CAGE - Centre for Arctic Gas Hydrate Environment and Climate Report Series, Volume 3 (2015)

To be cited as: Panieri, G. et al. (2023). CAGE15-2 Cruise Report: Gas hydrate deposits and methane seepages offshore western Svalbard and Storfjordrenna: Biogeochemical and biological investigations. CAGE - Centre for Arctic Gas Hydrate Environment and Climate Report Series, Volume 3. https://doi.org/10.7557/cage.6932
Additional info at: https://septentrio.uit.no/index.php/cage/database

ISSN: 2703-9625
Publisher: Septentrio Academic Publishing Tromsø Norway

R/V Helmer Hanssen

15th -29th May 2015

Longyerbyen – Tromsø

Cruise report CAGE 15-2

Gas hydrate deposits and methane seepages offshore western Svalbard and Storfjordrenna: Biogeochemical and biological investigations

Chief Scientist: Giuliana Panieri
Master: Hans Hansen

With contributions by: William Ambrose, Åström Emmelie, Michael Carroll, Dan Fornari, Sophie Joanna George, Carolyn Graves, Friederike Gründger, Weil-Li Hong, Gregory J. Kurras, Andrea Schneider, Giacomo Osti, Pavel Serov, Anna Silyakova, Mette Svenning, Marta Torres.

Contents

Appendix

1. Summary

The main goal of CAGE 15-2 cruise was to study the gas hydrate system and methane emissions off western Svalbard and in Storfjordrenna. We addressed this through a comprehensive scientific program comprising dives with the MISO-Tow Cam adapted to the multicorer frame from UiT-NPI (TowCam/Multicorer, TCM), methane measurements in sediments and water column, sediment coring (multicorer + gravity corer), water column and sediment biogeochemistry, microbiology, micropaleontology, macrobiology, and bathymetric mapping.

In addition, during the ecosounder and TCM surveys we collected data for selecting the locations for the CAGE observatories to be deployed during the cruise CAGE 15-3 cruise.

The areas investigated (Fig. 1) were:

- W Prins Karls Forland (two sites at *ca* 90 m and 240 m water depth),
- An area located at the coordinate 78N 08E called "site 7808" (ca 90 m water depth; marker CAGE 882),
- Vestnesa Ridge (ca 1200 m water depth; markers CAGE 888 and 895),
- Storfjordrenna (two sites at ca 350, benthic station SR1, and 390 m water depth, Pingos site; marker CAGE 933),
- Craters area (ca 350 m water depth).

We planned the following activities during the CAGE15-2 cruise:

1. EM 300 Simrad swath bathymetry mapping to identify seabed morphology
2. Mapping of flare distributions
3. CTD stations at different water depths and in different areas for measurements of i) ocean water masses characteristics, and ii) water sampling for water/gas chemistry and microbiology investigations across methane seeps.
4. TCM surveys (video-camera) to image seabed fluid flow expressions, sites of bacteria mats and gas bubbles. These results were used to define sampling stations and collect data for the future deployment of CAGE observatories (cruise CAGE15-3)
5. Repeated deployments with TCM to sample surficial and shallow sediments with respect to microbiology, geochemistry, biogeochemistry, and micropalentology.
6. Gravity corer for studying sediment biogeochemistry, biomarkers, microbiology, and foraminifera.
7. Van Veen grabs sampling for studying macrofauna.
8. Scrape sampling to collect fauna communities and possible carbonate blocks.

2. Scientific party

Scientists	Institution	Discipline
Giuliana Panieri	CAGE-UiT	Micropalentology
Andrea Schneider	CAGE-UiT	Micropalentology
Carolyn Graves	CAGE-UiT	Micropalentology and water column
Silyakova Anna	CAGE-UiT	Water column
Serov Pavel	CAGE-UiT	Seismic and water column
Gründger Friederike	CAGE-UiT	Microbiology
Mette Svenning	AMB - UiT	Microbiology
George Sophie Joanna	AMB - UiT	Microbiology
WeiLi Hong	CAGE - UiT	Biogeochemistry
Marta Torres	OSU -USA	Biogeochemistry
Åström Emmelie	CAGE-UiT	Macrofauna
Michael Carroll	CAGE-UiT, APN	Macrofauna
William Ambrose	Bates college, USA	Macrofauna
Giacomo Osti	CAGE-UiT	Seismic and Sediments
Dan Fornari	WHOI	TOW CAM
Gregory J. Kurras	WHOI	TOW CAM
Engineers		
Bjørn Runar		
Leif Svendsen		

CAGE – UiT	CAGE - Centre for Arctic Gas hydrate, Environment and climate Department of Geology UiT The Arctic University of Norway
WHOI	Woods Hole Oceanographic Institution, USA
AMB – UiT	Department of Arctic and Marine Biology UiT The Arctic University of Norway
APN	Akvaplan-niva, Tromsø, Norway
Bates College, USA	Department of Biology, Bates College, Maine, USA
OSU, USA	College of Earth, Ocean, and Atmospheric Sciences, Oregon, USA

Shifts: Shift 1: working 08:00 am-08:00 pm and Shift 2: working 08:00 pm-08:00 am

3. Deviations from the intended cruise schedule

The cruise followed the intended cruise schedule as planned.

4. Compliance with the regulations for responsible marine research

We complied with the regulations for responsible marine research. The cruise activities were outside of the Svalbard National Park boundaries. None of our activities affected a high percentage of occurring microorganisms in the seep areas adversely, and none of our activities left a long-term impact on the ecosystems. The entire cruise took place outside of the West Svalbard National Park boundaries. We did not take any unnecessary samples. During the cruise, the ship was operated in clean ship mode except for disposal of sediments after sampling.

5. Compliance with the regulations for work routine for bringing and storing chemicals onboard R/V Helmer Hanssen

Chemical risk assessment for each methodology that involves chemicals washad been compiled prior to the cruise and sent to Inger Solheim, Trine Dahl, Ingvild Hald, and Lia Karin, according to the rules established at UiT, The Arctic University of Norway. The chemical risk assessment was also given to the Captain of HH.

Table. Reference number of risk assessment and relative method deposited in the Agresso system (UiT).

Risk assessment (fac/dept/year and no.)	**Method**
NT/IG/CAGE/2015/1	Pre-treatment of samples for micropaleontological investigations (PANIERI)
NT/IG/CAGE/2015/2	Pre-treatment for seawater samples (HONG)
NT/IG/CAGE/2015/3	Microbial rate measurements & Fixation of microbial cells from sediment and seawater samples (GRUENDGER)
NT/IG/CAGE/2015/4	Microbiology sampling (SVENNING)
NT/IG/CAGE/2015/5	Sampling of macrofauna (CARROLL)
NT/IG/CAGE/2015/6	Headspace gas extraction from bottom sediments (SEROV)
NT/IG/CAGE/2015/7	Gas chromatography (SEROV)
NT/IG/CAGE/2015/8	Pre-treatment of water samples (SILYAKOVA)

6. Investigated areas

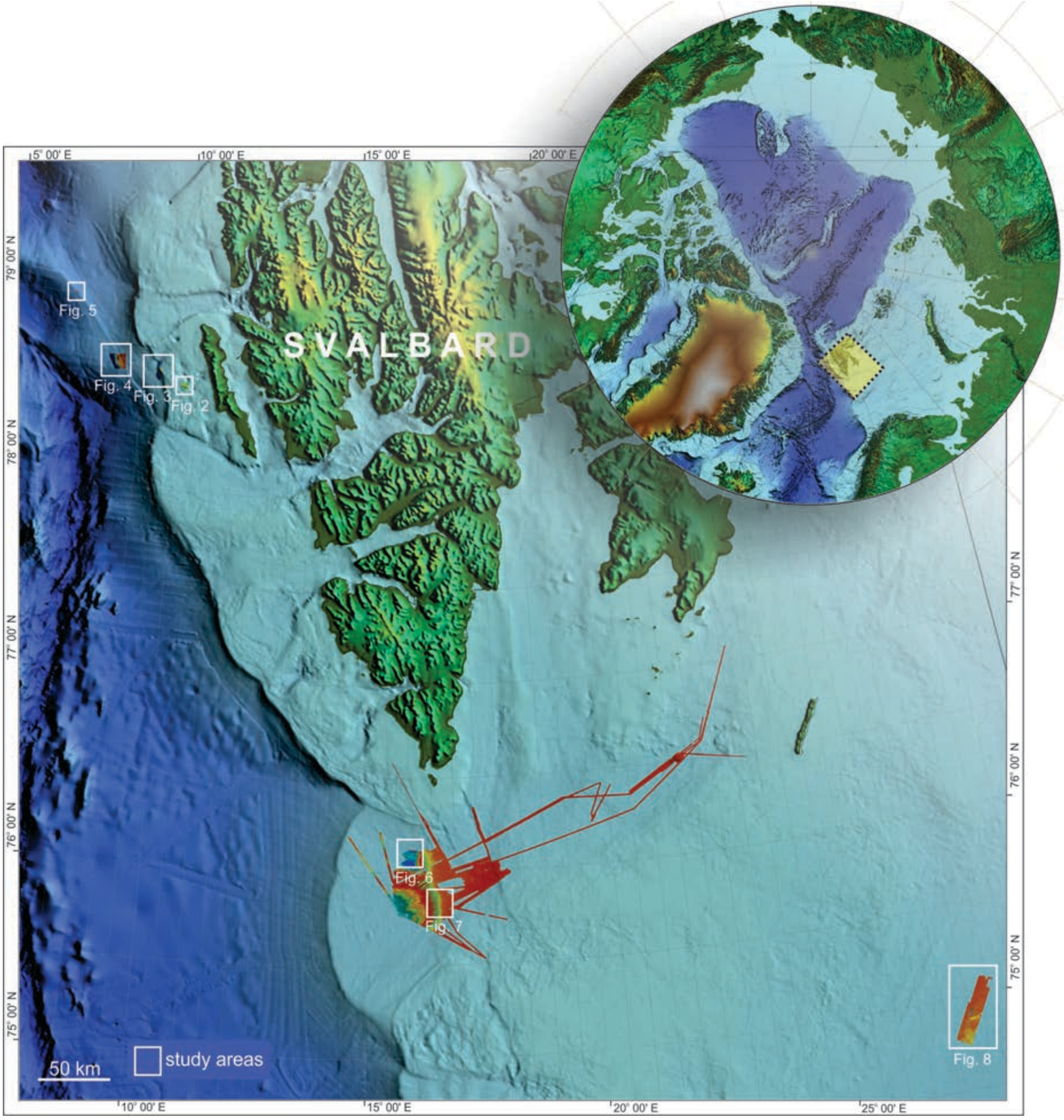


Figure 6.1: Overview map showing the working area off NW Svalbard in the Fram Strait, in Sorfjordrenna, and in the Barents Sea.

6.1 Vestnesa Ridge (markers CAGE885 and CAGE888)

Vestnesa is an elongated ~100 km long, SE-NW oriented sediment drift, located at about 79°N at water depths of ~1200 m. The whole area is characterized by intensive faulting and rifting, and it is associated with high heat flow values (up to three times higher than in the Barents Sea and the rest of Norway). Vestnesa Ridge is located on <20 Ma oceanic crust of the eastern spreading segment of the Molloy Ridge in the eastern Fram Strait, offshore western Svalbard (Ritzmann et al., 2004; Engen et al., 2008) (Fig. 1). The basaltic basement is overlain by sediments, up to 6 km thick (Crane et al., 2001), which consist of silty turbidites and muddy-silty contourites of late Weichselian and Holocene age, deposited at an average rate of 9.6 cm·ka− 1 since 19.000 yrs BP (Howe et al., 2008). The upper part of the sediment sequence includes glacigenic sediments, which reflect the intensification of Northern Hemisphere glaciations since the late Pliocene (Moran et al., 2006). Pre-glacial and glacial sediments are permeated by free gas and gas hydrate, the presence of which is revealed by a prominent bottom simulating reflector (BSR) in seismic profiles. The increase in seismic velocity above the BSR is caused by the presence of hydrate, and a large reduction in seismic velocity beneath it is caused by the presence of free gas (Posewang and Mienert, 1999; Westbrook et al., 2008; Hustoft et al., 2009; Chabert et al., 2011). A plume of gas bubbles from a pockmark on the Vestnesa Ridge was first observed in 2008 from RRS James Clark Ross cruise JR211 (reported in Hustoft et al., 2009, together with later observations).

The pockmarks along the ridge have different diameters from 400 to 600 m; the two that we have investigated during this cruise are the most active. In one of them, Panieri et al. (2014) documented at ∼2m below seafloor the occurrence of gas hydrate attesting to the presence and current abundant supply of methane to the seafloor. The two pockmarks lie at the top of a gas chimney (Hustoft et al., 2009; Petersen et al., 2010; Bünz et al., 2012). The formation of chimneys such as these and the accompanying migration of free gas is likely to have occurred over thousands of years (Liu and Flemings, 2007; Hustoft et al., 2009).

The gas venting at Vestnesa Ridge has a deep, thermogenic origin (Smith et al., 2014), and the combination of cold temperatures in the water column makes the top of the hydrate stability zone in the water column anomalously shallow (about 300 m), thus allowing for the possibility that hydrate-coated gas bubbles can contribute to the transfer of methane into the atmosphere (Smith et al., 2014). The processes of sedimentation and fluid/gas release as well as the distribution of heat flow are mostly controlled by the warm West Spitsbergen Current (Vanneste et al., 2005a; Buenz et al., 2012).

6.2 Prins Karls Forland (PKF)

Prins Karls Forland is located west of Svalbard. The sea floor west of Prins Karls Forland exhibits an irregular bathymetry. A distinct coast-parallel ridge complex occurs on the outer shelf, 20–30 km offshore. The area is characterized by smaller subparallel ridges and small depressions (ca 20 m deep) formed at the margin of a glacier that advanced and retreated, covering Svalbard and the Barents Sea during the Pliocene–Pleistocene (Solheim et al., 1998; Vorren et al., 1998). Landvik et al. (2005) interpret the ridge complex to be moraine ridges. The area was covered by slow-flowing ice sheets with the shelf break marking approximately the seaward extent of the maximal ice coverage (Landvik et al., 1998). The shelf was flooded as glacial ice retreated about 13 000 years ago (Landvik et al., 2005).

During a cruise in 2011 with the R/V James Clarke Ross, gas emissions were found at the forlandet morain complex (Wright, 2012). Additional evidence for hydrocarbon seepage at the shelf was presented by Knies et al. (2004) who discovered seep-typical sulfur-oxidizing bacterial mats using ROV. Gas emissions occur at the 396 m flares on the upper slope, but also at the outer shelf at water depths up to 150 m (Westbrook et al., 2009). Elevated bottom-water methane concentrations and the stable carbon isotope composition of methane in the water column indicate seepage at the shelf (Damm et al., 2005; Gentz et al., 2014).

The present-day landward limit of hydrate stability offshore western Svalbard is at ~ 400 m water depth (Berndt et al., 2014). Seafloor methane seepage occurs west of Prins Karls Forland in the inter-fan region between the Isfjorden and Kongsfjorden cross-shelf troughs (Sahling et al., 2014; Westbrook et al., 2009).

Warm and saline Atlantic Water of the West Spitsbergen Current (WSC) (Aagaard et al., 1987) flows over the upper slope offshore Western Spitsbergen, while colder Arctic water of the East Spitsbergen Current flows northward over the shelf (Saloranta and Svendsen, 2001). Historical temperature measurements in the WSC record multiple warming and cooling events since 1950, with overall warming since 1975 (Ferré et al., 2012; Westbrook et al., 2009). Spielhagen et al. (2011) showed that the current Fram Strait ocean temperatures represent a maximum for the last 2,000 years.

6.3 Site 7808 (marker CAGE882)

This site is located offshore the west Svalbard continental margin in an area where bottom-simulating reflector (BSR), free gas and gas hydrate were observed (Sarkar et al., 2012).

Multibeam data from the site 7808 shows ~5000 m long curved depression on the seafloor. Its maximal width is ~1000 m, and its depth reaches ~30 m. On the seismic pattern this depression is underlain by a prominent subvertical structure-seismic chimney. The seismic chimney is a ~1000 m wide zone where subparallel seismic reflectors fold up, dim and abruptly terminate in the central part of the chimney. It has a complicated structure, likely combining two separate chimneys with blanked amplitudes, interrupted by a low-amplitude reflector sequence in the middle part. The upper part of the structure is characterized by a section of chaotic high-amplitude reflections underlying the seafloor reflector. The structure may be interpreted as a pathway for vertical migration of gas-saturated fluids along the faults, tapering out on the seafloor. High-amplitude chaotic reflectors indicate presence of gas accumulations in the upper sediment section.

6.4 Storfjordrenna Pingos (marker CAGE HH933)

The area where we have identified pingos is located at 76 ^{o}N 16 ^{o}E. Multibeam data revealed the presence of circular morphologic features in water depth of ca 390 m. These features are 250-300 ca m in diameter and stand more than 10-15 m higher than the surrounding seafloor. From the morphologic characteristics these features were previously described as pingos and it was during the CAGE 15-2 that we demonstrated their origin by performing detailed surveys, sediment sampling and preliminary on-board investigations.

In the marine real, researchers studying the submarine geology of the Beaufort Shelf that used the name "PLF" to describe bathymetric features similar to terrestrial pingos observed along the coastal plain of the Beaufort Sea (Shearer et al., 1971). Terrestrial pingos are conical, ice-cored hills or mounds Mackay, 1998, and references therein commonly 10–40 m in height and 100 m or more in diameter. The marine features are similar in size to the largest terrestrial pingos, rising as shallow as 18 m below the sea surface. Paull et al. (2007) suggested a new model to explain the formation of the pingos that involves gas-driven sediment expansion and movement.

6.5 Craters area

The crater field is part of the major trough in the west-central Barents Sea, the Bjornoyrenna, with a water depth between 320 and 340 m (Solheim and Elverhøi 1993). The first survey of the area was done in 1987 and 15-20 depression were mapped in an area of about 30 km^2 (Solheim et al., 1988); another survey done few years later discovered that the density of the depression was even greater (Solheim and Elverhøi 1993). Successively, a survey in 1991 reported fewer craters than previously found, CTD measurements conducted during this cruise revealed high methane concentration in the area (Suess and Altenbach, 1992). Lammers et al. (1995) suggested that the craters must have been formed by a cataclysmic blow-out event sometime in the past.

The Quaternary sediment cover over this region of the Barents Sea is generally thin, from a couple of meters to about 30 m (Solheim and Elverhøi 1985). The lithified Quaternary clays have been deposited directly on eroded, up-dipping Mesozoic hydrocarbon-bearing sedimentary rocks. The main source of the observed methane plume is, therefore, suspected to be caused by widespread diffusion of light thermogenic hydrocarbons through weakness zones in the Quaternary capping sediments.

Pockmark craters formed by gas and pore water expulsion, characteristic of soft sediments (Hovland and Judd, 1988), have previously been described from other parts of the Barents Sea shelf (Solheim and Elverhøi 1985). However, most of the craters found in this area are orders of magnitude larger than normal pockmarks (Solheim and

Elverhøi 1993) and were not formed in the soft sediments, but in indurated strata.

The hydrography is characterized by a mixture of Arctic and Atlantic water masses, predominantly along the polar front (Swift, 1986).

7. Cruise objectives

The goal of the cruise was to study gas hydrate system and methane emissions off western Svalbard and in Storfjordrenna. In addition, we aimed to observe methane emissions at the seafloor and collect samples at methane seep sites.

The main objectives of the cruise were:

7.1 Real imaging of the methane emissions at the seafloor

This objective has been reached through the use of the TowCam/Multicorer (TCM). The system has been built using the UiT-NPI multicorer frame adapted to host the MISO TowCam system and deep-sea digital camera and CTD real-time systems. Note that a few additional components were added to the TCM original design during the cruise. Dr. Anna Silyakova, provided a Contros HydroC™ Plus self-recording methane sensor that was mounted on the forward top platform of the TCM. Also, a MISO 24VDC, NiMH battery pack (2-batteries providing a total of ~20 amp/hr), and a GoPro Hero4 camera in a MISO 6000 m DSPL housing were used on numerous deployments, along with two DSPL 5150 SeaLite LED lights for illumination.

7.2 Acoustic imaging of fluid migration pathways and seep sites

2D-high resolution reflection seismic data to image fluid migration pathways were collected. The Simrad EK60 scientific echosounder system was used for flare imaging in order to identify active seeps and variations in their activity.

7.3 Mulibeam bathymetry

Multibeam mapping of the flare areas was done using a Kongsberg EM300 multibeam sonar system used for swath-bathymetrical surveys. In this survey, the multibeam sonar was operating in a frequency of 30 kHz.

7.4 Surveys of methane concentrations and distribution in the water column

A CTD outfitted with a Niskin rosette was deployed along vertical and horizontal transect in the area of gas venting. Gas flares identified by acoustic techniques were used to guide the sampling. The distribution of methane concentration around the gas vents provides information about changes of the gas injection into the water column in comparison with earlier data.

Real time CTD attached to the tow cam recorded data during each TCM dive (survey and multicorer sampling). Gas flares identified by acoustic techniques (eco sounder) and real time observation using the TCM were used to guide the collection of water samples for chemical and microbiological studies when promising features were observed.

The Contros HydroC™ Plus CH_4 self-recording methane sensor provided by Anna Silyakova was mounted on the forward top platform of the TCM and used during some of the lowerings.

7.5 Surveys of benthic and pelagic methanotrophic activity

The microbiological characteristics of the Svalbard margin are largely unknown. Consequently, a detailed characterization of the sedimentary environments and the benthic sea water system in the Svalbard margin was conducted. The knowledge on microbiological approaches in sediments and sea water can support the origin and the fate of the gases that emanate from the deep sediment to the upper sediment layers though the water column and finally to the atmosphere.

We aim to identify the microbial communities responsible for methane consumption in arctic sediments and benthic sea water associated with methane hydrates and cold seeps. We would like to determine their structure, function and metabolic activities across vertical (depth profiles of sediment cores) and horizontal (sampling sites around previously identified cold seeps with varying methane fluxes) gradients. This will be done by DNA and RNA analyses followed by high throughput sequencing analysis and bioinformatics. Microbial methane oxidation and sulfate reduction rates will be measured via radiotracer injection. To gain a better understanding of the methane cycle we will enrich methane-oxidizing microorganisms from these deep sea water and sediments.

We will combine our microbiological data with geochemical results from sediment and pore water analyses to characterize the different areas of gas venting sites along the Svalbard margin and detect possible impacts due to climate changes.

Sampling with TCM has helped in defining sampling stations of surface sediments (max 60 cm) in the vicinity of methane flares or stations where we observed material mats. The purpose is to study microbial methanotrophic activity and sediment pore water chemistry. In addition to surface sampling, we collected gravity corers to study deeper parts of the sediment with respect to microbiology and geochemistry in venting sites.

7.6 Investigation of benthic foraminiferal community and biomarkers

During the CAGE-15-2 cruise, we sampled sediments for future analysis of both living and dead benthic foraminifera from seafloor methane seep environments in order to evaluate the suitability of foraminiferal calcite carbon-13 isotopic signatures ($\delta^{13}C$) as a proxy for methane seepage activity. Distinguishing living and dead foraminifera will allow investigation of the relative importance of primary and secondary foraminiferal calcite in negative carbon isotopic excursions, which have been observed in association with methane seepage.

We applied three different staining methods for living foraminifera from the near-surface sediments (0-3 cm sediment depth) and sampled sediments from deeper sediment intervals without staining. In addition, we sampled water from the interstitial

pore space to directly compare the carbon isotopic signature of dissolved inorganic carbon (DIC) and foraminiferal calcite.
Samples for biomarkers analyses were taken from the same intervals of micropalentology sampling. In fact, for the studies of methane seeps, the $\delta^{13}C$ of lipid biomarkers have been used to track carbon flow within microbial communities as well as to determine dominant reactions (Hinrichs et al., 2000; Wegener et al., 2008, Niemann and Elvert, 2008).

7.7 Investigation of benthic faunal community structure

The main objective of the benthic faunal sampling was to qualitatively and quantitatively characterize the organisms inhabiting seafloor sediments. In the present cruise, sampling was done primarily with respect to locations with methane emanating from the seafloor. In addition to the TowCam photo surveys, we used a variety of sampling methods described below to collect benthic invertebrates (benthos) from the seafloor. We sampled within identified methane seep areas in at Prins Karls Forland, Vestnesa Ridge, and Storfjordrenna to identify the impact that methane seeps have on benthic faunal composition.

7.8 Biogeochemistry

The objectives of the pore water program were to evaluate: 1) biogeochemical processes in methane-bearing sediment, 2) the presence of gas hydrate; and 3) the nature and source of fluid flow. Biogeochemical processes can be modeled with a complete set of parameters related to carbon cycling, which include alkalinity, sulfate, ammonium, methane and the isotopic composition of the carbon and sulfur species. The presence of gas hydrate is commonly documented based on chloride concentration and the isotopic composition of the water. Changes in chemical and isotopic composition of interstitial fluids have been shown to be powerful tracers of fluid sources, migration patterns, and fluid-rock reactions within the sediments. In addition to the above objectives, changes in pore fluid composition may also illuminate the recent history of fluid flow, by analyzing non-steady state profiles of dissolved species. Pore water chemistry will also as provide supporting data to studies of seafloor habitats and microbiological processes associated with areas of seepage.

8. Cruise activities and preliminary results

The main activities during the cruise included:

- CTD stations at different water depths and in different areas for characterization of i) ocean water masses and ii) water/gas chemistry and microbiology changes across methane seeps.

- TCM surveys (video-camera) to image seabed fluid flow expressions, sites of bacteria mats and gas bubbles. These were used to define sampling stations and collect data for the future deployment of CAGE observatories (cruise CAGE15-3).
- Repeated deployments with TCM to sample surficial and shallow sediments with respect to microbiology, geochemistry, biogeochemistry, and micropalentology.
- Gravity corer for the study of sediment biogeochemistry, biomarkers, microbiology, and foraminifera.
- Van Veen grabs sampling for macrofauna studies.
- Scrape sampling to collect fauna communities and possible carbonate blocks.

Below, detailed description of activities and preliminary results:

8.1 Acoustic imaging of flares

Single beam echo sounders are common among all types of ships. The primary purpose is for sediment imaging of the uppermost sediments, but it can be used to detect and image gas flares from the seafloor using 18 KHz and 38 KHz transducers.
In a single beam echo sounder, the transducer projects a sound pulse through water in a controlled direction and the reflected wave is received. The depth is calculated from the travel time of the sound pulse. R/V Helmer Hanssen has a keel-mounted Simrad EK 60 single beam echo sounder with transducers at three different frequencies, 18 KHz, 38 KHz and 120 KHz. The 18 KHz transducer can be used for depths up to 10 km whereas 38 KHz and 120 KHz can only be used for depths up to 2 km and 500m, respectively. Ecosounder data were collected during all profiles and transits for flare imaging. The new data were used to identify the most active sites and locate the best sites for sampling, and expand the CAGE flare data set.

8.2 Multibeam echosounder

During Cruise CAGE15-2, the hull-mounted Kongsberg Simrad EM 300 multi-beam echo sounder was used for bathymetric mapping continuously while we were in the study area. Parts of the data were processed on-board.

8.3 Microbiology: surveys of benthic and pelagic methanotrophic activity

(Friederike Gründger, Mette Svenning, Sophie George)

8.3.1. Sampling and analyses

We sampled benthic seawater and sediment from within different gas venting areas bordering Svalbard to determine the microbial community composition and its active members of the community in the sediment surface and the anaerobic zone of sediment beneath including the sulfate-methane-transition zone (SMTZ).

8.3.2. Seawater sampling

Benthic seawater samples were collected by 5-L Niskin bottles mounted in the TCM from Prince Karls Foreland (PKF), area 7808, Vestnesa Ridge (VR), Pingos (PLF), and Craters area in Storfjordrenna.

For microbial community analysis, 1 L seawater was filtered immediately after sampling through polycarbonate filters (Nuclepore Track-Etched Membrane, 0.22 µm, Whatman) and stored at -20°C. DNA extraction and sequence analysis will be completed in the home lab. For quantification of different microbial groups, 15 ml formaldehyde solution (38 %) was added to 300 ml seawater sample. After 4 h fixation time at 4°C in the dark, water samples (100 ml and 200 ml) were filtered through polycarbonate filters (Nuclepore Track-Etched Membrane, 0.22 µm, Whatman) and stored at -20°C for further analysis.
Methane oxidation rates were measured on board by injection of ^{14}C-labelled methane tracer ($^{14}CH_4$). Each seawater sample was collected in quadruplicates in 20-ml crimp-top vials, filled and closed bubble-free with PTFE coated bromobutyl stoppers (Wheaton, USA). After injection of 10 µl of $^{14}CH_4$ tracer (~3 kBq, American Radiolabeled Chemicals, USA), seawater samples were incubated for 3 d at 4°C in the dark. The incubation was terminated by adding 1 ml sodium hydroxide (30 %) to the seawater sample. Additionally, 2 ml N_2 was injected to each sample to allow the methane to emit from the liquid into the gas phase. Samples were mixed and stored at 4°C to be later measured in home laboratories. The control samples were fixed with 0.5 HgCl solution immediately afterwards tracer injection.

Table 8.1: Overview of seawater sampling procedures

Seawater sample	Volume	Vial	Preservation	Note
Radioactive tracer $^{14}CH_4$	4x 20 ml	20-ml glass vial	+4°C	
DNA	1000 ml	Membrane filter	-20°C	
Quantification	300 ml	Membrane filter	-20°C	Fixation with FA
Enrichments	5 ml	38-ml serum bottle	+4°C	CH_4 purged serum bottle
Nutrients	15 ml	Falcon tube	-20°C	

8.3.3. Sediment sampling

Sediment samples were taken by multicorer or gravity corer within methane flare areas from Prince Karl`s Forland (PKF), 7808, Vestnesa Ridge (VR), Pingos (PLF), and Craters area in Storfjordrenna. For the identification of the microbial community and their metatranscriptome, sediment samples were collected from each multicorer firstly in 2 cm intervals from the sediment surface through to the upper 6 cm and continuing in 6 cm intervals for the following deeper sediment. Samples from the gravity corer were collected in intervals of colour changes. For both multi- and gravity corer, 20 ml of sediment from the chosen depths was collected into 50-ml Falcon tubes and frozen immediately after sampling (dry shipper, -80°C). From these samples DNA and RNA will be extracted in the home laboratories followed by high throughput sequencing analysis and bioinformatics.

Sediment from the multicorer was further sampled for more extensive analysis.
For quantification 0.5 ml sediment, taken from the same intervals like the DNA/RNA samples, was fixed with formaldehyde solution (4 %). After 4 h fixation at 4°C in the dark, sediment samples were washed twice with sterilized seawater and stored in sterilized seawater/ethanol (1:1) solution at -20°C. Analyses will be completed later in home laboratories.
To obtain methane oxidation and sulfate reduction rates, radioactive tracers ($^{14}CH_4$ and $^{35}SO_4$, respectively) were added to sediment samples. Sediments from the multicorer were sub-sampled vertically with acrylic core liners for methane oxidation and sulfate reduction measurements in triplicates each. Radioactive tracers, $^{14}CH_4$ (dissolved in water, injection volume 50 µl, activity ~3 kBq) and $^{35}SO_4$ (dissolved in water, injection volume 10 µl, activity 300 kBq) were injected in 1 cm depth intervals into separate replicate sub-cores and incubated for 28 h on board at 4°C in the dark. Before fixation, the upper 10 cm of each sub-core were sectioned into 1 cm intervals, the next 16 cm into 2 cm intervals and the following sediment into 5 cm intervals. To stop the microbial activity, sectioned samples were mixed with 20 ml sodium hydroxide (2.5 % w/w) in 50-ml serum bottles or 10 ml zinc acetate (20 % w/w) in 50-ml Falcon tubes for methane oxidation and sulfate reduction, respectively. The control samples were fixed immediately afterwards tracer injection without incubation. Fixed sediment samples were stored at 4°C until later rate measurements in our home laboratories.

Tube worms embedded in the sediment were carefully removed from their chitin tube and washed twice in sterile sea water. Three worms were fixed individually in 3 % paraformaldehyde for 4 hours. After fixation the worms were washed in sterile sea water and stored in ethanol 1:1 at -20°C.
In addition, three 20cc samples were collected for future incubation experiments at varying temperatures. These samples were kept anoxic on gas-tight bags maintained anoxic via GasPak EZ Gas generating pouches, and stored at 4C.

Table 8.2: Overview of sediment sampling procedures

Sediment sample	**Volume**	**Vial**	**Preservation**	**Note**
Radioactive tracer $^{14}CH_4$ & ^{35}S	3x 1, 2, 5 ml	Sub-core & glass syringe	+4°C	
DNA / RNA	5-15 ml	50-ml Falcon tube	-80°C	
Quantification	2x 0.5 ml	2-ml vial	-20°C	Fixation with FA, stored in EtOH solution
Cultivation	10-50 ml	100-ml glass bottle	+4°C	purge with N_2
Enrichments	5 ml	38-ml serum bottle	+4°C	CH_4 purged serum bottle, slurry with sterilized seawater

Our microbiological data will be complemented with geochemical analyses of pore water depth profiles, nutrient composition, methane concentration, isotopic signature of CH_4, concentration of sulfate, chloride, and dissolved inorganic carbon (DIC). Sulfate and DIC are essential for the discussion of various biogeochemical reactions as well as microbiology studies. Geochemistry samples were collected from the same sites and depths as the microbiology samples.

Table 8.3: Overview of seawater samples taken during the cruise. # Number of the Niskin bottle; MOx aerobic methane oxidation; FISH fluorescence *in situ* hybridisation (quantification of microorganisms by staining with fluorescence markers).

Sampling site	**Water depth [mbsf]**	**bottle no.**	**Measurements**
TC 850	85.18	#1, #2, #3, #4, #5, #6	MOx activity, DNA, FISH
TC 851	87.40	#1, #2, #3, #4, #5, #6	MOx activity, DNA, FISH, enrichment #2 and #6
CTD 860	84.01	#1 (benthic water)	MOx activity, DNA, FISH
TC 881	901.53	#2, #4	DNA/RNA, enrichments
TC 885	1201.72	#1, #2, #3	MOx activity, DNA, FISH,
TC 892	1203.64	#1, #2, #3, #5, #6	MOx activity, DNA, FISH, enrichments from #2 and #6
TC 903	377.93	#6	MOx activity, DNA, FISH
MC 904	385.51	Surface water from top of the core	MOx activity, DNA, FISH, enrichment
TC 937	377.16	#4	MOx activity, DNA, FISH
MC 938	377.97	Surface water from top of the core	MOx activity, DNA, FISH
TC 944	363.81	#3, #4, #5, #6	MOx activity, DNA, FISH

Table 8.4: Overview of sediment and tube worm samples taken during the cruise. Microbial communities; AOM anaerobic methane oxidation; SR sulfate reduction; FISH fluorescence *in situ* hybridisation (quantification of microorganisms by staining with fluorescence markers).

Sampling site	**Water depth [mbsf]**	**Measurements**
GC 877 A & B	879.85	DNA/RNA for Oregon and Tromsø
MC 880	889.28	DNA/RNA from MC I: 3-10 cm (sandy layer), 10-20 cm (clay layer), enrichment; MC II: 0-4 cm

MC 884	901.61	DNA/RNA every 1 cm to 10 cm, 15 cm and 20 cm; DNA filter core surface water
MC 886	1201.50	AOM & SR activity, DNA/RNA, FISH, enrichments from benthic water
VR2?		Enrichments: surface water and sediment 2-3 cm; DNA/RNA: 1 cm, 2-3 cm, 5 cm, 20 cm and bottom; DNA filtration core surface water
MC 893	1203.41	AOM & SR activity, DNA/RNA, FISH, enrichments from benthic water
MC 904	385.51	AOM & SR activity, DNA/RNA, FISH
Grab 931	350.38	DNA/RNA sediment surface layer; tube worms (siboglinidae) fixed, frozen for DNA
MC 938	377.97	AOM & SR activity, DNA/RNA, FISH, enrichments from benthic water
Grab 951	335.01	Surface water enrichment; DNA/RNA surface sediment; tube worm enrichment
MC 964	349.76	AOM & SR activity, DNA/RNA, FISH (reference station)

8.4 Investigation of benthic foraminiferal community and biomarkers

(Giuliana Panieri, Carolyn Graves, Andrea Schneider)

8.4.1 Sample collection for micropalentology

We collected material from four sites using the MISO TowCam-guided multicorer:

- Prins Karls Forland (PKF)
- 7808 site
- Vestnesa Ridge (VR)
- Pingos-like features (PLF)
- Storfjordrenna (SR)
- Crater area

When a site with suitable seafloor conditions such as soft mud, presence of bacterial mats or authigenic carbonates, and absence of larger clasts was observed in the TowCam imagery, we triggered the multicorer sampling. The multicorer touched ground for about 20 seconds and was then brought on board R/V Helmer Hanssen. The moment of sampling itself could not be observed, but the seafloor conditions before the sampling as well as after sampling with mud/dust clouds right above the seafloor.

