough along the eastern side (Menze et al., 2020). Warm Polar surface water dominates the area down to ~100m depth (Menze et al., 2020).

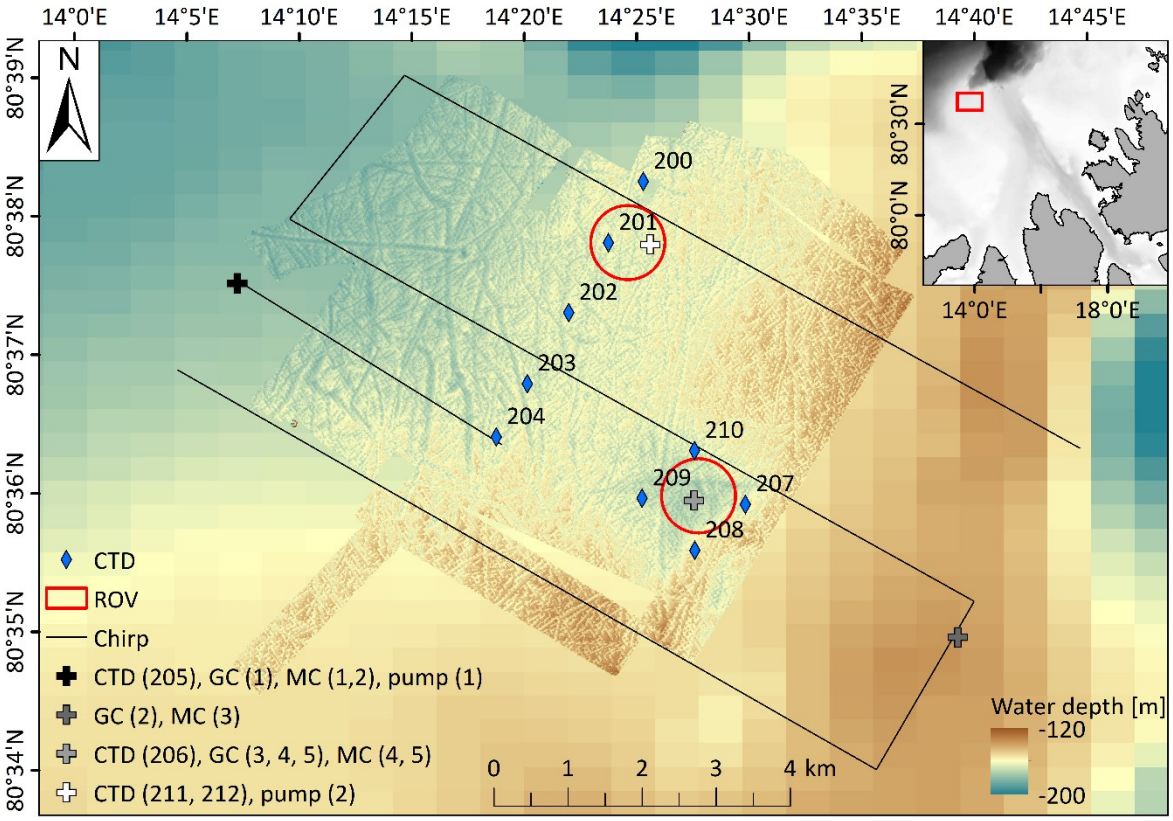


*Fig. 1. Bathymetry at Norskebanken illustrating the sampling and surveys performed. Several annotations are used for clarity, indicating the different measurements acquired. The two red circles indicate the areas where we performed ROV-based microbathymetry and video-mapping, and the corresponding figures are shown in section 4.7. GC: gravity core; MC: Multicore. The pump was developed by NIOZ institute for biomass (see description below). A description of the ROV and the mounted equipment are described in section 5.*

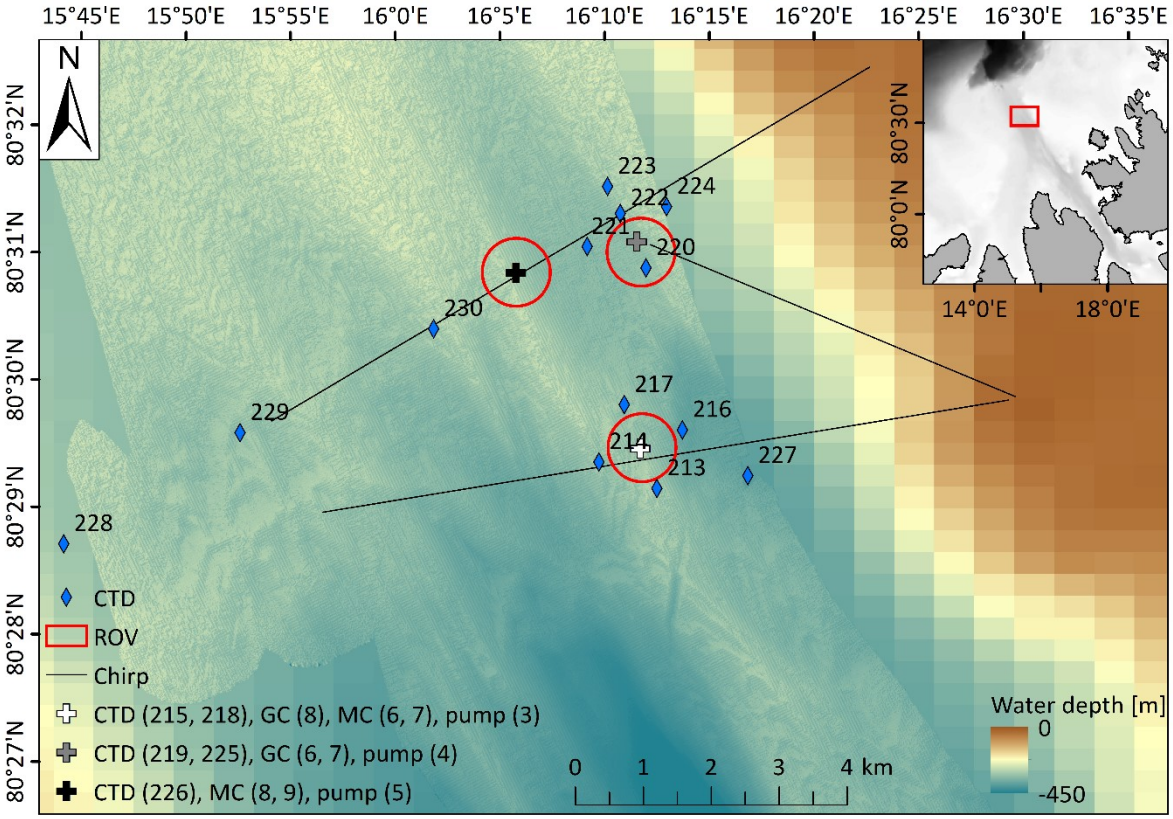


*Fig. 2. Bathymetry in Hinlopen Trough illustrating the sampling and surveys performed. See Fig. 1 for description of the legend.*

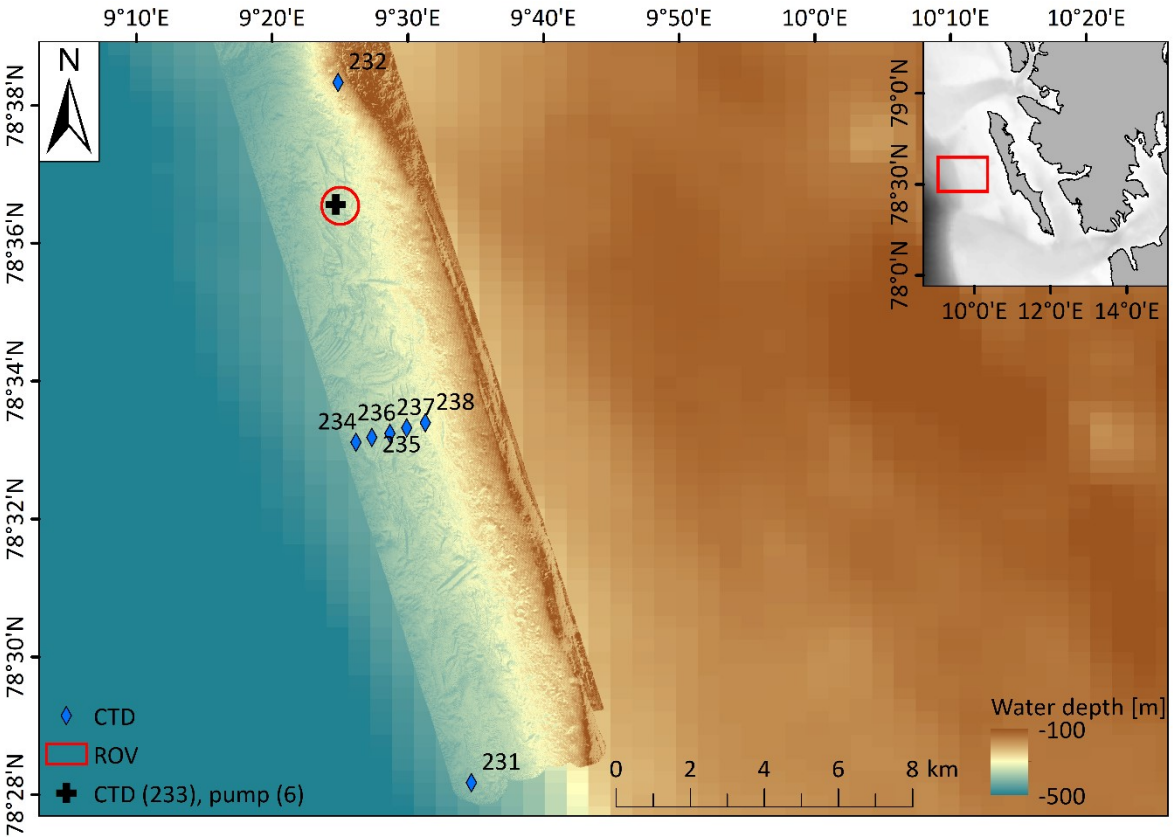


*Fig. 3. Bathymetry obtained during the cruise offshore Prins Karls Foreland illustrating the sampling and surveys performed. See Fig. 1 for description of the legend.*

# 4 SCIENTIFIC EQUIPMENT AND METHODS

## 4.1 Hydroacoustic systems (Manuel Moser)

### 4.1.1 Singlebeam EK80

R/V Kronprins Haakon is equipped with two Kongsberg Simrad EK80 singlebeam echosounder systems (flush mount and drop keel), both having six frequency channels: 18, 38, 70, 120, 200 and 333 kHz. All channels operate in narrowband using a continuous wave (CW) pulse type, but the four latter channels can also acquire broadband data using a linear frequency modulated (LFM) pulse type.

During the cruise, we only used the EK80 mounted on the drop keel, except in the transit from Hinlopen Trough to Kongsfjorden, where we had to switch to the flush mount EK80 due to strong waves. In order to avoid interferences with the EM710 multibeam echosounder, the EK80 was mostly recording when the EM710 was not. The main purpose of recording EK80 data was to identify active gas seepage from the seafloor. As this high frequency echosounder system is very sensitive to gas bubbles in the water column, the rising bubbles appear as high amplitude anomalies (acoustic flares) in the water column. “On-the-way-measurements” were conducted in narrowband and higher frequency channels were set to passive mode. Additionally, we conducted specific EK80 surveys to collect broadband data with the four highest frequency channels. For these channels, we selected the following frequency ranges: 45-90, 90-170, 160-260, 280-450 kHz. Other acoustic systems, which could interfere with the EK80, were turned off during these measurements.

The data collected during these explicit EK80 surveys will be used to perform an experiment with the aim to determine the bubble size distribution (BSD) of flares based on EK80 data and to compare the results with BSDs derived from optical checkerboard measurements on some of the aforementioned flares.

### 4.1.2 Multibeam EM710

Multibeam echosounders use a swath of beams giving off-track depth. Basic components of a multibeam system are two linear transducer arrays in a Mills cross configuration with separate units for transmitting and receiving. Echosounders measure the two-way travel time that a sound wave initiated by the transmitter needs to reach the seafloor and be reflected back to the receiver. The time-depth conversion can be done using the sound velocity through seawater calculated from the closest CTD measurements.

R/V Kronprins Haakon is equipped with the flush mount Kongsberg EM302 multibeam echosounder system and the Kongsberg EM710 multibeam echosounder system mounted on the drop keel. For better data quality, we only used the EM710. Its nominal sonar frequency of the sound waves is 70 kHz with an angular coverage sector of up to 140° and 400 beams per ping. The system was mainly used with a 60°/60° opening angle, but it was reduced to 50°/50° during the survey west of Svalbard for a higher across track resolution. The ping rate depends on the water depth and opening angle and switched frequently between 0.5 and 2 Hz. The EM710 provides high-resolution bathymetric data up to a water depth of 2800 m, but it performs best in areas shallower than 1000 m. The achievable swath width on the seafloor depends on the bathymetry and the selected opening angle.

During the cruise, the EM710 provided continuous bathymetric data to give an overview of the seafloor morphology in the study area, but it was not logging during ROV surveys to avoid interferences with the ROV (see Appendix 1 for survey lines). The QPS Qimera software was used to create preliminary high-resolution bathymetric maps.

Another application of the EM710 is to monitor the water column. The acquired data were analyzed using the QPS FMMidwater software. Before any analysis could be done, the provided sonar source files (*.all, *.wcd) had to be converted to the generic water column file format (*.gwc). The analysis of water column data allows the detection of acoustic flares indicating gas seepage from the seafloor to the water column and the spatial mapping on top of the bathymetry (Fig. 4).

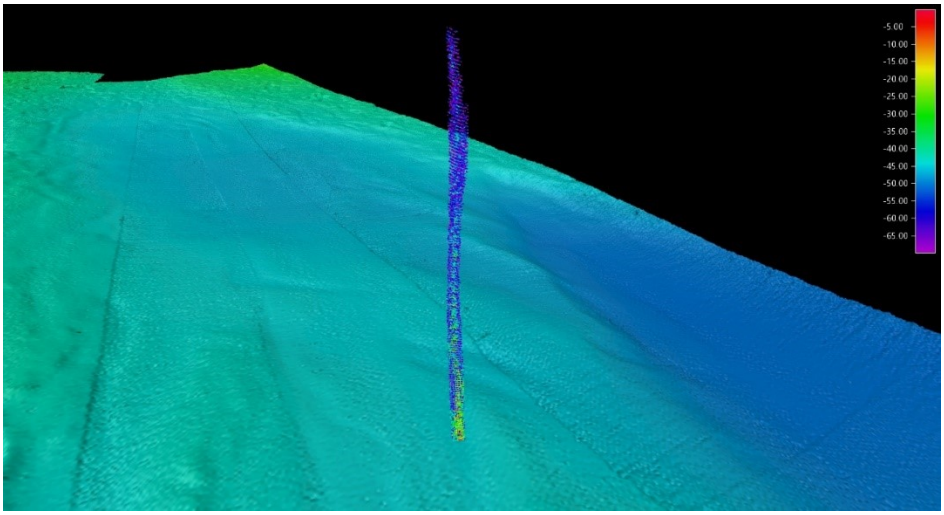


*Fig. 4: Snapshot from the QPS Fledermaus software showing a three-dimensional view of a selected flare ca. 222 m high superimposed on the bathymetry. The colormap of the raw amplitude ranges from -70 (purple) to 0 (red).*

The following steps were carried out to extract the flare data prior the previous plot:

a) Identification of acoustic flares in the water column data, either in fan view (left panel) or in R-stack view (right panel) (Fig. 5):

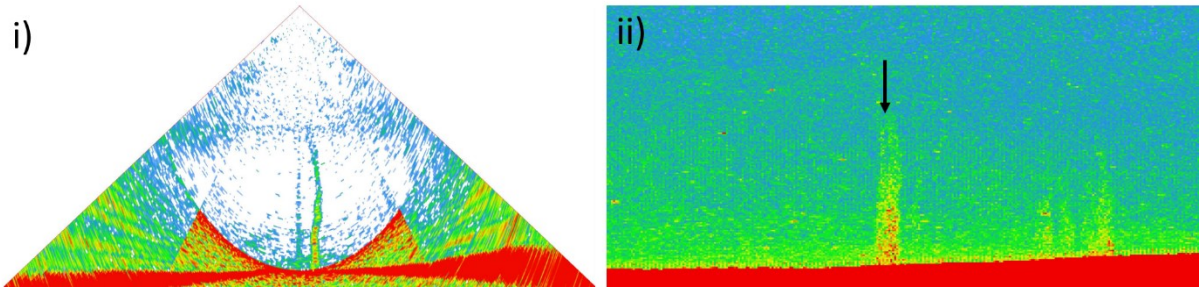


*Fig. 5: i) Fan view showing a single flare. ii) R-stack view showing several flares near the flare on the left panel (black arrow). The colormap of the raw amplitude ranges from -70 (blue) to 0 (red).*

b) Selection of the flare (Fig. 6):

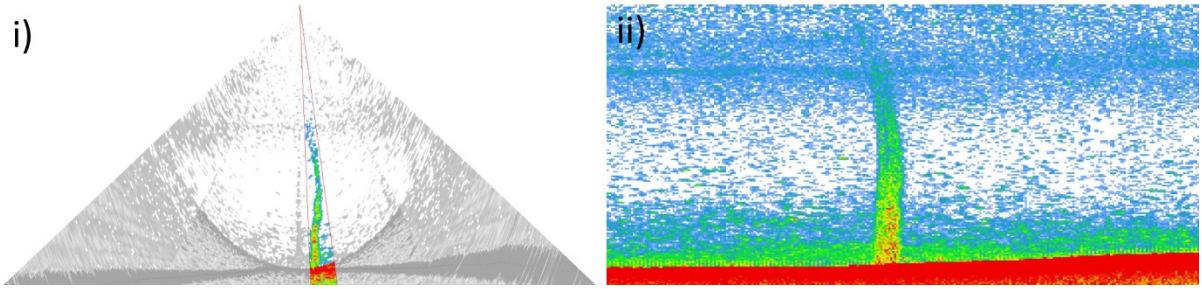


*Fig. 6: i) Adjustment of the considered beam range in the fan view. ii) R-stack view for the adjusted beam range. The colormap of the raw amplitude ranges from -70 (blue) to 0 (red). The selection is then exported to an ASCII file.*

## 4.2 ADCP (Knut Ola Dølven)

The ship is equipped with 4 “Ocean Surveyor” Acoustic Doppler Current Profilers (ADCP) from Teledyne RD, operating at narrowband and broadband at 150 kHz and 38 kHz. Two of the ADCPs (one 38 kHz and one 150 kHz) are mounted on the lowered keel 7 meters below the sea surface and two (one 38 kHz and one 150 kHz) are flush-mounted. Data is collected through a deck unit communicating with the device and a standard PC in the Instrument room. ADCP data was collected to measure ocean currents and look for methane bubbles using the backscatter intensity data. An ADCP transect from the 150 kHz narrowband acquired in the Hinlopen Trough along the CTD 225-228 (Fig. 2) line shows an outflow on the eastern side of the Trough (Fig. 7). A transect was done on the shelf edge offshore Prins Karls Forland with the flush-mounted 38 kHz ADCP in broadband with high resolution simultaneous with the EK80 multibeam sonar to look for bubbles using the backscatter intensity data.

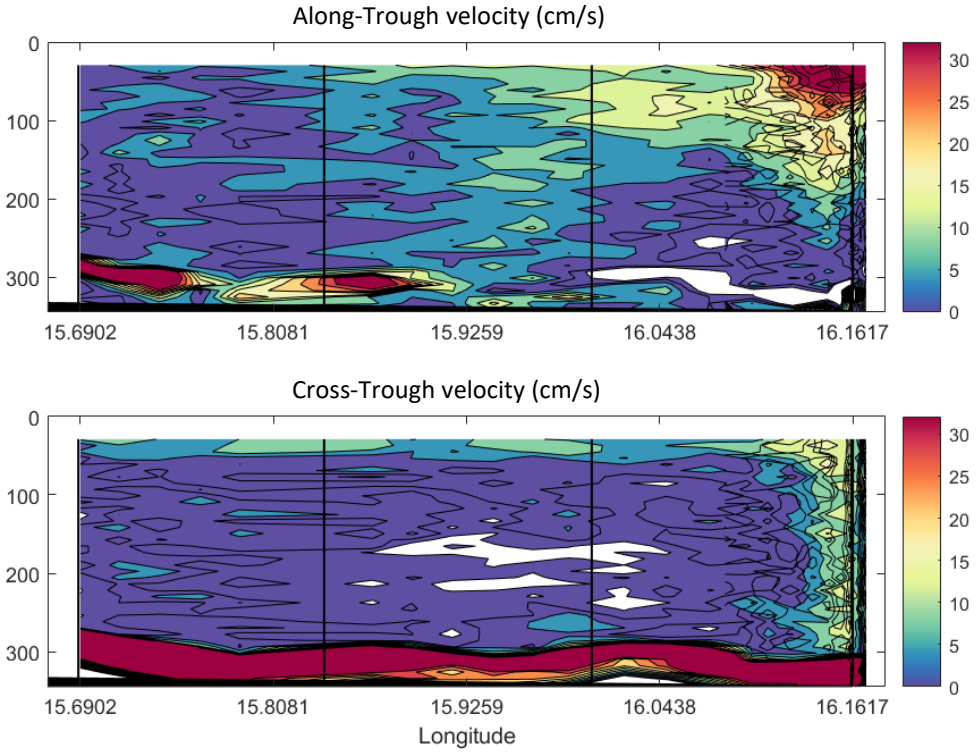


*Fig. 7: ADCP data from transect along (top panel) and across (bottom panel) Hinlopen Trough. Amplified current direction in the bottom part of the water column (dark red) is noise due to interaction with the seafloor and turned off bottom-track.*

## 4.3 CTD (Benedicte Ferre and Knut Ola Dølven)

The CTD (Conductivity, Temperature, Depth) sensors measure the physical properties of seawater. In addition to measuring the conductivity, temperature and pressure (from which depth is calculated), the CTD sensors can measure or calculate salinity of seawater, density, P-wave velocity, turbidity, fluorescence/chlorophyll, and oxygen content. R/V Kronprins Haakon uses the SBE 911plus CTD to produce vertical profiles of seawater properties. A winch lowers the CTD system into the water at 1 m/s. The CTD sensors record data at a rate of 24 samples per second. A total of 12 × 10-liters Niskin bottles are attached to the CTD instrument set up to collect water samples from chosen depth. A single conductor cable supplies power to the system and transmits data from and to the CTD system in real time. We performed 38 CTD casts during the cruise (Appendix 2).

Together with the ADCP data, CTD transect performed across the Hinlopen Trough (Fig. 2 and Fig. 7) showed the ocean current regime and hydrography described in Menze et al. (2020). Warm Atlantic water occupied the lower parts of the water column, while slightly cooler and fresher warm Polar Surface Water occupied the uppermost part of the water column.

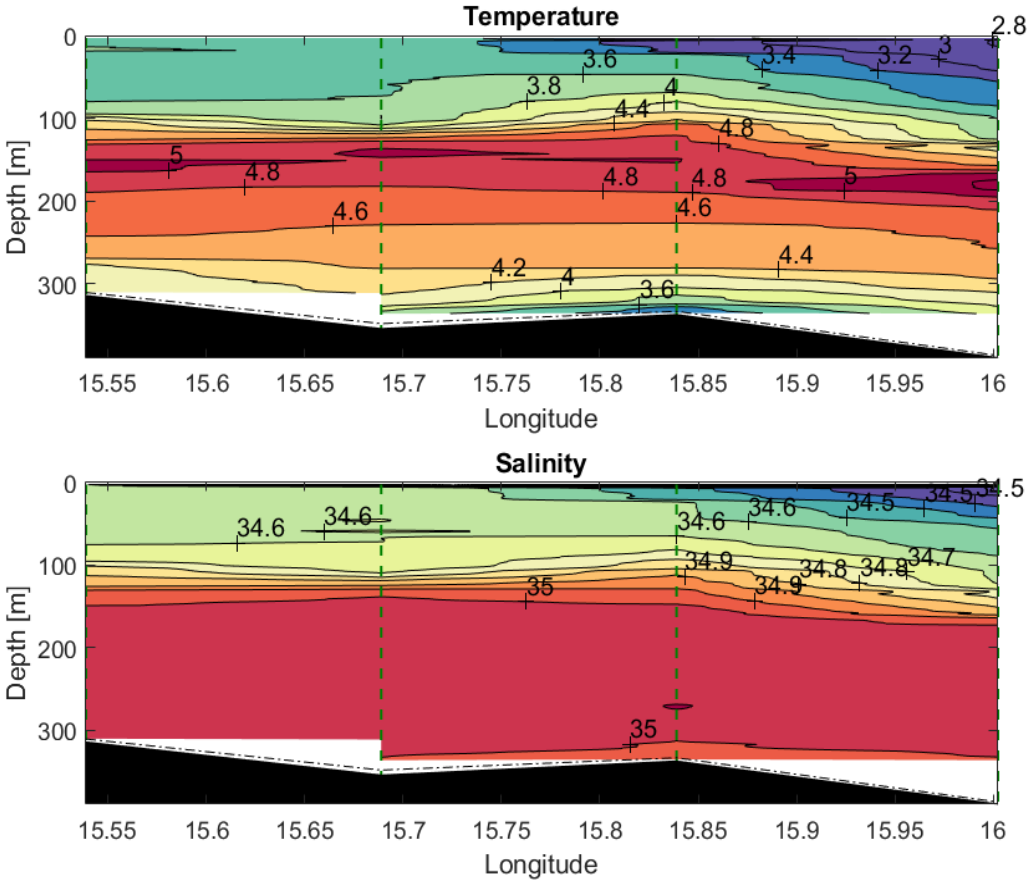


*Fig. 8: Temperature and Salinity of transect across Hinlopen Trough looking northward (from West (left) to East (right)). Green vertical lines show position of CTD stations. Interpolation was done using cubic spline interpolation.*

### 4.3.1 Water sampling for methane concentration

To prepare water samples for measurements of methane concentrations we applied the conventional headspace gas extraction technique. Water samples were collected bubble free into 120 ml crimp seal bottles, and poisoned with 1 ml NaOH solution. In exchange with sampled water 5 ml of nitrogen gas was added and the bottles were vigorously shaken to facilitate equilibration of dissolved and headspace gas. 288 Bottles were kept in the fridge (5 °C) until analysis back in Tromsø with the Gas Chromatographer – FID at CAGE.

### 4.3.2 Incubation experiment at the Norskebanken flares (Muhammed Fatih Sert)

Our previous observations at Arctic seeps showed that dissolved organic matter (DOM) composition are more bio-labile and chemically diverse comparing to the non-seep areas. Continuous methane flux from the seeps and consequent microbial oxidation by methane oxidizing bacteria were implied as the most possible mechanism that create differences in composition. In order to verify previous observations, investigate underlying mechanisms that create compositional difference between seep

and non-seep sites, and identify the microbial community that are responsible from the proposed mechanism, a three-day incubation experiment was planned and carried out at the seep and non-seep sites of the Norskebanken area.

Water samples for incubation medium were taken from Niskin bottles mounted on the CTD rosette system, following the samples for methane concentration and MOx rate. Then 12 L of seawater were taken into 12 x1 L glass bottles. Four of these bottles were treated immediately to represent $t_0$ characterization for the incubation. Other four bottles were immediately placed in the incubator at 4°C and dark conditions. Bottles were placed horizontally to prevent any gas exchange. The last four bottles were added methane from the rubber septa of the bottle caps. Same incubation setup were carried out in both seep and non-seep sites. There were therefore 24 bottles used in total (Fig. 9).

From $t_0$ bottles, nutrient and dissolved organic carbon samples were collected and placed in the freezer. For flow cytometry, 1.8 ml samples taken from the bottles and 90 uL glutaraldehyde were added to stop any microbial activity. Dissolved oxygen concentrations were measured after 6 hours of collection by fiber optic oxygen sensor through septa on the bottle caps. Then, the remaining waters were filtered through 0.2 um poresized filter for DNA/RNA sampling. All the collected filtrate were then treated for solid phase extraction (SPE). The same methodology applied after 72 hours for the $t_{final}$ incubation bottles.

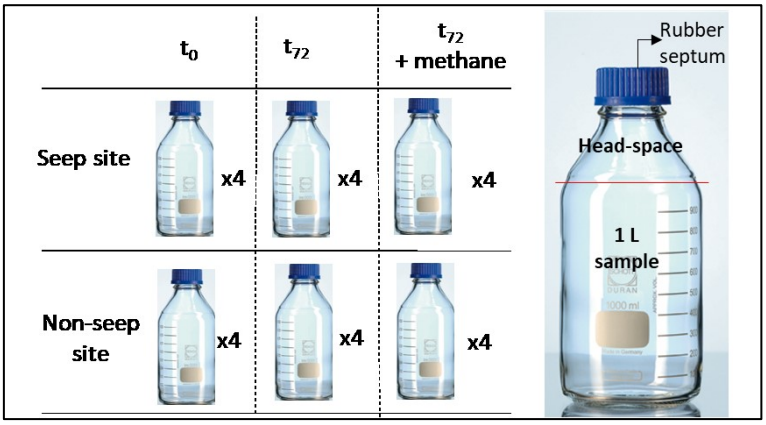


*Fig. 9: Shematic representation of the incubation setup and incubation bottles.*

The methodology for SPE of DOM is modified from Dittmar et al. (2008). Briefly, styrene diviniyl benzene polymer type of cartridges (Bond Elut, PPL, ENV) were conditioned by 6 ml of methanol and rinsed respectively with 12 ml of milliQ, 6 ml of methanol and 12 ml of pH2 milliQ water. Then, acidified seawater samples were flushed through the conditioned cartridges. After the sample, cartridges were rinsed by 12 ml pH 2 milliQ water. 2 ml of methanol were used for final elution of the sample. The samples will be kept in -20 °C freezer until further analysis.