From each successful multicorer cast, one or two core pipes were used for micropaleontological purposes. Replicate sampling was performed when enough material is present.

We stained material of the uppermost core section using three different methods: CellTracker Green (CTG), TEM, and Rose Bengal (RB) in order to compare the results of the different staining methods. Furthermore, we sampled porewater for isotopic analyses of the dissolved inorganic carbon (DIC). The sampling was as follows:

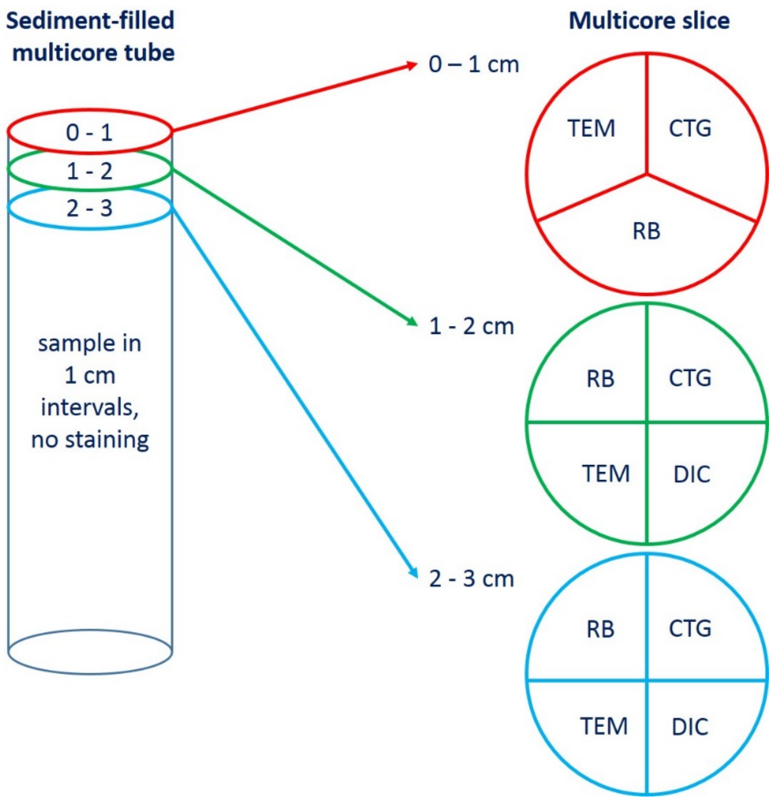


Figure 8.1. Sampling and staining scheme of different depth intervals below seafloor. CTG – CellTracker Green. RB – Rose Bengal. DIC – dissolved inorganic carbon from porewater.

8.4.2 Staining preparations

8.4.2.1 TEM-staining (0-1 cm depth only)

A TEM solution of 10 ml glutaraldehyde (defrosted), 25 ml cacodylate buffer and 15 ml distilled water was prepared 1/2 hour prior to sampling under the fume hood. During subsampling, 20 ml (1/4 core slice, 1 cm thick) of sediment from 0-1 cm depth was transferred in a 60 ml HPDE bottle. We added the TEM solution until the bottle was almost full, we shook the bottle gently, sealed it with Parafilm, and stored it in the fridge at 4°C.

8.4.2.2 CellTracker Green staining (CTG) (uppermost 3 cm)

The CTG reagent solution was prepared as follows: 1.4 ml of DMSO (not anhydrous) was added to 1 mg CellTracker Green (solid, stored in freezer at -20°C) in a plastic vial as it came from the supplier. The CTG solution was removed from the freezer, thawed approx. 20 minutes before dissolving it, and shook to dissolve. The CTG-DMSO mixture was then transferred into 1.5 ml Eppendorf vials using a 100 ml pipette in 110 ml

aliquots, and finally stored in the freezer at -20°C. The content of each Eppendorf vial is enough for 3 samples (uppermost 3 cm of 1 multicorer tube).
After core recovery, 20 ml of seawater from the core top and about 20 ml (1/4 core slice, 1 cm thick) of sediment were added to a 125 ml HPDE bottle. We thawed the CTG-DMSO mixture beforehand, added 35 µl to each sample and shook it gently. The UTC time when the CTG-DMSO mixture was added was noted on the bottle, which was then stored for 8 to 12 hours in the fridge at 4°C. Thereafter, we added ~ 10 ml of formalin (36 %) with a pipette under the fume hood, noted the UTC time when the formalin was added, and stored the sample in the fridge at 4°C.

8.4.2.3 Rose Bengal staining (RB) (uppermost 3 cm)

We dissolved Rose Bengal Powder in distilled water prior to sampling, added it to the sediment sample, shook gently, and stored the material in the fridge at 4°C.

8.4.3 Porewater sampling for DIC measurements (uppermost 3 cm)

In order to obtain porewater for DIC measurements, 6 Eppendorf vials (1.5 ml) were filled with sediment from 1-2 and 2-3 cm depth below surface, and centrifuged at ~ 13,400 rpm for 30 seconds. Porewater was filtered through 0.2 µm cellulose-acetate filters and added to 2 ml glass vials with 10 µl HgCl and stored in the fridge at 4°C.

8.4.4 Samples collection for biomarkers

We collected material from four sites using the MISO TowCam-guided multicorer:

- Prins Karls Forland (PKF)
- 7808 site
- Vestnesa Ridge (VR)
- Pingos-like features (PLF)
- Storfjordrenna (SR)
- Crater area

Samples for biomarkers were taken at the same stratigraphic interval from where the samples from micropaleontology were taken. Samples were preserved in aluminum foil and stored in the freezer (-20°C).

Table 8.5. Samples collected for living foraminifera and biomarkers

Multi core ID	0-1 cm	RB	TEM	CTG	PW	1-2 cm	RB	TEM	CTG	PW	2-3 cm	RB	TEM	CTG	PW	Description	Foram sampling	Biomarker sampling
CAGE 15-2 880 A		x		x			x		x			x		x		ox. layer on surface, 4-8 grey, sandy, drier, 8-37 grey homogeneous mud	3-**37** (end)	
CAGE 15-2 880 B		x	x	x			x		x			x		x				
CAGE 15-2 884		x	x	x			x		x	x		x		x	x		3-**24** (end)	
CAGE 15-2 886		x	x	x			x		x	x		x		x	x	0-1 wet, oxidized, pebbles 2 shrimps, 1-2 brown & black mud, tubes, 2-3 black mud, less wet, tubes	0-3 cm only	
CAGE 15-2 893 A		x	x	x	x		x		x	x		x		x	x		0-3 cm only in A	
CAGE 15-2 893 B		x	x	x	x		x		x	x		x		x	x	thin oxidozed layer, black mud starts in first cm bubbles while subsampling grey mud with mousse texture in lower part of core 34-35 shell fragment, carbonate	1 cm intervals 3-**36** cm (end of core)	1 cm interval 3-10 cm, below 10 cm: every second cm to bottom of core
CAGE 15-2 904 A		x	x	x	x		x		x	x		x		x	x	H2S smell 0-4 brown mud, stressed sea spider, tubes	every cm from 10-21 cm	every cm 3-10, thereafter
CAGE 15-2 904 B		x	x	x	x		x		x	x		x		x	x	H2S smell		
CAGE 15-2 932		x	x	x	x		x		x	x		x		x	x	0-8 brown mud, tubes 8-15 dark brown no tubes, H2S smell	until **15** cm (end)	every cm 3-10, 11-12 and 13-14
CAGE 15-2 938 A		x	x	x	x		x		x	x		x		x	x	5-7 many wormtubes 8-9 shells 12-16 many shells 23 sulfide shell (?)	until **31** cm (end of core)	every cm 3-10, thereafter every 2nd cm
CAGE 15-2 938 B																15-17 shell layer total length 38 cm		every cm 1-5, 5-**38** (end of core) in 2 cm intervals
CAGE 15-2 945		x														**3 cm** of brown mud with nice sediment-water interface		0-3 as one sample
CAGE 15-2 960		x	x	x	x		x		x	x		x		x	x	brown mud with wormtubes		3-**7 cm** (end of core)

8.5 Investigation benthic faunal community structure

(William Ambrose, Emmelie Åström, Michael Carroll)

Prins Karls Forland shallow site (90 m) supported high densities of sea urchins and sea anemones in a mixed sediment bottom with gravel and stones filled with small amount of sand.

The site 7808, located at 900m depth, had surprisingly high densities of macrofaunal organisms, considering the depth. From the seafloor images, we observed large numbers of snakeblennies (burrowing fish), sea spiders (pycnigoindae), gastropod molluscs (snails), and stalked crinoids that would be considered more typical of shallower (continental shelf) habitats. We did not collect faunal samples from this very interesting area.

Macrofaunal communities at Vestnesa are dominated by high densities of specialized tube worms (polychaeta) of the family Siboglinidae adapted to chemosynthetic environments. These result in higher diversity and biomass than usual in deep sea habitats. We collected samples for quantitative faunal analysis at stations #891 MC and #896 MC, and qualitative samples for porosity, TOC, grainsize and benthic pigments from #888. A few of the collected cores contained gaseous sediments, bubbling when brought onboard on deck.

The Storfjordrenna Pingo area had sediment characteristics indicative of seafloor methane seeps, with very black mud and a strong H_2S odor, and authigenic carbonate crusts in evidence. Bacterial mats were seen in photos at Pingo 1 and 2 and we collected benthic macrofauna from both multicore and grab samples at the two first Pingo seeps (#904 and #922).At both Pingo seeps we saw features including Siboglinid polychaetes (frenulating seep worms) and bivalves in the family of Thyasiridae, which are known to be associated with methane seeps and other reducing environments. Notably, we found numerous examples of the undescribed species of Thyasiridae that we first discovered in 2014 in the same region. At Storfjordrenna there were fishing trawlers in the area and evidence of trawl marks on the sea bottom, but there was also coverage of bacterial mats and we when we resampled seep station SR1 from 2014 at a known flare, we also found characteristic seep fauna. A triangle scrape yielded live Siboglinids polychaetes for DNA barcoding, bacterial DNA/RNA and stable isotopes.

The Barents Sea craters area was characterized by a thin veneer of soft mud habitat in between the craters themselves that looked relatively homogenous, and containing clusters of blenny (fish) holes as well as more regularly spaced smaller holes that could be large bivalves (e.g. Mya sp., Clinocardium ciliatum). There was large slabs of rock debris surrounding the edge of the craters, and in the craters themselves these slabs were also evident and were colonized primarily be sponges, soft corals, and other epifauna. We repeated the BR 3 station from 2014 at the “flarefield” #946 for quantitative faunal grab sampling and in the end, a triangle scrape for qualitative sampling of macrofauna was launched.

	Depth:90	90	900	1202	1204	1201	1203	378	383	350	334
Station:	**PKF 90 #853 C**	**PKF 90 #863 N**	**7808 #882**	**VR #886**	**VR 1 #888 (#887 logg)**	**VR2 #891**	**VR 3 #896**	**PLF 1 #904**	**PLF 2 #922**	**SR 1 #925**	**BR 3 #946**
Samples											
Photos miso	X	X	X	X	X	X	X	X	X	X	
Quantitative	X g	X g (incom plete)				X mc	X mc	X mc	X	X	X
Multicore			X	X	X	X	X	X	X		
Porsoity			x		x	x	x	x	x	x	x
Chl/pigments	X*	X	X		X	X		X	X	X	X
Grainsize	X	X	X		X	X		X	X	X	X
TOC/PON	X	X	X		X	X		X	X	X	X
Gravitycore			X					X	X		
Shells bivalves								X	X	X	
Isotopes biol. Fauna	X							X	X	X	X
Reference material (Ethanol)								x		x	x
Reference material (Formaldehyde)										X	

8.6 Biogeochemistry

(Weil-Li Hong, Marta Torres)

8.6.1 Pore water sampling

A total of 199 pore water samples were collected from 6 Tow-cam multicores, and 7 gravity cores using 10 cm rhizons, previously soaked in distilled water. Fluids from gravity cores were extracted in a 2°C refrigerated room, multicores were processed on deck, temperature ~1°C . Most samples yield >12 ml of water, with a few ranging from 1 to 5 ml, which was collected in 20 ml acid washed syringes and subsequently filtered through 0.2 µm cellulose acetate in-line filters. Fluids were analyzed onboard for alkalinity and dissolved Fe^{2+} and subsampled as shown in Table 1. The location of the cores and general working area are shown in Figure 1. The numbers of pore water samples were summarized in the Table 2.

Table 1. Subsamples collected from rhizon samples		
Analyses	Volume (ml)	Treatment
Alkalinity	2	Titrated onboard
$[Cl^-]$ $[SO_4^{-2-}]$ $[HS^-]$	1.5	Aliquot taken in a 10 ml plastic vial containing 6 ml of 23.8 mM $Zn(OAc)_2$
Sulfur isotopes	2	Aliquot taken in a 10 ml plastic vial containing 6 ml of 23.8 mM $Zn(OAc)_2$
^{13}C-DIC	0.5 to 1.5	1.5 ml glass vials containing 10 µl $HgCl_2$
[DIC]	0.5 to 1.5	1.5 ml glass vials containing 10 µl $HgCl_2$
Nutrients	0.5 to 1	1.5 ml eppendorf vials, frozen
O/H isotopes	0.5 to 1	1.5 ml glass vials, no treatment
Cations	2 to 5	Plastic 5 ml acid washed vials, acidified with ultrapure concentrated (65 %) HNO_3, ~10 µl/ml sample

Table 2 Numbers of pore water samples collected		
Site	# pore water samples	Area
GC877	16	Site 7808
GC878	25	
MC880	10	
MC886	18	Vestnesa ridge pockmark
GC890	15	
MC893	20	
MC904	18	Pingo-like features, Storfjordrenna
GC911	8	
GC918	7	
GC920	11	
MC932	6	
MC938	19	
GC940	16	
MC960	5	Crater area
MC965	5	Control site

8.6.2 Sediment sampling

Sediments from multicores were collected on a companion tube to the pore water analyses, as listed in Table 3. The upper 3 cm of the core was sampled for foraminifera. The remaining of the core was sectioned in 2 cm intervals, and each slice was subsampled for analyses of methane, sediment composition and biomarkers. In some cases, a sample was frozen for DNA analyses at OSU.

All gravity cores (with exception of core 920GC) chosen for pore fluid analyses, were also sampled for methane, sediment composition, and biomarkers (Table 3).

8.6.3 Shipboard analysis

Alkalinity was determined with a pH-controlled titration to a pH just under 4. The pH electrode was calibrated against pH 4, 7 and 10 Metrohm Instrument buffers. HCl titrant (12M Sigma-Aldrich TraceSELECT HCL diluted to 0.012M) was calibrated against 0.05M borax standard prepared in 0.7M KCl, diluted to 2, 10, 50 mM alkalinity. Each 2 ml sample aliquot was diluted with 8 ml of KCl (0.7M), and sequential aliquots of 0.012M HCl standard were added while constantly stirring in an open 50 ml beaker. The amount of acid and pH was manually recorded during each addition. Alkalinity was calculated from the slope and intercept of the regression line of Gran function plots, which were made by plotting Gran functions against the titrant volume. Gran function (GF) is defined as:

$$GF=(V_0+V_t)*10^{-pH}$$

where V_0 is the initial volume of sample and V_t is the volume of titrant added. Eight to ten points were used for regression.

Dissolved iron was determined spectrophotometrically using a ferrospectral complex in ascorbic acid (1 %) at 565 nm. Calibration curves were prepared from iron sulfate standards (10 standards from 0.067 to 1 mg/L Fe) and run with each sample batch. Standard and ferrospectral solutions were prepared daily with anoxic MilliQ water using acid-washed volumetric flasks. Measurements were done within an hour after the water samples were extracted.

8.6.4 Preliminary Results

Site 7808

We collected 2 gravity cores (877GC and 878GC) and 1 multicore (MC880) from this location. The alkalinity profiles from these three sites are in good agreement (Figure 2A). Highest alkalinity (9.33 mM) was measured at 3.54 mbsf from GC878. Based on the alkalinity profile, we suspect that none of the cores penetrated sulfate reduction zone. Abundant dissolved iron (up to 62.6 mM) was detected above ~2 mbsf from all cores suggesting a 2-meter thick iron reduction zone.

Vestnesa Ridge

We collected 2 multicores (MC886 and MC893) and 1 gravity core (GC890) from Vestnesa ridge. Alkalinity is no higher than 11.38 mM (33 cmbsf at MC893) (Figure 2b). We observed gas cracks from the sediments of MC893. The presence of gas bubbling and gas hydrate were also suspected from other multicores at site 893. We detected lower iron concentration (<27.4 mM) and thinner iron reduction zone (<1.5 m) comparing to the mud diapir area suggesting active sulfide mineral precipitation.

Storfjordrenna seeps

We collected pore water samples from 3 multicores (MC904, MC932, and MC938) and 4 gravity cores (GC911, GC918, GC920, and GC940) from the pingo-like features in this area. Alkalinity is noticeably higher compared to the other two study areas. The highest alkalinity (43.93 mM) was measured from the bottom of site GC920 (2.4 mbsf) (Figure 2c). Very high Fe^{2+} concentration (up to 219.6 mM) was detected from two of the cores. We observed a very confined iron reduction zones (< 30 cm) in this area. Dissolved iron is effectively scavenged by hydrogen sulfide and precipitates as iron sulfide minerals, consistent with observation of black sediments in most of the cores.

Crater area

Only a short multicore was recovered from this area. Five pore water samples were collected and analyzed onboard for alkalinity and dissolved iron concentration. Alkalinity is low (~2.6 mM) and constant throughout the core (Figure 2d). Abundant dissolved iron (> 27 mM) is always present in the samples indicating the >8.5 cm thick iron reduction zone. Based on the low alkalinity and high dissolved iron content, we expect very low methane concentration in the sediments.

Control site

A 10 cm multicore was recovered from area without any detectible flares from echo sounder data. Five pore water samples were collected for shipboard analyses, anion and cation concentration. Alkalinity is always low (~2.6 mM) except for the last sample, in which alkalinity reaches 3.07 mM (Figure 2e). A larger analytical error may associated with this measurement relative to the rest of the analyses in this expedition, because of the small amount of sample available (0.5 ml) for titration. High dissolved iron (> 17mM) was detected from all samples suggesting no penetration below the iron reduction zone. The sediments were disturbed during transfer from the upper deck, so some degree of contamination with overlying bottom seawater may have occurred. However, the high dissolved iron concentration measured indicate that the pore water signal is preserved in our pore water samples, although potential contamination may still be possible.

Figure 8.2 Site7808

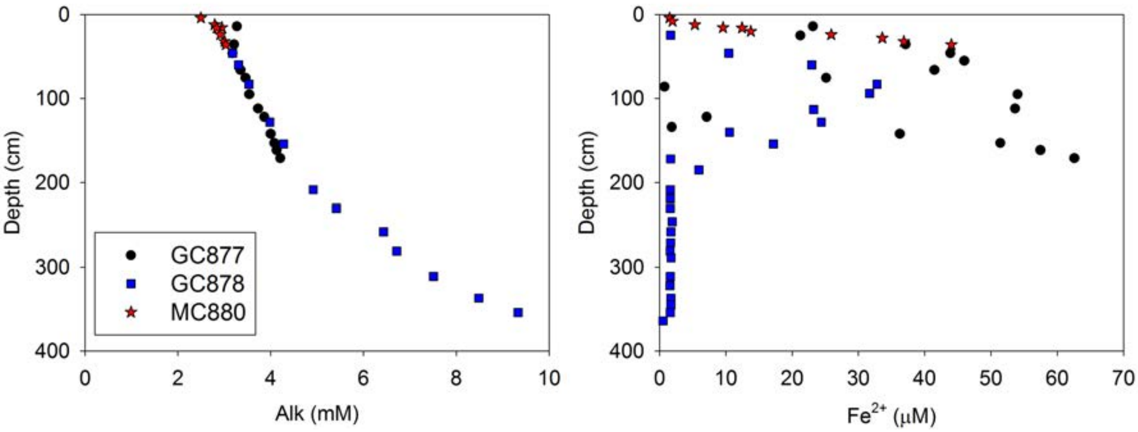


Figure 8.3. Vestnesa

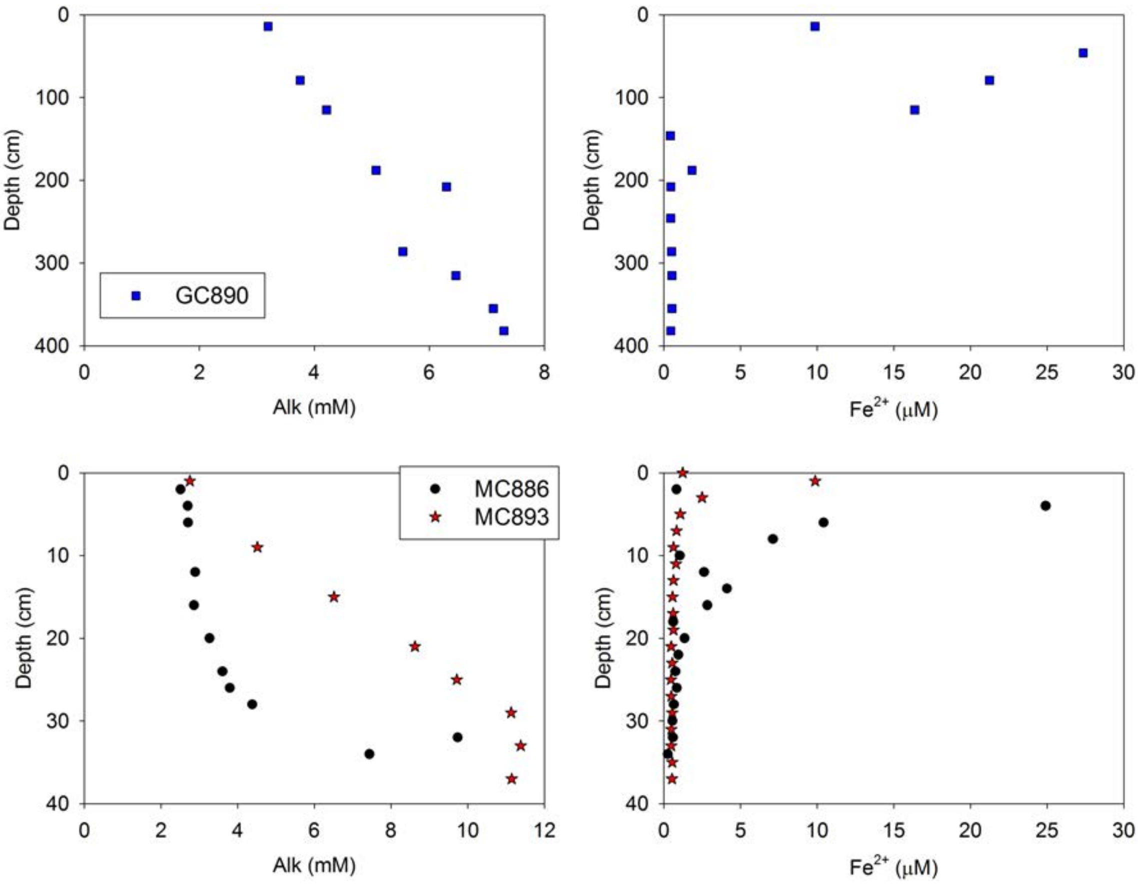


Figure 8.4 Pingo

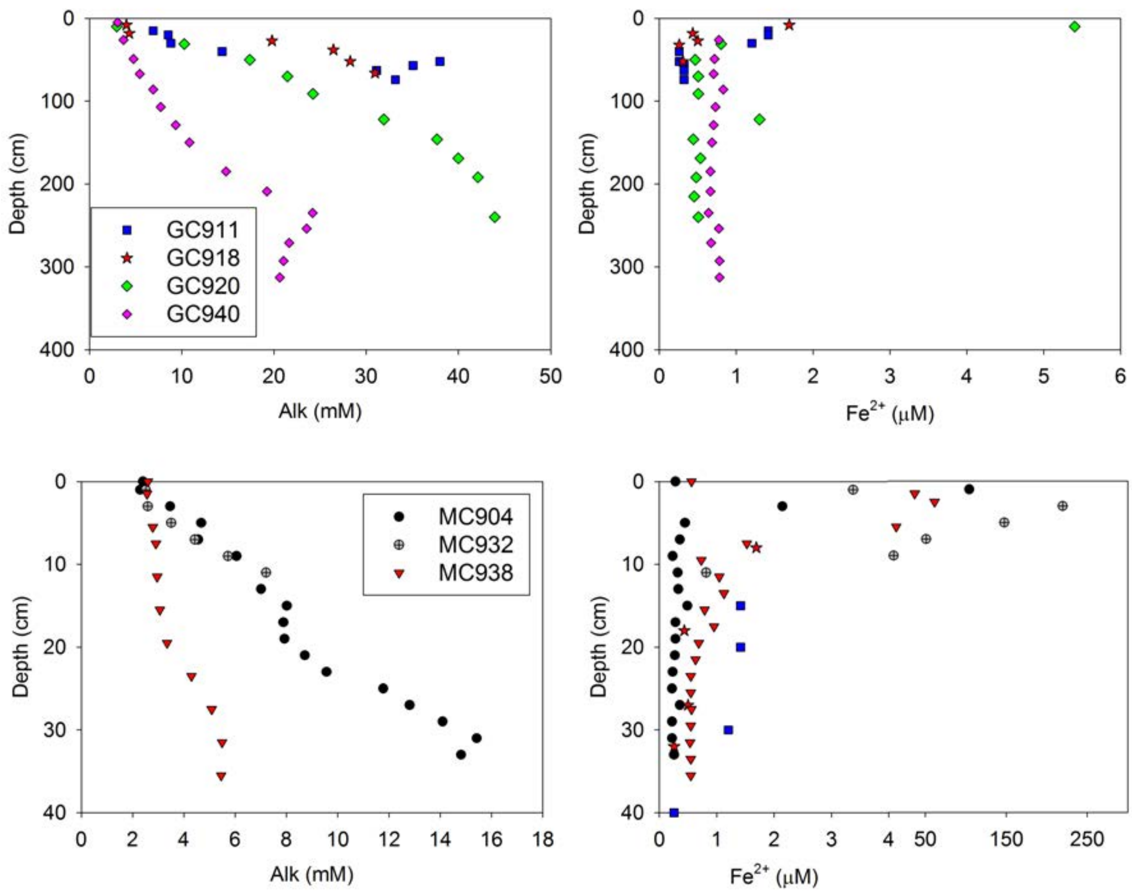


Figure 2d Crater area

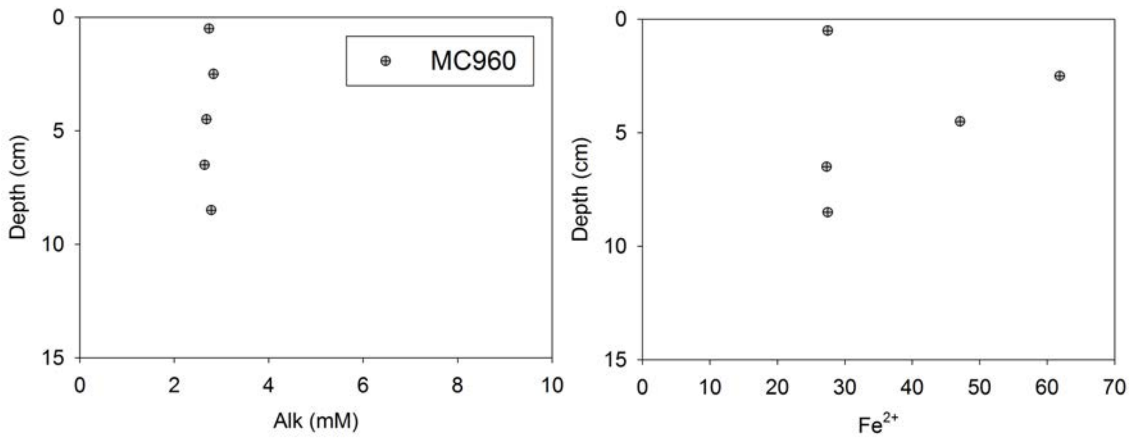
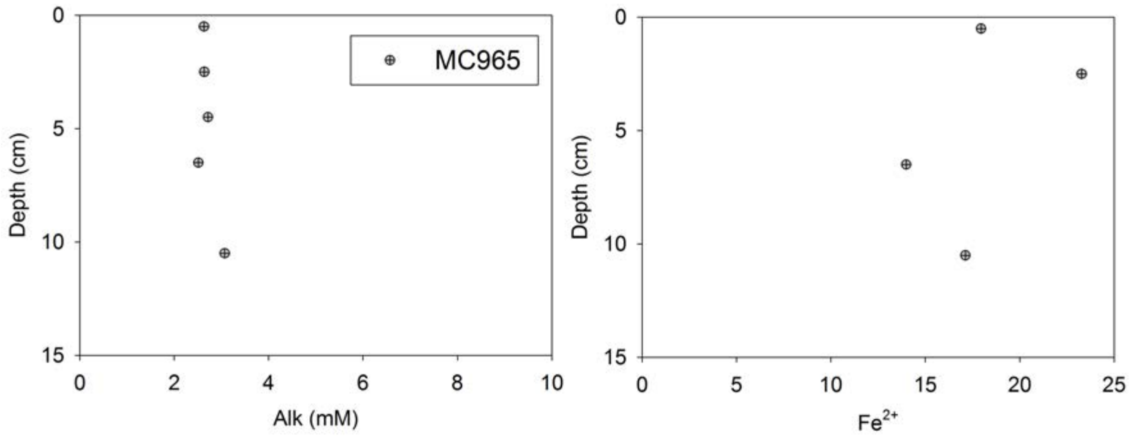


Figure 8.5 Control site



8.7 Methane concentration and gas analyses

(Anna Silyakova, Pavel Serov)

8.7.1 Water sampling for methane and gas analyses

Water samples were transferred from Niskin bottle (mounted on a CTD rosette or tow camera system) into 100 ml glass bottle using silicon tube to avoid air bubbles. Each bottle was filled to the top, and water was let running until overflowing 2-3 volumes. 1 ml supersaturates NaOH solution was added to water sample with syringe, after that bottle was capped and sealed. Samples were stored in dark at 2°C temperature until measured. A week after sampling, water samples were analyzed with gas chromatography. Prior analysis, 5 ml of N_2 headspace gas was added into each sample through rubber septa with needle, simultaneously taking out 5 ml of water. After adding headspace gas, each sample was shaken for about 2 minutes to reach equilibrium between water and gas phases inside the sample. 100 µl of gas phase was subsampled from each water sample and injected into gas chromatograph (GC) Trace 1310 (ThermoScientific) equipped with FID (Flame Ionization Detector) and alumina bond column for hydrocarbons separation (Rt®-Alumina BOND Na_2SO_4, 30 m, 0.53 mm ID, 10.0 µm). GC settings were 40°C in the oven, 170°C in the FID and 130°C in the injector. Methane measurements were calibrated with 10, 50 and 100 ppm levels of methane. Concentrations in nmol/l in each sample were calculated using equilibrium equation from Wiesenburg and Guinasso, 1979.

8.7.2 Water sampling for nutrients, barium and oxygen isotope

Water samples for nutrients were collected from Niskin bottles into 20 ml scintillations vials made of polyethylene, and frozen immediately at -20°C for further analyses. Water samples for oxygen isotopes ($\delta^{18}O$) were collected into glass scintillation vials with plastic caps, air bubbles free. For barium, samples were collected into 30 ml acid washed polyethylene vials allowing for some headspace on top. Both types of samples were stored at 2°C for further analyses.

9. Equipment on board

9.1 Subbottom profiler (Chirp)

A Edge Tech Chirp Subbottom profiler is a versatile wideband FM sub-bottom profiler that generates cross-sectional images of the seabed and collects digital normal incidence reflection data over many frequency ranges. It transmits an FM pulse that is linearly swept over a full spectrum frequency range (also called "chirp pulse").

The chirp system comprises of a hull-mounted 4 x 4 transducer array operated at an energy level of 4 kW and at a shot rate of 1.25 Hz. The signal lasts 40 ms, starts at 1.5 kHz and end at 9 kHz. The penetration depth depends on the sediment type/thickness we have observed was 20 m.

During this cruise, we imaged the morphology of the ocean floor and its shallow sub-bottom sedimentary layers and structures using the subbottom profiler. This can be used to locate the methane emission sites since they are characterized by blanking sediment.

9.2 Single beam echo sounder

Single beam echo sounders are common among all types of ships. Their primary purpose is to estimate the depth of the seafloor. In a single beam echo sounder, the transducer projects a sound pulse through water in a controlled direction and the reflected wave is received. The depth is calculated from the travel time of the sound pulse. R/V Helmer Hanssen has a keel-mounted Simrad EK 60 single beam echo sounder with transducers at three different frequencies, 18 KHz, 38 KHz and 120 KHz. During CAGE 15-2 cruise, the 38 KHz and 120 KHz has been used for depths up to 2 km and 500m respectively.

9.3 Multibeam Echosounder

In the hull of R/V Helmer Hansen there is a Kongsberg Simrad EM 300 multi-beam echo sounder. The multi-beam system measures the two-way travel time that a sound wave initiated by a transmitter needs to reach the sea floor and come back. These waves have a frequency of 30 kHz, which is too high to penetrate the seafloor sediments, but gives a high resolution for a bathymetric map.

A number of piezo-electric transmitters, mounted in the hull, transmit 135 beams producing a fan arc, perpendicular to the ship track. Each beam has a width as narrow as one vertical degree by one horizontal degree.

The swath width, dependent on seabed sediments, in shallow water (<500 m) is typically 4 times the water depth. Down to 2000 m, a swath width of 4-5 km is common. The maximum width is 5000 m. The swath width, dependent on seabed sediments, in the depth of the water (<500 m) is typically less than 4 times the water depth. Down to 2000 m, a swath width of 4-5 km is common. The multibeam system has been used to map the seafloor morphology and its acoustic backscatter.

We have to take into account that the amplitudes recorded are slightly attenuated (~6 dB) because of protective housing installed around the hardware to avoid damage of ice contact. The outer beams of the EM300 swath can be of low quality, due to speed and signal reception errors because of the great travel distance, large propagation angle and low angle of reflection. That is why we usually have an overlap of <25% between the connecting lines. Ship turns also produce unevenly spaced swaths and so, data logging is normally paused during turns. The data we have acquired during this cruise will be processed using programs such as Fledermaus, Globalmapper and ArcGIS.

9.4 CTD

CTD (Conductivity, Temperature, Depth) sensors measure or evaluate 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. Furthermore, it is possible to collect water samples from any depth of choice using max 12 Niskin bottles (5 Litres).

R/V Helmer Hanssen uses SBE 9 plus CTD for producing vertical profiles of seawater properties (Fig. 3.3.1). A winch is used to lower the CTD system into the water. The SBE 9plus CTD can measure physical properties of the seawater from up to eight auxiliary sensors, in marine or fresh-water environments at depths up to 6000 meters. The CTD sensors record data at a rate of 24 samples per second. The 9plus system uses the modular SBE 3plus temperature sensor, SBE 4C conductivity sensor, SBE 5T submersible pump, and TC duct. The submersible pump pumps water along the sensor to measure the conductivity. The TC duct makes sure that temperature and conductivity are measured on the same parcel of water. A single conductor cable supplies the power to the system and transmits data from and to the CTD system real time.