### 4.3.3 In-situ pumps and methane oxidation rates (Tim de Groot)

*Fig. 10: Tim de Groot near one of the pumps, ready to be deployed from the plankton net cable*

During the cruise, the water column was sampled for molecular analysis, methane concentrations and methane oxidation rates (MOx) (Appendix 2). Two in-situ devices developed at NIOZ (Fig. 10) allowed to pump a large volume of water over a 147mm filter at two depths resulting in highly concentrated biomass. One pump was always 5m above the seabed while the second pump was above the line of stratification, i.e. close to the sea surface. After the pumps were retrieved, the filter was cut in three sections so that it can be used for various purposes: i) to study lipids with focus on methanotrophs, ii) for DNA to gain knowledge about the local community and iii) to simulate Arctic biological community. For this third purpose, 3L of seawater was added to create a superficial arctic community. With this 'fake' arctic community, lab incubations were set up at various conditions (temperature, pH, salinity, and various concentrations of methane) to get a better understanding about methane consuming bacteria at these sites. Besides the in-situ filtration, MOx and Methane samples were taken using Niskin bottles to see at what rates methanotrophs consume methane in these seep areas. The main goal is to compare different seepage sites with additional data collected to see whether there is a link between sediment bacterial and water column communities.

## 4.4 Sediment, pore water and gas sampling (Claudio Argentino)

### 4.4.1 Gravity Core

The main objective of the coring was twofold: 1) collect sediment samples that will define the lithostratigraphy and type of sediments and minerals, in order to reconstruct the paleoenvironmental, geological and seep activity of the site. This will be done through the analysis of sediment geochemistry (X-Ray, XRF, mag.sus. and micropaleontological investigation. 2) Acquire samples for pore water and gas in the sediment analyses. The core locations were chosen where gas flares are registered in the water from single and multibeam profiles and from reference non-seep areas. We collected a total of 8 gravity cores (Fig. 11, Appendix 3). Sediment in the core-catcher was collected for every core (if present) and placed into plastic bags and kept in the cooling room at 4˚C. After retrieval, the plastic liners were cut into 1 m-sections, sealed with plastic caps, taped, labelled and stored at 4˚C. Plastic liners were drilled using 3 mm drill bits for further pore water sampling. Cores CAGE20-7-KH-01-GC-01, CAGE20-7-KH-01-GC-03-#1,#2, CAGE20-7-KH-02-GC-07-#1, #2, #3 were stored in the freezer at -20˚C as archive cores. Cores CAGE20-7-KH-01-GC-04-#1,#2, CAGE20-7-KH-02-GC-08-#1,#2,#3,#4,#5, CAGE20-7-KH-02-GC-06-#1,#2,#3 were stored in the cooling room at 4˚C.

*Fig. 11. Gravity corer used during the cruise. The barrel is 6 m-long and hosts a plastic liner with outer diameter of 12 cm.*

### 4.4.2 Multi core

We conducted a total of 9 multi core operations (Fig. 12, Appendix 3). Prior to coring operations, plastic liners were drilled using 3 mm and 1,5 cm drill bits for pore water and bulk sediment sampling (for headspace gas analysis), respectively. We maintained a 2 cm sampling resolution for pore water holes and 5 cm for larger holes. After retrieval, the plastic liners were sealed with plastic caps, taped, labelled and stored at 4˚C. Cores CAGE20-7-KH-01-MC-03-#1, CAGE20-7-KH-01-MC-03-#4, CAGE20-7-KH-02-MC-09-#2 were stored in the freezer at -20˚C as archive cores. Cores CAGE20-7-KH-01-MC-05-#1,#2 were stored in the cooling room at 4˚C.


*Fig. 12. Multi corer (frame 180x125x100cm) hosting 6 core liners (inner diameter 10cm, length 80cm).*

### 4.4.3 ROV Blade cores and push cores

We used the ROV to collect visually-guided sediment samples (See description of the ROV in section 5). We collected 7 push cores and 8 blade cores from seep areas and reference background areas (Fig. 13, Appendix 4). The blade corer frame has an automatic closing mechanism at the bottom to avoid sample loss. Push core and blade core liners were pre-drilled for pore water sampling with a resolution of 1-2 cm.

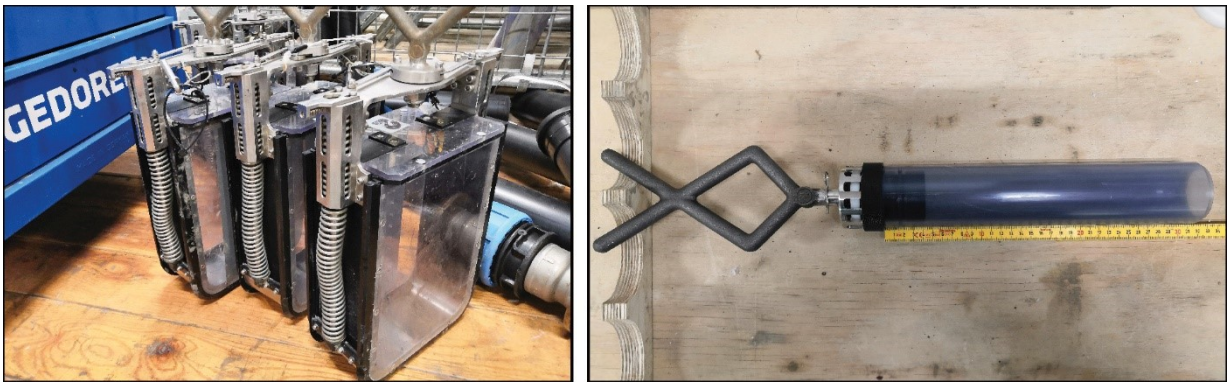

*Fig. 13. Blade corers (left) (frame 25 x 10 x 32 cm) and push corer (right) (inner diameter 5 cm, length inner cavity 28 cm) used during visually-guided sediment sampling with the ROV.*

### 4.4.4 Pore water and gas in the sediment

All pore water and gas sampling were conducted in a cooling room at 4 ˚C. Pore water was extracted by pressure filtration through 0.2 μm cellulose acetate filters. Rhizons with 10 ml syringes attached were inserted into the 3 mm holes and spacers were utilized to create a vacuum inside the syringes. We used 5-cm long rhizon filters. Around 190 pore water samples were collected and then split into 2 aliquots: 1) subsamples for DIC analysis (1 ml) were transferred to 1.5 ml micro tubes with screw caps and we added 10 μl of $HgCl_2$ to stop microbial activity. 2) Subsamples for sulfate analysis (> 1 ml) were transferred to 5 ml Eppendorf tubes. Subsamples for DIC analysis were stored at 4˚C, whereas subsamples for sulfate analysis were kept frozen at -20˚C.

Bulk sediment samples for headspace gas were collected using 5 ml syringes without the luer tip. Samples Sediment was transferred into a 20 ml serum vial containing two glass beads and added 5 ml of 1M NaOH to stop microbial activity. The vial was immediately closed with a rubber septum, sealed with an aluminum crimp cap and shaken. A total of 39 sediment samples for headspace gas analysis were collected. Samples were stored at 4˚C.

During this cruise we also used vacutainers. Vacutainers are sterile tubes (plastic or glass) with a rubber stopper (Fig. 14). The vacuum inside of the tube facilitates the drawing of liquids from the sediment that are eventually collected into the tube. With this method it is possible to analyze both the pore water composition and the headspace gas after equilibration at 25˚C. We sampled pore fluids from multi core CAGE20-7-KH-01-MC-05-#2 using vacutainers.

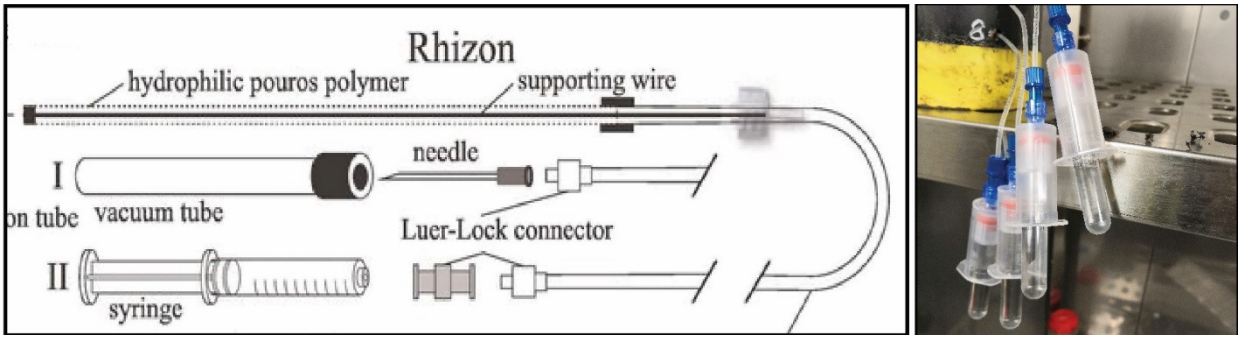


*Fig. 14. Scheme illustrating the equipment used for pore water sampling using vacutainers and syringes (picture on the left). Picture of the vacutainers we used during this cruise (picture on the right).*

**Porosity**
For porosity measurement, we collected 5 ml of bulk sediment using a 5 ml cut-off syringe from blade core CAGE20-7-KH-Dive18-BlaC-04. Five samples were collected from 5 stratigraphic intervals and transferred to Eppendorf tubes. Porosity will be determined from the water loss per volume of sediment upon drying.

**Biomarkers**
Samples for biomarker analysis were collected from blade cores CAGE20-7-KH-Dive18-BlaC-01, CAGE20-7-KH-Dive18-BlaC-02, CAGE20-7-KH-Dive17-BlaC-03, CAGE20-7-KH-Dive13-BlaC-01 and CAGE20-7-KH-Dive13-BlaC-03. Around 30 ml of sediment were collected using a spatula cleaned with ethanol. Samples were wrapped in aluminum foil, put into a zip lock bag and stored in the freezer at -20˚C.

**Macrofauna**
During subsampling of sediment of multi cores and blade cores, macrofauna specimens were isolated and put in plastic jars and fixed in 96% ethanol for DNA analysis. After 24 h, we replaced the ethanol in the jars with new ethanol. Samples were collected from ROV Dives 8, 13 and 17 and multi cores CAGE20-7-KH-01-MC-03-#2 and CAGE20-7-KH-01-MC-05-#3.

## 4.5 Micropaleontology (Giuliana Panieri)

### 4.5.1 Micropaleontology

For the characterization of the foraminiferal associations, sediment samples were collected from 9 multicorers (Appendix 3) and 5 blade-corers (Appendix 4). At each station, one sample from 0-1 cm was taken and fixed with Cell Tracker Green (CTG), and one from 0-2 cm was taken for eDNA for benthic monitoring. When possible, the sediment from 1-2 cm was collected and placed in labelled leak proof bottles with in situ sterile sea water.

### 4.5.2 eDNA for benthic monitoring

The protocol for sampling sediment eDNA for benthic monitoring according to ID-Gene ecodiagnostics (Geneva, Switzerland) was used to determine the biodiversity of foraminifera. Sediment was sampled using a sterilized spoon kept in a sterilized plastic bag, fixed with Life Guard TM (QIAGEN, ref. 12868-1000) solution for preserving eDNA, and stored to the freezer (-80°C).

### 4.5.3 DNA sampling (Agensi project)

This protocol is based on previous sampling campaign on KPH in 2019 with CAGE by Danielle Grant and Kristine Steinsland. For full details see CAGE19-3 2019 Cruise Report. The samples were taken using a sterile spoon to sample surface sediments at 0-1 cm and 1-2 cm depth, while being careful not to take sediment in contact with the core liners. The samples were collected in 80 or 40 ml labelled leak proof bottles. For each samples a close labelled bench control was kept.

### 4.5.4 Cell Tracker Green - CTG labelling

The samples used for CTG were treated with a method based on enzymatic reactions to distinguish living foraminifera (Bernhard et al., 2006; Pucci et al., 2009; Langlet et al., 2013, 2014). One milligram of Cell-Tracker™ Green (CTG 5 CMFDA: 5-chloromethylfluorescein diacetate) was dissolved in 1 ml of dimethylsulfoxide (DMSO) and diluted by 10 in situ sterile sea water. Samples were incubated for 20-30 h at *in situ* temperature without light in a solution of seawater, with a CTG final concentration of 1 micromol L-1, as described by Bernhard et al. (2006). During this time, CTG passes through the cellular membrane of living organisms, and reaches the cytoplasm where hydrolysis with nonspecific esterases creates fluorogenic elements. After the death of the cell, esterases are decomposed in a

few hours to some days at maximum, depending on environmental conditions (Bernhard et al., 2006), making the CTG method highly accurate to discriminate between living and dead organisms. After incubation, the samples were fixed in 96% ethanol and stored at 5 degree Celsius temperature.

## 4.6 Microbiology (Dimitri Kalenitchenko)

### 4.6.1 Methods and onboard analyses

**Samples collection**

Cold seeps environments are characterized by methane fluxes from reservoirs below the seabed to the water column. This source of carbon can be converted by bacterial/archaeal consortium into hydrogen sulfide. Thereafter, hydrogen sulfide become a source of energy for free living or symbiotic bacteria. For this cruise, we investigate the microbial community that occurs at methane flares. We combined precise sediment sampling using pushcorers and bladecorers deployed by the ROV with *in situ* water filtration (4.3.3) and seeping gas collection. Multicorer, deployed from the ship was used when the ROV was not able to collect samples or to collect reference cores. All samples collected including sampling depth are listed in Appendix 4.

**Sediment sample treatment**

All cores collected (push and multicorer) were profiled using microelectrodes reacting to hydrogen sulfide pH and oxygen. Then, we sliced the core every cm for the first 10 cm and then every 4 cm until the bottom of the core. Each of the core sampled for microbiology has a sister core were porewater composition and methane concentration will be measured (4.4). Blade corers were sampled using cutoff syringes following a 2 cm grid (Fig. 15). All samples were frozen after collection (-80ºC)


*Fig. 15. Microbiology sampling strategy for blade core samples.*

**Microprofiles**

One core from each mutlicorer deployment (see Appendix 3 for details) was transferred immediately after recovery of the sediment in a temperature-controlled room (6 ºC) to measure the chemical profile of $O_2$, $H_2S$ and pH within the sediment. The microprobes used were:

- A miniaturized 100 µm width Clarks type electrode for the oxygen profile.
- A miniaturized 100 µm width glass $H_2S$ amperometric sensor with built in internal reference, sensing and guard anode. The sensor signal is generated by the re-oxidation at the sensing

anode of the ferrocyanide that is formed by the oxidation of $HS^-$ ions by ferricyanide in the probe alkaline electrolyte.
- A miniaturized 100 µm width glass PH electrode with an electrical potential relative to the reference electrode that reflects the acidity of the sample.

All probes were calibrated before and after each profile.

**Gas samples treatment**
We collected 3 gas samples at superstation 1, 2 and 4 using the bubble catcher. 2 bottles containing 0.142 L of gas (~ 30 bar) were filtered through a sterile polysulfate cartridge (Sterivex, Millipore) and frozen after collection)-80ºC . The extra bottle was kept at 4ºC and the gas composition will be analyzed on shore.