During this cruise, we used the sound velocity profiles from different CTD station to calibrate depth calculations in the swath bathymetry data.

9.5 Methane sensor

Methane sensor 'HydroC plus' was attached to the frame of TCM for number of surveys. The sensor measures methane concentration in the water every 20 seconds. Water is pumped into the sensor through SeaBird pump. Dissolved gases and water vapor pass the hydrophobic membrane and form the internal headspace. After that, gas concentration is measured by Tunable Diode Laser Absorbtion Spectroscopy within a gas circuit. Methane is recorded in units of ppm and uatm. CTD data acquisition with SeaBird CTD sensor mounted on the tow camera system allows calculating methane concentration in nmol/l.

9.6 Multicorer

The multicorer has been converted in a TowCam/Multicorer, TCM. The frame has been used to place the tow cam and sensors: ctd, salinity, and methane (details below). The multicore recovers six parallel 70 cm long tubes with a diameter of 10 cm from the same spot at the seafloor. The core tubes are loaded with open upper and lower ends. When the multi corer lands on the seafloor, the tubes are pushed into the soft sediment by lead weights, and closed on both ends. Up to 60 cm of sediment and the immediate overlying water can be sampled. This allows the analysis of undisturbed faunal samples within their undisturbed environment. Once on board, the core tubes filled with water end sediment. The liners were carefully taken out of the sampling device, the ends were sealed, and the cores moved, in an upright position, in the wet laboratory. Once in the lab, in racket to keep them vertical, the sampling of pore water, microbiology, micropaleontology and macropaleontology start. Three extruders were used from the different groups that sampled contemporaneously.

In the present cruise, we were able to use real-time imaging capability to precisely guide the sampling locations of the MUC samples.

9.6.1 Configuration of the TCM

TCM was configured with the following MISO equipment/sensors:

- SeaBird Instruments (SBE) 25plus CTD with SBE dissolved O2 and pH sensors
- OIS 16 megapixel deep---sea digital camera (shutter speed of 1/60 sec, and F---stop of F6.3---7.1 used during the cruise) (images were acquired at rates of between 10---15 sec, see log for rep rate for each lowering)
- MISO 600 watt/sec deep---sea strobe – 2 heads
- MISO green lasers – dots spaced 20 cm apart
- SBE---32 – 12---position pylon for water sampling
- 6 (six) 5---liter Niskin water sampling bottles
- 3 (three) MISO 24VDC/40 amp/hr deep---sea batteries to supply power to the TCM
- MISO deep---sea power junction box
- Valeport 500 kHz altimeter
- Benthos 200 kHz forward---looking obstacle avoidance sonar
- MISO DataLink subsea telemetry system for data and images
- MISO in---line tensiometer
- MISO TowCam compass (Lowell Instrument 3---axis magnetometer, accelerometer)

9.7 Sediment coring

The gravity corer onboard Helmer Hanssen consists of a 6m long iron barrel with iron weights attached on top of it. The whole apparatus weigh close to 2 tons. The gravity corer has an inner diameter of 11cm. A plastic liner with outer diameter of 11cm and inner diameter of 10 cm is inserted in to the steel barrel. During the coring operation, a core catcher and core cutter is attached to the lower end of the gravity corer. Core catcher keeps the sediments from falling out of the core, whereas core cutter helps the penetration of the core in to the sediments.

The gravity corer lies on a rail, which, during operation, is lifted vertically and the gravity corer is lowered to around 20m away from the seabed using a winch. When at the chosen core location, the gravity corer is dropped. The winch has a wire length of 2900 meters. When the gravity corer is lifted from the seabed and is brought to deck, the core catcher and core cutter are sampled first, if there are sediments present in them. Then, the plastic liner is taken out, cleaned, cut to 1-meter sections, and labeled. Many of the cores have been sectioned and sampled for pore water, biogeochemistry, microbiology, methane content, and micropalentology. Once described and sampled the half cores were stored in the cold room.

9.8 Van Veen grab

The van Veen grab is a quantitative tool for benthic sampling. It samples an area 0.1 m^2 to 20cm depth in the sediment. Six replicate grabs were taken at each station, the replication providing a measure of intra-site variability necessary for inter-site statistical comparisons. The samples from the grabs were washed with seawater on board through a 0.5 mm sieve, which retained all organisms greater than this size. Washed samples were preserved in buffered formalin, stained with rose bengal, and stored in sample buckets for further processing on land. In the laboratory (Akvaplan-niva), each individual organism will be sorted and identified to species, counted and weighed. This will result in species abundances and biomasses per sample, which will then be used to characterize community composition.

9.9 Triangle Scrape

The triangle scrape is a benthic trawl that moves across the seafloor surface towed by the ship (2kts). It measures 1x1x1m and trails a net. This dredge is designed for mass collection of larger seafloor organisms in a non-quantifiable manner. In this cruise, we used this technique for collection of benthic fauna for tissue stable isotope analyses, wherein food sources and trophic level can be resolved through isotopes of Carbon and Nitrogen, respectively. We ran triangle scrapes in both methane seep and non-seep areas in order to determine if we can detect whether methane based carbon is a detectible component of the marine food web in seep areas. Organisms were separated from the bottom sediments, identified to lowest taxonomic unit and frozen for further analyses in the laboratory on land.

10. Cruise narrative

It was agreed that the date/time base for all observations and data collected with the TCM would be in UTC (GMT; local time is UTC+2).

Friday 15-05-2015

6:00 UTC - Meeting with the Captain and the Chief mate to explain the scientific objectives of the cruise, locations and the delicate operation related to deployment of the TowCam. GP gave to the captain the risk assessment evaluation for all the chemicals that were used on board during the cruise, the list of participants and the Next-in-Kin form.

10:30 UTC - Operational meeting with the HH crew, UiT Engineers, WHOI Engineers: plan and scientific objectives of the cruise were presented. DF explained the Tow Cam directly on deck and instructed the HH crew on the TCM operations.

17:30 UTC - Scientific meeting. We discussed the scientific goals, locations, and sampling strategy.

20:00 UTC - The mobilization of the TCM and the lab installation was completed.

21:00 UTC - R/V Helmer Hanssen left the harbor of Longyearbyen starting the CAGE 15-2 cruise with a group of 14 scientists that comprise 2 WHOI Engineers, and 2 UiT Engineers. The ship was heading to the area West of Prins Karls Forland.

Saturday 16-05-2015

05:00 UTC - We reached our first working area, Prins Karls Forland (PKF) at: 78° 33. 78068N 10° 10. 29392 E. Based on the wind direction, the speed and the current, the ship was allowed to drift to keep the desired position at the site. However, the strong current and the bad weather conditions did not allow for the deployment of the TCM. We conducted a CTD vertical sound velocity survey (Helmer Hanssen Ship station 849;, from now on Helmer Hanssen Helmer Hanssen Ship station is indicated as HH) and after we started the survey of the PKF area with Multibeam and ecosounder to locate the best stations for the TowCam deployment as soon as the weather was good. During the survey, all the flares and relative intensity have been marked (weak, small, double flares, strong flares) using the Olex navigation software. The multibeam lines were 7 ca. 150 m apart; Lines 6, 7, 8 and 9 were repeated twice.

10:15 UTC -Helicopter from Svalbard for safety trail.

12:40 UTC - In the afternoon, the weather conditions were bad and the Captain did not allow a TCM deployment; we decided to perform a very detailed survey at Polastern site at ca 78° 33 N 10° 09 E.

Sunday 17-05-2015

During the night, the weather condition allowed the lowering of the TCM. The last multibeam line in the Polastern site was interrupted and we decided to move back to Prins Karls Forland.

1:10 UTC - We were at the northern station in Prins Karls Forland; the captain let the ship drift to make sure that the deployment could be done. Once the conditions were suitable, we started the TCM survey at HH 850 (originally composed of 3 lines). During the first TCM survey, 6 water samples were collected. The criteria used to fire the Niskin bottles were: evident bacterial mats at the seafloor observed in the real time images, flares in the eco er, strong flares previously mapped and indicated in Olex navigation software from the survey done on Friday 16-05.

6:30 UTC - Cruise meeting. Work done during the night, the plan for the day, and preliminary observations from the pictures taken from the TCM were discussed.

7:40 UTC - TCM in water to complete the survey in the area but the winch had problems since the remote control was not working. The technical problems continued until the afternoon; while the WHOI Engineers were trying to resolve the winch problem, we decided to move to a control area with no flares to collect control samples for macrofauna. Once we reached the station, we did one CTD (HH852) and 7 grab samples (1 failed) (from HH853 to HH859).

18:58 UTC - The problems with the winch were solved and we did several TCM lowerings. We surveyed PKF (HH861, HH862). During all the lowering we observed promising sites with flares, bacterial mats and without evident gravels. However, the multicoring in this area were not successful although various methods/approach were taken in terms of lowering speeds and distance from the bottom to commence the bottom approach, as well as amount of lead weights on the multicorer top platform. The unsuccessful was due to the very hard and rocky substrate and we decided to use the Van Veen Grab for macrofauna sampling (HH 863 to HH870). The sampling site was decided after observing the images from TCM surveys. The seafloor appeared to be densely colonized by brittle stars. During the recovery of one grab sample (HH 864), one block of carbonate was collected. Then we decided to move south to do more MCT lowering.

22:52 UTC – we reached the southern station in PKF and started TCM survey and sampling. Multicoring operations failed and we encountered similar situations like in the northern area. Very often the liners were empty or with few stones (from HH 871 to HH873).

Monday 18-05-2015

During the night we did several TCM lowering, but multicoring operations failed. However, we took a lot of images to define the site for the deployment of the CAGE observatories during the next CAGE 15-3 cruise. Then we decided to steam to the deepest area at 236-256 m depth (Polarstern site) and we started TCM lowering.

04:36 UTC - Tow cam in the water at the Polarstern site. We started the surveying of the area (HH 874). Greater water clarity was noted given the deeper depth and the imaging capability was good given that this was the first opportunity to try the camera and strobes in their oblique orientation. It was noted that there is some minor obstruction to the image area because of the limited space in the back wing of the TCM, so a portion of the top of the image is obscured because of the base of the TCM frame. No multicoring was attempted at this site because of the abundant pebbles and the seafloor.

6:30 UTC - Cruise meeting. The operations done during the night, the plan for the next days, and preliminary observations were explained. After that, we steamed to the site 7808.

8:30 UTC - we started the ecosounder and multibeam lines in the area 7808 and we did 2 CTD deployments (HH875, HH876). The CTD HH875 was done in one site where

ecosounder indicate a flare. Later we had technical problems with the TCM, primarily due to both the much colder bottom water (-0.8°C) below ~750 m depth, and to some extent the higher wind/seas encountered during these days.
During the time at the 7808 site, we also experienced more swell and wind and on several lowerings the TCM was not well controlled on either launch or recovery. We met with the Captain and crew and decided to always use the tag lines on launch and recovery poles and tag lines on recovery to stabilize the TCM during launch & recovery. That system then worked very well and we did not experience serious operational issues on launch/recovery on subsequent lowering.

After seeing the real time images from TCM surveys, we locate the best place for sampling and collected two gravity cores (HH877, HH878).

19.20 UTC - we did another TCM lowering (HH 879). We observed few small flares aligned at the base of one crest. The sediment at the seafloor was light-dark grey with sparse stones. During the tow cam survey we saw bioturbation, very often in clusters of 40-50 cm in diameter. We did multicoring (HH880).

Tuesday 19-05-2015

During the night we did a detailed survey (chirp and eco sounder). During the subsequent TCM lowering (HH881 and HH882) we released the marker at 78° 41, 318N - 8° 15, 890 E. In a promising site we did a grab (HH883), but failed. We did a successful multicore (HH884).

Once the operations in the site 7808 were finished, we steamed to Vestnesa where we started the ecosounder survey (Vestnesa line 1 and Vestnesa line 2). We target on two very active pockmarks where strong flares were seen during the last CAGE surveys (2013, 2014). During the survey we encountered and marked in Olex navigation software several flares. Operations at the Vestnesa site were very successful.

22:35 UTC - we deployed the TCM (HH885) but because the water temperature was below zero, Tow cam pictures were taken every 15 seconds to save some battery and permit a longer lowering. During the survey, we did a Multicorer (HH886) when we saw a potential carbonate crust and white bacterial mats in patches surrounded by iron sulphide bearing black sediments.

Wednesday 20-05-2015

The TCM surveys continued the whole night and the rest of the day. During the HH 887 survey we did a Multicorer (HH 888) and we released the marker (HH 888) at 79° 99.64N – 6° 54.146 E. In the same location we took one gravity core (ss 890). Then we did the HH 891 tow cam survey number 14, and multicorer HH 891. The computer stop during the night at 1:00 UTC and after Bjørn Runar Olsen and Giacomo Osti recovered the data from the chirp.

13:00 UTC - we started the HH 892 survey number 15. Our target was the southern pockmark in Vestnesa. During the survey we have observed carbonate crust and patches of bacterial mat; we decided to stop the survey and take multicorer (HH 893).

We recovered 5 of 6 cores. At deck, we observed gas hydrate dissociation in all the 5 cores liners and the bubbling last for ca 30 minutes. Water samples were taken from the Niskin bottles and from the water at the top in the liners.

18:07 UTC we started HH 894 TCM survey number 16. During the survey we observed area with potential chemosynthetic benthic communities of polychaete tubes (up to 20 cm high), patches of white bacterial mats, carbonate crust and possible thin (3-5 cm) layer of gas hydrate at the seafloor. We released a marker at station number 895 (79° 00.186 N - 6° 55.448 E) and did a multicorer (HH 896) approximately at the same position of the marker where carbonate crust, bacterial mats and possible gas hydrate were observed in real time images.

Thursday 21-05-2015

We were still in Vestnesa area where we did the last TCM survey (HH 897 tow cam survey number 17). During the survey done along the internal flank of the pockmark, we observed gas hydrate at the seabed, bacterial mats and carbonate crust. In the real time images for few seconds we saw a 3-4 m high carbonate body and almost touched with the TCM.

At 01:29 UTC - we had to pull out the tow cam because the wind picked up. The operation of recovery went well although the strong wind. Afterward we did a scrape on the area, trying to collect carbonate crusts, but the scrape come up almost empty (the water depth was ca 1200 m) and only rare pebbles were collected. As forecast, the wind increased and we decided to move south. After few hours, since the weather was improving, we decided to reach the 7808 site to do more Tow cam surveying and multicorer. Unfortunately, when the TCM was ready to be deployed, the wind and waves picked up in the area and bad weather conditions did not allow for the deployment of the TCM. Then we moved to Storfjordrenna.

At 20:30 pm cruise meeting. All the groups explained what they did in the last two days, and discussed about preliminary measurement on some of the samples. GP explained the plan for the next day and informed that the tow cam images taken during the cruise could not be distributed during the cruise but once the CAGE copyright is incorporated.

Friday 22-05-2015

7:30 UTC we arrived in the PLF area in Storfjordrenna and commenced multibeam and echosounder surveying. In the area of the survey there was a lot of drift ice, which complicated towing and maneuvering. During the survey we saw flares coming from each of the seabed domes “pingos” (PLF 1, PLF2, PLF 3) present in the area.

11:15 UTC - we asked the captain to deploy the TCM for a short line drifting with the ship against the ice, but the abundant drift ice did not allow for the deployment of the TCM.

16:40 UTC - we started CTD at the top of each pingo; HH900 (only one Niskin taken) was on PLF1, HH901 was on PLF2, HH902 on PLF3.

17:00 UTC - Captain allowed the deployment the TCM. In few minutes we were ready to deploy and start the TCM lowering HH 903. We started the survey but we were quite far from the station (ca 2km; 2 hours drifting at 0.3-0.9 nautical mile). During the survey we measured an increase of +0.7° up to 1.2° C in temperature in the flare at the top of the pingos (HH 904; 4 cores recovered).

21:02 UTC - we started the HH 905 TCM survey. During this tow we measured methane using the methane sensor in the flares at the top of the pingos; in the flare at the top of each pingo we registered an increase in temperature of 0.8 to 0.12°C and preliminary measurement from the sensor indicated methane up to 260 ppm.

22:16 UTC - We took a multicorer (HH 906; reported in the ship station log as scrape but corrected in the table here enclosed) but failed. We did a second try during the HH907 tow cam line 20; during the survey we registered again weak increase in temperature at the top of the pingos (0.9°C) and did multicoring at HH 908 in an area of strong flare.

After we did two CTD stations: HH 909 on top of PLF1, and HH 910 control station out of flares.

Saturday 23-05-2015

During the whole night and the rest of the day we did several operations in the Pingos sites and they were very successful in terms of both imaging and sampling, despite variable amounts of ‘growler’ ice in the area, which complicated towing and maneuvering.

3:22 UTC - HH 911 gravity core on top of PLF3; recovered gas hydrate and hydrate samples were sampled from the core catcher using flasks provided by NILU.

4:30 UTC - HH 912 gravity core on top of PLF3; recovered gas hydrate.

5:36 UTC - HH 913 gravity core on top of PLF1; recovered gas hydrate.

6:44 UTC - HH 914 gravity on PLF2; recovered gas hydrate and hydrate samples were sampled from the core catcher using flasks provided by NILU.

7:45 UTC - HH 915 gravity in the control station with no flares.

8:33 UTC - we started a survey of the area (multibeam and ecosounder line from 11 to 20) and we discovered a new pingos (PLF 4) with flares coming out from the top. Another feature similar to pingo was seen (PLF 5), but during the survey we did not see any flares of methane. Since the weather conditions were very good, early afternoon we started another TCM surveying: HH 916, then multicoring HH 917 in an area with 0.85°C temperature of the bottom water and sparse tubeworm at the seabed. The mutlicorer failed.

16:51 HH 918 gravity on top of PLF4, 85 cm of recovery and HH 919 gravity again on top of PLF4, 96 cm of recovery. During the opening of the liners there was a strong H2S smell from the sediment. HH 920 GC on top of PLF5, 2.62 cm of recovery and carbonate crust was found. Then, HH 921 GC from the central part of the pingos area with the purpose to check is there was gas hydrate or not. The recovery was very good and no gas hydrate or carbonate crust were observed. We did also HH 922 grab station for macrofauna on PLF2. After the grabs we surveyed an area north to the pingos looking for more flares.

Sunday 24 -05-2015

During the night we finished the survey in pingos area, moved to the Benthic station SR1 and commenced multibeam and echosounder surveying. During the survey we did not see all the flares observed and market Olex navigation software in 2014 (cruise "Marine Geological Cruise to Storfjordrenna and Bjørnøyrenna", R/V Helmer Hanssen 7th July – 21st July, 2014, chief scientist Karin Andreassen). We did a CTD vertical sound velocity survey (HH923) and a TCM survey (HH 924 tow cam line 22). The seafloor was strongly disturbed by trawling occurring in the area. During the lowering there were 12 Russian fishing boats and the Norwegian coast guard in the area around. After 1,30 h of taw we decided of not taking samples since the risk of disturbed samples was too high. However, in the tow cam images patches of bacteria and few carbonate crusts were observed. At 11:20 UTC the TCM was on board. After we took Van Veen grab (HH925-930) and we did a triangular scrape (HH931) and we collected possible methane-derived authigenic carbonate crusts.
After we sailed back into the Pingos area. Since there was no ice we did a TCM surveys HH932 tow cam line 23, we released the marker HH 933 at 76° 06 06.422 N 15° 58.031 E and we did multicoring HH 934, but failed. We did TCM HH 935 tow cam line 24 and multicoring HH 936.

19:25 UTC - We started the HH 937 tow cam line 25, with the main purpose of measuring anomalies in turbidity, temperature and pH at and around the pingos. We started from PLF3, through PLF2 to PF1 back to PLF3. We did multicoring (HH938) on top of PLF3.

Monday, 25-5-2015

We started the day with two gravity cores on the flanks of PLF 3 (HH 939 and HH 940). Since all the scientist were satisfied with the quality and the amount of samples collected in the Pingo area, we decided to move in the Craters area and we transited east into the Barents Sea even thought it was not in the plan of the cruise. During the transit we surveyed (multibeam and ecosounder) two seafloor depressions observed in out bathymetric map, looking for flares and methane emissions, but we did not see any anomalies indicative of gas in the water column. We did a CTD vertical sound velocity survey and CTD for water sampling (HH 941-942).

Tuesday, 26-5- 2015

3:50 UTC - we arrived in the Craters area where large craters and flares were identified by previous CAGE and other published work. We did a CTD vertical sound velocity survey (HH943) and started the ecosounder and multibeam surveying. When the survey was finished, at 10:13 we started HH 944 tow cam line 26, on two craters that from the multibeam data recorded during the survey seemed to be different in term of morphology and presence of flares. Multicoring at HH 945 in an area where we saw methane in the ecosounder and we saw muddy sediments in the real time TCM images. We recovered two liners with 4 cm of sediment. After we did 5 Van Veen grab (from HH 946 to HH 951) in an area with flares in between the investigated two craters. After we tried to take several cores (HH 947 – 958 GC), but all of them were empty.

Wednesday, 27-5-2015

During the night we did surveying on the craters area (Line 11-Line 20).

7:22 UTC we started HH959 tow cam line 27. We took a multicorer HH 960 MC. All the 6 liners recovered max 10 cm of sediment.

10:07 utc we started HH961 tow cam line 28, after the tow cam we tried scrape with the aim of collecting the sponges observed attached to the blocks in the center and along the rim of the craters. The first scrape HH 962 scrape was empty, we tried a second time in a different station HH 963 scrape where we collected pebbles with sponges and small corals attached.

15:54 UTC - A last site was conducted as a ‘control’ site ~1 hr steam south from the craters site during the transit back to Tromsø. We did HH964 tow cam line 29, to take one multicorer at the control station HH 965 for incubation test. After we did a triangular scrape (HH966).

With this action station work of HH cruise CAGE15-2 ended. At 17:00 UTC we started our journey to Tromsø.

Thursday, 28-5-2015

We continued our passage to Tromsø.

Friday, 29-5-2015

6:00 UTC - We arrived in Tromsø. With the unloading of the ship in the morning cruise CAGE 15-2 ended.

11. Study areas and relative samples/activities

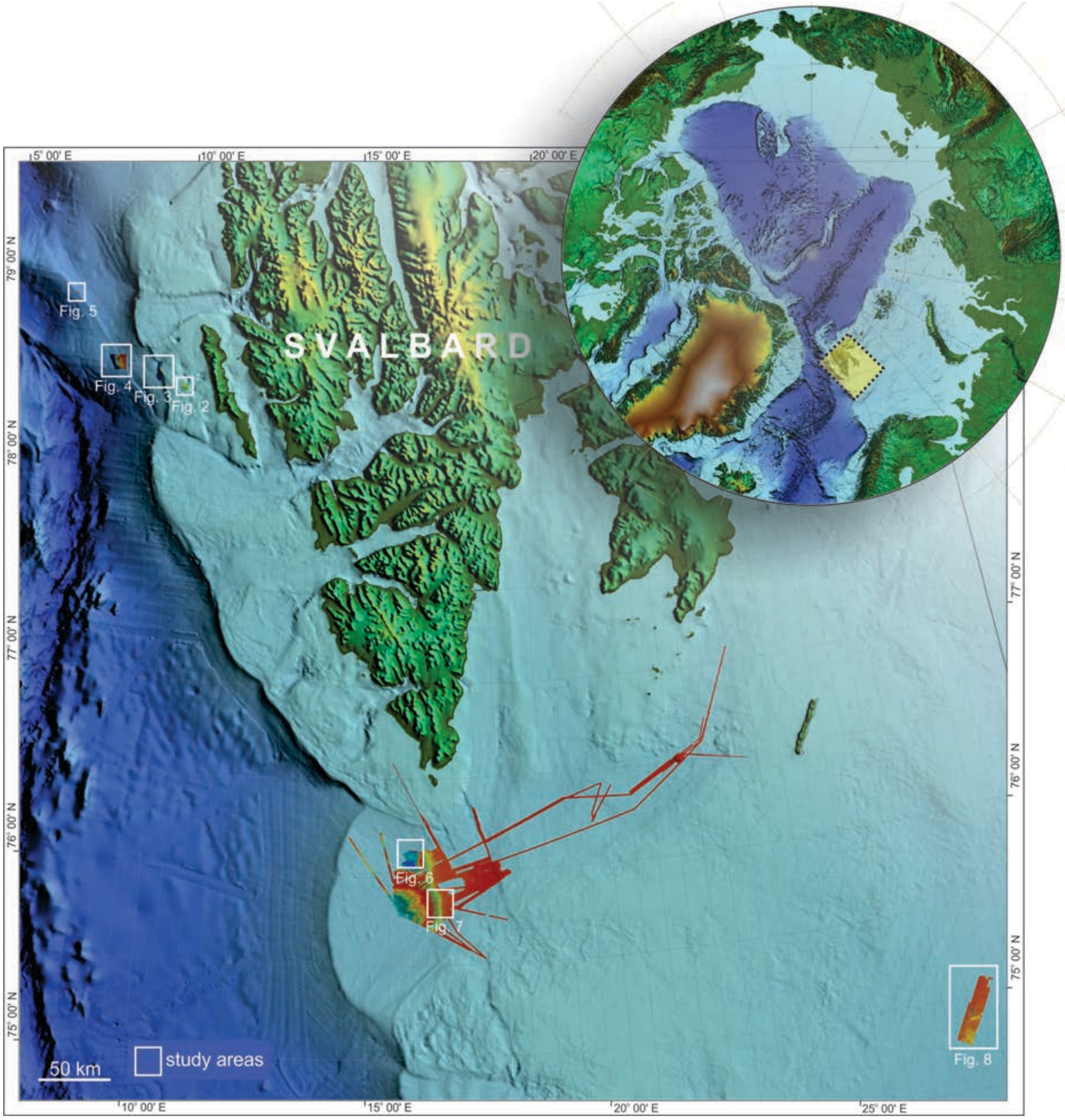


Figure 11.1 Overview map showing the working area off NW Svalbard in the Fram Strait, in Sorfjørdrenna and in the Barents Sea.

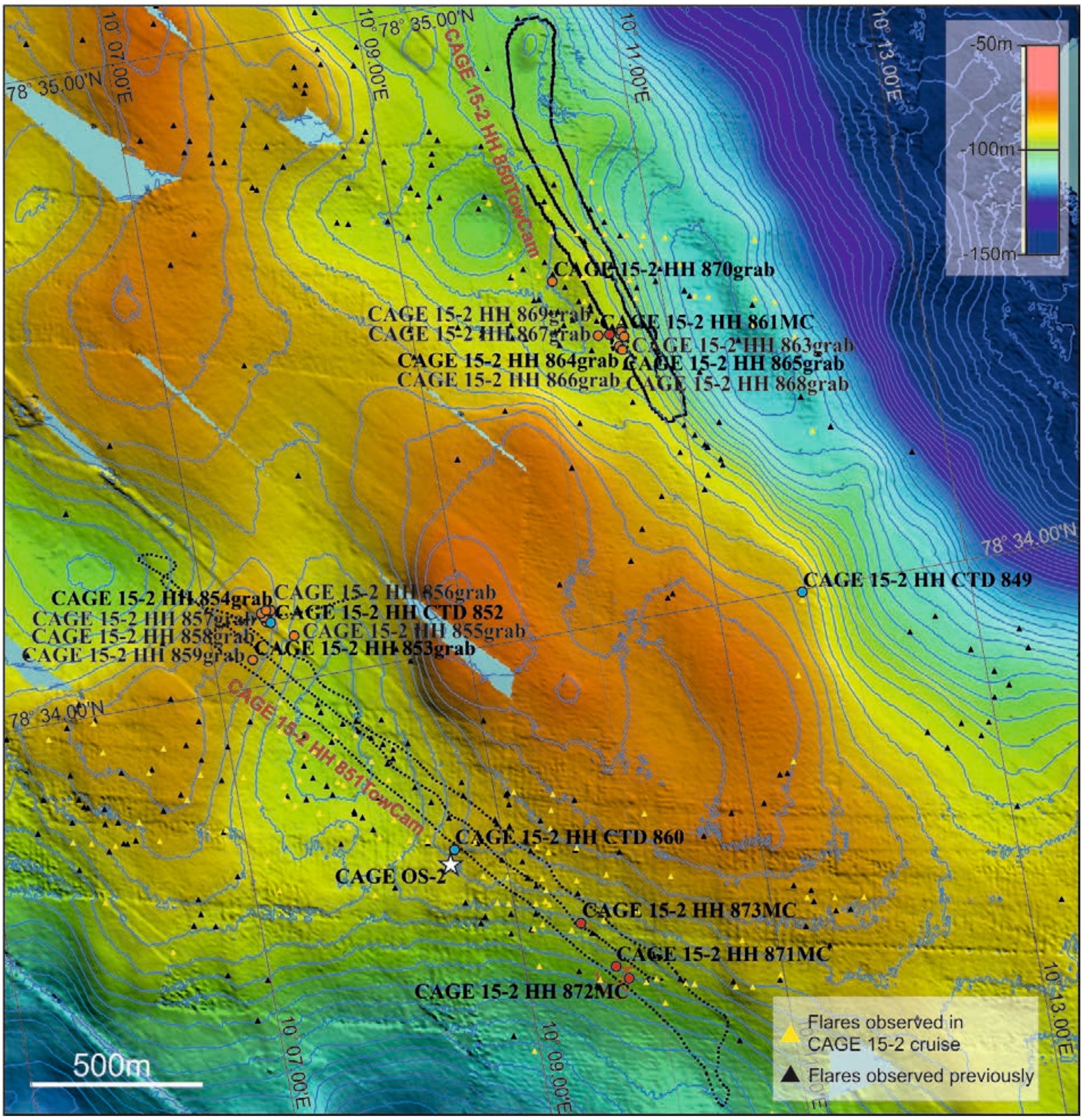


Figure 11.2: Bathymetric map showing the TCM lowerings, multicorer, gravity corer, grab stations and CTD in Prins Karls Forland area. Flares are also indicated.

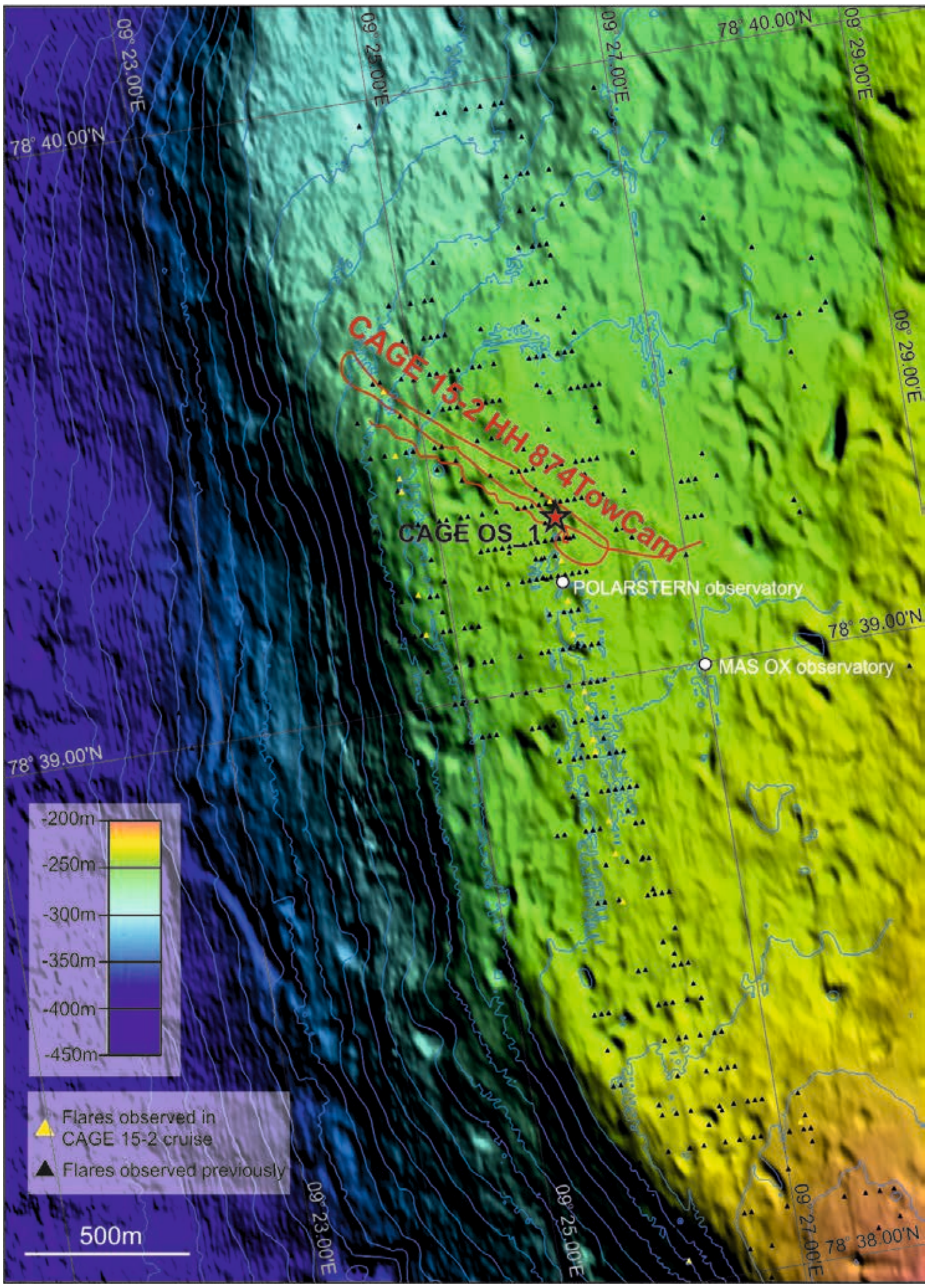


Figure 11.3: Bathymetric map showing the TCM lowerings, in Prins Karls Forland area close to the Polsatern site. Polastern observatory site and MASOX observatory site are also indicated.

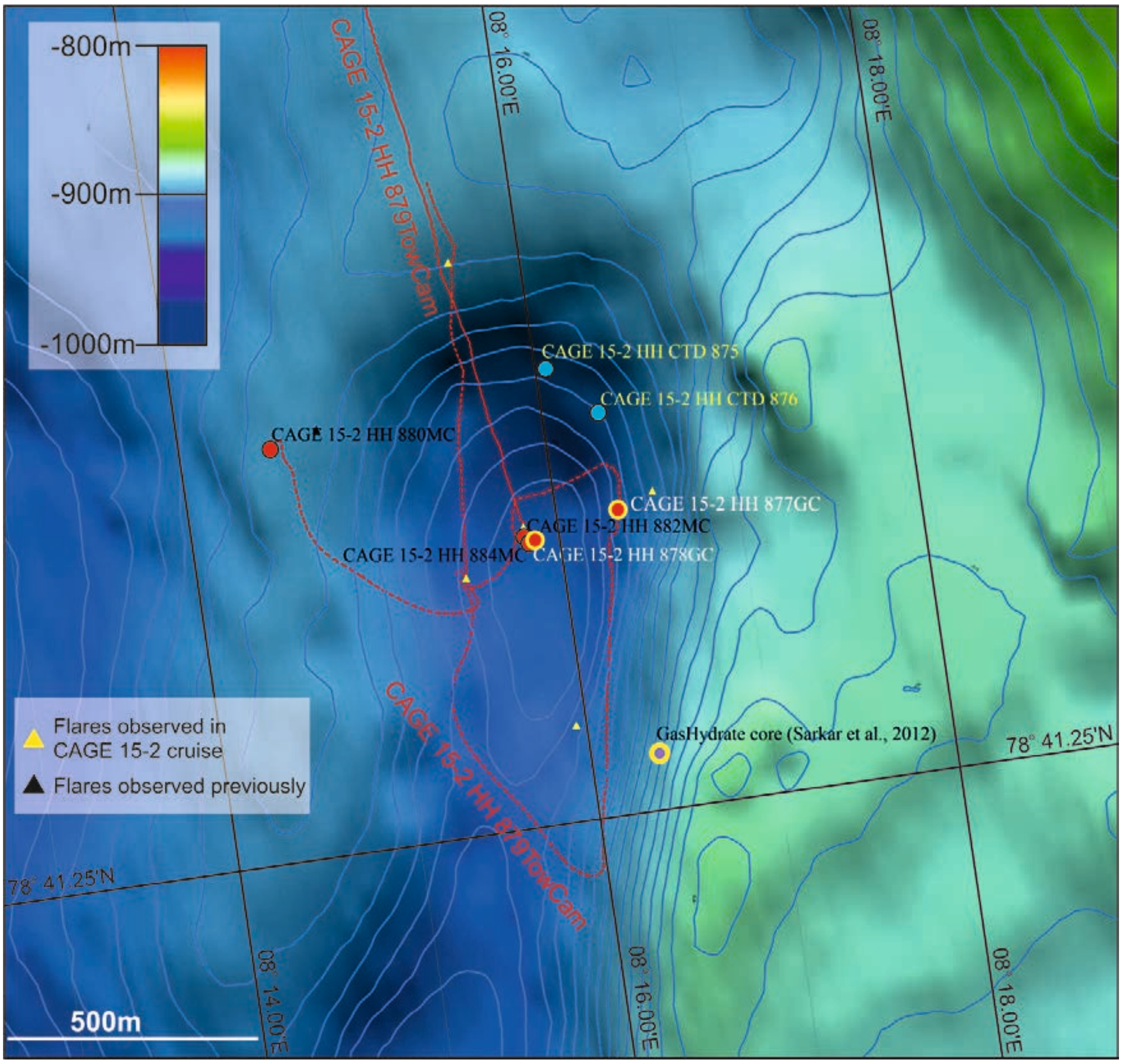


Figure 11.4: Bathymetric map showing the TCM lowerings, multicorer, gravity corer and CTD in the 7808 site. Location of a sediment core collected during the cruise JR211 where gas hydrate was found by Sarkar et al. (2012) is indicated.

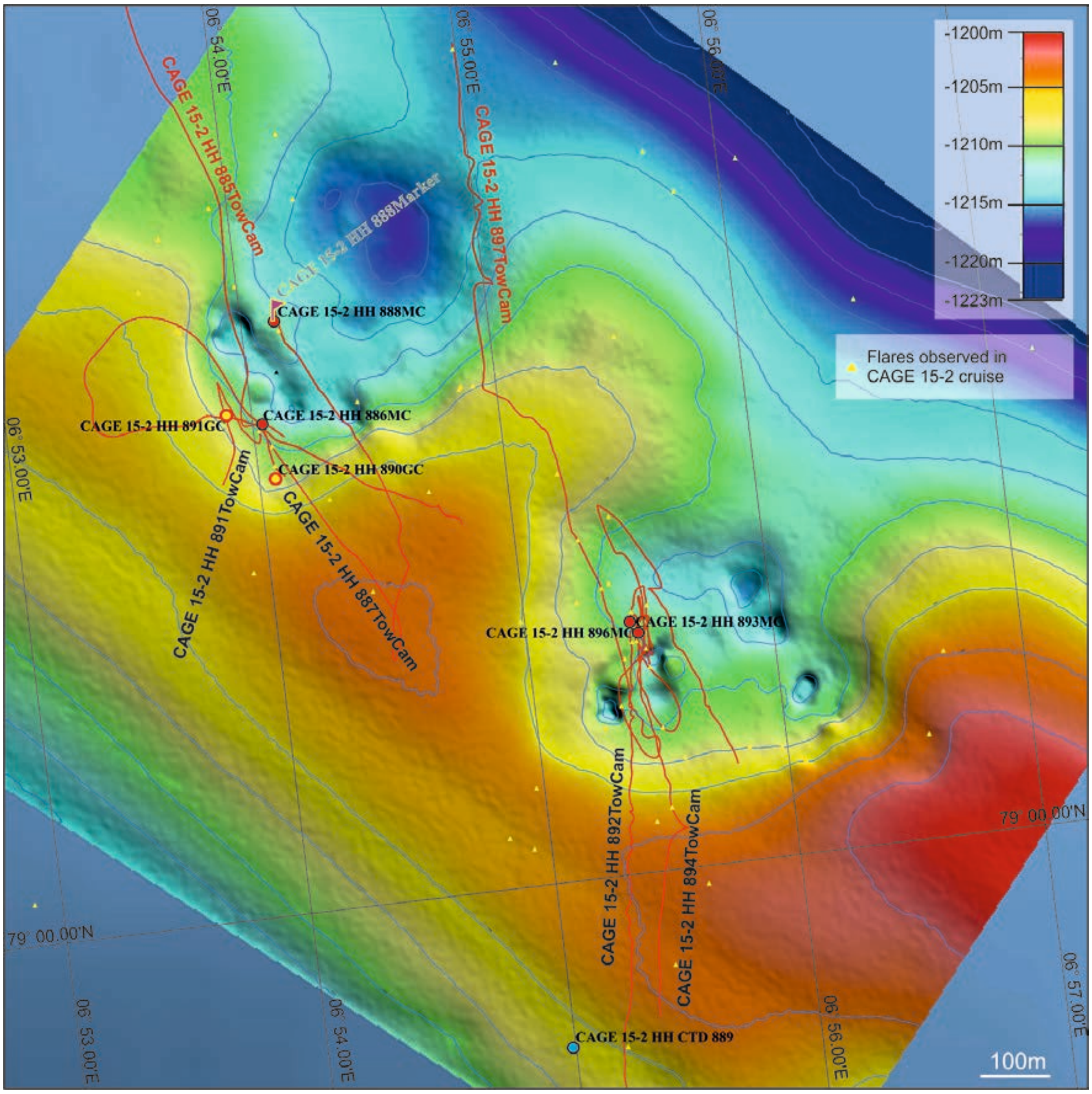


Figure 11.5. Bathymetric map showing the TCM lowerings, multicorer, gravity corer, grab stations and CTD in two active pockmarks along the crest of Vestnesa Ridge. Flares are also indicated. Detailed bathymetry from P-Cable 3D seismic data acquired in 2013 (Chief scientist of the cruise: Stefan Bunz).

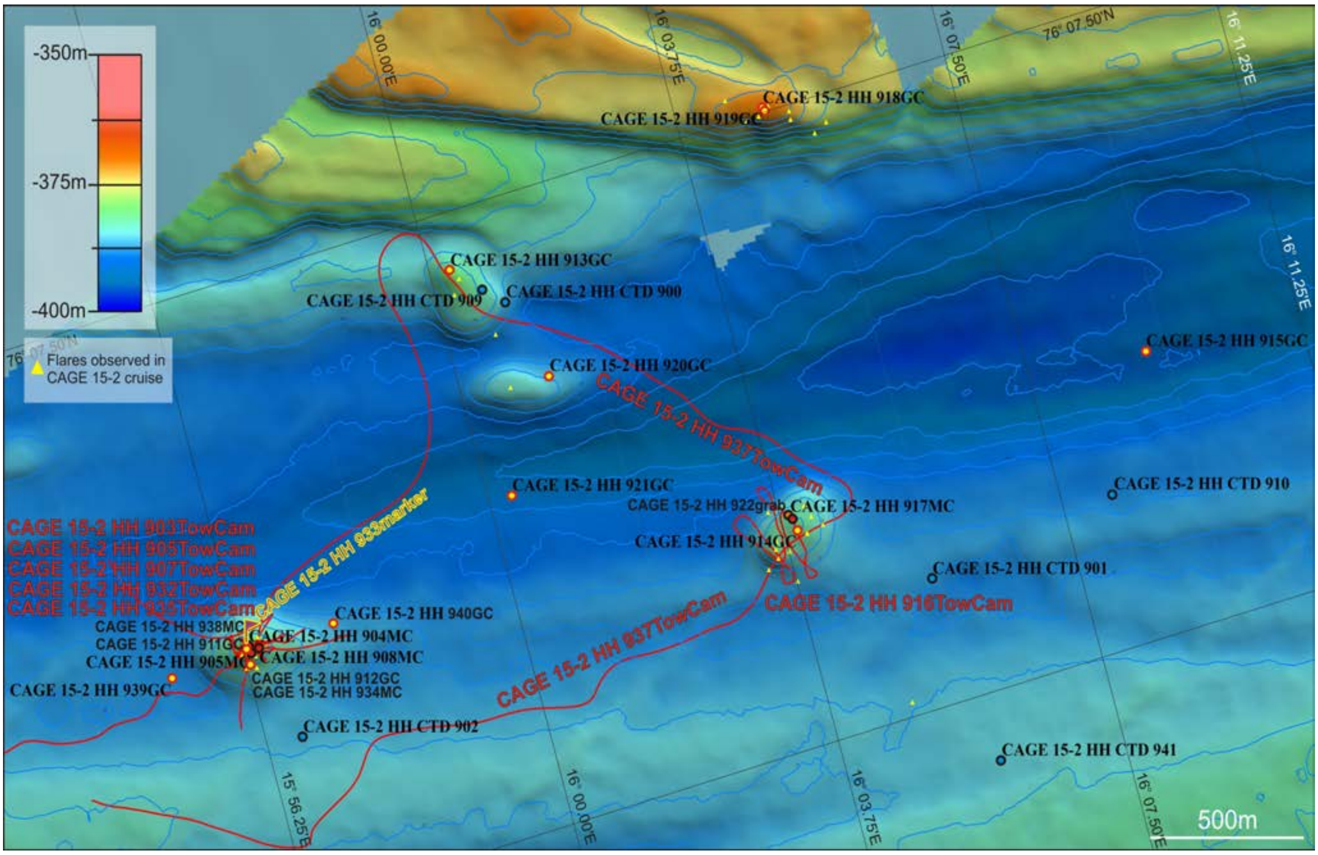


Figure 11.6. Bathymetric map showing the TCM lowerings, multicorer, gravity corer, grab stations and CTD in the Pingo area. Flares are also indicated.

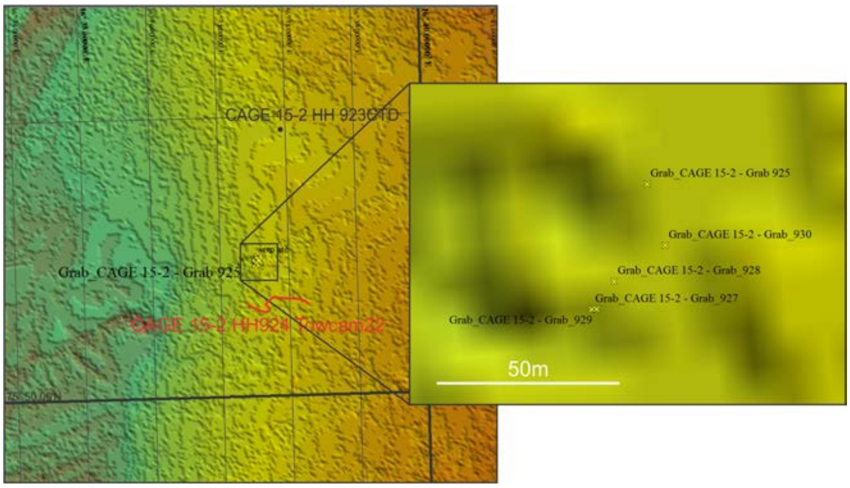


Figure 11.7. Bathymetric map showing the TCM lowerings, grab stations and CTD in Storfjordrenna Benthic station SR1.

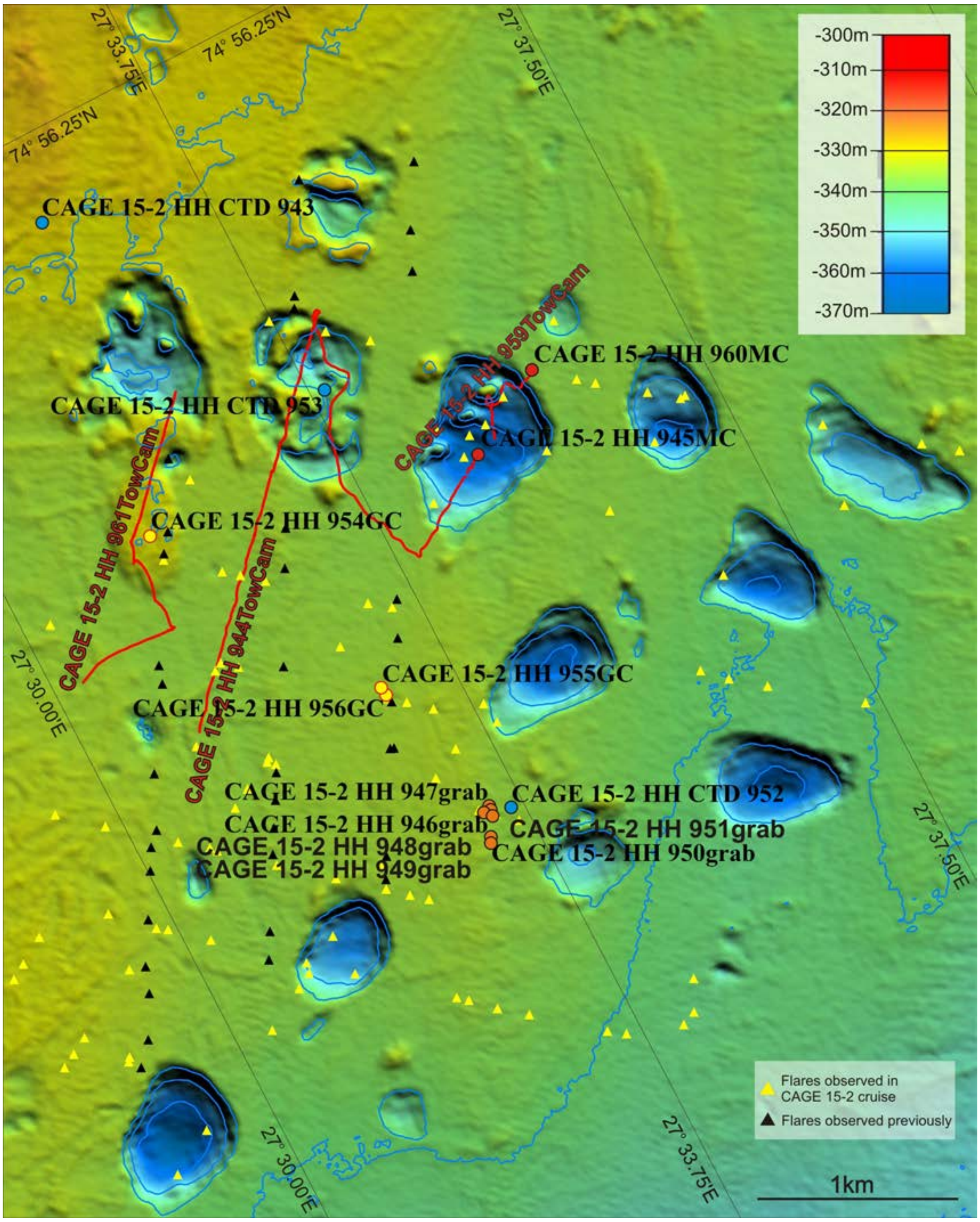
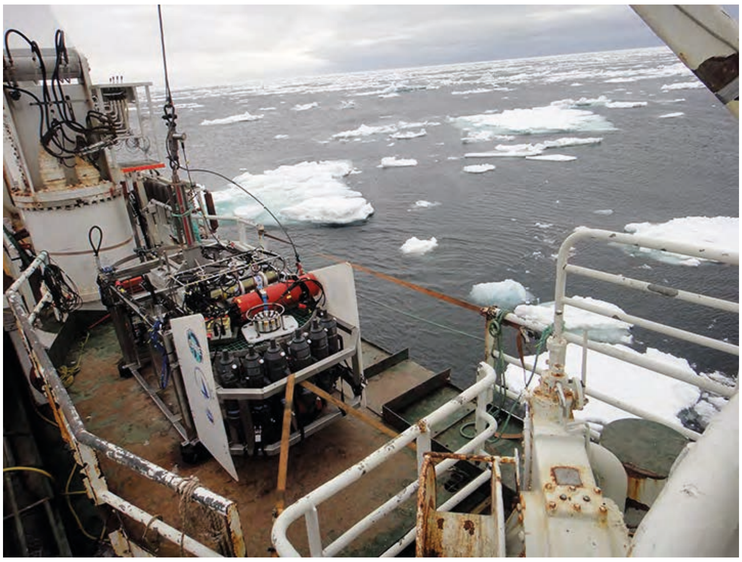
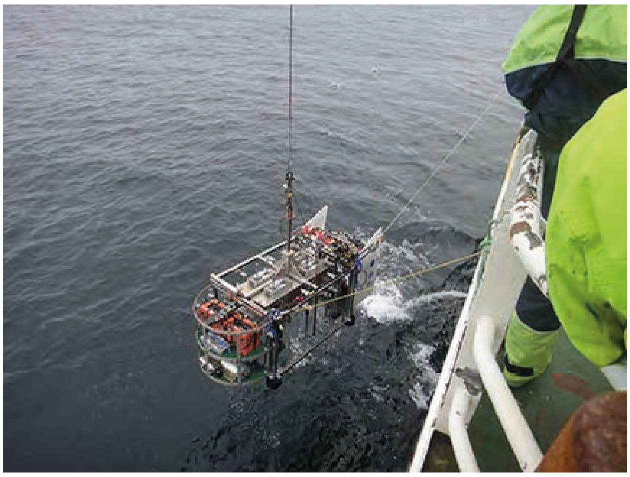


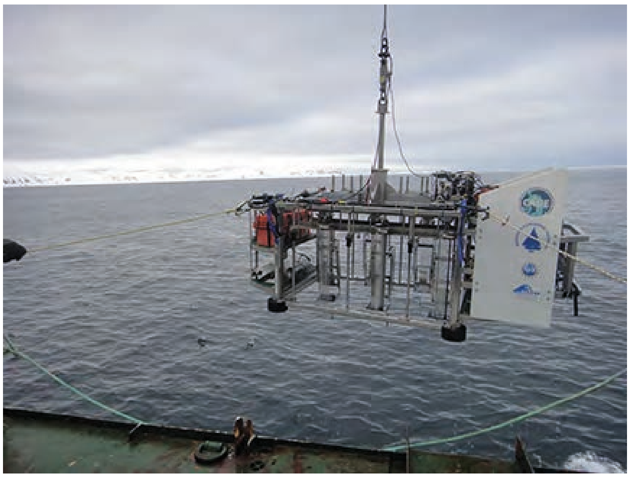
Figure 11.8. Bathymetric map showing the TCM lowerings, multicorer, gravity corer, grab stations and CTD in the craters area. Flares are also indicated.

12.TCM system: some images

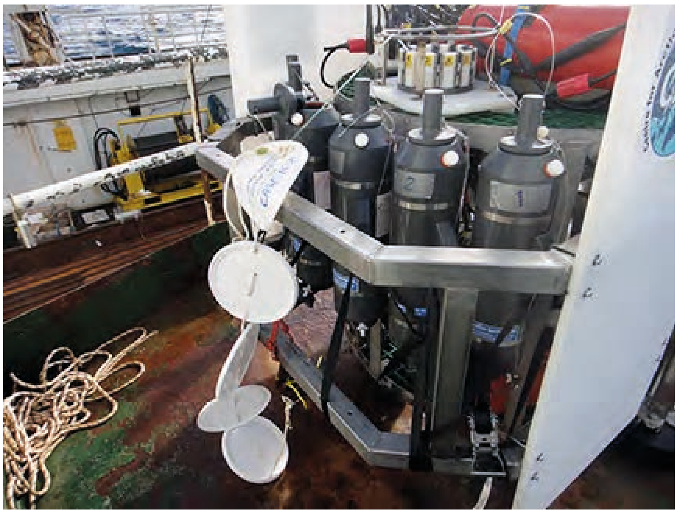


Figures 12.1/2 - Views of the TCM on H. Hanssen during CAGE15-2 cruise. Left aft-view showing Niskin rack and SBE-32 bottle release pylon. Orange pressure case forward of the Niskin bottles is the DataLink housing. The WHOI-MISO in-line tensiometer (red arrow) is visible just above the TCM bail and the eye at the base of the conducting cable from the winch.





Figures 12.3/4 -Left-showing TCM being lifted out of the water after being hooked with recovery poles and tag lines. Right -showing TCM at the 01 deck level on recovery as it is boomed-in for placement on the deck.

Figures 12.5/6 -Left-TCM recovered from one of the Vestnesa lowerings showing successful core recovery. Right- First marker rigged on the TCM plyon (position #4) for deployment at a site of active gas hydrate deposit at Vestnesa.

Figures 12.7 - Example of successful TCM cores from Vestnesa site.

13.TCM images from investigated areas

13.1 Prince Karl Foreland Site (ca 90 m depth)

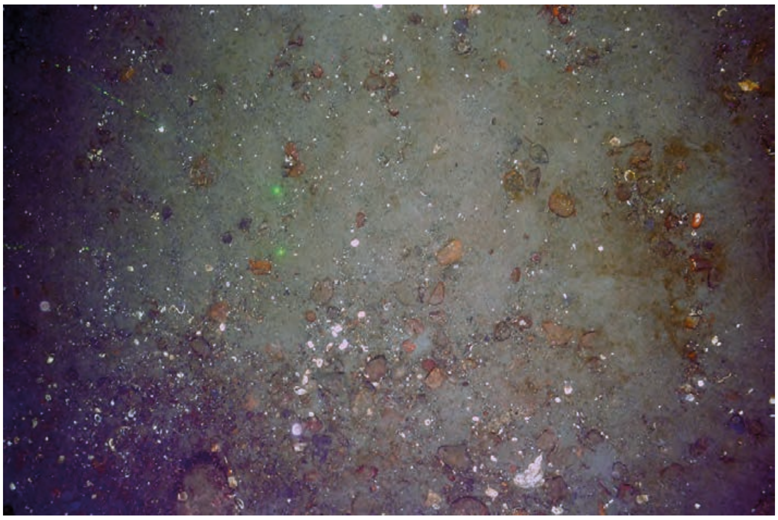


Figure 13.1 - TCM image from HH850 (PKF) from 97 m depth, at 2.6 m altitude, showing gravelly seafloor with abundant shells. All images are labeled with the prefix “CAGE15-2-“; followed by the station number: “HH850_”; followed by the date/time in YYYY--MM-DD_HH-MM-SS format; “2015-05-17_03-43-46”. This image is labeled “CAGE15-2-HH850_2015-05-17_03--43--46”. Green laser dots are spaced 20 cm apart. Top of image is towards the direction of travel of the TCM. Note that after station HH851 the laser dots appear in the middle--top of each image because of the reconfiguration of the camera & lasers.

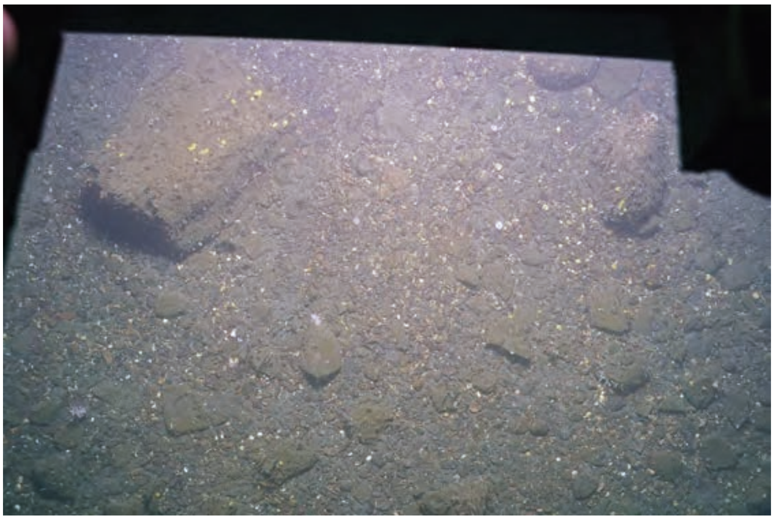


Figure 13.2 - TCM image using the oblique orientation of camera while multicoring capability of the system is enabled. Loss of image area of ~10% along the top portion of the frame results from this configuration, which was constrained by the dimensions of the wings and available desk space. Image: CAGE15--2-HH861_2015--05-17_19-17-45. Depth 89 m, altitude 3.5 m.

13.2 Prince Karl Foreland Site (240 m depth; Polastern site)

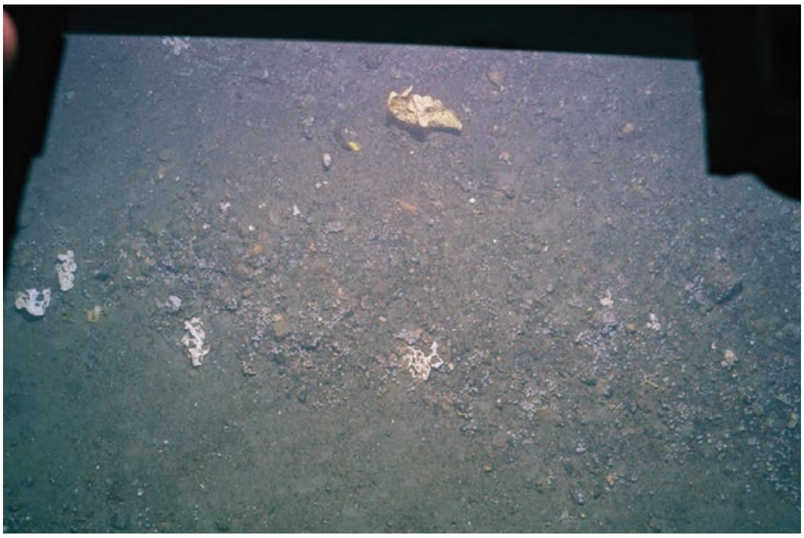


Figure 13.3 - Image CAGE15-2--HH874_2015-05--18_05--02-54, taken at 238 m depth from 3.5 m altitude at the Polarstern site during station HH874 showing high diversity of epibenthic fauna, including sponges, tunicates, and erect bryozoans.

13.3 7808 site

Figure 13.4 - Image: CAGE15-2-HH881_2015-05-19_09-35-33, from the 7808 Site at 884 m depth at 3.2 m altitude.

13.4 Vestnesa

Figure 13.5 - Example image from the Vestnesa site showing bacterial mat/hydrate exposure at 1204 m depth at 3.4 m altitude: Image --CAGE15-2-HH885_2015-05-20_00-43--00.

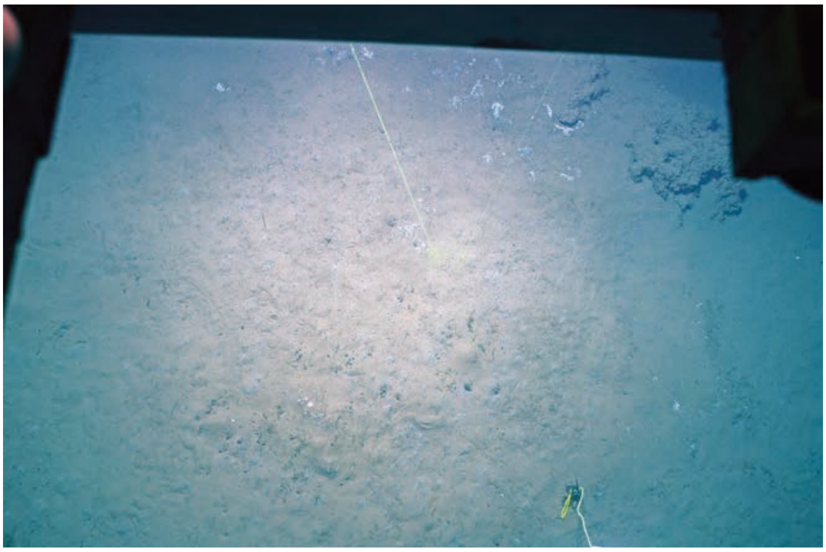


Figure 13.6 - Example image from the Vestnesa site: CAGE15-2-- HH894_20150520_203816, at 1200 m depth at 5.5 m altitude. The chain anchor of the 2 marker deployed at the Vestnesa site is visible in the lower right of image.

13.5 Storfjordrenna Pingos

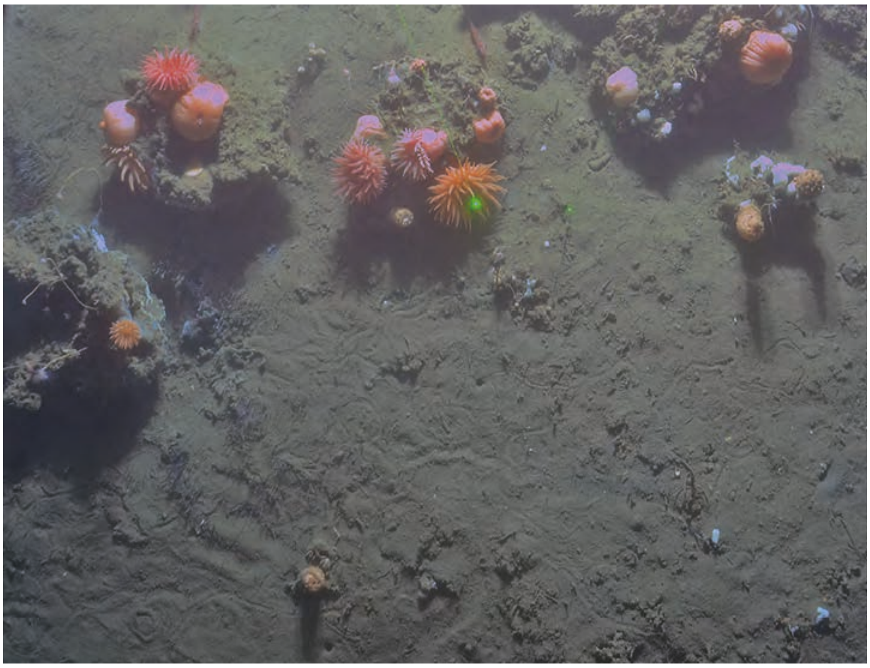


Figure 13.7 - Image CAGE15-2--HH905_2015--05-22_22-01-12; 376 m depth, 4.6 m altitude, showing abundant anemones and sponges attached to the small rocks, and other sessile and mobile bottom fauna and numerous animal tracks.

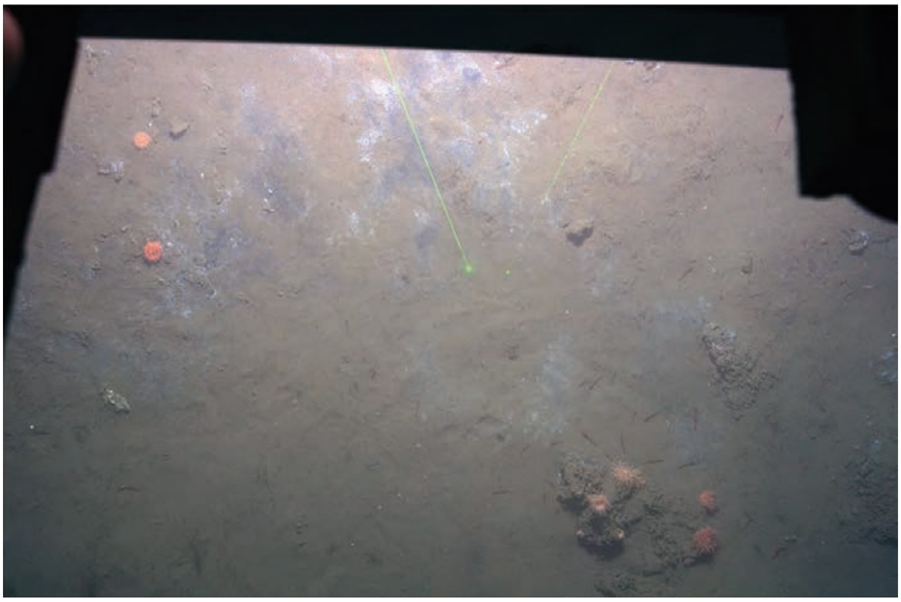


Figure 13.8 - Image CAGE15-2--HH907_2015--05-22_23-29-24; 373 m depth, 5.0 m altitude, showing patchy bacteria mat (gray/whitish areas) with various bottom fauna and small rocks.

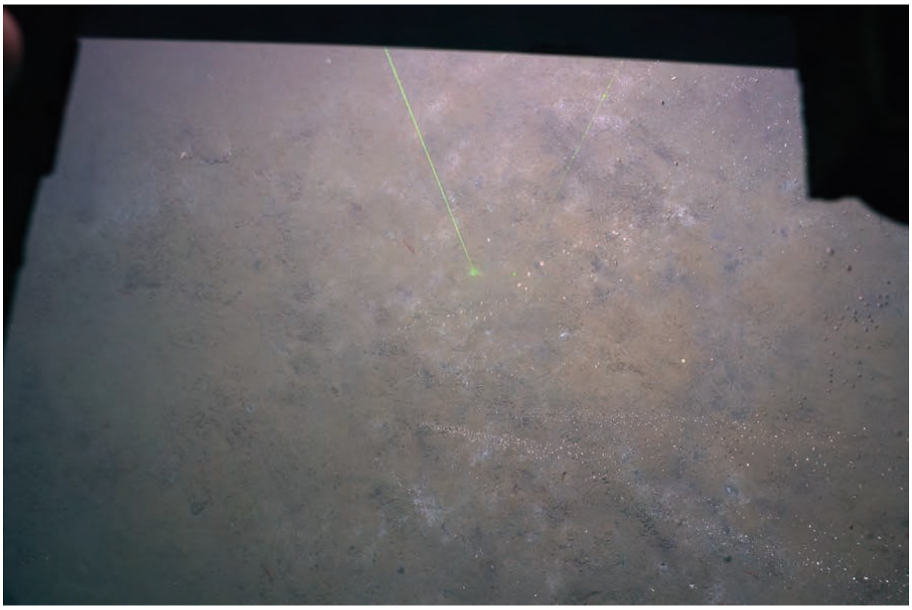


Figure 13.9 - CAGE15-2-HH905_2015-05-22_22-03-35; 374 m depth, 3.0 m altitude, showing bacterial mat area with ~4 distinct bubble streams coming from the seafloor.

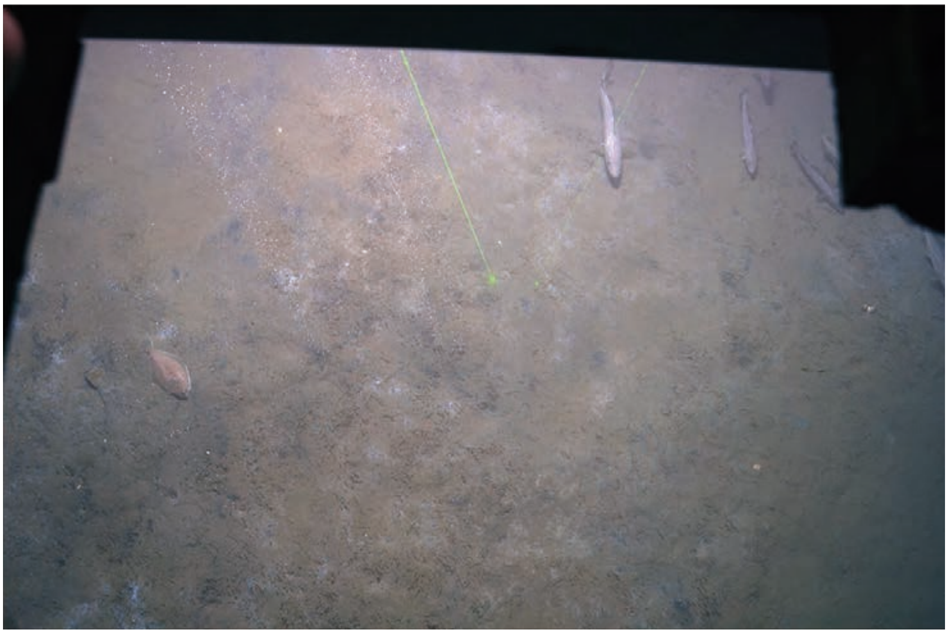


Figure 13.10 - Image CAGE15-2--HH907_2015--05-22_23-26-36; 374 m depth, 3.8 altitude. Bacterial mat area with ~3 distinct bubble streams coming from the seafloor in the area between the flat fish on left and the lasers. Abundant codfish were observed in this area on the ‘summit’ of the Pingos.