### 4.6.2 Future work

We will extract the DNA and the RNA from 2 grammes of each of the 162 samples collected. Nucleic acids will then be sequenced using specific primers targeting Bacteria and Archaea to reveal the microbial community diversity in the sediment surrounding the flare and within the gas. In collaboration with Tim de Groot (NIOZ) we will track the flare signature in the water column.

## 5 ROV ÆGIR6000

The ROV ÆGIR6000 is a SUPPORTER 2-type ROV from Kystdesign in Aksdal, Norway (Fig. 16). The ROV has a total combined power of 115 Kw, a depth rating of 6000 m and is maneuvered by 7 thrusters. Its dimensions are (LxBxH) 2.75 m x 1.7 m x 1.65 m and it weighs 3600 kg in air. The ROV can carry a payload of 400 kg and has two strong manipulators arms. 8 HD and composite video camera inputs provide full vision of operation and partly have zoom and focus capability. The lighting capacity includes ten dimmable lights and has a maximum total load of 2300W. The SUPPORTER 2 can accommodate up to 24 additional hydraulic tooling functions, up to 21 additional survey sensors and 8 camera connectors. All hydraulic functions are proportionally controlled, and all electrical power supplies are ground fault monitored. The ROV control system offers a variety of auto-functions like AutoPOS and AutoTRACK capabilities. The control pod and telemetry system for survey operations works via up to 6 fiber optic cables. The umbilical cable on RV Kronprins Haakon provides 4 fiber optic cables. In addition to the video feed, the system is capable of supporting several additional communication channels both serial and Ethernet.

The ROV is equipped with an EM 2040 multibeam echo sounder for deep water multibeam mapping of the near bottom sounding environment in great detail. The basic EM 2040 has a transmit transducer, a receive transducer, a processing unit and a deck-side processing computer. The EM2040 operates at 200 – 400 KHz, with 400 beams in single-swath mode offering 0.4 x 0.7 degree angular resolution. A swath angle of up to 140 degrees can be reached providing a maximum coverage of 4 to 5 times the water depth. During the cruise, the maximum swath width varied between 60 and 70 degrees on either side in order to improve data quality and reduce the amount of noisy data at the outer beams. The ROV flew approximately 10 m above seafloor in the Norskebanken area and about 20 m above seafloor in Hinlopen Trough and offshore Prins Karls Forland, obtaining a data resolutions not lower than 25 cm.

The ROV is equipped with a large drawer to store sample material during dives. Aside from the manipulator arms providing the opportunity to take direct carbonate or rock samples, the ROV ÆGIR6000 provides a number of sampling tool, most prominently push coring device that can take up to 28 cm long sediment cores with a diameter of 5 cm (Fig. 13). Another device is the blade corer that can sample a larger rectangular area of approximately 20x12 cm and has an automatic closing

mechanism ensuring that sediments could not be lost during retrieval of the sediments (Fig. 13). Manipulators allowed also to precisely use a checkerboard to measure bubble sizes and rising speed, to deploy the hydrophone and to locate the bubble catcher in the proper position.


*Fig. 16. ROV ÆGIR6000 and TMS system, ready to be deployed from the moon pool.*

# 6 ROV ÆGIR6000 DIVES (ALESSANDRA SAVINI AND BENEDICTE FERRE)

A total of 30 ROV dives were conducted with the ROV ÆGIR6000 during the CAGE 20-7 cruise: 14 at the Norskebanken area (from Dive 1 to Dive 15) between 150 and 170 m water depth; 8 in the Hinlopen Trough between 330 and 350 m water depth, 4 at the slope edge offshore Prins Karls Forland between 350 and 380 m water depth, and 1 in the Adventfjorden at 110 m depth (see pictures in the narrative and coordinates in Appendix 4). Each of the dives had different objectives such as seafloor inspection, validation and sampling of flares extracted from multibeam surveys performed from the ship, microbathymetry and video mapping. Onboard multibeam data processing (bathymetry and backscatter) basically involved corrections for tide effects obtained from the TPXO web service (Egbert and Svetlana, 2002) and data cleaning for removing noise and artefacts. DTMs (Digital Terrain Model) and acoustic backscatter image were provided at a 25 cm grid spacing. All measurement and sampling were performed using the manipulated arms from the ROV. They include coring, gas sampling, hydrophones deployment and bubble information from the checkerboard. All information is reported in Appendix 4.

## 6.1 ROV dives at Norskebanken

We selected two subareas to investigate and sample the Norskebanken area: one located in the northwest, where several flares were detected by the vessel-based MBES survey, and one in the southeast, where a clear flares was mapped at 175 m depth (red circles in Fig. 1, Appendix 4).

**ROV DIVE 01**

ROV AEGIR6000 carried out the first ROV-based multibeam survey of the cruise during DIVE01 to the southeast of the Norskebanken area. The survey was performed at 10 m above the seafloor on an almost flat seabed, from 176 to 178 m deep, and along 4 survey lines (oriented SW-NE), each roughly 0.6 km long and spaced from 30 to 70 meters from each other (Fig. 17). The survey took ~ 3 hours to cover a total area of 0.15 km$^2$ and provided a full bathymetry and acoustic imagery coverage.

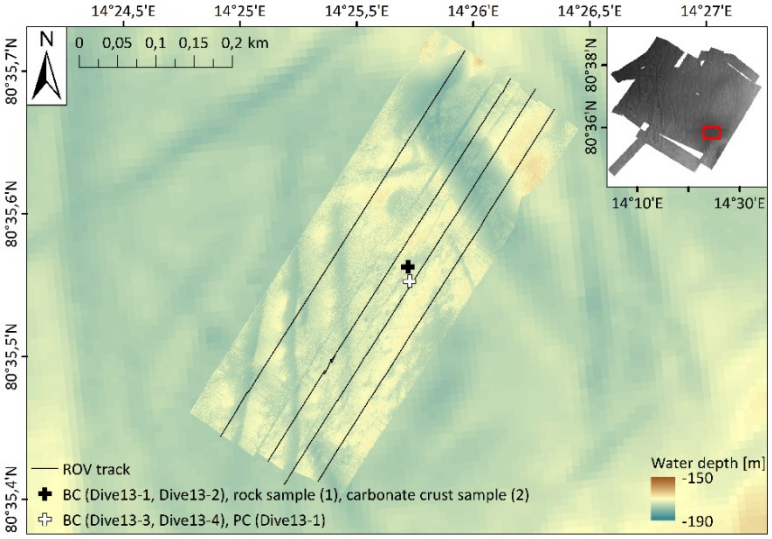


*Fig. 17. Microbathymetry acquired from the ROV-mounted multibeam during dive 01. Specific sampling performed during different dives are also indicated. The inset map shows the global bathymetry acquired from the ship-mounted EM710 and the red square highlights the area covered by the ROV. BC: Blade core; PC: push core.*

**ROV DIVE 02**

The second ROV-based multibeam survey was carried out during DIVE02 to the northwest of the Norskebanken area. The survey was performed at 10 m altitude above an almost flat seabed, from 168 to 174 m deep, and along a set of 3 survey lines (oriented WSW-ENE), each roughly 1.3 km long spaced by between 60 and 70 m. The survey took 3 hours to cover a total area of 0.35 km$^2$ and provided a full bathymetry and acoustic imagery coverage (Fig. 18).

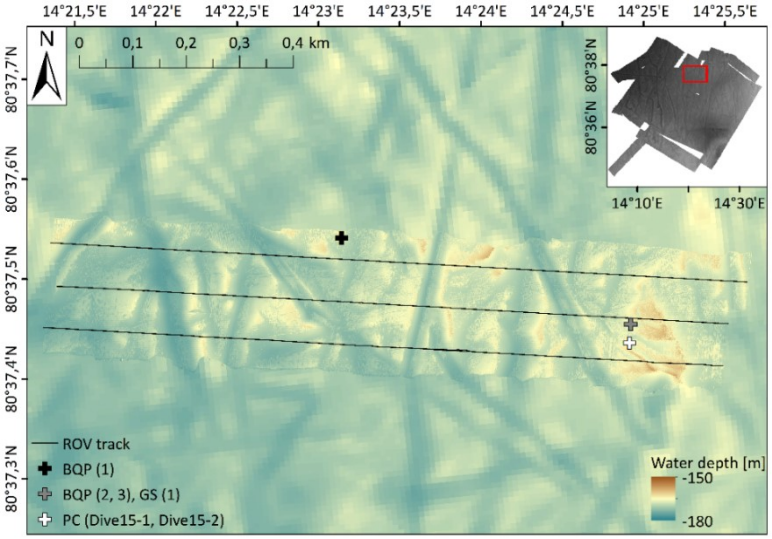


*Fig. 18.Microbathymetry acquired from the ROV-mounted multibeam during dive 02. Specific sampling performed during different dives are also indicated. The inset map shows the global bathymetry acquired from the ship-mounted EM710 and the red square highlights the area covered by the ROV. BQP: Bubble quantification panel; GS: Gas sampler; PC: push core.*

**ROV DIVE 03**

We acquired video footage through a bottom-oriented camera over two closed restricted sectors of the northwestern area, where ROV-MBES survey was performed during DIVE02. Track-lines of DIVE03 were designed to obtain a photomosaic on some of the targets from the microbathymetry and assumed to be associated to flares. Video footage were thus acquired along 60 m long parallel lines, spaced 2 m from each other, at constant speed of 0.5 kn and altitude of 2 m, in order to obtain a field of view slightly larger than 2 m. The survey took almost 3 hours to cover 2 small sectors of the seafloor, extended 720 $m^2$ and 600 $m^2$ (Fig. 19). Real-time and onboard observations of the surveyed lines did not reveal any place with active emission of gas bubbles from the seafloor. Only few areas with bacterial mats were detected and thus selected for further sampling operations.

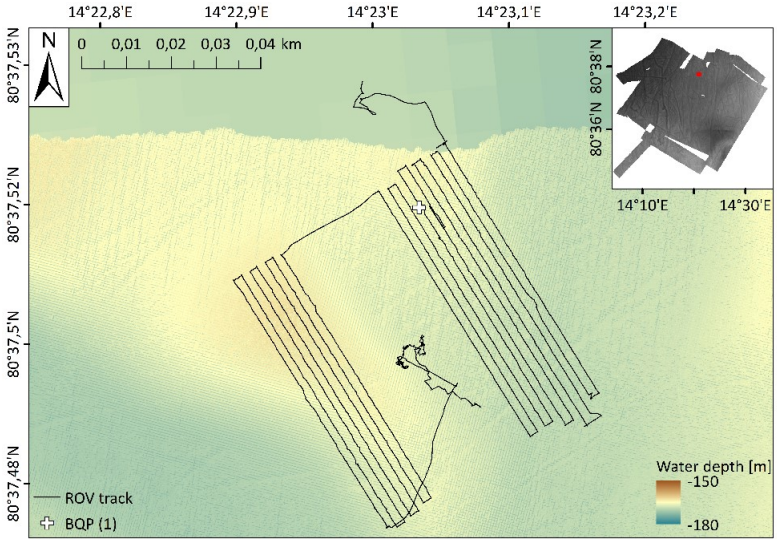


*Fig. 19. ROV track for the photomosaic during dive 03. Specific sampling performed during different dives are also indicated. The inset map shows the global bathymetry acquired from the ship-mounted EM710 and the red square highlights the area covered by the ROV. BQP: Bubble quantification panel.*

**ROV DIVE 05**

We acquired video footage through the bottom-oriented camera over two closed restricted sectors of the south-eastern area of Norskebanken, where ROV-MBES survey was performed during DIVE01. Track-lines of DIVE05 were designed in order to obtain a photomosaic on some of the targets detected on the microbathymetry and assumed to be associated to a big flare (Fig. 20). Video footage were thus acquired along 60 m long parallel lines, spaced 2 m from each other, at constant speed of 0.5 kn and altitude of 2 m, in order to obtain a field of view slightly larger than 2 m. The survey took almost 3 hours to cover 2 small sectors of the seafloor, extended 840 $m^2$ and 1200 $m^2$. Real-time and onboard observations of the surveyed lines supported the identification of gas bubbles, to detect the position for further integrated sampling missions.

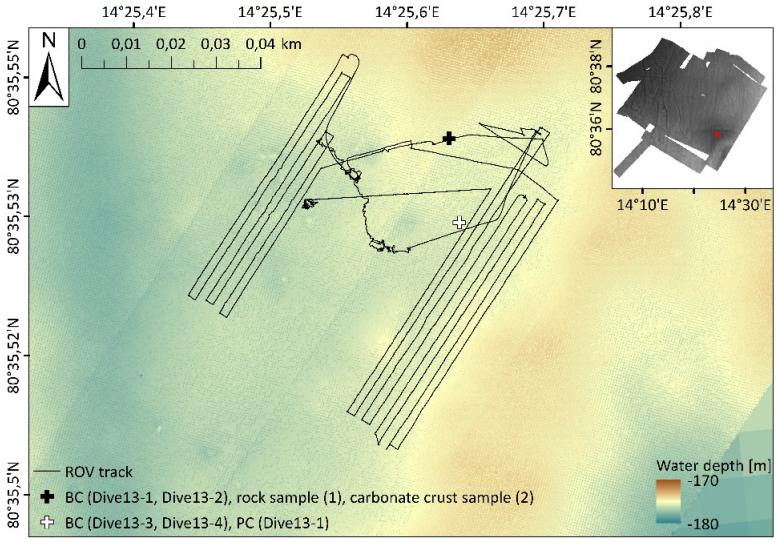


*Fig. 20. ROV track for the photomosaic during dive 03. Specific sampling performed during different dives are also indicated. The inset map shows the global bathymetry acquired from the ship-mounted EM710 and the red square highlights the area covered by the ROV. BQP: Bubble quantification panel.*

## 6.2 ROV dives in Hinlopen Trough

The Hinlopen Trough was explored at three main locations where relevant flares were detected during MBES survey (Fig. 2).

**ROV DIVE 23**

ROV AEGIR6000 carried out an ROV-based multibeam survey to the western sector of the Hinloppen Trough, between 330 m and 370 m depth. The survey was performed at 20 m above an almost flat seabed along 5 parallel survey lines (oriented NW-SE), each roughly 0.6 km long and spaced about 60 m from each other. The survey took almost 4 hours to cover a total area of 0.20 km$^2$ and provided a full bathymetry and acoustic imagery coverage (Fig. 21).