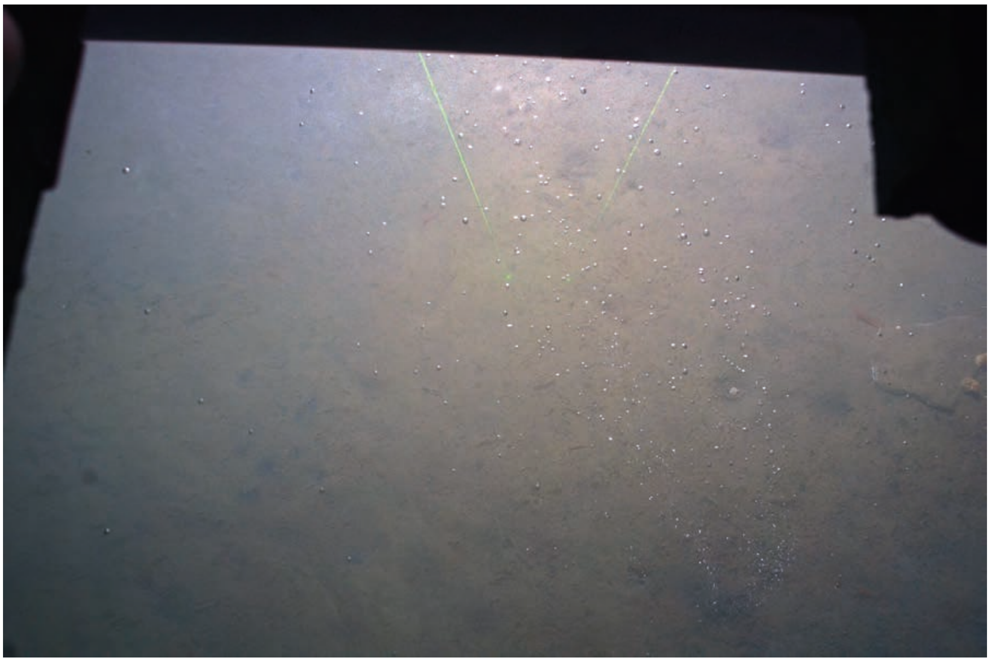


Figure 13.11 - Image CAGE15-2--HH937_2015-05-24_22-53-44; 378 m depth, 2.3 m altitude, showing bubble streams issuing from the seafloor and bacterial mat area at upper left of image.

13.6 Craters area

Figure 13.12 - Tabular block surrounding by sediment outside one of the craters surveyed during HH944. Image CAGE15-2--HH944_2015-05-26_12--21-53; 331 m depth, 2.8 m altitude.

Figure 13.13 - Image CAGE15-2--HH944_2015-05-26_13-45-23; 343 m depth, 5.3 m altitude, showing tabular rock fragments observed outside the crater on HH944.

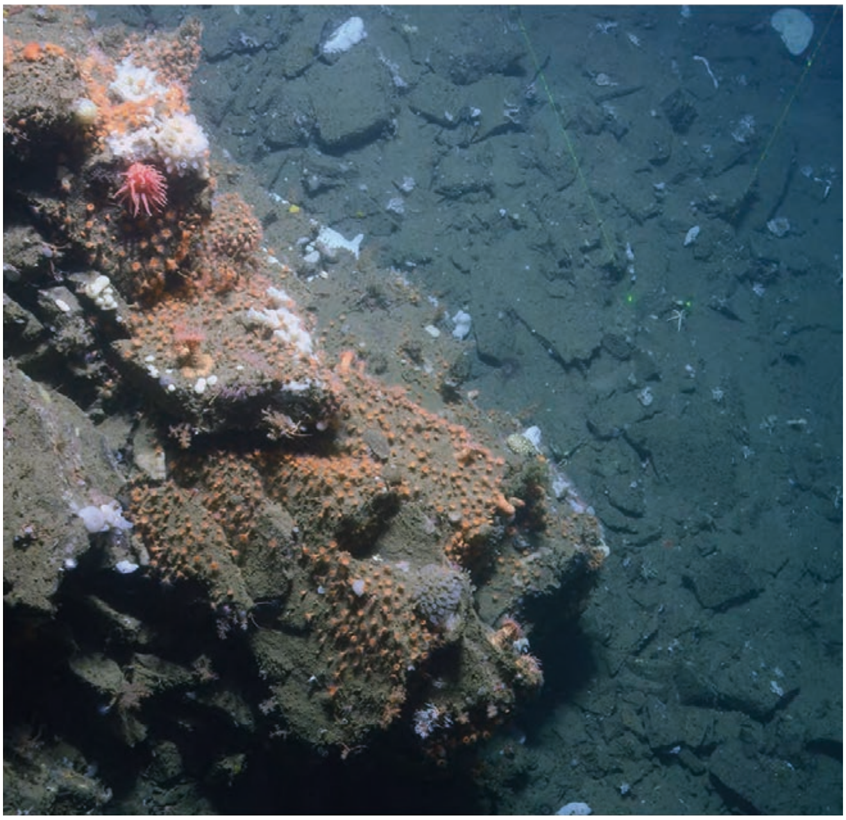


Figure 13.14 - Image CAGE15-2-HH944_2015-05-26_13-25-53; 340 m depth, 4.9 m altitude, showing extensive colonization of sessile fauna on tabular rock outcrops and talus blocks inside the upper crater wall at the end of the traverse on HH944.

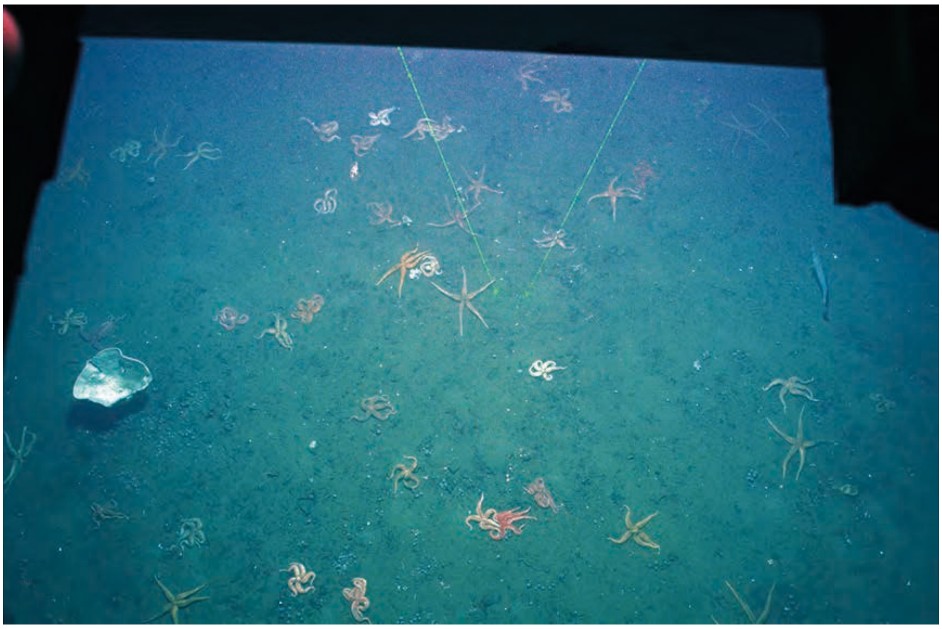


Figure 13.15 - Image CAGE15-2--HH944_2015--05-26_14-00-33; 329 m depth, 6.0 m altitude, showing numerous starfish, vase sponges and other encrusting sponges observed at the NE rim of the first crater traversed during HH944.

14. Data and Sample Storage and Availability

A Cruise Summary Report has to be compiled and submitted one month after the cruise to the CAGE director, the public relation office, and to the CAGE data manager for approval.
Data and sample storage is done by the CAGE data management, which organizes and supervises data storage. Data are only available to the project user groups if not decided otherwise by the CAGE leader team. For the data availability, the chief scientist is responsible.

15. Acknowledgments

We would like to thank captain Hans Hansen, his officers and crew of RV Helmer Hanssen for their professional support of our science programme and their assistance in the TCM operations during CAGE15-2.
We would like to thank Mr. H. Marshall Swartz -WHOI-PO Dept. and MISO Facility (on shore engineering support), and the Engineer Bjørn-Runar Olsen for his dedication to making things work.
We would like to thank Bjorn-Runar Olsen, Steinar Iversen, and Reidar Kaasa who were instrumental in helping to mobilize and stage the TCM for operations during cruise over the past 4 months of planning for the TCM deployments on CAGE15-2.

Financial support for the research comes from the Centre of Excellence CAGE – Centre for Arctic Gas Hydrate, Environment and Climate funded by the Norwegian Research Council (Project Nr. 223259). We gratefully appreciate all the support.

CAGE15-2 Team

References

Aagaard, K., Foldvik, A., and Hillman, S. R. 1987. TheWest Spitsbergen Current: disposition and water mass transformation, *Journal of Geophysical Research* 92, 3778–3784.

Berndt, C., Feseker, T., Treude, T., Krastel, S., Liebetrau, V., Niemann, H., Bertics, V. J., Dumke, I., Dünnbier, K., Ferré, B., Graves, C., Gross, F., Hissmann, K., Hühnerbach, V., Krause, S., Lieser, K., Schauer, J and Steinle, L. 2014. Temporal Constraints on Hydrate-Controlled Methane Seepage off Svalbard. *Science* 343, 284–287.

Bünz, S., Polyanov, S., Vadakkepuliyambatta, S., Consolaro, C., Mienert, J. 2012. Active gas venting through hydrate-bearing sediments on the Vestnesa Ridge, offshore W-Svalbard. *Marine Geology* 332, 189 –197.

Chabert, A., Minshull, T.A., Westbrook, G.K., Berndt, C., Thatcher, K.E., Sarkar, S., 2011. Characterization of a stratigraphically constrined gas hydrate system along the Western continental margin of Svalbard from ocean bottom seismometer data. *Journal of Geophysical Research* 116, B12102.

Crane, K., Sundvor, E., Buck, R., and Martinez, F., 1991, Rifting in the northern Norwegian-Greenland Sea: Thermal tests of asymmetric spreading: *Journal of Geophysical Research: Solid Earth* (1978‐2012), v. 96, no. B9, p. 14529-14550.

Damm, E., Mackensen, A., Budéus, G., Faber, E., and Hanfland, C. 2005. Pathways of methane in seawater: plume spreading in an Arctic shelf environment (SW-Spitsbergen), *Continental Shelf Research* 25, 1453–1472.

Engen, O., Faleide, J. I., and Dyreng, T. K., 2008, Opening of the Fram Strait gateway: a review of plate tectonic constraints: *Tectonophysics* 450/1, 51-69.

Ferré, B., Mienert, J., Feseker, T. 2012. Ocean temperature variability for the past 60 years on the Norwegian-Svalbard margin influences gas hydrate stability on human time scales. *Journal of Geophysical Research* 117/C10, DOI: 10.1029/2012JC008300.

Gentz, T., Damm, E., Schneider von Deimling, J., Mau, S., McGinnis, D. F., and Schlüter, M.: A water column study of methane around gas flares located at the West Spitsbergen continental margin, *Continental Shelf Research* 72, 107–118.

Hinrichs, K.-U., Summons, R.E., Orphan, V., Sylva, S.P., Hayes, J.M., 2000. Molecular and isotopic analysis of anaerobic methane-oxidizing communities in marine sediments. Org. Geochem. 31, 1685–1701.

Howe, J., Shimmield, T.M. & Harland, R., 2008. Late quaternary contourites and glaciomarine sedimentation in the Fram Strait. *Sedimentology* 55(1), 179–200.

Hustoft, S., Bünz, S.,Mienert, J., Chand, S., 2009. Gas hydrate reservoir and active methane venting province in sediments on b20 Ma young oceanic crust in the Fram Strait, offshore NW-Svalbard. *Earth Planetary Science Letters* 284, 12–24.

Judd, A.G., Hovland, M., 2007. Seabed Fluid Flow - The impact on Geology, Biology and the Marine Environment. Cambridge University Press, Cambridge.

Knies, J. et al., 2004. Near-surface hydrocarbon anomalies in shelf sediments off Spitsbergen: Evidences for past seepages. *Geochemistry, Geophysics, Geosystems* 5(6).

Lammers, S., Suess, E., Hovland, M. 1992. A large methane plume east of Bear Island (Barents Sea): implications for the marine methane cycle. *Geologische Rundschau* 84/1, 59-66.

Landvik, J. Y., Bondevik, S., Elverhoi, A., Fjeldskaar, W., Mangerud, J., Salvigsen, O., Siegert, M. J., Svendsen, J.-I., and Vorren, T. O. 1998. The last glacial maximum of Svalbard and the Barents Sea area: ice sheet extent and configuration. *Quaternary Science Reviews* 17, 43–75.

Liu, X., Flemings, P.B., 2007. Dynamic multiphase flow model of hydrate formation in marine sediments. *Journal of Geophysical Research* 112, B03101.

Moran, K., et al., 2006. The Cenozoic palaeoenvironment of the Arctic Ocean. *Nature* 441 (1), 601–605.

Mienert, J., Posewang, J., 1999. Evidence of shallow- and deep-water gas hydrate destabilizations in North Atlantic polar continental margin sediments. *Geo-Marine Letters* 19, 143–149.

Niemann, H., M. Elvert, 2008. Diagnostic lipid biomarker and stable carbon isotope signatures of microbial communities mediating the anaerobic oxidation of methane with sulphate, Org. Geochem., 39(12), 1668–1677, doi:10.1016/j.orggeochem.2007.11.003.

Panieri, G. et al., 2014. Record of methane emissions from the West Svalbard continental margin during the last 16 , 000 years revealed by δ 13 C of benthic foraminifera. *Global and Planetary Change*, 122, 151–160..

Paull, C.K. et al., 2007. Origin of pingo-like features on the Beaufort Sea shelf and their possible relationship to decomposing methane gas hydrates. *Geophysical Research Letters*, 34(1), pp.1–5.

Petersen, C.J., Bünz, S., Hustoft, S., Mienert, J., Klaeschen, D., 2010. High-resolution P-cable 3D seismic imaging of gas chimney structures in gas hydrated sediments of an Arctic sediment drift. *Mar. Pet. Geol.* 27, 1981–1994.

Ritzmann, O., Jokat,W., Czuba,W., Guterch, A.,Mjelde, R., Nishimura, Y., 2004. A deep seismic transect from Hovgård Ridge to northwestern Svalbard across the continental-ocean transition: a sheared margin study. *Geophys. J. Int.* 157 (2), 683–702.

Sahling, H. et al., 2014. Gas emissions at the continental margin west off Svalbard: mapping, sampling, and quantification. *Biogeosciences Discussions* 11(5), 7189–7234.

Saloranta, T. M. and H. Sevndsen. 2001. Across the Arctic front west of Spitsbergen: high-resolution CTD sections from 1998–2000. *Polar Research* 20(2), 177–184.

Sarkar, S., Berndt, C., Minshull, T. A., Westbrook, G. K., Klaeschen, D., Masson, D. G., Chabert, A., and Thatcher, K. E.: Seismic evidence for shallow gas-escape features associated with a retreating gas hydrate zone offshore west Svalbard, *Journal of Geophysical Research* 117, B09102.

Suess, E., Altenbach, A.V. 1992. Europaisches Nordmeer, Reise Nr. 17, 15. Juli-29. August 1991. Meteor-Ber Univ Hamburg No 92–3:1–164.

Smith, A.J. Mienert, J., Bünz, S., Greinert, J., Rasmussen, T. L. 2014. 900-m high gas plumes rising from marine sediments containing structure II hydrates at Vestnesa Ridge, offshore W-Svalbard. *Geophysical Research Abstracts* 15(3), EGU2013-9302.

Solheim, A., Elverhoi, A., 1993. Gas related sea floor craters in the Barents Sea. *Geo-Mar Lett.* 13, 235–243.

Solheim, A. & Elverhøi, A., 1985: A pockmark field in the central Barents Sea; gas from a petrogenic source? *Polar Research* 3, 11-19.

Solheim, A. Milliman, J. D., Elverhøi, A. 1988. Sediment distribution and sea-floor morphology of Storbanken: implications for the glacial history of the northern Barents Sea. *Canadian Journal of Earth Sciences* 25(4): 547-556.

Solheim, A., Faleide, J. I., Andersen, E. S., Elverhøi, A., Forsberg, C. F., Vanneste, K., Uenzelmann-Neben, G., and Channell, J. E. T.: Late Cenozoic seismic stratigraphy and glacial geological development of the east Greenland and Svalbard-Barents Sea continental margins, *Quaternary Science Reviews* 17, 155–184, 1998.

Spielhagen, R.F. et al., 2011. Enhanced modern heat transfer to the Arctic by warm Atlantic Water. Science (New York, N.Y.), 331(6016), pp.450–453.

Swift, JH. 1986. The Arctic waters. The Nordic Seas. Hurdle BG, Ed. New York.

Vanneste, M., Harbitz, C.B., De Blasio, F.V., Glimsdal, S., Mienert, J., Elverhøi, A., 2011. Hinlopen-Yermak Landslide, Arctic Ocean—Geomorphology, landslide dynamics and tsunami simulations. In: Shipp, R.C., Weimer, P., Posamentier, H.W. (Eds.), Mass-transport deposits in deepwater settings. Publ, *SEPM Society for Sedimentary Geol. Spec,* p. 96.

Vorren, T. O., Laberg, J. S., Blaume, F., Dowdeswell, J. A., Kanyon, N. H., Mienert, J., Rumohr, J., and Werner, F. 1998. The Norwegian-Greenland Sea continental margins: morphology and late Quaternary sedimentary processes and environment, *Quaternary Science Reviews* 17, 273–302.

Wegener, G., Niemann, H., Elvert, M., Hinrichs, K. U., and Boetius, A. 2008. Assimilation of methane and inorganic carbon by microbial communities mediating the anaerobic oxidation of methane, Environ. Microbiol., 10, 2287-2298

Westbrook, G.K., Chand, S., Rossi, G., Long, C., Bünz, S., Camerlenghi, A., Carcione, J.M., Dean, S., Foucher, J.P., Flueh, E., Gei, D., Haacke, R.R., Madrussani, J., Mienert, J., Minshull, T.A., Nouzé, H., Peacock, S., Reston, T., Vanneste, M., Zillmer, M., 2008. Estimation of gas-hydrate concentration from multi-component seismic data at sites on the continental margins of NW Svalbard and the Storegga region of Norway. *Mar. Pet. Geol.* 25, 744–758.

Wright, I. C.: RRS James Clark Ross Cruise 253 (26 July–25 Aug 2011) Arctic methane hydrates, National Oceanography Centre, Southampton, Southampton, 2012.

References

Aagaard, K., Foldvik, A., and Hillman, S. R. 1987. TheWest Spitsbergen Current: disposition and water mass transformation, *Journal of Geophysical Research* 92, 3778–3784.

Berndt, C., Feseker, T., Treude, T., Krastel, S., Liebetrau, V., Niemann, H., Bertics, V. J., Dumke, I., Dünnbier, K., Ferré, B., Graves, C., Gross, F., Hissmann, K., Hühnerbach, V., Krause, S., Lieser, K., Schauer, J and Steinle, L. 2014. Temporal Constraints on Hydrate-Controlled Methane Seepage off Svalbard. *Science* 343, 284–287.

Bünz, S., Polyanov, S., Vadakkepuliyambatta, S., Consolaro, C., Mienert, J. 2012. Active gas venting through hydrate-bearing sediments on the Vestnesa Ridge, offshore W-Svalbard. *Marine Geology* 332, 189 –197.

Chabert, A., Minshull, T.A., Westbrook, G.K., Berndt, C., Thatcher, K.E., Sarkar, S., 2011. Characterization of a stratigraphically constrined gas hydrate system along the Western continental margin of Svalbard from ocean bottom seismometer data. *Journal of Geophysical Research* 116, B12102.

Crane, K., Sundvor, E., Buck, R., and Martinez, F., 1991, Rifting in the northern Norwegian-Greenland Sea: Thermal tests of asymmetric spreading: *Journal of Geophysical Research: Solid Earth* (1978‑2012), v. 96, no. B9, p. 14529-14550.

Damm, E., Mackensen, A., Budéus, G., Faber, E., and Hanfland, C. 2005. Pathways of methane in seawater: plume spreading in an Arctic shelf environment (SW-Spitsbergen), *Continental Shelf Research* 25, 1453–1472.

Engen, O., Faleide, J. I., and Dyreng, T. K., 2008, Opening of the Fram Strait gateway: a review of plate tectonic constraints: *Tectonophysics* 450/1, 51-69.

Ferré, B., Mienert, J., Feseker, T. 2012. Ocean temperature variability for the past 60 years on the Norwegian-Svalbard margin influences gas hydrate stability on human time scales. *Journal of Geophysical Research* 117/C10, DOI: 10.1029/2012JC008300.

Gentz, T., Damm, E., Schneider von Deimling, J., Mau, S., McGinnis, D. F., and Schlüter, M.: A water column study of methane around gas flares located at the West Spitsbergen continental margin, *Continental Shelf Research* 72, 107–118.

Hinrichs, K.-U., Summons, R.E., Orphan, V., Sylva, S.P., Hayes, J.M., 2000. Molecular and isotopic analysis of anaerobic methane-oxidizing communities in marine sediments. Org. Geochem. 31, 1685–1701.

Howe, J., Shimmield, T.M. & Harland, R., 2008. Late quaternary contourites and glaciomarine sedimentation in the Fram Strait. *Sedimentology* 55(1), 179–200.

Hustoft, S., Bünz, S.,Mienert, J., Chand, S., 2009. Gas hydrate reservoir and active methane venting province in sediments on b20 Ma young oceanic crust in the Fram Strait, offshore NW-Svalbard. *Earth Planetary Science Letters* 284, 12–24.

Judd, A.G., Hovland, M., 2007. Seabed Fluid Flow - The impact on Geology, Biology and the Marine Environment. Cambridge University Press, Cambridge.

Knies, J. et al., 2004. Near-surface hydrocarbon anomalies in shelf sediments off Spitsbergen: Evidences for past seepages. *Geochemistry, Geophysics, Geosystems* 5(6).

Lammers, S., Suess, E., Hovland, M. 1992. A large methane plume east of Bear Island (Barents Sea): implications for the marine methane cycle. *Geologische Rundschau* 84/1, 59-66.

Landvik, J. Y., Bondevik, S., Elverhoi, A., Fjeldskaar, W., Mangerud, J., Salvigsen, O., Siegert, M. J., Svendsen, J.-I., and Vorren, T. O. 1998. The last glacial maximum of Svalbard and the Barents Sea area: ice sheet extent and configuration. *Quaternary Science Reviews* 17, 43–75.

Liu, X., Flemings, P.B., 2007. Dynamic multiphase flow model of hydrate formation in marine sediments. *Journal of Geophysical Research* 112, B03101.

Moran, K., et al., 2006. The Cenozoic palaeoenvironment of the Arctic Ocean. *Nature* 441 (1), 601–605.

Mienert, J., Posewang, J., 1999. Evidence of shallow- and deep-water gas hydrate destabilizations in North Atlantic polar continental margin sediments. *Geo-Marine Letters* 19, 143–149.

Niemann, H., M. Elvert, 2008. Diagnostic lipid biomarker and stable carbon isotope signatures of microbial communities mediating the anaerobic oxidation of methane with sulphate, Org. Geochem., 39(12), 1668–1677, doi:10.1016/j.orggeochem.2007.11.003.

Panieri, G. et al., 2014. Record of methane emissions from the West Svalbard continental margin during the last 16 , 000 years revealed by δ 13 C of benthic foraminifera. *Global and Planetary Change*, 122, 151–160..

Paull, C.K. et al., 2007. Origin of pingo-like features on the Beaufort Sea shelf and their possible relationship to decomposing methane gas hydrates. *Geophysical Research Letters*, 34(1), pp.1–5.

Petersen, C.J., Bünz, S., Hustoft, S., Mienert, J., Klaeschen, D., 2010. High-resolution P-cable 3D seismic imaging of gas chimney structures in gas hydrated sediments of an Arctic sediment drift. *Mar. Pet. Geol.* 27, 1981–1994.

Ritzmann, O., Jokat,W., Czuba,W., Guterch, A.,Mjelde, R., Nishimura, Y., 2004. A deep seismic transect from Hovgård Ridge to northwestern Svalbard across the continental-ocean transition: a sheared margin study. *Geophys. J. Int.* 157 (2), 683–702.

Sahling, H. et al., 2014. Gas emissions at the continental margin west off Svalbard: mapping, sampling, and quantification. *Biogeosciences Discussions* 11(5), 7189–7234.

Saloranta, T. M. and H. Sevndsen. 2001. Across the Arctic front west of Spitsbergen: high-resolution CTD sections from 1998–2000. *Polar Research* 20(2), 177–184.

Sarkar, S., Berndt, C., Minshull, T. A., Westbrook, G. K., Klaeschen, D., Masson, D. G., Chabert, A., and Thatcher, K. E.: Seismic evidence for shallow gas-escape features associated with a retreating gas hydrate zone offshore west Svalbard, *Journal of Geophysical Research* 117, B09102.

Suess, E., Altenbach, A.V. 1992. Europaisches Nordmeer, Reise Nr. 17, 15. Juli-29. August 1991. Meteor-Ber Univ Hamburg No 92–3:1–164.

Smith, A.J. Mienert, J., Bünz, S., Greinert, J., Rasmussen, T. L. 2014. 900-m high gas plumes rising from marine sediments containing structure II hydrates at Vestnesa Ridge, offshore W-Svalbard. *Geophysical Research Abstracts* 15(3), EGU2013-9302.

Solheim, A., Elverhoi, A., 1993. Gas related sea floor craters in the Barents Sea. *Geo-Mar Lett.* 13, 235–243.

Solheim, A. & Elverhøi, A., 1985: A pockmark field in the central Barents Sea; gas from a petrogenic source? *Polar Research* 3, 11-19.

Solheim, A. Milliman, J. D., Elverhøi, A. 1988. Sediment distribution and sea-floor morphology of Storbanken: implications for the glacial history of the northern Barents Sea. *Canadian Journal of Earth Sciences* 25(4): 547-556.

Solheim, A., Faleide, J. I., Andersen, E. S., Elverhøi, A., Forsberg, C. F., Vanneste, K., Uenzelmann-Neben, G., and Channell, J. E. T.: Late Cenozoic seismic stratigraphy and glacial geological development of the east Greenland and Svalbard-Barents Sea continental margins, *Quaternary Science Reviews* 17, 155–184, 1998.

Spielhagen, R.F. et al., 2011. Enhanced modern heat transfer to the Arctic by warm Atlantic Water. Science (New York, N.Y.), 331(6016), pp.450–453.

Swift, JH. 1986. The Arctic waters. The Nordic Seas. Hurdle BG, Ed. New York.

Vanneste, M., Harbitz, C.B., De Blasio, F.V., Glimsdal, S., Mienert, J., Elverhøi, A., 2011. Hinlopen-Yermak Landslide, Arctic Ocean—Geomorphology, landslide dynamics and tsunami simulations. In: Shipp, R.C., Weimer, P., Posamentier, H.W. (Eds.), Mass-transport deposits in deepwater settings. Publ, *SEPM Society for Sedimentary Geol. Spec,* p. 96.

Vorren, T. O., Laberg, J. S., Blaume, F., Dowdeswell, J. A., Kanyon, N. H., Mienert, J., Rumohr, J., and Werner, F. 1998. The Norwegian-Greenland Sea continental margins: morphology and late Quaternary sedimentary processes and environment, *Quaternary Science Reviews* 17, 273–302.

Wegener, G., Niemann, H., Elvert, M., Hinrichs, K. U., and Boetius, A. 2008. Assimilation of methane and inorganic carbon by microbial communities mediating the anaerobic oxidation of methane, Environ. Microbiol., 10, 2287-2298

Westbrook, G.K., Chand, S., Rossi, G., Long, C., Bünz, S., Camerlenghi, A., Carcione, J.M., Dean, S., Foucher, J.P., Flueh, E., Gei, D., Haacke, R.R., Madrussani, J., Mienert, J., Minshull, T.A., Nouzé, H., Peacock, S., Reston, T., Vanneste, M., Zillmer, M., 2008. Estimation of gas-hydrate concentration from multi-component seismic data at sites on the continental margins of NW Svalbard and the Storegga region of Norway. *Mar. Pet. Geol.* 25, 744–758.

Wright, I. C.: RRS James Clark Ross Cruise 253 (26 July–25 Aug 2011) Arctic methane hydrates, National Oceanography Centre, Southampton, Southampton, 2012.

Appendix
Tables with coordinates for each activity

Table A.1. CTD Coordinates; some of the coordinates are corrected according to the real operation on-board.

Site ID	Ship station	CTD ID	Lat	Long
Control site	849	CAGE 15-2 HH CTD 849	7833.995749N	01011.678022E
Control site	852	CAGE 15-2 HH CTD 852	7834.093521N	01007.515896E
Prins Karls Forland	860	CAGE 15-2 HH CTD 860	7833.696073N	01008.607578E
7808 site	875	CAGE 15-2 HH CTD 875	7841.496321N	00816.038253E
7809 site	876	CAGE 15-2 HH CTD 876	7841.436067N	00816.320199E
Vestnesa	889	CAGE 15-2 HH CTD 889	7859.875224N	00654.997291E
Pingo-area	899	CAGE 15-2 HH CTD 899	7607.203085N	01544.273673E
Pingo-area	900	CAGE 15-2 HH CTD 900	7606.834404N	01600.478571E
Pingo-area	901	CAGE 15-2 HH CTD 901	7606.201408N	01602.953665E
Pingo-area	902	CAGE 15-2 HH CTD 902	7606.266509N	01558.263637E
Pingo-area	909	CAGE 15-2 HH CTD 909	7606.86138N	01600.341985E
Pingo-area	910	CAGE 15-2 HH CTD 910	7606.243818N	01604.373935E
Storfjordrenna (SR1)	923	CAGE 15-2 HH CTD 923	7550.799127N	01638.270388E
Pingo-area	941	CAGE 15-2 HH CTD 941	7605.890208N	01603.103771E
Pingo-area	942	CAGE 15-2 HH CTD 942	7556.835133N	01641.970914E
Crater-area	943	CAGE 15-2 HH CTD 943	7456.023023N	02732.118789E

Control site	953	CAGE 15-2 HH CTD 965	7446.457000N	02739.635992E

Table A.2. Multicore Coordinates; some of the coordinates are corrected according to the real operation on-board.

Site ID	**Ship station**	**TCM station ID**	**Lat**	**Long**
Prins Karls Forland	861	CAGE 15-2 HH 861MC	7834.450000N	01010.452000E
Prins Karls Forland	862	CAGE 15-2 HH 862MC	7834.454124N	01010.533427E
Prins Karls Forland	871	CAGE 15-2 HH 871MC	7833.471180N	01009.700000E
Prins Karls Forland	872	CAGE 15-2 HH 872MC	7833.448890N	01009.795000E
Prins Karls Forland	873	CAGE 15-2 HH 873MC	7833.548000N	01009.496000E
7808 site	880	CAGE 15-2 HH 880MC	7841.449000N	00814.500000E
7808 site	882	CAGE 15-2 HH 882MC	7841.312000N	00815.819000E
7808 site	884	CAGE 15-2 HH 884MC	7841.306000N	00815.825000E
Vestnesa	886	CAGE 15-2 HH 886MC	7900.381500N	00654.040000E
Vestnesa	888	CAGE 15-2 HH 888MC	7900.460000N	00654.149000E
Vestnesa	893	CAGE 15-2 HH 893MC	7900.187998N	00655.440599E
Vestnesa	896	CAGE 15-2 HH 896MC	7900.193020N	00655.441790E
Pingo area	904	CAGE 15-2 HH 904MC	7606.429000N	01558.050000E
Pingo area	905	CAGE 15-2 HH 905MC	7606.421000N	01558.060000E
Pingo area	908	CAGE 15-2 HH 908MC	7606.4243000N	01558.124000E
Pingo area	917	CAGE 15-2 HH 917MC	7606.367698	01602.071623E
Pingo area	934	CAGE 15-2 HH 934MC	7606.418667	01558.021484E
Pingo area	935	CAGE 15-2 HH 935MC	7606.416000N	01558.023000E
Pingo area	938	CAGE 15-2 HH 938MC	7606.441000N	01558.159000E
Crater area	945	CAGE 15-2 HH 945MC	7454.930000N	02735.021000E
Craters area	960	CAGE 15-2 HH 960MC	7455.064000N	02735.906000E
Conttol site	964	CAGE 15-2 HH 964MC	7448.354252 N	02741.839336 E

Table A.3. Gravity cores Coordinates.

Site ID	Ship station	Gravity core ID	Date	Depth (m)	Lat	Lon	Comment
78.08 site	877	CAGE15-2 HH 877 GC	18.05.2015	879.85	7841.311414 N	00816.317842 E	H2S smell from core catcher
78.08 site	878	CAGE15-2 HH 878 GC	18.05.2015	889.70	7841.305931 N	00815.847787 E	H2S smell from core catcher
78.08 site	879	CAGE15-2 HH 879 GC	18.05.2015	889.32	7841.306000 N	00815.847655 E	
Vestnesa Ridge	890	CAGE15-2 HH 890 GC	20.05.2015	1199.54	7900.338434 N	00654.074766 E	
Vestnesa Ridge	891	CAGE15-2 HH 891 GC	20.05.2015	1200.74	7900.390234 N	00653.896663 E	
Pingo area	911	CAGE15-2 HH 911 GC	23.05.2015	379.29	7606.415044 N	01558.062159 E	H2S smell, gas hydrate
Pingo area	912	CAGE15-2 HH 912 GC	23.05.2015	379.60	7606.401695 N	01558.117381 E	H2S smell, gas hydrate
Pingo area	913	CAGE15-2 HH 913 GC	23.05.2015	380.98	7606.909481 N	01600.147594 E	H2S smell, gas hydrate
Pingo area	914	CAGE15-2 HH 914 GC	23.05.2015	381.00	7606.342848 N	01602.097127 E	H2S smell, gas hydrate
Pingo area	915	CAGE15-2 HH 915 GC	23.05.2015	395.72	7606.450018 N	01604.862715 E	Reference
Pingo area	918	CAGE15-2 HH 918 GC	23.05.2015	371.03	7607.007951 N	01602.631401 E	
Pingo area	919	CAGE15-2 HH 919 GC	23.05.2015	370.53	7607.007804 N	01602.635481 E	
Pingo area	920	CAGE15-2 HH 920 GC	23.05.2015	386.38	7606.699755 N	01600.648939 E	
Pingo area	921	CAGE15-2 HH 921 GC	23.05.2015	393.23	7606.534168 N	01600.168497 E	
Pingo-area	939	CAGE15-2 HH 939 GC	25.05.2015	387.25	7606.415808 N	01557.457019 E	
Pingo-area	940	CAGE15-2 HH 940 GC	25.05.2015	386.34	7606.413822 N	01558.671520 E	
Crater-area	954	CAGE15-2 HH 954 GC	26.05.2015	328.09	7455.141808 N	02731.620254 E	
Crater-area	955	CAGE15-2 HH 955 GC	26.05.2015	333.72	7454.493449 N	02733.005103 E	
Crater-area	956	CAGE15-2 HH 956 GC	26.05.2015	334.01	7454.479462 N	02733.016261 E	No recovery
Crater-area	957	CAGE15-2 HH 957 GC	26.05.2015	0.00	7457.647974 N	02737.952769 E	No recovery

Crater-area	958	CAGE15-2 HH 958 GC	26.05.2015	341.74	7457.507880 N	02740.436321 E

Table A.4. Van Veen grab Coordinates.

Site ID	Ship station	Grab #	Date	Time (UTC)	Depth (m)	Lat	Lon
Control site	853	Grab 1	17/05/15	14:45:53	82.48	7834.042984 N	1007.308409 E
Control site	854	Grab 2	17/05/15	15:03:50	83.23	7834.113652 N	1007.533983 E
Control site	855	Grab 3	17/05/15	15:05:34	83.26	7834.111908 N	1007.550225 E
Control site	856	Grab 4	17/05/15	15:12:15	82.95	7834.095418 N	1007.513087 E
Control site	857	Grab 5	17/05/15	15:18:31	83.20	7834.095759 N	1007.516058 E
Control site	858	Grab 6	17/05/15	15:24:41	82.96	7834.102835 N	1007.521662 E
Control site	859	Grab 7	17/05/15	16:01:43	85.89	7834.068661 N	1007.656831 E
Prins Karls Foreland	863	Grab 1	17/05/15	21:07:15	89.04	7834.453053 N	1010.590061 E
Prins Karls Foreland	864	Grab 2	17/05/15	21:25:32	88.92	7834.424631 N	1010.595481 E
Prins Karls Foreland	865	Grab 3	17/05/15	21:26:54	89.58	7834.419457 N	1010.610186 E
Prins Karls Foreland	866	Grab 4	17/05/15	21:42:22	88.81	7834.443987 N	1010.528285 E
Prins Karls Foreland	867	Grab 5	17/05/15	21:52:39	89.10	7834.445889 N	1010.591590 E
Prins Karls Foreland	868	Grab 6	17/05/15	22:03:06	88.99	7834.447895 N	1010.590361 E
Prins Karls Foreland	869	Grab 7	17/05/15	22:08:01	88.45	7834.449128 N	1010.557654 E
Prins Karls Foreland	870	Grab 8	17/05/15	22:22:39	89.74	7834.544109 N	1010.164586 E
Pingo-area	922	Grab	23/05/15	21:11:21	381.61	7606.363766 N	1602.085455 E
Storfjordrenna (SR1)	925	Grab 1	24/05/15	12:04:08	350.44	7550.494138 N	1637.557781 E
Storfjordrenna (SR1)	926	Grab 2	24/05/15	12:17:05	350.85	7550.483897 N	1637.559620 E
Storfjordrenna (SR1)	927	Grab 3	24/05/15	12:32:26	350.31	7550.478984 N	1637.528846 E
Storfjordrenna (SR1)	928	Grab 4	24/05/15	12:46:53	350.71	7550.481284 N	1637.539556 E
Storfjordrenna (SR1)	929	Grab 5	24/05/15	13:00:35	349.75	7550.477740 N	1637.529732 E
Storfjordrenna (SR1)	930	Grab 6	24/05/15	13:15:14	350.18	7550.485907 N	1637.570441 E
Crater-area	946	Grab 1	26/05/15	17:09:17	334.52	7454.075383 N	2733.414333 E
Crater-area	947	Grab 2	26/05/15	17:22:39	335.47	7454.080123 N	2733.423857 E
Crater-area	948	Grab 3	26/05/15	17:37:19	334.49	7454.079416 N	2733.412655 E

Crater-area	949	Grab 4	26/05/15	17:48:18	334.84	7454.077801 N	2733.399572 E
Crater-area	950	Grab 5	26/05/15	18:18:13	334.89	7454.005137 N	2733.292151 E
Crater-area	951	Grab 6	26/05/15	18:18:47	335.01	7453.994271 N	2733.283539 E

Table A.5. Triangular scrape Coordinates.

Site ID	Ship station	Date	Time (UTC)	Depth (m)	Lat	Lon	Comment
Vestnesa Ridge	898	21.05.2015	02:57:51	1203.11	7900.172844 N	0655.446706 E	No recovery
Vestnesa Ridge	898	21.05.2015	03:14:50	1201.29	7900.317161 N	0655.436646 E	No recovery
Pingo area	906	22.05.2015	22:16:57	377.52	7606.421077 N	1558.060817 E	
Pingo area	906	22.05.2015	22:17:08	376.64	7606.420851 N	1558.059758 E	
Storfjordrenna (SR1)	931	24.05.2015	13:47:23	350.67	7550.464216 N	1637.528208 E	
Storfjordrenna (SR1)	931	24.05.2015	13:57:48	350.38	7550.645058 N	1637.680694 E	
Crater-area	962	27.05.2015	12:51:12	334.80	7454.963244 N	2731.439002 E	No recovery
Crater-area	962	27.05.2015	13:04:44	329.79	7455.188380 N	2731.513574 E	No recovery
Crater-area	963	27.05.2015	13:45:09	328.07	7455.666692 N	2732.973063 E	
Crater-area	963	27.05.2015	13:57:49	331.55	7455.672908 N	2733.654952 E	
WA	966	28.05.2015	14:02:58	174.06	7106.655508 N	2422.427157 E	
WA	966	28.05.2015	14:16:19	150.10	7106.756659 N	2421.298073 E	

Table A.6. Niskin bottles attached at the TCM Coordinates.

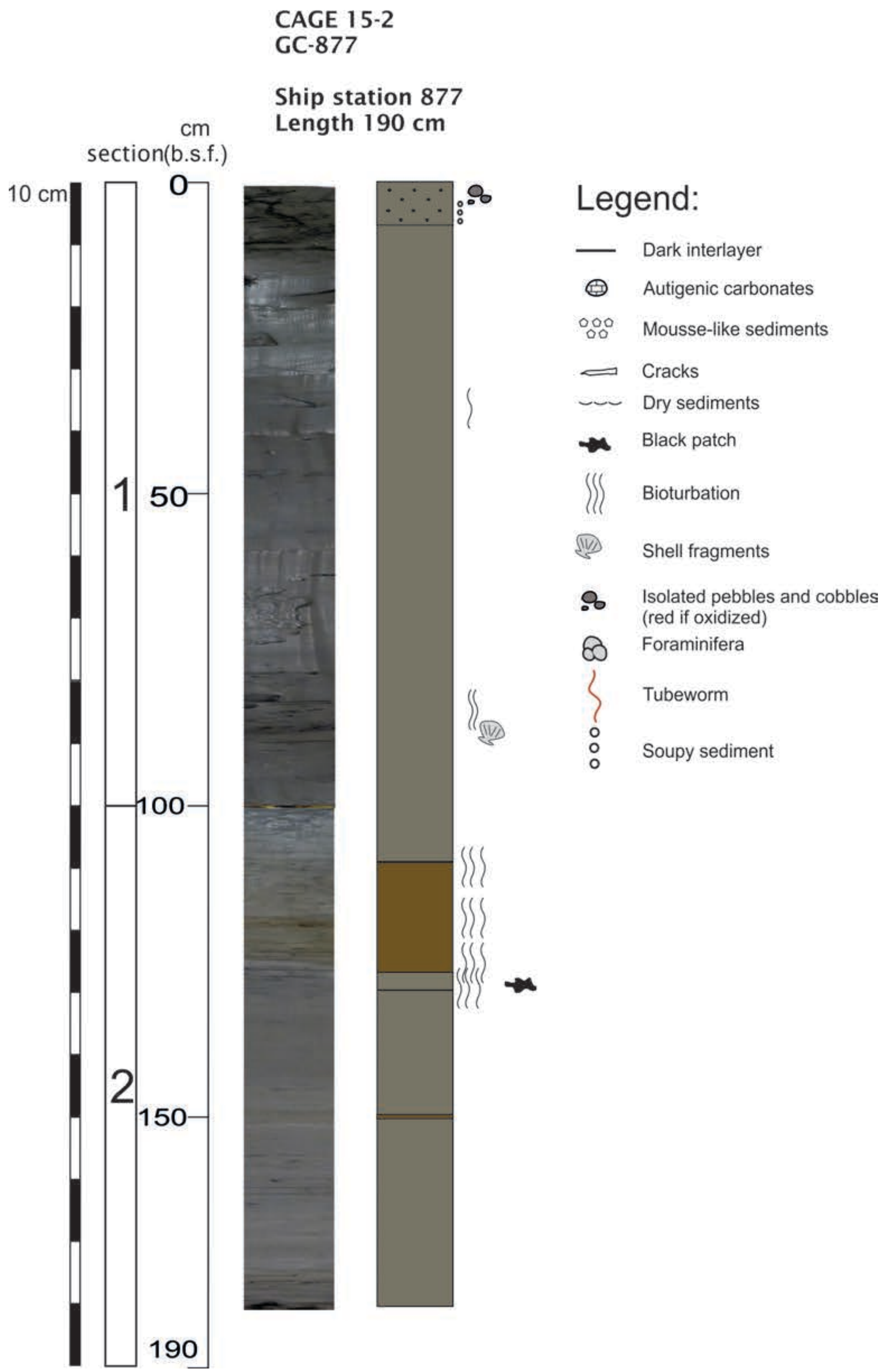
Site ID	Ship station	Niskin on TCM station	bottle	lat	long
Control site	850	CAGE 15-2 HH 850TC	1	07834.449N	01010.818E
Control site	850	CAGE 15-2 HH 850TC	2	07834.454N	01010.550E
Control site	850	CAGE 15-2 HH 850TC	3	07834.479N	01010.692E
Control site	850	CAGE 15-2 HH 850TC	4	07834.516N	01010.655E
Control site	850	CAGE 15-2 HH 850TC	5	07834.533N	01010.627E
Control site	850	CAGE 15-2 HH 850TC	6	07834.601N	01010.603E
Control site	851	CAGE 15-2 HH 851TC	1	07833.518N	01009.612E
Control site	851	CAGE 15-2 HH 851TC	2	07833.547N	01009.449E
Control site	851	CAGE 15-2 HH 851TC	3	07833.684N	01008.889E
Control site	851	CAGE 15-2 HH 851TC	4	07833.709N	01008.521E
Control site	851	CAGE 15-2 HH 851TC	5	07833.769N	01008.779E
Control site	851	CAGE 15-2 HH 851TC	6	07833.651N	01009.300E
Prins Karls Foreland	861	CAGE 15-2 HH 861TC	1	07834.445N	01010.548E
Prins Karls Foreland	861	CAGE 15-2 HH 861TC	2	07834.464N	01010.556E
Prins Karls Foreland	871	CAGE 15-2 HH 871TC	1	07833.472N	01009.700E
Prins Karls Foreland	873	CAGE 15-2 HH 873TC	1	07833.548N	01009.496E
Prins Karls Foreland	874	CAGE 15-2 HH 874TC	1	07839.499N	00924.733E
Prins Karls Foreland	874	CAGE 15-2 HH 874TC	2	07839.398N	00925.497E
Prins Karls Foreland	874	CAGE 15-2 HH 874TC	3	07839.291N	00926.049E
Prins Karls Foreland	874	CAGE 15-2 HH 874TC	4	07839.338N	00925.430E
Prins Karls Foreland	874	CAGE 15-2 HH 874TC	5	07839.380N	00925.230E
Prins Karls Foreland	874	CAGE 15-2 HH 874TC	6	07839.403N	00925.077E
7808 site	879	CAGE 15-2 HH 879TC	1	07841.678N	00815.586E
7808 site	879	CAGE 15-2 HH 879TC	2	07841.345N	00816.359E

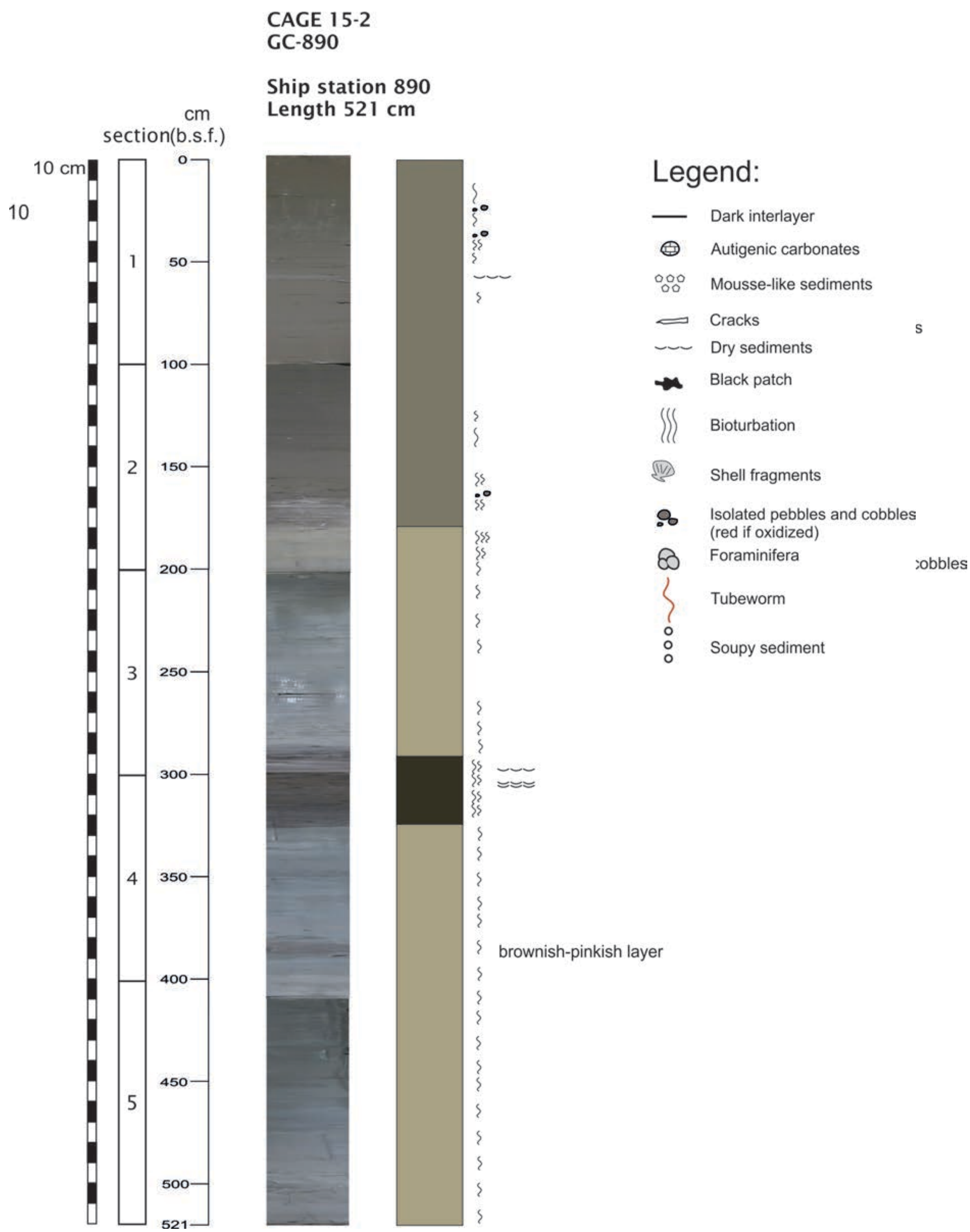
7808 site	879	CAGE 15-2 HH 879TC	3	07841.283N	00816.256E
7808 site	881	CAGE 15-2 HH 881TC	1	07841.328N	00815.812E
7808 site	881	CAGE 15-2 HH 881TC	2	07841.328N	00815.816E
7808 site	881	CAGE 15-2 HH 881TC	3	07841.312N	00815.812E
7808 site	881	CAGE 15-2 HH 881TC	5	07841.321N	00815.814E
7808 site	881	CAGE 15-2 HH 881TC	6	07841.323N	00815.816E
7808 site	884	CAGE 15-2 HH 884TC	1	07841.324N	00815.323E
7808 site	884	CAGE 15-2 HH 884TC	2	07841.311N	00815.819E
7808 site	884	CAGE 15-2 HH 884TC	3	07841.308N	00815.822E
7808 site	884	CAGE 15-2 HH 884TC	4	07841.308N	00815.822E
7808 site	884	CAGE 15-2 HH 884TC	5	07841.306N	00815.840E
7808 site	884	CAGE 15-2 HH 884TC	6	07841.327N	00815.929E
Vestnesa	885	CAGE 15-2 HH 885TC	1	07900.401N	00653.996E
Vestnesa	885	CAGE 15-2 HH 885TC	2	07900.375N	00654.096E
Vestnesa	885	CAGE 15-2 HH 885TC	3	07900.365N	00654.140E
Vestnesa	885	CAGE 15-2 HH 885TC	4	07900.365N	00654.140E
Vestnesa	885	CAGE 15-2 HH 885TC	5	07900.365N	00654.140E
Vestnesa	885	CAGE 15-2 HH 885TC	6	07900.365N	00654.140E
Vestnesa	887	CAGE 15-2 HH 887TC	1	07900.302N	00654.690E
Vestnesa	887	CAGE 15-2 HH 887TC	2	07900.360N	00654.077E
Vestnesa	887	CAGE 15-2 HH 887TC	3	07900.280N	00654.312E
Vestnesa	887	CAGE 15-2 HH 887TC	4	07900.454N	00654.150E
Vestnesa	887	CAGE 15-2 HH 887TC	6	07900.467N	00654.140E
Vestnesa	891	CAGE 15-2 HH 891TC	1	07900.417N	00654.076E
Vestnesa	891	CAGE 15-2 HH 891TC	2	07900.417N	00654.076E
Vestnesa	891	CAGE 15-2 HH 891TC	3	07900.366N	00653.910E
Vestnesa	891	CAGE 15-2 HH 891TC	4	07900.366N	00653.910E
Vestnesa	891	CAGE 15-2 HH 891TC	5	07900.366N	00653.910E
Vestnesa	891	CAGE 15-2 HH 891TC	6	07900.366N	00653.910E

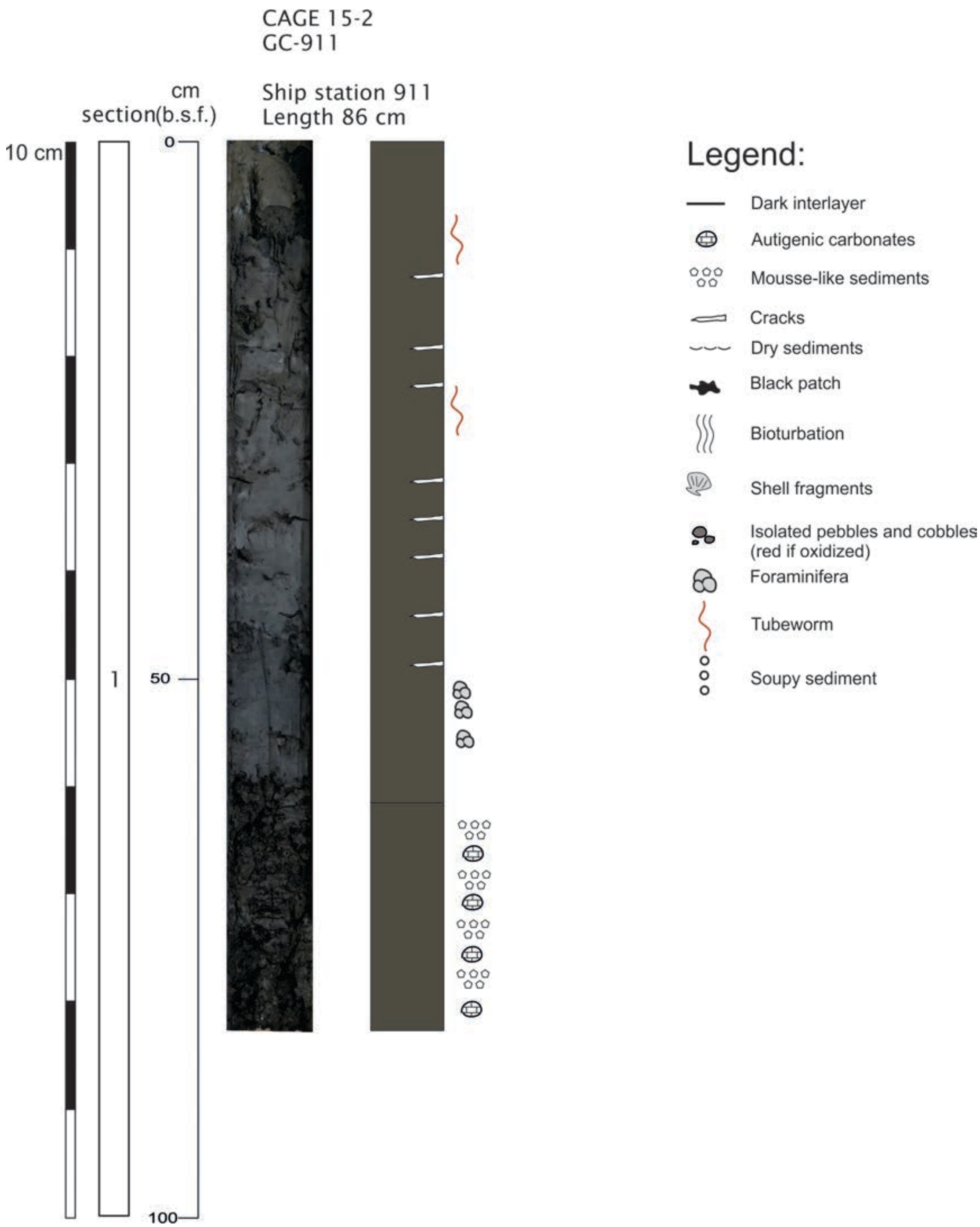
Vestnesa	892	CAGE 15-2 HH 892TC	1	07900.047N	00655.335E
Vestnesa	892	CAGE 15-2 HH 892TC	2	07900.096N	00655.370E
Vestnesa	892	CAGE 15-2 HH 892TC	3	07900.127N	00655.387E
Vestnesa	892	CAGE 15-2 HH 892TC	4	07900.199N	00655.448E
Vestnesa	892	CAGE 15-2 HH 892TC	5	07900.199N	00655.440E
Vestnesa	892	CAGE 15-2 HH 892TC	6	07900.197N	00655.438E
Vestnesa	894	CAGE 15-2 HH 894TC	1	07900.054N	00655.499E
Vestnesa	894	CAGE 15-2 HH 894TC	3	07900.185N	00655.436E
Vestnesa	894	CAGE 15-2 HH 894TC	5	07900.191N	00655.483E
Vestnesa	894	CAGE 15-2 HH 894TC	6	07900.191N	00655.483E
Vestnesa	897	CAGE 15-2 HH 897TC	1	07900.151N	00655.351E
Pingo area	904	CAGE 15-2 HH 904TC	1	07606.381N	01557.684E
Pingo area	904	CAGE 15-2 HH 904TC	2	07606.398N	01557.767E
Pingo area	904	CAGE 15-2 HH 904TC	3	07606.405N	01557.858E
Pingo area	904	CAGE 15-2 HH 904TC	4	07606.421N	01557.960E
Pingo area	904	CAGE 15-2 HH 904TC	5	07606.421N	01558.100E
Pingo area	904	CAGE 15-2 HH 904TC	6	07606.423N	01558.060E
Pingo area	905	CAGE 15-2 HH 905TC	1	07606.433N	01558.045E
Pingo area	905	CAGE 15-2 HH 905TC	2	07606.428N	01558.125E
Pingo area	905	CAGE 15-2 HH 905TC	3	07606.422N	01558.069E
Pingo area	905	CAGE 15-2 HH 905TC	4	07606.418N	01558.059E
Pingo area	907	CAGE 15-2 HH 907TC	1	07606.400N	01558.016E
Pingo area	907	CAGE 15-2 HH 907TC	2	07606.417N	01558.100E
Pingo area	907	CAGE 15-2 HH 907TC	3	07606.399N	01558.143E
Pingo area	907	CAGE 15-2 HH 907TC	4	07606.411N	01558.100E
Pingo area	907	CAGE 15-2 HH 907TC	5	07606.430N	01558.100E
Pingo area	916	CAGE 15-2 HH 916TC	1	07606.345N	01601.840E
Pingo area	916	CAGE 15-2 HH 916TC	2	07606.360N	01601.810E
Pingo area	916	CAGE 15-2 HH 916TC	3	07606.330N	01601.830E

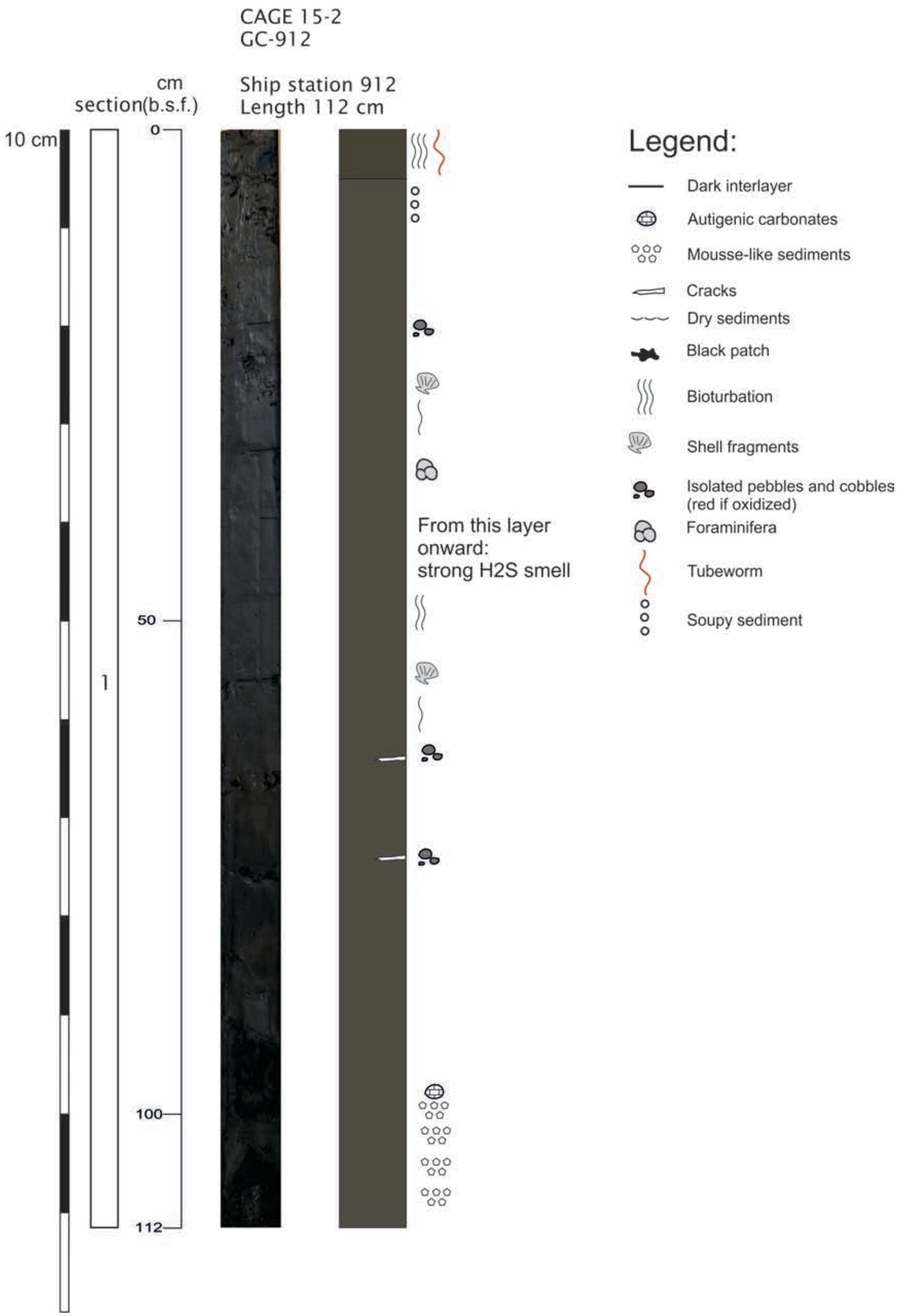
Pingo area	916	CAGE 15-2 HH 916TC	4	07606.291N	01601.966E
Pingo area	916	CAGE 15-2 HH 916TC	5	07606.337N	01601.978E
Pingo area	916	CAGE 15-2 HH 916TC	6	07606.342N	01601.970E
Storfjordrenna (SR1)	924	CAGE 15-2 HH 924TC	1	07550.497N	01637.456E
Storfjordrenna (SR1)	924	CAGE 15-2 HH 924TC	2	07550.326N	01637.640E
Storfjordrenna (SR1)	924	CAGE 15-2 HH 924TC	3	07550.340N	01637.700E
Storfjordrenna (SR1)	924	CAGE 15-2 HH 924TC	4	07550.349N	01637.860E
Pingo-area	932	CAGE 15-2 HH 932TC	1	07606.410N	01558.010E
Pingo-area	932	CAGE 15-2 HH 932TC	2	07606.439N	01558.041E
Pingo-area	932	CAGE 15-2 HH 932TC	3	07606.434N	01558.022E
Pingo-area	932	CAGE 15-2 HH 932TC	5	07606.423N	01558.020E
Pingo-area	932	CAGE 15-2 HH 932TC	6	07606.430N	01557.980E
	937	CAGE 15-2 HH 937TC	1	07606.336N	01602.210E
	937	CAGE 15-2 HH 937TC	2	07606.840N	01600.234E
	937	CAGE 15-2 HH 937TC	3	07606.854N	01600.221E
	937	CAGE 15-2 HH 937TC	4	07606.427N	01558.090E
	944	CAGE 15-2 HH 944TC	1	07454.745N	02731.590E
	944	CAGE 15-2 HH 944TC	2	07454.928N	02732.250E
	944	CAGE 15-2 HH 944TC	3	07455.200N	26 33.256E
	944	CAGE 15-2 HH 944TC	4	07455.298N	02733.604E
	944	CAGE 15-2 HH 944TC	5	07455.367N	02733.840E
	944	CAGE 15-2 HH 944TC	6	07454.930N	02735.021E
	959	CAGE 15-2 HH 959TC	1	07455.064N	02735.881E
	961	CAGE 15-2 HH 961TC	1	07455.292N	02731.949E
	961	CAGE 15-2 HH 961TC	2	77 55.447N	02732.500E
	961	CAGE 15-2 HH 961TC	3	07455.449N	02732.530E
	961	CAGE 15-2 HH 961TC	4	07455.425N	02732.440E

Lithological log



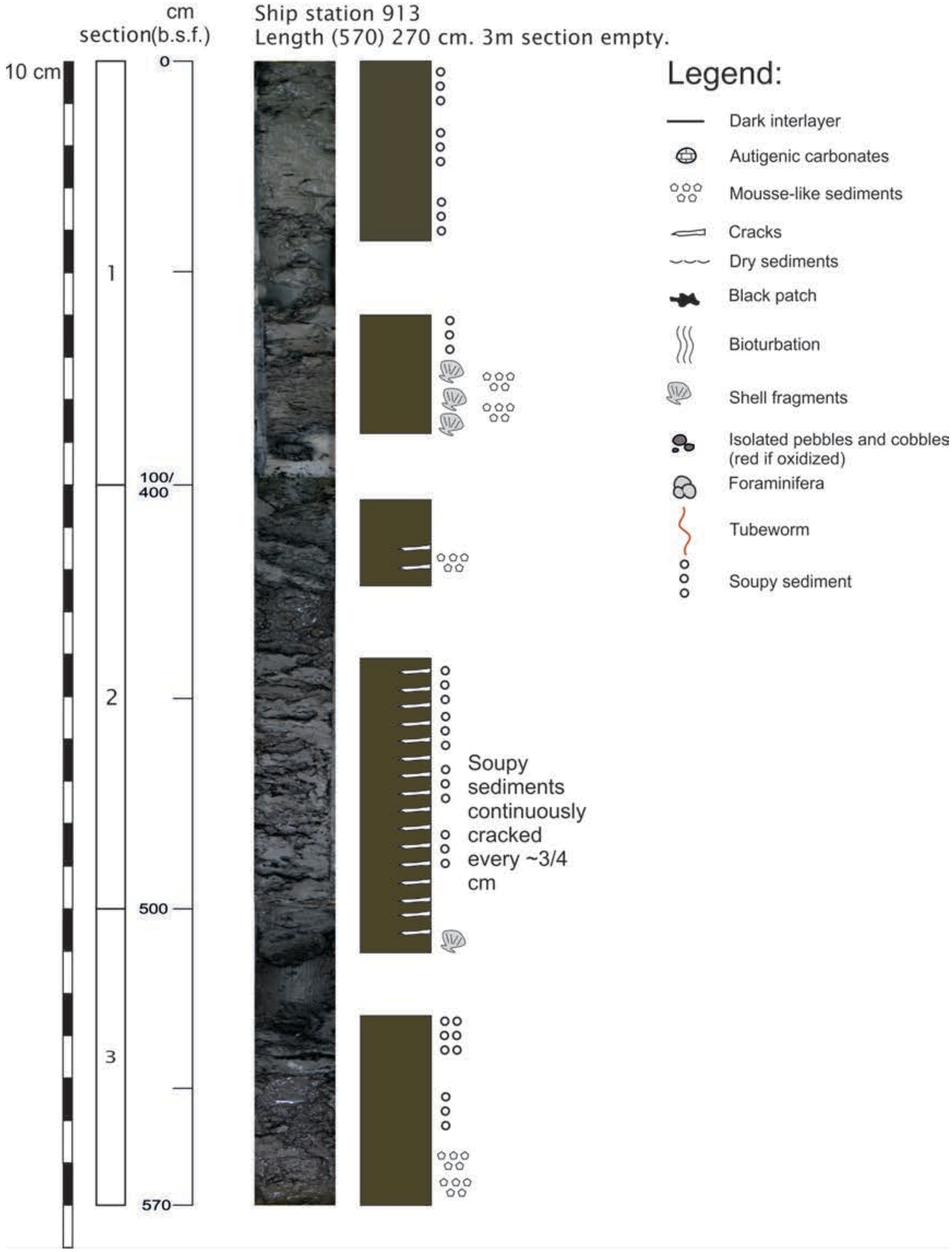

CAGE 15-2
GC-890
Ship station 890
Length 521 cm
cm
section(b.s.f.)
10 cm
10
1
2
3
4
5
0
50
100
150
200
250
300
350
400
450
500
521
brownish-pinkish layer
Legend:
Dark interlayer
Autigenic carbonates
Mousse-like sediments
Cracks
Dry sediments
Black patch
Bioturbation
Shell fragments
Isolated pebbles and cobbles
(red if oxidized)
Foraminifera
Tubeworm
Soupy sediment

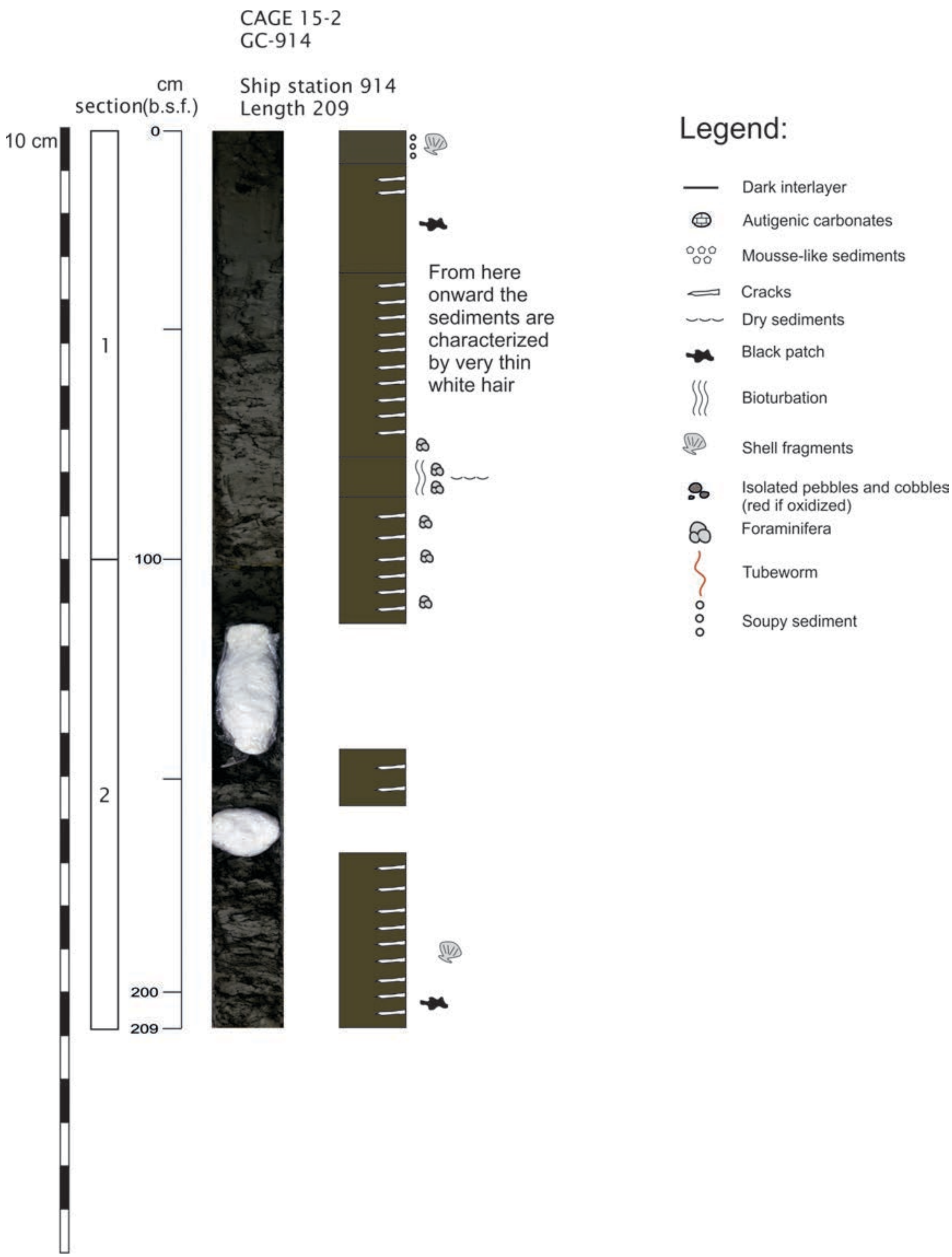

CAGE 15-2
GC-911
Ship station 911
Length 86 cm
cm
section(b.s.f.)
10 cm
0
50
100
1
Legend:
Dark interlayer
Autigenic carbonates
Mousse-like sediments
Cracks
Dry sediments
Black patch
Bioturbation
Shell fragments
Isolated pebbles and cobbles
(red if oxidized)
Foraminifera
Tubeworm
Soupy sediment