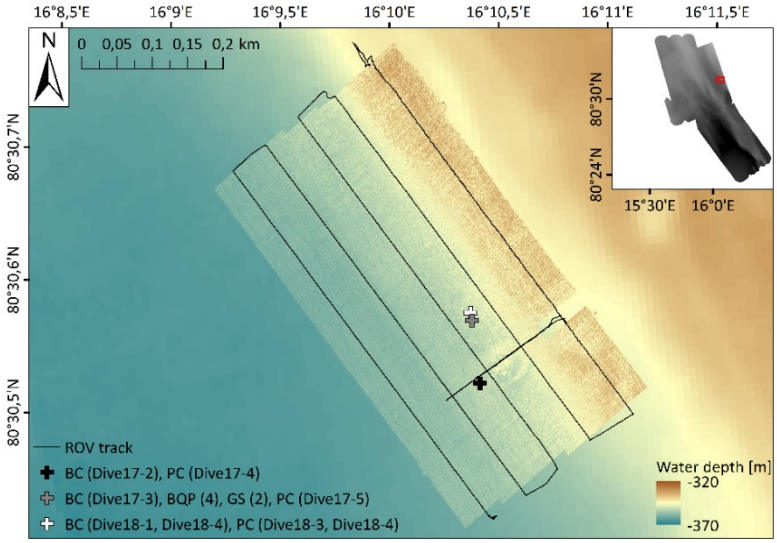


*Fig. 21. ROV track for the photomosaic during dive 23. Specific sampling performed during different dives are also indicated. The inset map shows the global bathymetry acquired from the ship-mounted EM710 and the red square highlights the area covered by the ROV. BQP: Bubble quantification panel; BC: Blade core; PC: push core.*

## 6.3 ROV dives offshore Prins Karls Forland

The area was deeply explored where relevant flares were detected during MBES survey (Fig. 3).

**ROV DIVE 28**

ROV AEGIR carried out an ROV-based multibeam survey toward the west of the MASOX area, between 375 m and 395 m depth. The survey was performed at 20m of altitude above an almost flat seabed along 5 parallel survey lines (oriented NNW-SSE), each roughly 0.6 km long and spaced between 65 and 75 meters from each other. The survey took almost 4 hours to cover a total area of 0.22 km$^2$ and provided a full bathymetry and acoustic imagery coverage (Fig. 22).

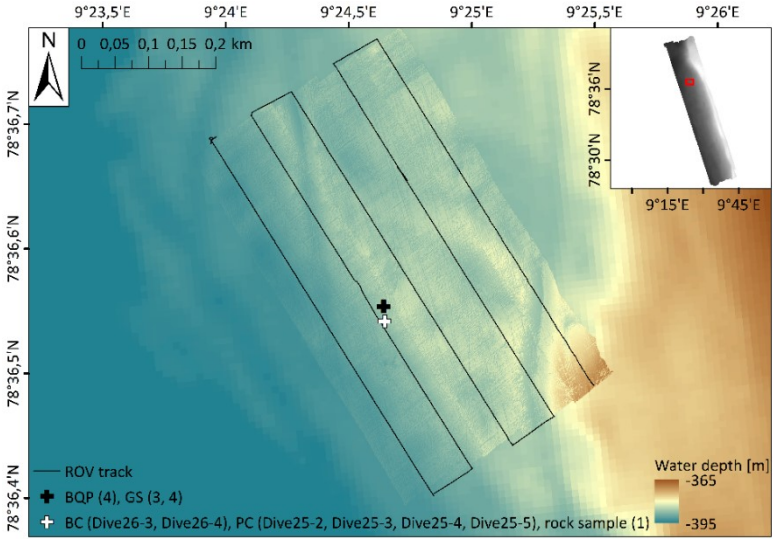


*Fig. 22. Microbathymetry acquired from the multibeam mounted on the ROV during dive 28. Specific sampling performed during different dives are also indicated. The inset map shows the global bathymetry acquired from the ship-mounted EM710 and the red square highlights the area covered by the ROV. BQP: Bubble quantification panel; GS: Gas sample; BC: Blade core; PC: push core.*

**ROV DIVE 29**

We acquired video footage offshore Prins Karls Forland during DIVE 29 through the camera oriented towards the bottom, over a restricted sector of the microbathymetry acquired at the MASOX area. Track-lines of DIVE29 were designed in order to obtain a photomosaic surrounding the area sampled during dives 25, 26 and 27. Video footage were acquired along 50 meters long parallel lines, spaced 2 m from each other, at constant speed of 0.5 kn and altitude of 2 meters, in order to obtain a field of view slightly larger than 2 m. The survey took almost 3 hours to cover a small sector of the seafloor, extended 500 m$^2$ (Fig. 23).

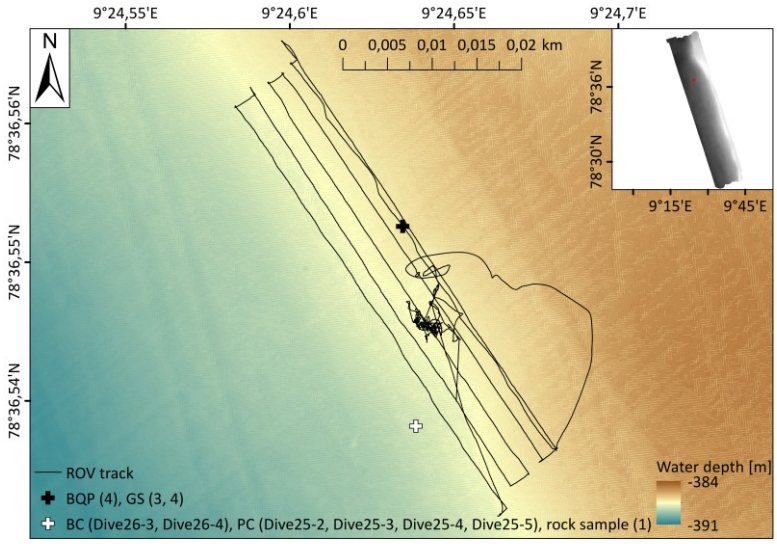


*Fig. 23. ROV track for the photomosaic during dive 29. Specific sampling performed during different dives are also indicated. The inset map shows the global bathymetry acquired from the ship-mounted EM710 and the red square highlights the area covered by the ROV. BQP: Bubble quantification panel; GS: Gas sample*

# 7 CRUISE NARRATIVE

The times specified here are in local time. ROV dive numbers are referred to with #.

November 2nd 2020

We left Longyearbyen at 18:00. All the equipment was already loaded when the ship was in Tromsø on October 10th so little needed to be done prior departure. We had to rearrange some boxes that were buried behind the previous cruise's equipment but the crew was very helpful and efficient.

November 3rd 2020

When we opened the boxes, we discovered that some have been damaged with water. Some work clothes were wet and card boxes were moldy, but most importantly the box containing the GC was flooded. We do not know at this stage if it is fixable. We performed an ROV test at 13:00 and left toward the area at 14:40 after a successful test. After a rough transit with winds up to 15m/s and high waves, we arrived on the site at Norskebanken at 11:00. The sea conditions were too rough to perform a CTD cast for the sound velocity profile, so we immediately started the multibeam survey and will correct the data afterwards.

November 4th 2020

We located two areas to explore based on the ship multibeam data. The flares were quite small in the entire area except a large one on the south east. We decided to perform 2 microbathymetry around this flare (#1) and another one on the North West (#2). The first survey started at 10 am, and we headed for the second area at 14:20. The second survey started at 15:25. ROV on deck at 20:50. Chirp test. We moved to the 1st CTD is at 21:15, the last CTD was on over at 1:45.

November 5th 2020

We performed a short chirp line to locate an area without flare for reference gravity and multicore. However, the seafloor was too gravely and only 50 cm of gravity core could be collected. The

multicore did not penetrate the sediment surface. After three attempts and one broken liner, we decided to perform multibeam lines. We performed a CTD over the same reference site at 8:50, and deployed the 2 pumps from NIOZ for DNA using the cable from the plankton net at 9:10. The entire operation was over by 10:00. ROV down for video mapping (#3) at 11:00 around the CTD transect location. After 4 hours, we went to the second site (#4) on the south to explore the area around the big flare, but the camera got detached so the ROV had to come back onboard to fix it. ROV back in the water ~17:00 (#5). The second site is softer and an appropriate location for coring.

CTDs start at 20:10 around the big flare, ending ~00:00.

November 6th 2020

We performed an EK80 line across the flares for bubble size distribution, followed by a chirp survey in order to locate an appropriate location for a multicorer and gravity core reference. Surveys finished at 7:15. Multicorer at 7:40, gravity core at 8:20. We deployed the ROV (#6) to locate a large flare based on the MB data, but we did not manage to locate it from the ROV. We further noticed that the coordinates given from the MB were not accurate and the flare was probably in a 10 m area around it. The ROV was deployed (#7) at 12:20 in the north west of our area. We reached a bubble plume at 12:52 (80.625N 14.3835), deploy the checkboard for 15 min, followed by the hydrophone (15:50). The ROV was brought back on deck to unload the hydrophone and went back down immediately (#8). The bubble catcher was filled with fish, so we had to bring the ROV back on deck to try to remove them. They got out once the ROV reached the moon pool as the water left the device. The ROV went back down and reached the seafloor at 16:20. The hydrophone was pushed aside to place the bubble catcher on top of the flare (Fig. 24), where we filled up the 3 bottles (16:35). We left the bubble catcher there while we explored another intense flare (14 24.741, 80 37.399). We discovered after coming back to the bubble catcher that the flask was barely filled (17:20), so we decided to empty it and carry all the equipment to this second flare, much more active. We collected on the way some carbonate crust (Fig. 25), two sponges (18:38) (example in Fig. 25). We deployed the checkerboard for 15min (Fig. 26), followed by the hydrophone. ROV back on deck ~20:10. We performed an EK80 survey across and along these 2 flares for bubble size estimation. We then went with the ROV (#9) to the location where we spotted an intense flare from the multibeam but never saw it with the ROV for gravity cores and multicores.

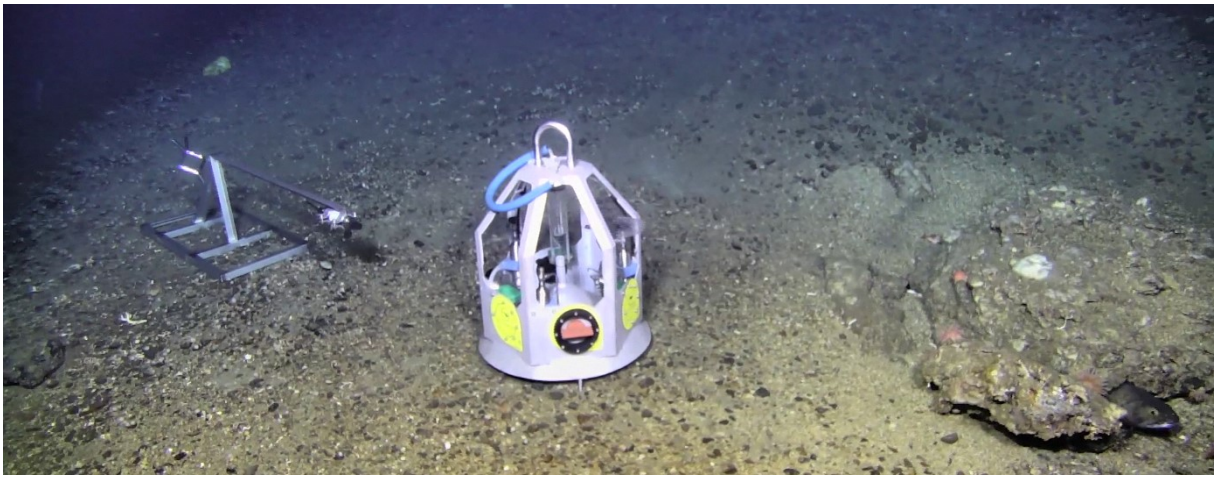

*Fig. 24. Bubble catcher (middle) and hydrophone (left)*

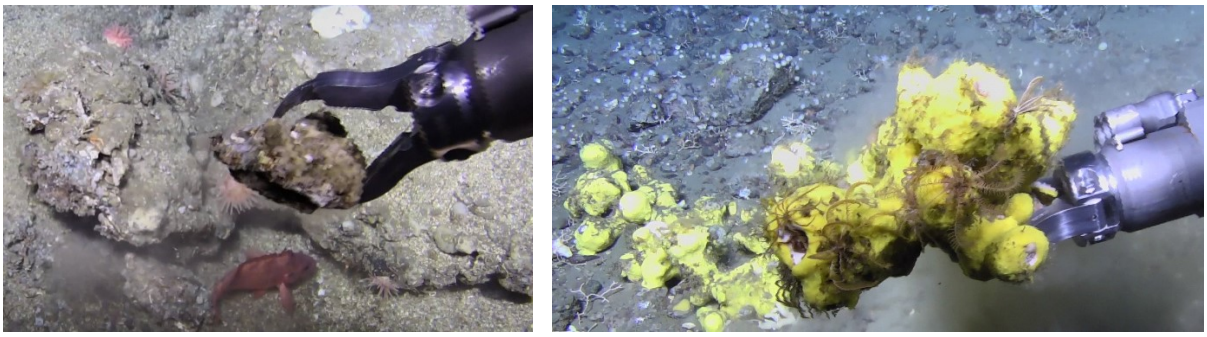

*Fig. 25. Carbonate crust (left) and sponge (right) sampled on Norskebanken*

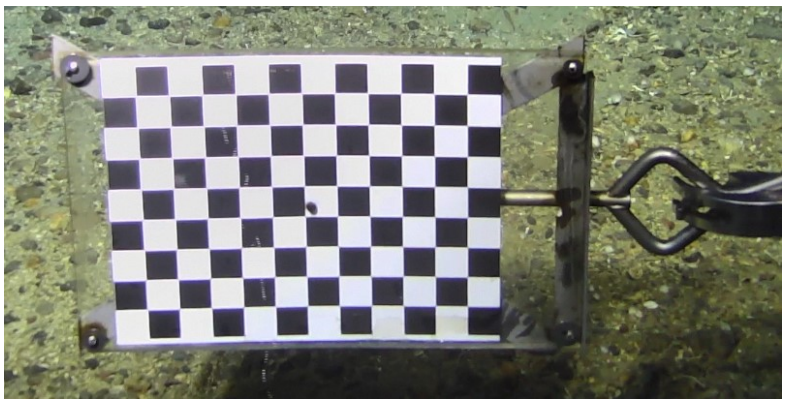

*Fig. 26. Checkerboard used to measure bubble sizes and rising speed. We can spot the bubbles rising rapidly along the black boxes towards the left.*

November 7th 2020

After the coring was finished, we went to Hinlopet for a quick multibeam survey. The ROV (#10) started the descent at 8:15, followed by the CTD for a "CTD-grab" (Fig. 27). We did the same experiment with the pump connected to the plankton net (#11) and the ROV came up at 11:00 to take the hydrophone and checkerboard (#12). The ROV came up to load the pushcorers and blade corers, and went down to the ghost flare at XXX. However, the sediment is to XXXX and the push cores came back empty. Some sediment in the blade corers (#13). We came back up to take out the corers, and came back down to move the hydrophone away for reference. The boat also changed position. Back on deck at 17:30, and in the water again at 18:20 to retrieve the hydrophone (#15, still no luck with the data). Push core at the same location. We moved to the Hinlopen Trough (superstation 2) where we noticed some nice flares, and performed 5 CTDs in a square grid around the biggest one.