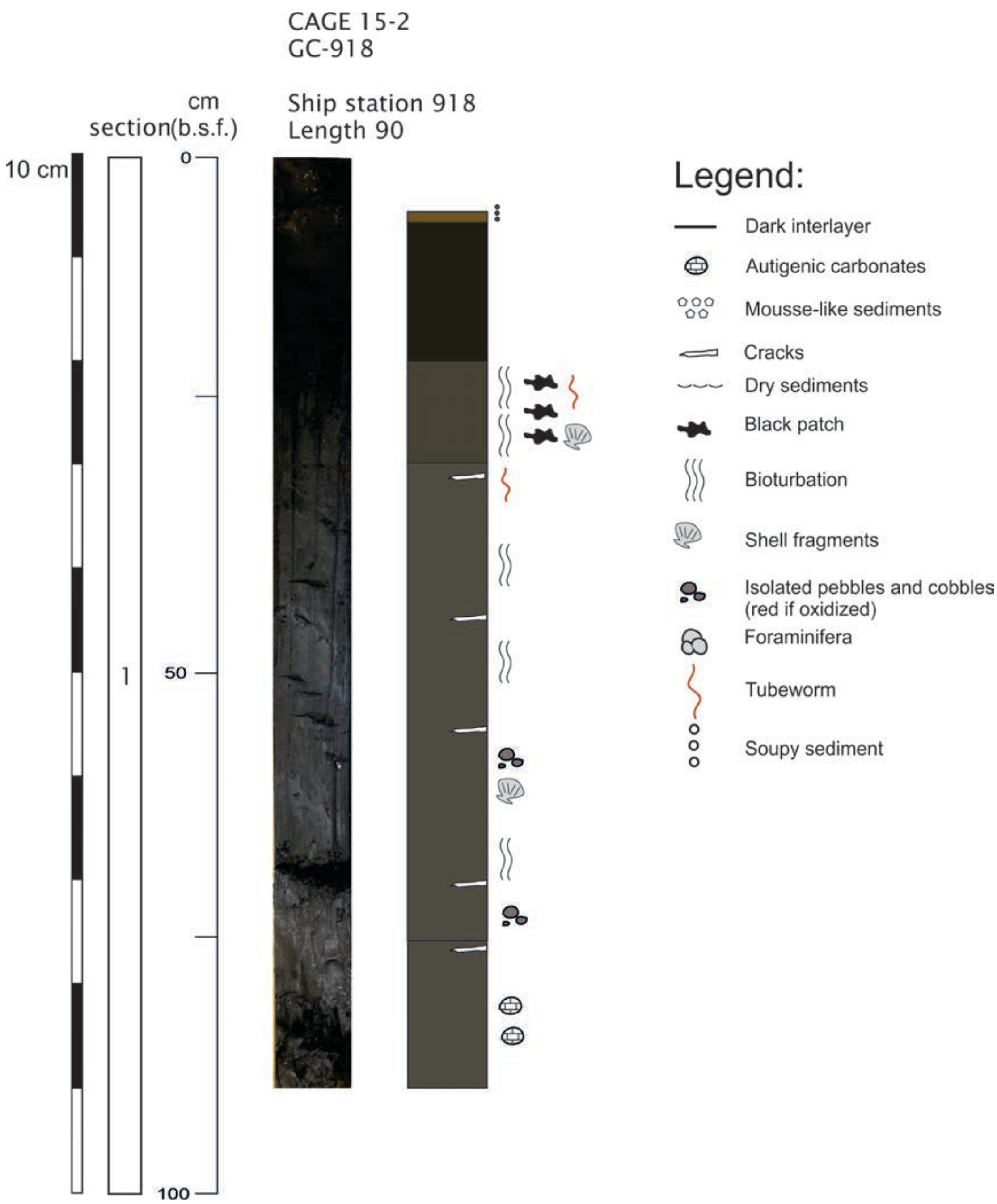

CAGE 15-2
GC-912
Ship station 912
Length 112 cm
cm
section(b.s.f.)
10 cm
0
50
100
112
1
From this layer onward: strong H2S smell
Legend:
Dark interlayer
Autigenic carbonates
Mousse-like sediments
Cracks
Dry sediments
Black patch
Bioturbation
Shell fragments
Isolated pebbles and cobbles (red if oxidized)
Foraminifera
Tubeworm
Soupy sediment

CAGE 15-2
GC-913

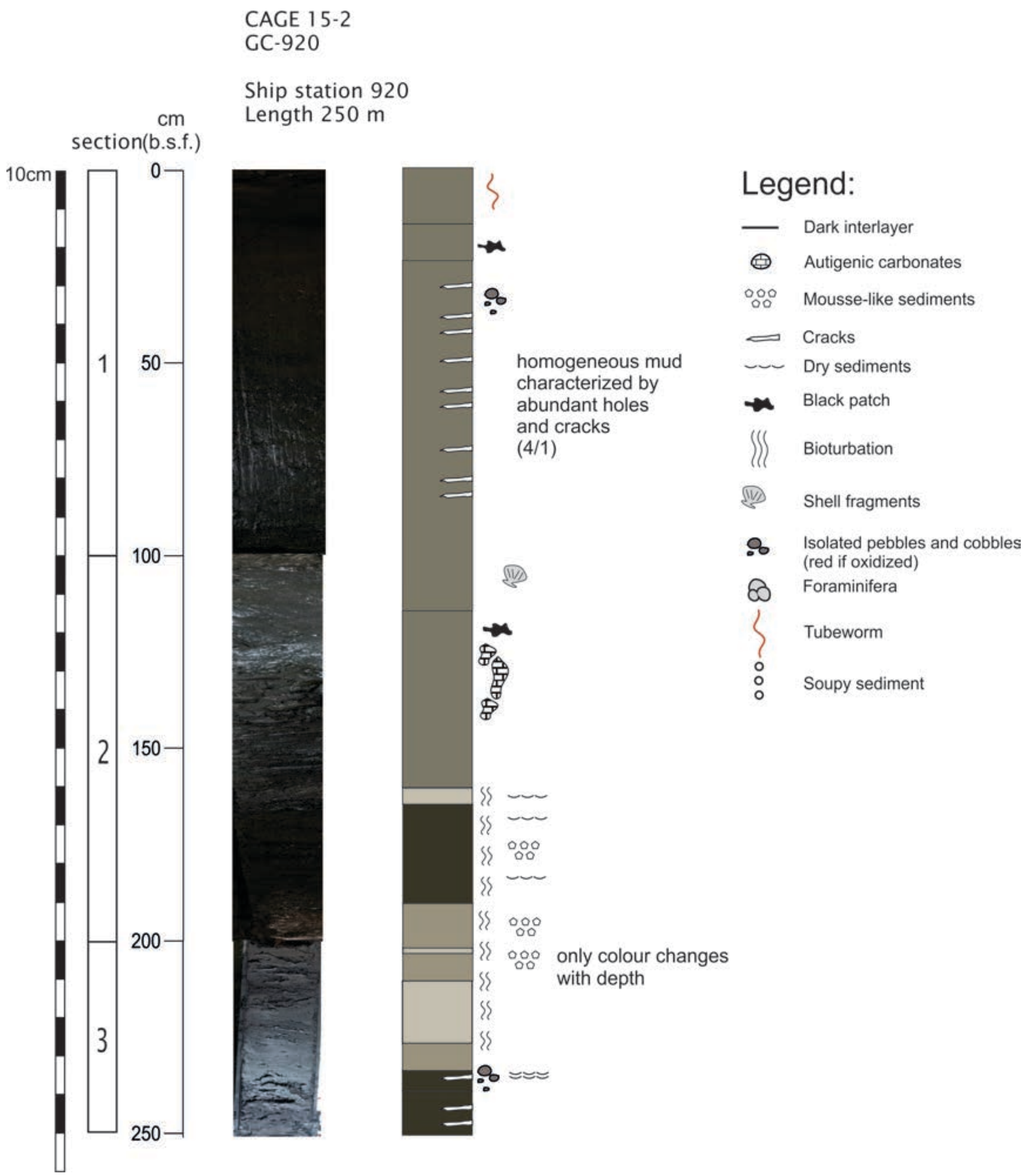
Ship station 913
Length (570) 270 cm. 3m section empty.




CAGE 15-2
GC-914
Ship station 914
Length 209
cm
section(b.s.f.)
10 cm
0
100
200
209
1
2
From here onward the sediments are characterized by very thin white hair
Legend:
Dark interlayer
Autigenic carbonates
Mousse-like sediments
Cracks
Dry sediments
Black patch
Bioturbation
Shell fragments
Isolated pebbles and cobbles (red if oxidized)
Foraminifera
Tubeworm
Soupy sediment

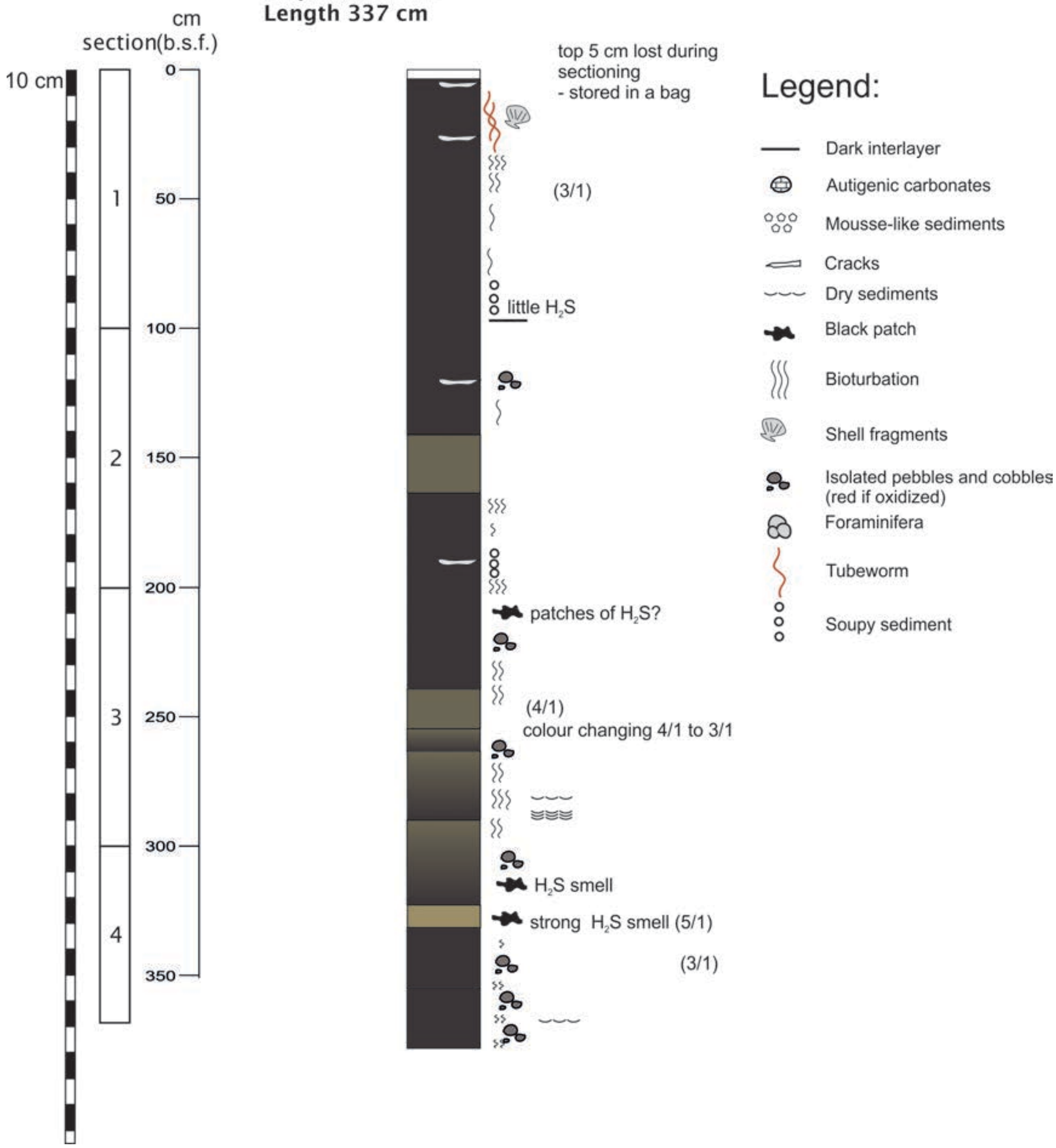


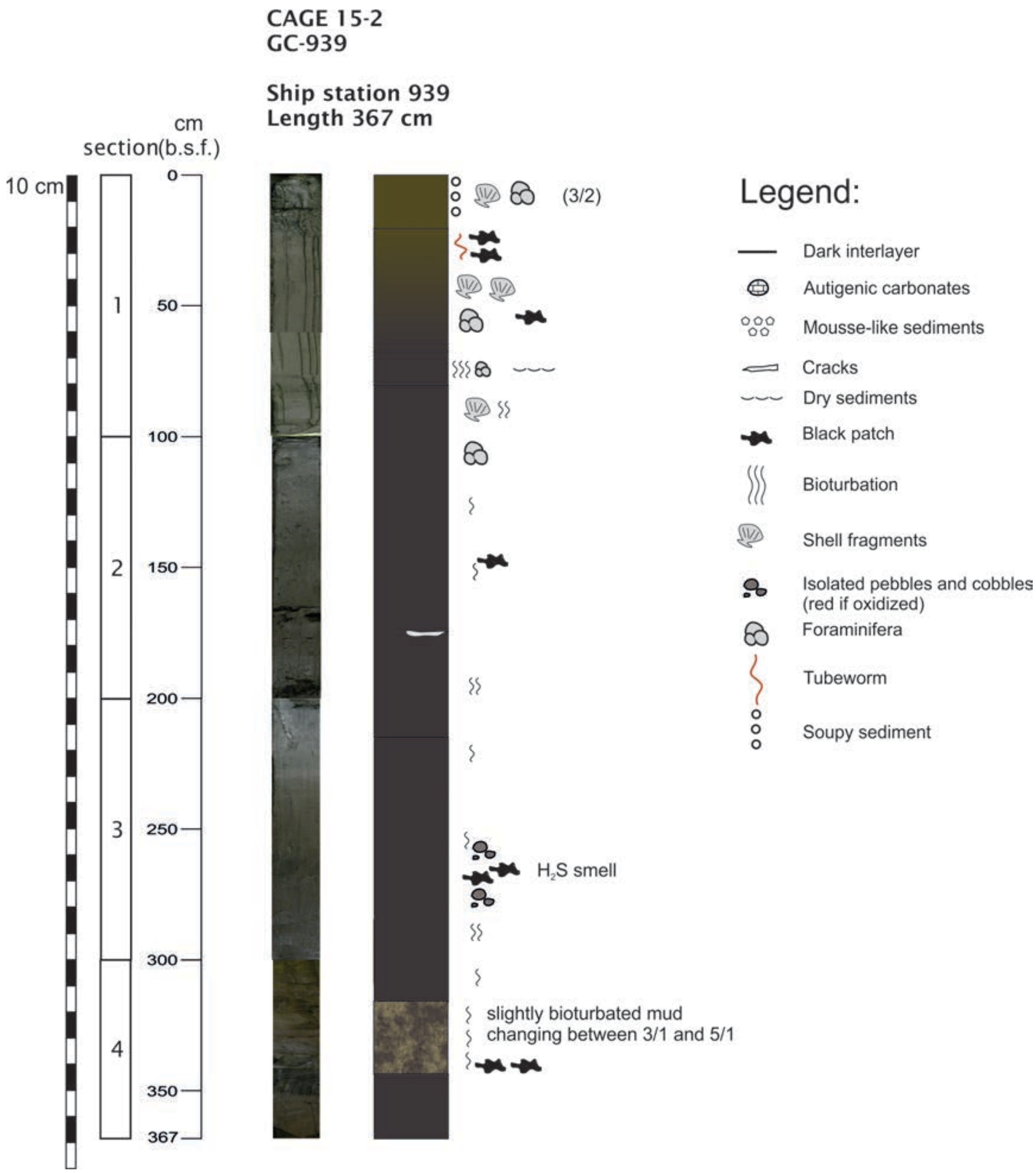
CAGE 15-2
GC-918
Ship station 918
Length 90
cm
section(b.s.f.)
10 cm
0
50
100
1
Legend:
Dark interlayer
Autigenic carbonates
Mousse-like sediments
Cracks
Dry sediments
Black patch
Bioturbation
Shell fragments
Isolated pebbles and cobbles
(red if oxidized)
Foraminifera
Tubeworm
Soupy sediment


CAGE 15-2
GC-920
Ship station 920
Length 250 m
cm
section(b.s.f.)
10cm
0
50
100
150
200
250
1
2
3
homogeneous mud characterized by abundant holes and cracks (4/1)
only colour changes with depth
Legend:
Dark interlayer
Autigenic carbonates
Mousse-like sediments
Cracks
Dry sediments
Black patch
Bioturbation
Shell fragments
Isolated pebbles and cobbles (red if oxidized)
Foraminifera
Tubeworm
Soupy sediment

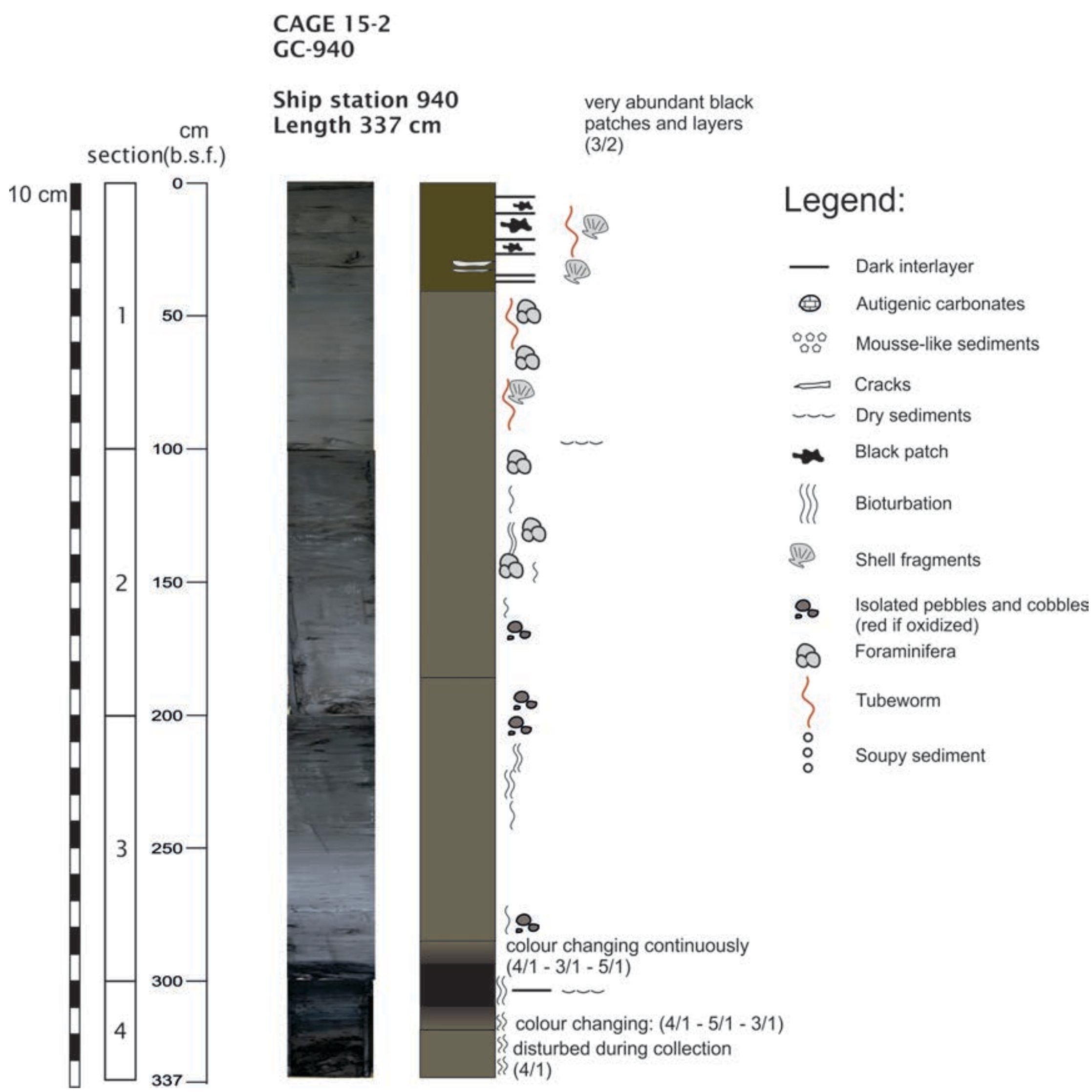
CAGE 15-2
GC-921

Ship station 921
Length 337 cm





CAGE 15-2
GC-939
Ship station 939
Length 367 cm
cm
section(b.s.f.)
10 cm
0
50
100
150
200
250
300
350
367
1
2
3
4
(3/2)
H2S smell
slightly bioturbated mud
changing between 3/1 and 5/1
Legend:
Dark interlayer
Autigenic carbonates
Mousse-like sediments
Cracks
Dry sediments
Black patch
Bioturbation
Shell fragments
Isolated pebbles and cobbles
(red if oxidized)
Foraminifera
Tubeworm
Soupy sediment


CAGE 15-2
GC-940
Ship station 940
Length 337 cm
cm
section(b.s.f.)
10 cm
0
50
100
150
200
250
300
337
1
2
3
4
very abundant black patches and layers (3/2)
colour changing continuously (4/1 - 3/1 - 5/1)
colour changing: (4/1 - 5/1 - 3/1)
disturbed during collection
(4/1)
Legend:
Dark interlayer
Autigenic carbonates
Mousse-like sediments
Cracks
Dry sediments
Black patch
Bioturbation
Shell fragments
Isolated pebbles and cobbles (red if oxidized)
Foraminifera
Tubeworm
Soupy sediment

Stasjonslapper på HELMER HANSSEN (Logg fra år 2015 og utover)