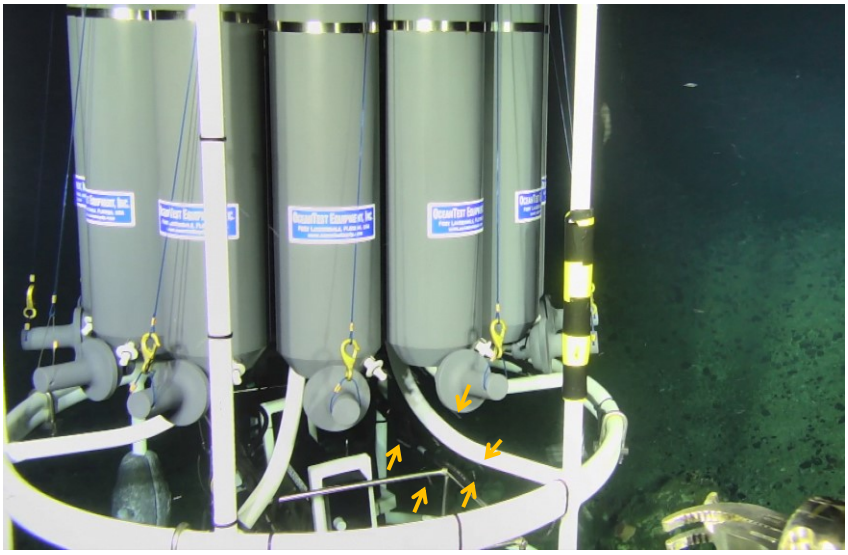

*Fig. 27. "CTD-grab" from the ROV. The bubbles are hard to see on the pictures but are indicated by the orange arrows.*

November 8th 2020

After a night of multibeam survey in the Hinlopen Trough, we came back where we did the CTD for an additional CTD followed by the NIOZ pumps. The ROV went in the water at 9:22 (#16) to dive in the same location (80 28.886 16 09.313), however the sediment in suspension hindered our view and we could not perform any sampling nor measurement. The methane sensor from the ROV showed dissolved methane near the seafloor of ~50 nmol/L. We decided to move north of this area at 12:00 (#17) to see if the sediments are more settle (80 30.533, 16 10.165), and found the seafloor covered with bacterial mats and tub worms (Fig. 28). High methane concentration of more than 400 nmol/L from the Franatech sensor. Several bubble plumes are also visible. We take 3 push cores and 3 blade cores. Back on deck for quick process of the samples and the ROV dives back (#18) at 13:35 to perform a checkerboard in 2 close bubble plumes, followed by a bubble catcher, blade cores and push cores. We found a plastic bottle along the way that we took back on deck. We went back down (#19) for a CTD and multicorer grab, however the water was once again filled with sediment and we were not able to perform anything. The ROV went back up for maintenance and we performed a CTD transect along and across this area.

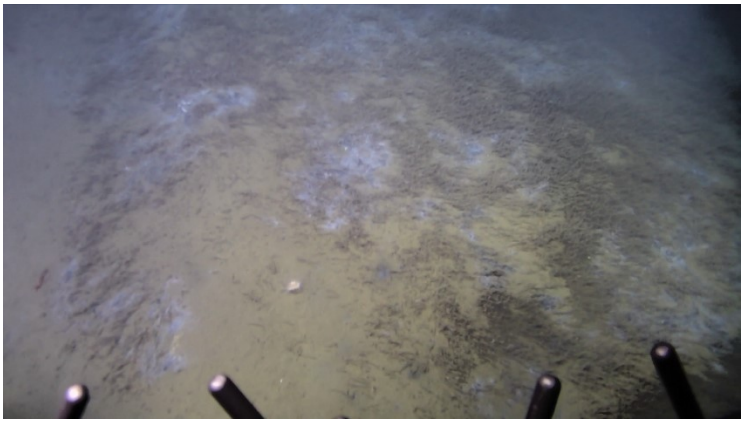

*Fig. 28. Seafloor at Hinlopen Trough covered with bacterial mat and tube worms*

November 9th 2020

After performing a short EK80 line above the northern flare area, we performed a chirp survey in order to locate appropriate locations for 2 Gravity cores. We performed another quick survey along the flares in the south of the Hinlopen Trough and finished the night with a multibeam survey on the south of the area.

The ROV went for their dive #20 to finish the samples from the Northern area, with a bubble catcher, a CTD grab and a pump. The ROV went back up so the ship could move to the south area, hoping that the seafloor will not be as turbid than the day before (#21). The visibility was good, but we struggled to find bubble streams, and the only ones we could find were sporadic with not enough flow to fill the bubble catcher nor measure the bubble sizes with the checkerboard. Only small flares could be seen, not enough to fill the bottle catcher. While we were looking for a better bubble stream, the water became too turbid so we decided to perform a multicorer in a bacterial mat. During the first attempt, only one liner was filled with sediment. The second one was more successful. We finished the evening with one gravity core as the second one had to be canceled due to bad wind and wave conditions. The night was spent doing a multibeam survey.

November 10th 2020

We performed a CTD cast followed by the pumps at 6:20 on the western flares. The ROV went down at 8:20 on the western flares (#22) but the water became turbid very rapidly. The fish attracted by the ROV light were resuspending the fine sediment, so we turned off the lights for a few minutes. The first time the fish disappeared and the water was clear, but they came back quickly after and our second attempt with the lights off was not successful. The methane concentration from the Franatech was 120 nmol/L. The ROV went back up to install the multibeam and perform a microbathymetry until 18:00 (#23). After a multibeam survey to continue mapping the Trough and decide on 6 CTD stations, we started casting at 22:40. However, the sea became too rough to continue and we had to abort the survey before performing the 2 last CTDs. The bridge decided to continue the multibeam survey without notice.

November 11th 2020

After discussing with the captain, we decided to try and perform the planned multicorer at the pump station 5. The weather allowing it, the liners were satisfying in the second one so we started to head towards Kongfjorden for shelter around 8:45.

November 12th 2020

We arrived in Kongfjorden around 2:30 and stayed put until further notice. This gave us time to explore the fjord with the ROV (#24) and to get 2 push cores, but the numerous fish around the ROV started to resuspend the sediment and the visibility became too weak after less than 1h dive. We were able to leave the fjord to go toward the MASOX area around 12:00 and arrive on the site to perform the first MB line at 18:50. Several CTD casts were needed to adjust the sound velocity profile.

November 13th 2020

We continued the multibeam survey during the night. After 3.5 lines, the data indicated a very high seepage activity and we chose one location with particularly intense seepage for our samples. We brought the ROV to the position (#25, SS4) to perform some checkerboard measurement from several of the bubble streams (from 13:02). The methane concentration from the FRANATECH sensor was showing methane concentrations up to 1500 nmol/L. We sampled gas with the bubble catcher

and 4 push cores in the same area. Only 2 came back with sediment. As we only have one gas bottle left, we needed to dive 2 more times in order to have 2 replicates for DNA purpose and one for gas content measurement. During the second dive in the area (#26), we collected 2 blade cores in addition to the gas. During the third dive (#27), we only collected gas. We used the same location for a CTD followed by a pump for MOx's measurement. In order to compare flares activity depending on the tide, we performed a second shorter MB line across this same location, followed by the same line for EK80 for bubble size estimate. We finished the evening with 5 CTDs across the MASOX site to add data to our frequent sampling there.

November 14th 2020

We continued the interrupted MB lines as soon as the CTDs were finished, i.e. 1:15. After the end of the survey (10:42), we headed toward the pump area for a microbathymetry followed by a video mapping. The ROV operation had to be aborted during the video mapping due to bad weather. We left the area by doing an ADCP/MB profile along the flares before heading to Adventfjorden.

November 15th 2020

We arrived in Adventfjorden around 6:30 and started with an EK80 line to explore possible active pockmark as reported in Forwick et al. (2009). We did not see any methane seepage in the single beam inside the pockmarks, but located a small one at the mouth of Adventfjorden. We nonetheless took the ROV down one of the pockmarks but instead of bubbles, we saw a lot of plastic. We went back to the flare location for an ROV dive but could not see the flare. We therefore went back to the previous pockmark for 2 gravity cores. We arrived at Bykaia around 18:00.

November 16th 2020

The last day of the cruise was dedicated to cleaning of all labs and corridors, and preparing our boxes for storage.

## 8 ACKNOWLEDGEMENTS

We thank the captain and his crew of R/V Kronprins Haakon, as well as Stormer Jensen for their excellent support. We are also grateful for the work performed by the ROV team and their great professionalism and efficiency. All the cruise participants contributed to make this cruise a success in terms of friendly atmosphere and good science. This cruise was conducted under the framework of the Centre of Excellence on Gas Hydrates, Environment and Climate (CAGE) (Norwegian Research Council (NFR) project number 223259/F5 at the University of Tromsø.

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## Appendix 1. ACOUSTIC SURVEYS

| Location | Line ID | Date | Time (UTC) START | Lat. [N] Long. [E] START | Time (UTC) STOP | Lat. [N] Long. [E] STOP |
|---|---|---|---|---|---|---|
| Norskebanken | CAGE20-7-KH-001-MB | 03.11 | 21:11 | 80°35.971' 14°14.789' | 21:40 | 80°37.876' 14°23.659' |
| Norskebanken | CAGE20-7-KH-002-MB | 03.11 | 21:44 | 80°37.649' 14°23.998' | 22:17 | 80°35.658' 14°15.108' |
| Norskebanken | CAGE20-7-KH-003-MB | 03.11 | 22:21 | 80°35.620' 14°16.347' | 23:00 | 80°38.009' 14°27.176' |
| Norskebanken | CAGE20-7-KH-004-MB | 03.11 | 23:14 | 80°37.855' 14°28.501' | 23:52 | 80°35.397' 14°17.258' |
| Norskebanken | CAGE20-7-KH-005-MB | 03.11 | 23:57 | 80°35.368' 14°18.692' | 00:33 | 80°37.699' 14°29.369' |
| Norskebanken | CAGE20-7-KH-006-MB | 04.11 | 00:38 | 80°37.547' 14°30.301' | 01:16 | 80°35.165' 14°19.568' |
| Norskebanken | CAGE20-7-KH-007-MB | 04.11 | 01:21 | 80°35.128' 14°20.810' | 01:56 | 80°37.406' 14°31.342' |
| Norskebanken | CAGE20-7-KH-008-MB | 04.11 | 01:13 | 80°37.232' 14°32.136' | 02:39 | 80°34.930' 14°21.679' |
| Norskebanken | CAGE20-7-KH-009-MB | 04.11 | 02:44 | 80°34.885' 14°23.051' | 03:19 | 80°37.120' 14°33.469' |
| Norskebanken | CAGE20-7-KH-010-MB | 04.11 | 03:27 | 80°36.929' 14°34.415' | 04:07 | 80°34.571' 14°23.241' |
| Norskebanken | CAGE20-7-KH-011-MB | 04.11 | 05:37 | 80°34.567' 14°23.218' | 04:37 | 80°35.811' 14°12.734' |
| Norskebanken | CAGE20-7-KH-012-MB | 04.11 | 04:37 | 80°35.813' 14°12.732' | 05:15 | 80°38.085' 14°23.350' |
| Norskebanken | CAGE20-7-KH-013-MB | 04.11 | 05:15 | 80°38.087' 14°23.367' | 05:48 | 80°37.030' 14°35.703' |
| Norskebanken | CAGE20-7-KH-014-MB | 04.11 | 05:48 | 80°37.027' 14°35.710' | 06:34 | 80°34.276' 14°23.111' |
| Norskebanken | CAGE20-7-KH-015-MB | 04.11 | 06:34 | 80°34.276' 14°23.081' | 07:08 | 80°35.792' 14°10.800' |
| Norskebanken | CAGE20-7-KH-016-MB | 04.11 | 07:08 | 80°35.799' 14°10.761' | 07:44 | 80°37.611' 14°21.242' |
| Norskebanken | CAGE20-7-KH-017-MB | 04.11 | 07:44 | 80°37.622' 14°21.208' | 08:13 | 80°35.606' 14°25.374' |
| Norskebanken | CAGE20-7-KH-018-CHIRP | 05.11 | 01:13 | 80°36.060' 14°17.333' | 01:13 | 80°37.417' 14°06.265' |
| Norskebanken | CAGE20-7-KH-019-MB | 05.11 | 04:56 | 80°36.136' 14°09.375' | 04:56 | 80°38.423' 14°20.917' |
| Norskebanken | CAGE20-7-KH-020-MB | 05.11 | 05:40 | 80°38.473' 14°19.990' | 05:40 | 80°36.271' 14°07.992' |

| | | | | | | |
|---|---|---|---|---|---|---|
| Norskebanken | CAGE20-7-KH-021-MB | 05.11 | 06:24 | 80°36.418'<br>14°07.290' | 06:24 | 80°38.640'<br>14°18.881' |
| Norskebanken | CAGE20-7-KH-022-MB | 05.11 | 07:06 | 80°38.764'<br>14°18.049' | 07:06 | 80°38.169'<br>14°14.699' |
| Norskebanken | CAGE20-7-KH-023-MB | 05.11 | 07:16 | 80°38.162'<br>14°14.633' | 07:16 | 80°37.398'<br>14°06.456' |
| Norskebanken | CAGE20-7-KH-024-SB | 05.11 | 23:55 | 80°37.583'<br>14°31.101' | 23:55 | 80°35.013'<br>14°24.060' |
| Norskebanken | CAGE20-7-KH-025-SB | 06.11 | 00:39 | 80°35.017'<br>14°23.932' | 00:39 | 80°35.387'<br>14°27.173' |
| Norskebanken | CAGE20-7-KH-026-SB | 06.11 | 00:57 | 80°35.264'<br>14°27.933' | 00:57 | 80°36.807'<br>14°14.991' |
| Norskebanken | CAGE20-7-KH-027-CHIRP | 06.11 | 01:50 | 80°36.806'<br>14°03.309' | 01:50 | 80°33.463'<br>14°32.505' |
| Norskebanken | CAGE20-7-KH-028-CHIRP | 06.11 | 03:05 | 80°33.462'<br>14°32.549' | 03:05 | 80°34.600'<br>14°37.541' |
| Norskebanken | CAGE20-7-KH-029-CHIRP | 06.11 | 03:22 | 80°34.607'<br>14°37.543' | 03:22 | 80°37.821'<br>14°08.871' |
| Norskebanken | CAGE20-7-KH-030-CHIRP | 06.11 | 04:37 | 80°37.829'<br>14°08.871' | 04:37 | 80°38.783'<br>14°14.494' |
| Norskebanken | CAGE20-7-KH-031-CHIRP | 06.11 | 04:54 | 80°38.788'<br>14°14.532' | 04:54 | 80°35.638'<br>14°42.875' |
| Norskebanken | CAGE20-7-KH-032-SB | 06.11 | 20:11 | 80°37.339'<br>14°25.685' | 20:11 | 80°37.641'<br>14°21.670' |
| Norskebanken | CAGE20-7-KH-033-SB | 06.11 | 20:29 | 80°37.599'<br>14°21.800' | 20:29 | 80°37.331'<br>14°25.804' |
| Norskebanken | CAGE20-7-KH-034-SB | 06.11 | 20:50 | 80°37.076'<br>14°24.786' | 20:50 | 80°37.649'<br>14°24.776' |
| Norskebanken | CAGE20-7-KH-035-SB | 06.11 | 21:11 | 80°37.756'<br>14°23.566' | 21:11 | 80°37.267'<br>14°22.648' |
| Hinlopen | CAGE20-7-KH-036-MB | 07.11 | 03:19 | 80°33.728'<br>16°06.394' | 03:19 | 80°28.473'<br>16°12.409' |
| Hinlopen | CAGE20-7-KH-037-MB | 07.11 | 04:42 | 80°28.426'<br>16°09.757' | 04:42 | 80°29.861'<br>16°08.313' |
| Hinlopen | CAGE20-7-KH-038-MB | 07.11 | 20:49 | 80°29.881'<br>16°07.741' | 20:49 | 80°28.321'<br>16°09.788' |
| Hinlopen | CAGE20-7-KH-039-MB | 08.11 | 02:09 | 80°29.444'<br>16°08.784' | 02:09 | 80°28.263'<br>16°09.857' |
| Hinlopen | CAGE20-7-KH-049-MB | 08.11 | 02:38 | 80°29.761'<br>16°08.447' | 02:38 | 80°28.980'<br>16°09.223' |
| Hinlopen | CAGE20-7-KH-041-SB | 08.11 | 23:40 | 80°31.046'<br>16°09.343' | 23:40 | 80°29.966'<br>16°11.363' |

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|---|---|---|---|---|---|---|
| Hinlopen | CAGE20-7-KH-042-CHIRP | 09.11 | 00:21 | 80°31.662'<br>16°22.463' | 00:21 | 80°29.464'<br>15°51.911' |
| Hinlopen | CAGE20-7-KH-043-CHIRP | 09.11 | 01:36 | 80°28.698'<br>15°53.827' | 01:36 | 80°28.910'<br>16°27.040' |
| Hinlopen | CAGE20-7-KH-044-CHIRP | 09.11 | 02:44 | 80°28.933'<br>16°27.372' | 02:44 | 80°30.485'<br>16°10.954' |
| Hinlopen | CAGE20-7-KH-045-SB | 09.11 | 05:08 | 80°29.261'<br>16°08.801' | 05:08 | 80°28.134'<br>16°10.607' |
| Hinlopen | CAGE20-7-KH-046-MB | 09.11 | 05:44 | 80°28.313'<br>16°13.006' | 05:44 | 80°24.029'<br>16°26.728' |
| Hinlopen | CAGE20-7-KH-047-MB | 09.11 | 07:05 | 80°23.804'<br>16°23.864' | 07:05 | 80°28.018'<br>16°09.941' |
| Hinlopen | CAGE20-7-KH-048-MB | 09.11 | 08:18 | 80°27.781'<br>16°07.174' | 08:18 | 80°26.512'<br>16°11.377' |
| Hinlopen | CAGE20-7-KH-049-MB | 09.11 | 21:21 | 80°26.596'<br>16°10.934' | 21:21 | 80°23.419'<br>16°21.267' |
| Hinlopen | CAGE20-7-KH-050-MB | 09.11 | 22:18 | 80°23.221'<br>16°18.365' | 22:18 | 80°27.569'<br>16°04.261' |
| Hinlopen | CAGE20-7-KH-051-MB | 09.11 | 23:22 | 80°27.577'<br>16°04.250' | 23:22 | 80°34.038'<br>15°58.040' |
| Hinlopen | CAGE20-7-KH-052-MB | 10.11 | 00:50 | 80°33.973'<br>15°55.236' | 00:50 | 80°27.184'<br>16°01.804' |
| Hinlopen | CAGE20-7-KH-053-MB | 10.11 | 02:13 | 80°27.168'<br>16°01.829' | 02:13 | 80°22.897'<br>16°15.616' |
| Hinlopen | CAGE20-7-KH-054-MB | 10.11 | 03:23 | 80°22.738'<br>16°12.591' | 03:23 | 80°27.017'<br>15°58.298' |
| Hinlopen | CAGE20-7-KH-055-MB | 10.11 | 04:29 | 80°27.021'<br>15°58.294' | 04:29 | 80°27.892'<br>15°57.652' |
| Hinlopen | CAGE20-7-KH-056-MB | 10.11 | 17:43 | 80°27.908'<br>15°57.533' | 17:43 | 80°34.180'<br>15°52.101' |
| Hinlopen | CAGE20-7-KH-057-MB | 10.11 | 19:22 | 80°34.093'<br>15°49.090' | 19:22 | 80°27.927'<br>15°54.446' |
| Hinlopen | CAGE20-7-KH-058-MB | 11.11 | 02:39 | 80°28.060'<br>15°54.698' | 02:39 | 80°34.184'<br>15°45.548' |
| Hinlopen | CAGE20-7-KH-059-MB | 11.11 | 04:06 | 80°34.197'<br>15°45.513' | 04:06 | 80°27.915'<br>15°48.434' |
| Hinlopen | CAGE20-7-KH-060-MB | 11.11 | 05:52 | 80°27.944'<br>15°45.184' | 05:52 | 80°29.405'<br>15°44.179' |
| MASOX | CAGE20-7-KH-061-MB | 12.11 | 17:49 | 78°39.550'<br>09°41.290' | 20:33 | 78°28.205'<br>09°40.426' |
| MASOX | CAGE20-7-KH-062-MB | 12.11 | 21:17 | 78°28.394'<br>09°56.036' | 06:01 | 78°38.352'<br>09°06.549' |

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|---|---|---|---|---|---|---|
| MASOX | CAGE20-7-KH-063-MB | 13.11 | 07:02 | 78°36.832'<br>09°30.525' | 11:09 | 78°37.717'<br>09°21.523' |
| MASOX | CAGE20-7-KH-064-MB | 13.11 | 18:39 | 78°37.019'<br>09°57.418' | 19:38 | 78°32.845'<br>09°03.083' |
| MASOX | CAGE20-7-KH-065-SB | 13.11 | 19:40 | 78°32.774'<br>09°04.511' | 20:43 | 78°37.321'<br>09°56.368' |

## Appendix 2. CTD STATIONS

| Site/Area | Station Id | Date | Time (UTC) | Lat. [N]<br>Long. [E] | Water Depth [m] |
|---|---|---|---|---|---|
| Norskebanken | CAGE20-7-KH-200-CTD | 04.11 | 20:45 | 80°37.864'<br>14°24.701' | 169 |
| Norskebanken | CAGE20-7-KH-201-CTD | 04.11 | 22:46 | 80°37.444'<br>14°22.900' | 170 |
| Norskebanken | CAGE20-7-KH-202-CTD | 04.11 | 22:37 | 80°36.966'<br>14°20.855' | 170 |
| Norskebanken | CAGE20-7-KH-203-CTD | 04.11 | 23:46 | 80°36.481'<br>14°18.731' | 170 |
| Norskebanken | CAGE20-7-KH-204-CTD | 05.11 | 00:30 | 80°36.118'<br>14°17.144' | 171 |
| Norskebanken | CAGE20-7-KH-205-CTD | 05.11 | 07:48 | 80°37.398'<br>14°06.299' | 181 |
| Norskebanken | CAGE20-7-KH-01-Pump-01 | 05.11 | 08:10 | 80°37.397'<br>14°06.302' | 181 |
| Norskebanken | CAGE20-7-KH-206-CTD | 05.11 | 19:00 | 80°35.525'<br>14°25.570' | 176 |
| Norskebanken | CAGE20-7-KH-207-CTD | 05.11 | 20:06 | 80°35.465'<br>14°27.880' | 170 |
| Norskebanken | CAGE20-7-KH-208-CTD | 05.11 | 21:07 | 80°35.167'<br>14°25.457' | 163 |
| Norskebanken | CAGE20-7-KH-209-CTD | 05.11 | 22:09 | 80°35.578'<br>14°23.341' | 172 |
| Norskebanken | CAGE20-7-KH-210-CTD | 05.11 | 22:58 | 80°35.887'<br>14°25.852' | 172 |
| Norskebanken | CAGE20-7-KH-211-CTD | 07.11 | 07:55 | 80°37.398'<br>14°24.725' | 167 |
| Norskebanken | CAGE20-7-KH-01-Pump-02 | 07.11 | 08:34 | 80°37.402'<br>14°24.748' | 167 |

| | | | | | |
|---|---|---|---|---|---|
| Hinlopen | CAGE20-7-KH-212-CTD | 07.11 | 18:05 | 80°37.413' 14°24.770' | 167 |
| Hinlopen | CAGE20-7-KH-213-CTD | 07.11 | 21:29 | 80°28.321' 16°09.789' | 346 |
| Hinlopen | CAGE20-7-KH-214-CTD | 07.11 | 22:16 | 80°28.568' 16°07.235' | 352 |
| Hinlopen | CAGE20-7-KH-215-CTD | 07.11 | 23:22 | 80°28.917' 16°09.294' | 352 |
| Hinlopen | CAGE20-7-KH-216-CTD | 08.11 | 00:14 | 80°29.002' 16°11.393' | 389 |
| Hinlopen | CAGE20-7-KH-217-CTD | 08.11 | 01:30 | 80°29.256' 16°08.766' | 354 |
| Hinlopen | CAGE20-7-KH-218-CTD | 08.11 | 05:05 | 80°28.885' 16°09.311' | 351 |
| Hinlopen | CAGE20-7-KH-02-Pump-03 | 08.11 | 05:28 | 80°28.886' 16°09.311' | 351 |
| Hinlopen | CAGE20-7-KH-219-CTD | 08.11 | 18:24 | 80°30.542' 16°10.188' | 357 |
| Hinlopen | CAGE20-7-KH-220-CTD | 08.11 | 19:05 | 80°30.309' 16°10.618' | 357 |
| Hinlopen | CAGE20-7-KH-221-CTD | 08.11 | 20:11 | 80°30.530' 16°07.940' | 366 |
| Hinlopen | CAGE20-7-KH-222-CTD | 08.11 | 21:00 | 80°30.760' 16°09.710' | 346 |
| Hinlopen | CAGE20-7-KH-223-CTD | 08.11 | 21:42 | 80°30.986' 16°09.263' | 340 |
| Hinlopen | CAGE20-7-KH-224-CTD | 08.11 | 22:41 | 80°30.770' 16°11.959' | 324 |
| Hinlopen | CAGE20-7-KH-225-CTD | 09.11 | 11:05 | 80°30.538' 16°10.150' | 352 |

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|---|---|---|---|---|---|
| Hinlopen | CAGE20-7-KH-02-Pump-04 | 09.11 | 12:16 | 80°30.520'<br>16°10.194' | 352 |
| Hinlopen | CAGE20-7-KH-226-CTD | 10.11 | 05:18 | 80°30.395'<br>16°04.391' | 360 |
| Hinlopen | CAGE20-7-KH-02-Pump-05 | 10.11 | 05:39 | 80°30.395'<br>16°04.391' | 360 |
| Hinlopen | CAGE20-7-KH-227-CTD | 10.11 | 21:39 | 80°28.578'<br>16°14.226' | 396 |
| Hinlopen | CAGE20-7-KH-228-CTD | 10.11 | 22:51 | 80°28.690'<br>15°41.350' | 319 |
| Hinlopen | CAGE20-7-KH-229-CTD | 10.11 | 23:50 | 80°29.402'<br>15°50.350' | 337 |
| Hinlopen | CAGE20-7-KH-230-CTD | 11.11 | 00:39 | 80°30.035'<br>16°00.147' | 342 |
| Hinlopen | CAGE20-7-KH-231-CTD | 11.11 | 01:34 | 80°30.572'<br>16°10.160' | 396 |
| Hinlopen | CAGE20-7-KH-232-CTD | 13.11 | 06:13 | 78°38.310'<br>09°24.840' | 270 |
| MASOX | CAGE20-7-KH-233-CTD | 13.11 | 16:49 | 78°36.540'<br>09°24.620' | 390 |
| MASOX | CAGE20-7-KH-04-Pump-06 | 13.11 | 17:09 | 78°36.548'<br>09°24.620' | 390 |
| MASOX | CAGE20-7-KH-234-CTD | 13.11 | 21:28 | 78°33.099'<br>09°19.609' | 420 |
| MASOX | CAGE20-7-KH-235-CTD | 13.11 | 22:12 | 78°33.166'<br>09°31.251' | 408 |
| MASOX | CAGE20-7-KH-236-CTD | 13.11 | 22:53 | 78°33.222'<br>09°28.451' | 398 |
| MASOX | CAGE20-7-KH-237-CTD | 13.11 | 23:32 | 78°33.301'<br>09°29.680' | 370 |
| MASOX | CAGE20-7-KH-238-CTD | 14.11 | 00:14 | 78°33.750'<br>09°31.061' | 369 |

## Appendix 3. SEDIMENT SAMPLES FROM VESSEL

| Site/Area | Station Id | Date | Time (UTC) | Lat. [N] Long. [E] | Recovery [cm] | Water Depth [m] | Notes |
|---|---|---|---|---|---|---|---|
| Norskebanken | CAGE20-7-KH-01-MC-01 | 05.11 | 02:05 | 80°37.392' 14°06.269' | | 182 | Corer did not release. NO RECOVERY |
| Norskebanken | CAGE20-7-KH-01-MC-02 | 05.11 | 02:39 | 80°37.392' 14°06.269' | | 182 | No sediment. too gravely. NO RECOVERY |
| Norskebanken | CAGE20-7-KH-01-GC-01 | 05.11 | 03:02 | 80°37.389' 14°06.269' | 45 | 182 | 0.45 m recovery. PW sampling. |
| Norskebanken | CAGE20-7-KH-01-MC-03 | 06.11 | 06:53 | 80°34.359' 14°36.690' | | 142 | 4/6 cores contain sediment. #1: DNA (freezed). PW; #2: DNA; #3: ; #4: PW (Freezed archive); #5: empty; #6: lost liner. |
| Norskebanken | CAGE20-7-KH-01-GC-02 | 06.11 | 07:16 | 80°34.359' 14°36.693' | | 142 | NO RECOVERY |
| Norskebanken | CAGE20-7-KH-01-MC-04 | 06.11 | 21:48 | 80°35.535' 14°25.623' | | 175.5 | hydrophone did not record. 2/6 cores contain sediment. #1. #2: DNA. #3. #4. #5. #6: empty. |
| Norskebanken | CAGE20-7-KH-01-MC-05 | 06.11 | 22:19 | 80°35.534' 14°25.657' | | 175 | 3/6 cores contain sediment. #1. #2: PW. gas sampling. #3: DNA. #4. #5. #6: empty. |
| Norskebanken | CAGE20-7-KH-01-GC-03 | 06.11 | 22:38 | 80°35.535' 14°25.657' | 200 | 175 | 2.0 m recovery. PW sampling |
| Norskebanken | CAGE20-7-KH-01-GC-04 | 07.11 | 00:17 | 80°35.516' 14°25.626' | 140 | 175 | 1.4 m recovery. PW Sampling. Headspae gas samples for isotopic analysis |
| Norskebanken | CAGE20-7-KH-01-GC-05 | 07.11 | 00:46 | 80°35.516' 14°25.629' | | 175 | NO RECOVERY |
| Hinlopen | CAGE20-7-KH-02-GC-06 | 09.11 | 03:14 | 80°30.488' 16°10.885' | 313 | 344 | 3.13 m long. Sampled for PW using vacutubes. 4 sections. |
| Hinlopen | CAGE20-7-KH-02-GC-07 | 09.11 | 04:21 | 80°30.528' 16°10.208' | 290 | 353 | 2.90 m long. No sampling. Kept frozen at -20C for further analyses. |
| Hinlopen | CAGE20-7-KH-02-MC-06 | 09.11 | 17:50 | 80°28.860' 16°09.180' | 53 | 351 | 1/6 cores contains sediment. PW sampling (SO4, DIC). Stored at 4C |
| Hinlopen | CAGE20-7-KH-02-MC-07 | 09.11 | 18:35 | 80°28.899' 16°09.221' | | 351 | 1/6 cores contains sediment. Sliced for forams, DNA |
| Hinlopen | CAGE20-7-KH-02-GC-08 | 09.11 | 19:40 | 80°28.899' 16°09.216' | 413 | 351 | PW sampling (SO4, DIC). Stored at 4C |
| Hinlopen | CAGE20-7-KH-02-MC-08 | 11.11 | 06:55 | 80°30.393' 16°04.397' | | 335 | 1/6 core. 25 cm, PW sampling. |
| Hinlopen | CAGE20-7-KH-02-MC-09 | 11.11 | 07:46 | 80°30.394' 16°04.395' | | 335 | 3/6 cores. #1: 38 cm, forams DNA. #2: 36 cm, PW sampling, kept frozen as archive. #3: ~35 cm, microbiology. |
| Adventfjorden | CAGE20-7-KH-05-GC-09 | 15.11 | 12:48 | 78°16.198' 15°27.620' | | 109 | NO RECOVERY |
| Adventfjorden | CAGE20-7-KH-05-GC-10 | 15.11 | 13:19 | 78°16.198' 15°27.620' | | 109 | NO RECOVERY |
| Adventfjorden | CAGE20-7-KH-05-GC-11 | 15.11 | 13:42 | 78°16.198' 15°27.620' | 250 | 109 | PW sampling. Kept frozen at -20 C |

## Appendix 4. ROV DIVES INCLUDING STATIONS (HYDROPHONE, CHECKERBOARD AND SEDIMENT SAMPLES)

| Site/Area | Station Id | Date | Time (UTC) | Lat. [N] Long. [E] | Recovery [cm] | Water Depth [m] | Notes |
|---|---|---|---|---|---|---|---|
| Norskebanken | CAGE20-7-KH-01-MBat-01 | 04.11 | 09:06 | 80°35.662' 14°26.131' | | 175 | |
| Norskebanken | CAGE20-7-KH-01-MBat-02 | 04.11 | 15:01 | 80°37.372' 14°23.303' | | 175 | |
| Norskebanken | CAGE20-7-KH-01-Dive-04 | 05.11 | 15:05 | 80°37.526' 14°22.992' | | - | ROV Dive - No video |
| Norskebanken | CAGE20-7-KH-01-Dive-05 | 05.11 | 15:55 | 80°35.530' 14°25.520' | | 174 | |
| Norskebanken | CAGE20-7-KH-01-Dive-06 | 06.11 | 08:21 | 80°35.554' 14°25.527' | | 173 | ROV Dive - looking for big flare |
| Norskebanken | CAGE20-7-KH-01-Dive-07 | 06.11 | 11:17 | 80°37.461' 14°23.015' | | 166 | |
| Norskebanken | CAGE20-7-KH-01-BubQ-01 | 06.11 | 12:07 | 80°37.512' 14°23.010' | | 166 | |
| Norskebanken | CAGE20-7-KH-01-Dive-08 | 06.11 | 14:33 | 80°37.512' 14°23.010' | | 169 | ROV Dive - Fish in the bubble catcher; yellow and white sponges collected |
| Norskebanken | CAGE20-7-KH-01-Hydr-01 | 06.11 | 14:53 | 80°37.512' 14°23.010' | | 169 | ROV Hydrophone - hydrophone did not record |
| Norskebanken | CAGE20-7-KH-01-GasS-01 | 06.11 | 17:42 | 80°37.399' 14°24.741' | | 169 | ROV Gas Sampling - check right coordonates as these are from EM |
| Norskebanken | CAGE20-7-KH-01-BubQ-02 | 06.11 | 17:53 | 80°37.399' 14°24.741' | | 169 | ROV Bubble Quantification Pannel - check right coordonates as these are from EM |
| Norskebanken | CAGE20-7-KH-01-Hydr-02 | 06.11 | 18:15 | 80°37.399' 14°24.741' | | 169 | ROV Hydrophone - hydrophone did not record |
| Norskebanken | CAGE20-7-KH-01-Dive-09 | 06.11 | 19:07 | 80°37.399' 14°24.741' | | 168 | ROV Dive - hydrophone did not record |
| Norskebanken | CAGE20-7-KH-01-Dive-10 | 07.11 | 07:16 | 80°37.441' 14°22.913' | | 167 | |
| Norskebanken | CAGE20-7-KH-01-Dive-11 | 07.11 | 08:31 | 80°37.402' 14°24.748' | | 168 | ROV Dive - To hold plankton net |
| Norskebanken | CAGE20-7-KH-01-Dive-12 | 07.11 | 08:31 | 80°37.402' 14°24.748' | | 168 | |
| Norskebanken | CAGE20-7-KH-01-BubQ-03 | 07.11 | 10:22 | 80°37.398' 14°24.732' | | 168 | |
| Norskebanken | CAGE20-7-KH-01-Hydr-03 | 07.11 | 10:45 | 80°37.398' 14°24.732' | | 168 | |
| Norskebanken | CAGE20-7-KH-01-Dive-13 | 07.11 | 12:24 | 80°35.525' 14°25.663' | | 174 | ROV Dive - recorded later in toktlogger |
| Norskebanken | CAGE20-7-KH-Di-BlaC--02 | 07.11 | 13:02 | 80°35.538' 14°25.602' | 4 | 174 | ROV Blade Core - 4 cm long. Sampled for PW, DNA, Biomarker |
| Norskebanken | CAGE20-7-KH-Di-PusC--01 | 07.11 | 13:07 | 80°35.528' 14°25.613' | | 174 | ROV Push Core - NO RECOVERY |
| Norskebanken | CAGE20-7-KH-Di-BlaC--01 | 07.11 | 13:31 | 80°35.538' 14°25.614' | 7.5 | 174 | ROV Blade Core - 7.5 cm long. Sampled for PW |
| Norskebanken | CAGE20-7-KH-Di-CarC--02 | 07.11 | 13:42 | 80°35.538' 14°25.614' | | 174 | |
| Norskebanken | CAGE20-7-KH-01-RocC-01 | 07.11 | 13:43 | 80°35.538' 14°25.614' | | 174 | |
| Norskebanken | CAGE20-7-KH-Di-BlaC--04 | 07.11 | 14:00 | 80°35.528' 14°25.613' | 11 | 174 | ROV Blade Core - 11 cm long. Sampled for PW. |
| Norskebanken | CAGE20-7-KH-Di-BlaC--03 | 07.11 | 14:38 | 80°35.528' 14°25.613' | 22 | 174 | ROV Blade Core - 22 cm long. Sampled for PW. |
| Norskebanken | CAGE20-7-KH-01-Dive-14 | 07.11 | 16:00 | 80°37.404' 14°24.756' | | 167 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Norskebanken | CAGE20-7-KH-01-Dive-15 | 07.11 | 17:18 | 80°37.416' 14°24.750' | | 170 | |
| Norskebanken | CAGE20-7-KH-Di-PusC--01 | 07.11 | 17:31 | 80°37.380' 14°24.720' | | 169 | |
| Norskebanken | CAGE20-7-KH-Di-PusC--02 | 07.11 | 17:33 | 80°37.380' 14°24.720' | | 169 | |
| Hinlopen | CAGE20-7-KH-Di-PusC--05 | 08.11 | 11:28 | 80°30.528' 16°10.194' | | 353 | |
| Hinlopen | CAGE20-7-KH-02-Dive-17 | 08.11 | 11:38 | 80°30.546' 16°10.188' | | 351 | |
| Hinlopen | CAGE20-7-KH-Di-BlaC--03 | 08.11 | 11:40 | 80°30.528' 16°10.200' | 15 | 353 | ROV Blade Core - 15 cm long. Sampled for forams, DNA,microbiology |
| Hinlopen | CAGE20-7-KH-02-Dive-16 | 08.11 | 08:25 | 80°28.878' 16°09.312' | | 347 | |
| Hinlopen | CAGE20-7-KH-Di-BlaC--02 | 08.11 | 11:53 | 80°30.480' 16°10.200' | 18 | 353 | ROV Blade Core - 18 cm long. Sampled for PW and gas. Found bivalve at 14 cm. |
| Hinlopen | CAGE20-7-KH-Di-PusC--04 | 08.11 | 12:00 | 80°30.480' 16°10.194' | | 353 | ROV Push Core - microbiology |
| Hinlopen | CAGE20-7-KH-02-Dive-18 | 08.11 | 12:45 | 80°30.534' 16°10.194' | | 353 | ROV Dive - discard |
| Hinlopen | CAGE20-7-KH-02-BubQ-04 | 08.11 | 13:12 | 80°30.528' 16°10.194' | | 353 | ROV Bubble Quantification Pannel - 22 cm long. Sampled for PW , gas and porosity |
| Hinlopen | CAGE20-7-KH-02-GasS-02 | 08.11 | 13:40 | 80°30.528' 16°10.194' | 22 | 353 | ROV Gas Sampling - 22 cm long. Sampled for PW , gas and porosity |
| Hinlopen | CAGE20-7-KH-Di-BlaC--04 | 08.11 | 14:56 | 80°30.534' 16°10.194' | 22 | 353 | ROV Blade Core - 22 cm long. Sampled for PW , gas and porosity |
| Hinlopen | CAGE20-7-KH-Di-BlaC--01 | 08.11 | 15:08 | 80°30.534' 16°10.194' | 16 | 353 | ROV Blade Core - 16 cm long. Sampled for forams, DNA, Biomarkers. Found MDACs at 5 cm. |
| Hinlopen | CAGE20-7-KH-Di-PusC--04 | 08.11 | 15:17 | 80°30.534' 16°10.194' | | 353 | ROV Push Core - microbiology |
| Hinlopen | CAGE20-7-KH-Di-PusC--03 | 08.11 | 15:23 | 80°30.534' 16°10.194' | | 353 | ROV Push Core - SEDIMENT LOST DURING ROV ASCENT |
| Hinlopen | CAGE20-7-KH-02-Dive-19 | 08.11 | 16:55 | 80°30.534' 16°10.194' | | 354 | ROV Dive - Plastic bottle! |
| Hinlopen | CAGE20-7-KH-02-Dive-20 | 09.11 | 09:41 | 80°30.538' 16°10.165' | | 351 | |
| Hinlopen | CAGE20-7-KH-02-Dive-22 | 10.11 | 07:16 | 80°30.395' 16°04.393' | | 336 | |
| Hinlopen | CAGE20-7-KH-02-Dive-23 | 10.11 | 12:25 | 80°30.374' 16°10.182' | | 340 | |
| Kongsfjorden | CAGE20-7-KH-03-Dive-24 | 12.11 | 07:40 | 78°58.803' 11°37.693' | | 308 | ROV Dive - 15 cm long. No sub-sampling. Kept in a plastic bag in freezer at -20C. |
| Kongsfjorden | CAGE20-7-KH-Di-PusC--01 | 12.11 | 08:02 | 78°58.800' 11°37.698' | | 308 | ROV Push Core - 15 cm long. No sub-sampling. Kept in a plastic bag in freezer at -20C. |
| Kongsfjorden | CAGE20-7-KH-Di-PusC--01 | 12.11 | 08:04 | 78°58.800' 11°37.698' | | 387 | ROV Push Core - NO RECOVERY. Loss upon retrieval on deck |
| MASOX | CAGE20-7-KH-04-Dive-25 | 13.11 | 11:35 | 78°36.552' 09°24.630' | | 387 | |
| MASOX | CAGE20-7-KH-04-BubQ-04 | 13.11 | 12:02 | 78°36.552' 09°24.630' | | 387 | |
| MASOX | CAGE20-7-KH-04-GasS-03 | 13.11 | 12:28 | 78°36.552' 09°24.630' | | 387 | |
| MASOX | CAGE20-7-KH-Di-PusC--05 | 13.11 | 12:39 | 78°36.540' 09°24.636' | | 387 | ROV Push Core - NO RECOVERY. Loss upon retrieval on deck |
| MASOX | CAGE20-7-KH-Di-PusC--04 | 13.11 | 12:51 | 78°36.540' 09°24.636' | | 387 | ROV Push Core - NO RECOVERY. Loss upon retrieval on deck |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| MASOX | CAGE20-7-KH-Di-PusC--03 | 13.11 | 13:01 | 78°36.540' 09°24.636' | 17.5 | 387 | ROV Push Core - 17.5 cm long. PW sampling, Gas vacutainer sampling. Top sediment sampled for foram DNA |
| MASOX | CAGE20-7-KH-Di-PusC--02 | 13.11 | 13:04 | 78°36.540' 09°24.636' | | 387 | ROV Push Core - Microbiology |
| MASOX | CAGE20-7-KH-04-Dive-26 | 13.11 | 14:26 | 78°36.549' 09°24.624' | 12 | 387 | |
| MASOX | CAGE20-7-KH-04-GasS-03 | 13.11 | 14:41 | 78°36.552' 09°24.636' | 12 | 387 | |
| MASOX | CAGE20-7-KH-Di-BlaC--03 | 13.11 | 14:56 | 78°36.540' 09°24.636' | 12 | 387 | ROV Blade Core - microbiology, foram DNA |
| MASOX | CAGE20-7-KH-Di-BlaC--04 | 13.11 | 15:03 | 78°36.540' 09°24.636' | 18 | 387 | ROV Blade Core - PW sampling, forams top layer of sediment |
| MASOX | CAGE20-7-KH-Di-RocC--01 | 13.11 | 15:08 | 78°36.540' 09°24.630' | | 387 | ROV Rock Collection - Methane-derived authigenic carbonate |
| MASOX | CAGE20-7-KH-04-Dive-28 | 13.11 | 15:42 | 78°36.552' 09°24.636' | | 111 | |
| MASOX | CAGE20-7-KH-04-GasS-04 | 13.11 | 16:01 | 78°36.552' 09°24.636' | | 111 | |
| MASOX | CAGE20-7-KH-04-MBat-27 | 14.11 | 11:14 | 78°36.492' 09°25.470' | | 386 | |
| Adventfjorden | CAGE20-7-KH-05-Dive-30 | 15.11 | 08:44 | 78°16.200' 15°27.648' | | 111 | ROV Dive - EMPTY LINER. Sediment loss upon retrieval |
| Adventfjorden | CAGE20-7-KH-Di-PusC--03 | 15.11 | 09:04 | 78°16.200' 15°27.648' | | 111 | ROV Push Core - EMPTY LINER. Sediment loss upon retrieval |
| Adventfjorden | CAGE20-7-KH-Di-PusC--04 | 15.11 | 09:06 | 78°16.200' 15°27.648' | | 111 | ROV Push Core - EMPTY LINER. Sediment loss upon retrieval |