Vis valgte stasjoner

Temp (°C) Wind	(UTC)	(UTC)	Logg (nm)	Stasjonstype	StNr	Kommentar	Speed	Latitude	Longitude	Depth (m)	Water Temp (°C)	Wind Speed (m/s)	Humidity (%)	Wind dir (deg)	Sea	Weather	Clouds	Ice	Spredning
Speed	16/05/15	07:09:50	6956.60	CTD uten vann START	849		01-Feb	7833.907082 N	01011.310292 E	77.61	0.8	Sep-71	89	235	0	1	5	0	191.00
(m/s) Humidity	16/05/15	07:16:21	6956.72	CTD uten vann STOPP	849		0.6	7833.995749 N	01011.678022 E	83.15	0.8	Jul-31	91	224	0	1	5	0	-18.25
(%) Wind	17/05/15	06:27:12	7059.44	Foto START	850		0.9	7834.734139 N	01008.256400 E	85.60	01-Mar	02-Dec	83	68	0	1	5	0	145.06
dir	17/05/15	06:27:27	7059.45	Foto STOPP	850		0.7	7834.737348 N	01008.252288 E	85.18	01-Mar	Feb-21	83	50	0	1	5	0	145.06
Clouds Ice Trål-Kode Quantity Trål-Nr Trål-Se	17/05/15	07:37:59	7061.42	Foto START	851		0.6	7833.439894 N	01010.226495 E	88.57	01-Feb	Jun-14	83	10	0	1	5	0	-6.94
dyp Spredning Åpning	17/05/15	13:48:12	7065.52	Foto STOPP	851		0.6	7834.108924 N	01008.031492 E	87.40	02-Jun	May-78	74	6	0	1	5	0	312.06
nn START 849 1.2 7833.907082 N 01011.3	17/05/15	14:27:12	7066.39	CTD uten vann START	852		0.1	7834.085772 N	01007.364995 E	82.42	02-Feb	Apr-80	74	12	0	1	5	0	210.81
nn STOPP 849 0.6 7833.995749 N 01011.6	17/05/15	14:37:20	7066.53	CTD uten vann STOPP	852		0.2	7834.093521 N	01007.515896 E	82.83	02-Jul	May-63	74	10	0	1	5	0	-10.81
TART 850 0.9 7834.734139 N 01008.25640	17/05/15	14:37:31	7066.53	Grabb START	853		0.3	7834.093095 N	01007.517995 E	83.01	02-Jul	May-34	74	5	0	1	5	0	-10.81
TOPP 850 0.7 7834.737348 N 01008.25228	17/05/15	14:45:53	7066.60	Grabb STOPP	853		01-Mar	7834.042984 N	01007.308409 E	82.48	02-May	May-22	75	1	0	1	5	0	-17.81
START 851 0.6 7833.439894 N 01010.2264	17/05/15	14:52:57	7066.71	Grabb START	854		0.4	7834.095534 N	01007.436804 E	82.48	02-Aug	Apr-70	74	351	0	1	5	0	-21.69
STOPP 851 0.6 7834.108924 N 01008.0314	17/05/15	15:03:50	7066.77	Grabb STOPP	854		0.2	7834.113652 N	01007.533983 E	83.23	02-Jun	May-85	73	350	0	1	5	0	82.63
ann START 852 0.1 7834.085772 N 01007.3	17/05/15	15:03:56	7066.77	Grabb START	855		0.1	7834.113771 N	01007.534719 E	83.07	02-Jun	May-69	73	351	0	1	5	0	82.63
ann STOPP 852 0.2 7834.093521 N 01007.5	17/05/15	15:05:34	7066.78	Grabb STOPP	855		0.4	7834.111908 N	01007.550225 E	83.26	02-Jul	Apr-52	75	342	0	1	5	0	57.44
START 853 0.3 7834.093095 N 01007.5179	17/05/15	15:08:37	7066.80	Grabb START	856		0.4	7834.094680 N	01007.559644 E	83.93	02-Jul	May-43	76	9	0	1	5	0	
STOPP 853 1.3 7834.042984 N 01007.3084	17/05/15	15:12:15	7066.81	Grabb STOPP	856		0.5	7834.095418 N	01007.513087 E	82.95	02-Aug	Apr-72	76	355	0	1	5	0	-8.94
TART 854 0.4 7834.095534 N 01007.4368	17/05/15	15:13:54	7066.82	Grabb START	857		0.1	7834.093899 N	01007.513323 E	83.03	02-Jul	May-30	77	10	0	1	5	0	31.88
TOPP 854 0.2 7834.113652 N 01007.5339	17/05/15	15:18:31	7066.83	Grabb STOPP	857		0.3	7834.095759 N	01007.516058 E	83.20	02-Aug	Apr-87	78	353	0	1	5	0	37.88
TART 855 0.1 7834.113771 N 01007.5347	17/05/15	15:20:44	7066.83	Grabb START	858		0.2	7834.099311 N	01007.526184 E	83.16	02-Aug	Apr-51	78	355	0	1	5	0	-16.81
TOPP 855 0.4 7834.111908 N 01007.5502	17/05/15	15:24:41	7066.85	Grabb STOPP	858		0.3	7834.102835 N	01007.521662 E	82.96	02-Jul	05-Jun	78	26	0	1	5	0	285.69
bb START 856 0.4 7834.094680 N 01007.5	17/05/15	15:34:20	7066.90	Grabb START	859		0.4	7834.107443 N	01007.447398 E	81.73	02-Aug	05-Nov	78	9	0	1	5	0	209.56
STOPP 856 0.5 7834.095418 N 01007.5130	17/05/15	16:01:43	7067.08	Grabb STOPP	859		0.8	7834.068661 N	01007.656831 E	85.89	02-Aug	Apr-84	76	354	0	1	5	0	223.00
START 857 0.1 7834.093899 N 01007.5133	17/05/15	17:19:44	7068.58	CTD med vannhenter S	860		0.1	7833.675163 N	01008.557475 E	85.02	2.0	Apr-93	76	11	0	1	5	0	
TOPP 857 0.3 7834.095759 N 01007.5160	17/05/15	17:37:25	7068.65	CTD med vannhenter S	860		0.3	7833.696073 N	01008.607578 E	84.01	02-Aug	May-27	77	21	0	1	5	0	30.13
TART 858 0.2 7834.099311 N 01007.52618	17/05/15	18:56:53	7070.28	Multicorer START	861		0.5	7834.443965 N	01010.588243 E	88.05	01-Aug	Mar-83	71	65	0	1	5	0	160.13
TOPP 858 0.3 7834.102835 N 01007.5216	17/05/15	19:52:55	7070.89	Multicorer STOPP	861		01-Apr	7834.501226 N	01010.815292 E	91.88	01-Mar	Mar-76	74	82	0	1	5	0	76.13
START 859 0.4 7834.107443 N 01007.4473	17/05/15	20:18:05	7071.12	Multicorer START	862		0.3	7834.446976 N	01010.540746 E	88.30	01-Aug	Jan-75	71	64	0	1	5	0	-0.81
TOPP 859 0.8 7834.068661 N 01007.6568	17/05/15	20:24:05	7071.14	Multicorer STOPP	862		0.7	7834.454124 N	01010.533427 E	88.65	01-Jul	02-Oct	70	57	0	1	5	0	207.25
nnhenter START 860 0.1 7833.675163 N 0	17/05/15	21:05:53	7072.09	Grabb START	863		0.4	7834.453839 N	01010.536654 E	88.53	01-Jan	Mar-27	68	35	0	1	5	0	137.75
henter STOPP 860 0.3 7833.696073 N 010	17/05/15	21:07:15	7072.10	Grabb STOPP	863		0.4	7834.453053 N	01010.590061 E	89.04	01-Feb	Mar-19	68	52	0	1	5	0	Nov-19
r START 861 0.5 7834.443965 N 01010.58	17/05/15	21:17:43	7072.22	Grabb START	864		0.3	7834.463264 N	01010.484132 E	88.33	01-May	Apr-59	68	19	0	1	5	0	98.38
er STOPP 861 1.4 7834.501226 N 01010.81	17/05/15	21:25:32	7072.26	Grabb STOPP	864		0.2	7834.424631 N	01010.595481 E	88.92	01-Jul	Jun-48	68	24	0	1	5	0	Feb-88
er START 862 0.3 7834.446976 N 01010.54	17/05/15	21:26:16	7072.27	Grabb START	865		0.3	7834.421768 N	01010.604916 E	89.20	01-Jul	06-May	69	24	0	1	5	0	Feb-88
r STOPP 862 0.7 7834.454124 N 01010.53	17/05/15	21:26:54	7072.27	Grabb STOPP	865		0.1	7834.419457 N	01010.610186 E	89.58	01-Jun	Jun-44	69	26	0	1	5	0	238.00
START 863 0.4 7834.453839 N 01010.5366	17/05/15	21:34:14	7072.33	Grabb START	866		0.2	7834.450889 N	01010.616670 E	88.89	01-Apr	May-55	70	27	0	1	5	0	
STOPP 863 0.4 7834.453053 N 01010.5900	17/05/15	21:42:22	7072.37	Grabb STOPP	866		0.4	7834.443987 N	01010.528285 E	88.81	01-Mar	Jun-58	70	13	0	1	5	0	
START 864 0.3 7834.463264 N 01010.4841	17/05/15	21:45:23	7072.38	Grabb START	867		0.3	7834.449901 N	01010.558827 E	89.03	01-May	06-Jul	72	7	0	1	5	0	114.00
STOPP 864 0.2 7834.424631 N 01010.595	17/05/15	21:52:39	7072.44	Grabb STOPP	867		0.1	7834.445889 N	01010.591590 E	89.10	01-May	Jun-50	71	19	0	1	5	0	Jan-13
START 865 0.3 7834.421768 N 01010.6049	17/05/15	21:59:24	7072.46	Grabb START	868		0.5	7834.442890 N	01010.620435 E	89.35	01-Aug	May-84	71	20	0	1	5	0	82.31
TOPP 865 0.1 7834.419457 N 01010.6101	17/05/15	22:03:06	7072.50	Grabb STOPP	868		0.3	7834.447895 N	01010.590361 E	88.99	01-Sep	05-Jan	71	16	0	1	5	0	35.94
bb START 866 0.2 7834.450889 N 01010.61	17/05/15	22:07:15	7072.54	Grabb START	869		0.7	7834.442155 N	01010.563755 E	88.93	01-Aug	May-59	71	24	0	1	5	0	313.44
bb STOPP 866 0.4 7834.443987 N 01010.52	17/05/15	22:08:01	7072.54	Grabb STOPP	869		0.6	7834.449128 N	01010.557654 E	88.45	01-Aug	May-87	71	21	0	1	5	0	313.13
START 867 0.3 7834.449901 N 01010.5588	17/05/15	22:13:50	7072.58	Grabb START	870		0.6	7834.442370 N	01010.485782 E	88.86	01-Aug	05-Feb	71	21	0	1	5	0	212.38
STOPP 867 0.1 7834.445889 N 01010.591	17/05/15	22:22:39	7072.71	Grabb STOPP	870		0.9	7834.544109 N	01010.164586 E	89.74	01-Apr	Apr-18	71	17	0	1	5	0	272.69
START 868 0.5 7834.442890 N 01010.6204	17/05/15	23:05:05	7074.08	Multicorer START	871		1.0	7833.440848 N	01009.720266 E	92.92	01-Sep	Apr-25	70	41	0	1	5	0	
STOPP 868 0.3 7834.447895 N 01010.5903	17/05/15	23:16:54	7074.17	Multicorer STOPP	871		01-Feb	7833.490467 N	01009.583178 E	91.05	02-Feb	Mar-99	71	23	0	1	5	0	
TART 869 0.7 7834.442155 N 01010.5637	17/05/15	23:55:54	7074.64	Multicorer START	872		0.2	7833.463006 N	01009.793422 E	90.83	2.0	Feb-36	69	25	0	1	5	0	
TOPP 869 0.6 7834.449128 N 01010.5576	18/05/15	00:57:46	7075.15	Multicorer STOPP	872		1.0	7833.459211 N	01008.791196 E	97.46	2.0	Feb-41	69	63	0	1	5	0	177.06
TART 870 0.6 7834.442370 N 01010.4857	18/05/15	01:47:57	7076.05	Multicorer START	873		0.7	7833.551081 N	01009.459864 E	88.14	02-Apr	Feb-15	68	44	0	1	5	0	21.31
TOPP 870 0.9 7834.544109 N 01010.1645	18/05/15	01:48:44	7076.06	Multicorer STOPP	873		0.8	7833.553535 N	01009.417848 E	87.49	02-Mar	Feb-51	67	57	0	1	5	0	21.31
orer START 871 1.0 7833.440848 N 01009.	18/05/15	04:41:17	7088.11	Foto START	874		0.6	7839.206629 N	00927.531451 E	237.24	04-May	Apr-26	68	56	0	1	5	0	211.00
orer STOPP 871 1.2 7833.490467 N 01009.	18/05/15	09:12:39	7097.07	Foto STOPP	874		09-Apr	7840.127102 N	00850.548625 E	0.00	04-Sep	May-60	66	132	0	1	5	0	
orer START 872 0.2 7833.463006 N 01009.	18/05/15	13:31:30	7119.64	CTD med vannhenter S	875		0.1	7841.513131 N	00815.541604 E	880.96	04-Apr	Apr-97	66	189	0	1	5	0	
r STOPP 872 1.0 7833.459211 N 01008.79	18/05/15	15:17:52	7121.99	CTD med vannhenter S	875		01-Mar	7841.496321 N	00816.038253 E	880.63	04-Jun	Apr-43	85	174	0	1	5	0	
er START 873 0.7 7833.551081 N 01009.45	18/05/15	15:27:22	7122.17	CTD med vannhenter S	876		0.7	7841.328024 N	00816.294741 E	881.79	04-May	Mar-97	83	140	0	1	5	0	
er STOPP 873 0.8 7833.553535 N 01009.41	18/05/15	16:29:36	7122.68	CTD med vannhenter S	876		0.3	7841.436067 N	00816.320199 E	879.26	04-Jun	May-19	77	231	0	1	5	0	
TART 874 0.6 7839.206629 N 00927.53145	18/05/15	17:05:53	7123.26	Gravity core (GC)	877		0.3	7841.311414 N	00816.317842 E	879.85	04-Jun	Sep-72	76	265	0	1	5	0	
o STOPP 874 9.4 7840.127102 N 00850.54	18/05/15	18:40:09	7123.97	Gravity core (GC)	878		0.6	7841.305931 N	00815.847787 E	889.70	04-Jul	09-Mar	77	274	0	1	5	0	
nhenter START 875 0.1 7841.513131 N 00	18/05/15	18:40:14	7123.97	Gravity core (GC)	879		0.5	7841.306000 N	00815.847655 E	889.32	04-Jul	Aug-20	77	272	0	1	5	0	
nhenter STOPP 875 1.3 7841.496321 N 00	18/05/15	20:54:08	7128.09	Foto START	879		0.5	7841.789779 N	00815.657049 E	871.08	04-Jul	Mar-72	73	244	0	1	5	0	
nhenter START 876 0.7 7841.328024 N 00	19/05/15	01:16:14	7130.82	Foto STOPP	879		0.2	7841.446046 N	00814.297230 E	889.36	04-May	May-77	73	179	0	1	5	0	
nhenter STOPP 876 0.3 7841.436067 N 00	19/05/15	01:17:05	7130.82	Multicorer START	880		0.2	7841.447086 N	00814.281061 E	889.66	04-Apr	Jun-16	73	173	0	1	5	0	
core (GC) 877 0.3 7841.311414 N 00816.3	19/05/15	01:17:08	7130.82	Multicorer STOPP	880		0.3	7841.447289 N	00814.282242 E	889.28	04-Apr	Jun-79	73	168	0	1	5	0	
core (GC) 878 0.6 7841.305931 N 00815.8	19/05/15	08:37:52	7150.27	Foto START	881		0.7	7842.168844 N	00815.171838 E	885.10	04-Feb	11-Jan	79	180	0	1	5	0	
core (GC) 879 0.5 7841.306000 N 00815.8	19/05/15	10:31:48	7151.25	Foto STOPP	881		0.3	7841.317300 N	00815.819627 E	901.53	4.0	Jul-82	77	213	0	1	5	0	
START 879 0.5 7841.789779 N 00815.657	19/05/15	10:32:11	7151.26	Multicorer START	882		0.1	7841.317966 N	00815.818221 E	901.27	4.0	Sep-21	77	201	0	1	5	0	
STOPP 879 0.2 7841.446046 N 00814.297	19/05/15	10:32:15	7151.26	Multicorer STOPP	882		0.1	7841.317952 N	00815.816862 E	901.20	4.0	Aug-76	77	201	0	1	5	0	
rer START 880 0.2 7841.447086 N 00814.2	19/05/15	11:20:31	7151.36	Grabb START	883		0.3	7841.361131 N	00815.865057 E	900.38	04-Jan	Aug-92	78	202	0	1	5	0	
rer STOPP 880 0.3 7841.447289 N 00814.2	19/05/15	12:03:06	7151.61	Grabb STOPP	883		0.5	7841.364359 N	00815.847338 E	900.51	4.0	Sep-48	78	190	0	1	5	0	
START 881 0.7 7842.168844 N 00815.1718	19/05/15	13:01:31	7151.90	Multicorer START	884		0.2	7841.304950 N	00815.830057 E	902.24	04-Feb	08-Feb	77	210	0	1	5	0	
STOPP 881 0.3 7841.317300 N 00815.819	19/05/15	13:12:50	7151.95	Multicorer STOPP	884		0.3	7841.309816 N	00815.893416 E	901.61	04-Jan	09-Apr	78	197	0	1	5	0	
rer START 882 0.1 7841.317966 N 00815.8	19/05/15	22:26:10	7203.82	Foto START	885		0.8	7901.388000 N	00654.337325 E	1236.49	04-Feb	May-56	85	278	0	1	5	0	
rer STOPP 882 0.1 7841.317952 N 00815.8	20/05/15	00:43:22	7206.61	Foto STOPP	885		0.4	7900.381666 N	00654.038984 E	1201.72	04-Jan	Jul-30	86	280	0	1	5	0	
START 883 0.3 7841.361131 N 00815.865	20/05/15	00:43:39	7206.61	Multicorer START	886		0.6	7900.380961 N	00654.050902 E	1201.75	04-Feb	Jun-73	86	280	0	1	5	0	
STOPP 883 0.5 7841.364359 N 00815.847	20/05/15	00:43:43	7206.61	Multicorer STOPP	886		0.5	7900.380646 N	00654.053877 E	1201.50	04-Feb	06-Mar	86	280	0	1	5	0	
rer START 884 0.2 7841.304950 N 00815.8	20/05/15	03:31:49	7208.68	Foto START	887		0.4	7900.290219 N	00654.784749 E	1197.77	4.0	May-14	81	277	0	1	5	0	
rer STOPP 884 0.3 7841.309816 N 00815.8	20/05/15	05:24:57	7209.79	Foto STOPP	887		0.7	7900.461783 N	00654.148861 E	1203.74	4.0	May-72	82	311	0	1	5	0	
START 885 0.8 7901.388000 N 00654.3373	20/05/15	05:25:33	7209.79	Multicorer START	888		0.1	7900.464005 N	00654.145714 E	1203.71	04-Jan	May-25	82	306	0	1	5	0	
STOPP 885 0.4 7900.381666 N 00654.0389	20/05/15	05:25:39	7209.79	Multicorer STOPP	888		0.4	7900.464347 N	00654.145883 E	1203.72	04-Jan	May-37	82	315	0	1	5	0	
rer START 886 0.6 7900.380961 N 00654.0	20/05/15	06:40:43	7211.16	CTD med vannhenter S	889		0.6	7900.390106 N	00654.002791 E	1188.77	04-Jan	Mar-80	79	299	0	1	5	0	
rer STOPP 886 0.5 7900.380646 N 00654.0	20/05/15	07:26:44	7211.80	CTD med vannhenter S	889		1.0	7859.875224 N	00654.997291 E	1197.58	04-Feb	05-Sep	81	312	0	1	5	0	
START 887 0.4 7900.290219 N 00654.7847	20/05/15	08:14:59	7212.70	Gravity core (GC)	890		0.3	7900.338434 N	00654.074766 E	1199.54	4.0	Jun-20	78	333	0	1	5	0	
STOPP 887 0.7 7900.461783 N 00654.1488	20/05/15	10:51:02	7214.61	Gravity core (GC)	891		0.3	7900.390234 N	00653.896663 E	1200.74	04-Jan	Aug-70	90	353	0	1	5	0	-26.75
rer START 888 0.1 7900.464005 N 00654.1	20/05/15	13:46:35	7217.14	Foto START	892		0.4	7859.573040 N	00654.937830 E	1210.25	04-Jan	Sep-38	91	25	0	1	5	0	
rer STOPP 888 0.4 7900.464347 N 00654.1	20/05/15	15:26:01	7217.91	Foto STOPP	892		0.1	7900.188348 N	00655.441522 E	1203.64	04-Jan	Oct-89	90	13	0	1	5	0	
nhenter START 889 0.6 7900.390106 N 006	20/05/15	15:26:15	7217.91	Multicorer START	893		0.1	7900.188152 N	00655.440975 E	1203.46	04-Jan	Oct-26	89	2	0	1	5	0	
nhenter STOPP 889 1.0 7859.875224 N 006	20/05/15	15:26:20	7217.91	Multicorer STOPP	893		0.2	7900.187998 N	00655.440599 E	1203.41	04-Jan	Oct-98	89	7	0	1	5	0	
core (GC) 890 0.3 7900.338434 N 00654.07	20/05/15	18:10:27	7221.23	Foto START	894		0.2	7859.601131 N	00655.161137 E	1205.99	04-Feb	Aug-26	81	7	2	2	8	0	
e (GC) 891 0.3 7900.390234 N 00653.8966	20/05/15	20:29:44	7222.29	Foto STOPP	894		0.3	7900.178491 N	00655.444929 E	1201.90	04-Jan	Jun-72	83	349	2	2	8	0	
START 892 0.4 7859.573040 N 00654.9378	20/05/15	20:30:52	7222.29	Annen stasjon	895	Marker	0.5	7900.185969 N	00655.448825 E	1202.38	04-Jan	07-Jun	83	353	2	2	8	0	
STOPP 892 0.1 7900.188348 N 00655.4415	20/05/15	20:39:31	7222.33	Multicorer START	896	Marker	0.3	7900.192076 N	00655.438439 E	1202.65	04-Jan	Aug-30	83	347	2	2	8	0	
rer START 893 0.1 7900.188152 N 00655.4	20/05/15	20:40:25	7222.33	Multicorer STOPP	896	Marker	0.1	7900.193020 N	00655.441790 E	1202.53	04-Jan	Jun-64	84	340	2	2	8	0	
rer STOPP 893 0.2 7900.187998 N 00655.4	20/05/15	23:07:55	7225.20	Foto START	897	Marker	0.7	7859.707757 N	00656.541283 E	1196.37	4.0	Nov-29	94	347	2	2	8	0	
START 894 0.2 7859.601131 N 00655.161	21/05/15	01:29:12	7226.75	Foto STOPP	897	Marker	0.2	7900.656254 N	00654.988437 E	1208.42	4.0	14.91	95	356	2	2	8	0	
STOPP 894 0.3 7900.178491 N 00655.4449	21/05/15	02:57:51	7228.84	Trekantskrape START	898	Marker	0.6	7900.172844 N	00655.446706 E	1203.11	04-Feb	13.67	91	346	2	2	8	0	
sjon 895 Marker 0.5 7900.185969 N 00655.	21/05/15	03:14:50	7229.03	Trekantskrape STOPP	898	Marker	1.0	7900.317161 N	00655.436646 E	1201.29	04-Feb	13.99	93	355	2	2	8	0	
START 896 Marker 0.3 7900.192076 N 0065	22/05/15	06:48:17	7481.70	CTD uten vann START	899	Marker	01-Jun	7607.271174 N	01543.264447 E	372.72	0.0	Oct-45	73	305	2	2	8	0	202.38
STOPP 896 Marker 0.1 7900.193020 N 0065	22/05/15	06:59:54	7481.95	CTD uten vann STOPP	899	Marker	01-Jan	7607.203085 N	01544.273673 E	375.09	0.6	Oct-59	72	298	2	2	8	0	31.75
RT 897 Marker 0.7 7859.707757 N 00656.54	22/05/15	13:59:51	7508.49	CTD med vannhenter S	900		0.9	7606.887862 N	01600.289246 E	379.63	-0.3	Oct-54	90	258	2	2	8	0	
PP 897 Marker 0.2 7900.656254 N 00654.98	22/05/15	14:16:37	7508.64	CTD med vannhenter S	900		0.8	7606.834404 N	01600.478571 E	384.42	01-Jan	Sep-48	90	276	2	2	8	0	
START 898 Marker 0.6 7900.172844 N 006	22/05/15	14:51:43	7509.74	CTD med vannhenter S	901		01-Jan	7606.294762 N	01601.894792 E	384.02	0.5	Oct-43	88	266	2	2	8	0	
STOPP 898 Marker 1.0 7900.317161 N 006	22/05/15	15:10:06	7510.03	CTD med vannhenter S	901		01-Jan	7606.201408 N	01602.953665 E	386.97	0.4	Nov-70	88	266	2	2	8	0	16.94
TART 899 Marker 1.6 7607.271174 N 01543	22/05/15	16:01:41	7511.94	CTD med vannhenter S	902		0.3	7606.391125 N	01557.994577 E	380.72	-0.1	Jul-27	91	296	2	2	8	0	
TOPP 899 Marker 1.1 7607.203085 N 01544	22/05/15	16:19:41	7512.16	CTD med vannhenter S	902		01-Jan	7606.266509 N	01558.263637 E	386.18	0.7	May-70	88	284	2	2	8	0	
nhenter START 900 0.9 7606.887862 N 016	22/05/15	17:33:36	7514.50	Foto START	903		0.7	7606.529739 N	01553.134036 E	383.73	-0.8	Jun-42	88	305	2	2	8	0	184.69
nhenter STOPP 900 0.8 7606.834404 N 01	22/05/15	19:44:18	7516.06	Foto STOPP	903		0.2	7606.429375 N	01558.057852 E	377.93	0.9	10-Feb	87	281	2	2	8	0	
nhenter START 901 1.1 7606.294762 N 016	22/05/15	19:44:54	7516.06	Multicorer START	904		0.4	7606.428856 N	01558.073097 E	376.95	0.7	09-Jan	87	285	2	2	8	0	
enter STOPP 901 1.1 7606.201408 N 01602	22/05/15	21:09:10	7516.92	Multicorer STOPP	904		0.5	7606.422482 N	01558.692379 E	385.51	0.3	Aug-18	84	268	2	2	8	0	
nhenter START 902 0.3 7606.391125 N 01	22/05/15	21:09:53	7516.93	Foto START	905		0.7	7606.425904 N	01558.670363 E	386.13	0.3	Jul-90	84	271	2	2	8	0	
nhenter STOPP 902 1.1 7606.266509 N 01	22/05/15	22:16:25	7517.51	Foto STOPP	905		0.3	7606.421966 N	01558.063341 E	377.15	0.4	Mar-32	95	309	2	2	8	0	180.81
RT 903 0.7 7606.529739 N 01553.134036	22/05/15	22:16:57	7517.51	Trekantskrape START	906		0.3	7606.421077 N	01558.060817 E	377.52	0.4	Apr-42	95	294	2	2	8	0	179.94
STOPP 903 0.2 7606.429375 N 01558.0578	22/05/15	22:17:08	7517.51	Trekantskrape STOPP	906		0.2	7606.420851 N	01558.059758 E	376.64	0.4	Apr-26	95	302	2	2	8	0	179.94
rer START 904 0.4 7606.428856 N 01558.0	22/05/15	23:02:23	7518.25	Foto START	907		0.5	7606.389556 N	01558.413865 E	382.77	-0.9	Apr-58	92	315	2	2	8	0	
rer STOPP 904 0.5 7606.422482 N 01558.6	22/05/15	23:36:35	7518.54	Foto STOPP	907		0.2	7606.424640 N	01558.116504 E	0.00	-0.8	Jul-40	87	323	2	2	8	0	
START 905 0.7 7606.425904 N 01558.670	22/05/15	23:36:59	7518.54	Multicorer START	908		0.4	7606.423983 N	01558.124907 E	377.99	-0.8	Jun-35	87	321	2	2	8	0	
OPP 905 0.3 7606.421966 N 01558.063341	22/05/15	23:37:29	7518.55	Multicorer STOPP	908		0.9	7606.422074 N	01558.133649 E	317.52	-1.0	Jun-37	87	323	2	2	8	0	
e START 906 0.3 7606.421077 N 01558.06	23/05/15	00:47:15	7520.08	CTD med vannhenter S	909		0.6	7606.952250 N	01559.895876 E	384.97	-1.0	Jul-54	86	297	2	2	8	0	
e STOPP 906 0.2 7606.420851 N 01558.05	23/05/15	01:05:05	7520.23	CTD med vannhenter S	909		0.3	7606.861380 N	01600.341985 E	381.67	-0.9	05-Apr	82	292	2	2	8	0	
START 907 0.5 7606.389556 N 01558.4138	23/05/15	02:03:23	7521.31	CTD med vannhenter S	910		0.8	7606.579289 N	01604.322183 E	395.52	-0.7	Jun-79	92	313	2	2	8	0	
STOPP 907 0.2 7606.424640 N 01558.11	23/05/15	02:29:18	7521.75	CTD med vannhenter S	910		02-Aug	7606.243818 N	01604.373935 E	387.50	-0.7	Jul-27	94	312	2	2	8	0	
rer START 908 0.4 7606.423983 N 01558.1	23/05/15	03:22:30	7523.56	Gravity core (GC)	911		0.3	7606.415044 N	01558.062159 E	379.29	-1.1	Aug-74	82	307	2	2	8	0	
rer STOPP 908 0.9 7606.422074 N 01558.1	23/05/15	04:30:16	7524.63	Gravity core (GC)	912		0.2	7606.401695 N	01558.117381 E	379.60	-1.0	09-Jan	79	302	2	2	8	0	
nhenter START 909 0.6 7606.952250 N 01	23/05/15	05:36:17	7526.38	Gravity core (GC)	913		0.8	7606.909481 N	01600.147594 E	380.98	-1.0	May-60	81	319	2	2	8	0	
nhenter STOPP 909 0.3 7606.861380 N 01	23/05/15	06:44:40	7527.87	Gravity core (GC)	914		0.2	7606.342848 N	01602.097127 E	381.00	-1.2	May-31	80	325	2	2	8	0	
nhenter START 910 0.8 7606.579289 N 01	23/05/15	07:45:39	7529.45	Gravity core (GC)	915		0.6	7606.450018 N	01604.862715 E	395.72	-1.0	Mar-57	82	311	2	2	8	0	168.31
nhenter STOPP 910 2.8 7606.243818 N 01	23/05/15	13:25:10	7547.99	Foto START	916		01-Feb	7606.278892 N	01602.024105 E	385.30	-0.8	Apr-17	91	38	2	2	8	0	
core (GC) 911 0.3 7606.415044 N 01558.0	23/05/15	14:45:06	7548.92	Foto STOPP	916		0.1	7606.366420 N	01602.071583 E	382.98	-0.9	Apr-70	89	50	2	2	8	0	
core (GC) 912 0.2 7606.401695 N 01558.1	23/05/15	14:45:38	7548.92	Multicorer START	917		0.1	7606.367599 N	01602.071744 E	383.08	-0.8	Apr-86	89	43	2	2	8	0	
core (GC) 913 0.8 7606.909481 N 01600.1	23/05/15	14:45:40	7548.92	Multicorer STOPP	917		0.2	7606.367698 N	01602.071623 E	383.25	-0.8	Apr-93	89	42	2	2	8	0	
core (GC) 914 0.2 7606.342848 N 01602.0	23/05/15	16:51:37	7551.35	Gravity core (GC)	918		0.6	7607.007951 N	01602.631401 E	371.03	-0.7	Jun-33	88	38	2	2	8	0	
e (GC) 915 0.6 7606.450018 N 01604.8627	23/05/15	17:38:19	7552.34	Gravity core (GC)	919		0.5	7607.007804 N	01602.635481 E	370.53	0.0	Jun-16	89	44	2	2	8	0	
START 916 1.2 7606.278892 N 01602.024	23/05/15	18:26:41	7553.39	Gravity core (GC)	920		0.4	7606.699755 N	01600.648939 E	386.38	-0.4	May-75	90	40	2	2	8	0	78.13
STOPP 916 0.1 7606.366420 N 01602.071	23/05/15	19:09:49	7553.84	Gravity core (GC)	921		0.4	7606.534168 N	01600.168497 E	393.23	-0.6	Jun-63	87	57	2	2	8	0	
rer START 917 0.1 7606.367599 N 01602.0	23/05/15	19:43:27	7554.61	Grabb START	922		0.2	7606.378511 N	01602.254882 E	383.83	-0.5	Jul-23	88	60	2	2	8	0	
rer STOPP 917 0.2 7606.367698 N 01602.0	23/05/15	21:11:21	7555.45	Grabb STOPP	922		0.3	7606.363766 N	01602.085455 E	381.61	-0.4	Jun-34	89	50	2	2	8	0	

core (GC) 918 0.6 7607.007951 N 01602.6	24/05/15	06:45:24	7592.65	CTD uten vann START	**923**		0.8	7550.956202 N	01637.954024 E	350.28	03-Mar	Aug-90	74	39	2	2	8	0	16.56
core (GC) 919 0.5 7607.007804 N 01602.6	24/05/15	07:01:23	7592.83	CTD uten vann STOPP	**923**		0.7	7550.799127 N	01638.270388 E	349.57	03-Feb	Aug-36	78	42	2	2	8	0	196.25
ore (GC) 920 0.4 7606.699755 N 01600.648	24/05/15	09:40:26	7603.79	Foto START	**924**		1.0	7550.562352 N	01637.872797 E	344.83	03-Jun	Jul-61	79	49	2	2	8	0	
core (GC) 921 0.4 7606.534168 N 01600.1	24/05/15	11:17:34	7604.74	Foto STOPP	**924**		0.6	7550.262224 N	01638.214772 E	348.06	03-Jul	Jul-38	80	37	2	2	8	0	
b START 922 0.2 7606.378511 N 01602.25	24/05/15	12:04:03	7605.83	Grabb START	**925**		0.7	7550.494953 N	01637.559204 E	350.80	03-May	Jun-77	75	28	2	2	8	0	
b STOPP 922 0.3 7606.363766 N 01602.08	24/05/15	12:04:08	7605.83	Grabb STOPP	**925**		0.8	7550.494138 N	01637.557781 E	350.44	03-May	Jun-52	75	29	2	2	8	0	
ann START 923 0.8 7550.956202 N 01637.9	24/05/15	12:16:48	7605.92	Grabb START	**926**		0.8	7550.480641 N	01637.558297 E	350.15	03-May	Jul-93	77	18	2	2	8	0	
nn STOPP 923 0.7 7550.799127 N 01638.2	24/05/15	12:17:05	7605.92	Grabb STOPP	**926**		0.7	7550.483897 N	01637.559620 E	350.85	03-May	07-Feb	77	24	2	2	8	0	
START 924 1.0 7550.562352 N 01637.872	24/05/15	12:31:48	7606.02	Grabb START	**927**		0.1	7550.477255 N	01637.524845 E	350.22	03-May	Aug-35	77	33	2	2	8	0	
STOPP 924 0.6 7550.262224 N 01638.214	24/05/15	12:32:26	7606.02	Grabb STOPP	**927**		0.1	7550.478984 N	01637.528846 E	350.31	03-Jun	Aug-81	77	33	2	2	8	0	
b START 925 0.7 7550.494953 N 01637.55	24/05/15	12:46:51	7606.15	Grabb START	**928**		0.1	7550.481239 N	01637.539802 E	349.59	03-May	Aug-54	78	38	2	2	8	0	
b STOPP 925 0.8 7550.494138 N 01637.55	24/05/15	12:46:53	7606.15	Grabb STOPP	**928**		0.2	7550.481284 N	01637.539556 E	350.71	03-May	Aug-74	78	38	2	2	8	0	
b START 926 0.8 7550.480641 N 01637.55	24/05/15	13:00:23	7606.23	Grabb START	**929**		0.1	7550.477707 N	01637.528367 E	349.89	03-May	Jul-74	75	40	2	2	8	0	
b STOPP 926 0.7 7550.483897 N 01637.55	24/05/15	13:00:35	7606.23	Grabb STOPP	**929**		0.1	7550.477740 N	01637.529732 E	349.75	03-May	Aug-27	75	45	2	2	8	0	
b START 927 0.1 7550.477255 N 01637.52	24/05/15	13:15:10	7606.36	Grabb START	**930**		0.1	7550.485682 N	01637.570172 E	350.06	03-Apr	Sep-33	77	37	2	2	8	0	
b STOPP 927 0.1 7550.478984 N 01637.52	24/05/15	13:15:14	7606.36	Grabb STOPP	**930**		0.3	7550.485907 N	01637.570441 E	350.18	03-Apr	Sep-59	77	36	2	2	8	0	
b START 928 0.1 7550.481239 N 01637.53	24/05/15	13:47:23	7606.85	Trekantskrape START	**931**		0.8	7550.464216 N	01637.528208 E	350.67	03-May	Aug-86	77	38	2	2	8	0	
b STOPP 928 0.2 7550.481284 N 01637.53	24/05/15	13:57:48	7607.04	Trekantskrape STOPP	**931**		01-Mar	7550.645058 N	01637.680694 E	350.38	03-Apr	Sep-89	80	47	2	2	8	0	
b START 929 0.1 7550.477707 N 01637.52	24/05/15	16:43:35	7625.92	Foto START	**932**		1.0	7606.287484 N	01557.839660 E	386.23	-0.2	Apr-82	81	51	2	2	8	0	
b STOPP 929 0.1 7550.477740 N 01637.52	24/05/15	17:11:20	7626.15	Foto STOPP	**932**		0.2	7606.418765 N	01558.026865 E	378.41	-0.2	Mar-78	81	47	2	2	8	0	14.81
b START 930 0.1 7550.485682 N 01637.57	24/05/15	17:11:39	7626.15	Multicorer START	**933**		0.1	7606.418703 N	01558.022168 E	378.68	-0.3	Mar-60	81	54	2	2	8	0	14.81
b STOPP 930 0.3 7550.485907 N 01637.57	24/05/15	17:11:42	7626.15	Multicorer STOPP	**933**		0.3	7606.418667 N	01558.021484 E	378.78	-0.3	Mar-36	81	48	2	2	8	0	14.81
krape START 931 0.8 7550.464216 N 0163	24/05/15	18:08:08	7626.69	Multicorer START	**934**		0.2	7606.417240 N	01558.026277 E	377.65	-0.3	Apr-40	75	49	2	2	8	0	
krape STOPP 931 1.3 7550.645058 N 0163	24/05/15	18:08:42	7626.69	Multicorer STOPP	**934**		0.0	7606.416815 N	01558.022919 E	378.18	-0.3	Apr-93	75	52	2	2	8	0	
START 932 1.0 7606.287484 N 01557.839	24/05/15	19:40:56	7629.13	Foto START	**937**		0.2	7606.266935 N	01556.680812 E	382.94	-0.4	Mar-47	77	23	2	2	8	0	
TOPP 932 0.2 7606.418765 N 01558.0268	24/05/15	23:52:37	7632.81	Foto STOPP	**937**		01-Jun	7606.432436 N	01558.107703 E	377.16	-0.5	Mar-54	81	34	2	2	8	0	
r START 933 0.1 7606.418703 N 01558.022	24/05/15	23:53:11	7632.82	Multicorer START	**938**		01-Feb	7606.440973 N	01558.147610 E	377.83	-0.5	Mar-86	81	39	2	2	8	0	
r STOPP 933 0.3 7606.418667 N 01558.021	24/05/15	23:53:19	7632.82	Multicorer STOPP	**938**		01-Feb	7606.442772 N	01558.156016 E	377.97	-0.5	04-Dec	81	33	2	2	8	0	
orer START 934 0.2 7606.417240 N 01558.0	25/05/15	00:49:13	7633.95	Gravity core (GC)	**939**		0.9	7606.415808 N	01557.457019 E	387.25	-0.5	Feb-97	82	26	2	2	8	0	
orer STOPP 934 0.0 7606.416815 N 01558.0	25/05/15	02:20:17	7635.35	Gravity core (GC)	**940**		0.7	7606.413822 N	01558.671520 E	386.34	-0.6	Feb-88	78	28	2	2	8	0	
START 937 0.2 7606.266935 N 01556.680	25/05/15	03:16:46	7639.47	CTD uten vann START	**941**		0.1	7605.964646 N	01603.195678 E	384.76	-0.4	03-May	83	48	2	2	8	0	69.06
STOPP 937 1.6 7606.432436 N 01558.107	25/05/15	03:36:59	7639.57	CTD uten vann STOPP	**941**		0.3	7605.890208 N	01603.103771 E	384.46	-0.2	Feb-49	83	43	2	2	8	0	
orer START 938 1.2 7606.440973 N 01558.1	25/05/15	06:02:39	7656.45	CTD uten vann START	**942**		0.3	7556.836740 N	01642.203357 E	328.44	04-Jan	Mar-27	83	16	2	2	8	0	
orer STOPP 938 1.2 7606.442772 N 01558.1	25/05/15	06:14:53	7656.56	CTD uten vann STOPP	**942**		0.8	7556.835133 N	01641.970914 E	329.16	04-Jan	Mar-52	79	32	2	2	8	0	
core (GC) 939 0.9 7606.415808 N 01557.4	26/05/15	01:40:29	7835.03	CTD uten vann START	**943**		0.6	7455.910318 N	02732.027571 E	329.39	04-Jun	Oct-13	79	25	2	2	8	0	97.06
core (GC) 940 0.7 7606.413822 N 01558.6	26/05/15	01:52:42	7835.16	CTD uten vann STOPP	**943**		0.7	7456.023023 N	02732.118789 E	328.34	04-Jul	Jun-76	80	17	2	2	8	0	
nn START 941 0.1 7605.964646 N 01603.1	26/05/15	10:13:19	7868.82	Foto START	**944**		0.1	7454.497830 N	02730.704238 E	334.35	05-Jun	Aug-33	83	26	2	2	8	0	
vann STOPP 941 0.3 7605.890208 N 0160	26/05/15	16:12:38	7871.98	Foto STOPP	**944**		0.3	7454.932732 N	02735.015558 E	363.81	05-Mar	Jun-56	82	8	2	2	8	0	
vann START 942 0.3 7556.836740 N 0164	26/05/15	16:12:54	7871.98	Multicorer START	**945**		0.3	7454.933622 N	02735.009342 E	364.68	05-Mar	07-Dec	82	18	2	2	8	0	
vann STOPP 942 0.8 7556.835133 N 0164	26/05/15	16:12:57	7871.98	Multicorer STOPP	**945**		0.7	7454.933842 N	02735.007815 E	364.06	05-Mar	Jul-46	82	18	2	2	8	0	
nn START 943 0.6 7455.910318 N 02732.0	26/05/15	17:09:12	7873.65	Grabb START	**946**		0.2	7454.075179 N	02733.414447 E	334.43	05-Mar	Sep-54	75	21	2	2	8	0	
vann STOPP 943 0.7 7456.023023 N 0273	26/05/15	17:09:17	7873.65	Grabb STOPP	**946**		0.1	7454.075383 N	02733.414333 E	334.52	05-Mar	Oct-32	75	21	2	2	8	0	
START 944 0.1 7454.497830 N 02730.704	26/05/15	17:22:36	7873.72	Grabb START	**947**		0.5	7454.079786 N	02733.424748 E	334.45	05-May	Jun-46	72	27	2	2	8	0	
o STOPP 944 0.3 7454.932732 N 02735.01	26/05/15	17:22:39	7873.73	Grabb STOPP	**947**		0.8	7454.080123 N	02733.423857 E	335.47	05-May	May-88	72	23	2	2	8	0	
orer START 945 0.3 7454.933622 N 02735.0	26/05/15	17:37:14	7873.90	Grabb START	**948**		0.2	7454.079051 N	02733.412521 E	334.66	05-May	Aug-59	73	11	2	2	8	0	
orer STOPP 945 0.7 7454.933842 N 02735.0	26/05/15	17:37:19	7873.90	Grabb STOPP	**948**		0.4	7454.079416 N	02733.412655 E	334.49	05-May	09-May	73	7	2	2	8	0	
b START 946 0.2 7454.075179 N 02733.41	26/05/15	17:48:15	7873.98	Grabb START	**949**		0.1	7454.077628 N	02733.399220 E	334.64	05-Apr	Jun-36	71	40	2	2	8	0	
STOPP 946 0.1 7454.075383 N 02733.414	26/05/15	17:48:18	7873.98	Grabb STOPP	**949**		0.4	7454.077801 N	02733.399572 E	334.84	05-Apr	Jun-18	71	35	2	2	8	0	
b START 947 0.5 7454.079786 N 02733.42	26/05/15	18:18:08	7874.25	Grabb START	**950**		01-Jan	7454.006891 N	02733.294411 E	334.63	05-May	07-Dec	87	34	2	2	8	0	117.44
b STOPP 947 0.8 7454.080123 N 02733.42	26/05/15	18:18:13	7874.26	Grabb STOPP	**950**		1.0	7454.005137 N	02733.292151 E	334.89	05-May	Jul-46	87	34	2	2	8	0	117.44
b START 948 0.2 7454.079051 N 02733.41	26/05/15	18:18:43	7874.27	Grabb START	**951**		01-Mar	7453.995454 N	02733.283726 E	335.02	05-Jun	Jun-94	87	38	2	2	8	0	117.44
bb STOPP 948 0.4 7454.079416 N 02733.41	26/05/15	18:18:47	7874.27	Grabb STOPP	**951**		01-Jan	7453.994271 N	02733.283539 E	335.01	05-Jun	Jul-39	87	37	2	2	8	0	117.44
b START 949 0.1 7454.077628 N 02733.39	26/05/15	18:27:02	7874.54	CTD uten vann START	**952**		0.6	7454.102913 N	02733.532641 E	335.41	05-Apr	Jun-44	90	11	2	2	8	0	
b STOPP 949 0.4 7454.077801 N 02733.39	26/05/15	18:50:34	7874.89	CTD uten vann STOPP	**952**		0.3	7454.050968 N	02733.609466 E	335.15	05-Apr	Aug-36	88	16	2	2	8	0	227.44
TART 950 1.1 7454.006891 N 02733.29441	26/05/15	19:18:20	7876.26	CTD uten vann START	**953**		0.9	7455.236543 N	02733.581319 E	331.76	05-Apr	Aug-58	74	26	2	2	8	0	
TOPP 950 1.0 7454.005137 N 02733.2921	26/05/15	19:34:07	7876.39	CTD uten vann STOPP	**953**		0.7	7455.274758 N	02733.897891 E	333.04	05-Jun	May-94	71	13	2	2	8	0	
TART 951 1.3 7453.995454 N 02733.28372	26/05/15	19:55:03	7877.25	Gravity core (GC)	**954**		0.3	7455.141808 N	02731.620254 E	328.09	05-May	07-Jun	73	1	2	2	8	0	35.06
TOPP 951 1.1 7453.994271 N 02733.2835	26/05/15	20:26:52	7878.13	Gravity core (GC)	**955**		0.1	7454.493449 N	02733.005103 E	333.72	05-May	Jul-30	87	18	2	2	8	0	63.38
vann START 952 0.6 7454.102913 N 0273	26/05/15	20:52:37	7878.45	Gravity core (GC)	**956**		0.2	7454.479462 N	02733.016261 E	334.01	05-May	Jun-88	81	53	2	2	8	0	227.44
nn STOPP 952 0.3 7454.050968 N 02733.6	26/05/15	21:49:27	7882.09	Gravity core (GC)	**957**		0.9	7457.647974 N	02737.952769 E	0.00	05-Feb	Jul-80	85	25	2	2	8	0	May-56
vann START 953 0.9 7455.236543 N 0273	26/05/15	22:18:07	7882.97	Gravity core (GC)	**958**		0.6	7457.507880 N	02740.436321 E	341.74	5.0	06-Jan	77	16	2	2	8	0	May-38
vann STOPP 953 0.7 7455.274758 N 0273	27/05/15	07:22:48	7924.34	Foto START	**959**		0.7	7454.778253 N	02735.018936 E	336.32	05-Apr	Jul-16	78	47	2	2	8	0	
core (GC) 954 0.3 7455.141808 N 02731.62	27/05/15	08:44:28	7924.97	Foto STOPP	**959**		0.0	7455.066688 N	02735.883656 E	336.63	05-Jun	Aug-18	76	57	2	2	8	0	
ore (GC) 955 0.1 7454.493449 N 02733.00	27/05/15	08:44:41	7924.97	Multicorer START	**960**		0.2	7455.067280 N	02735.885406 E	336.64	05-Jun	08-Sep	76	56	2	2	8	0	
re (GC) 956 0.2 7454.479462 N 02733.016	27/05/15	08:44:45	7924.97	Multicorer STOPP	**960**		0.3	7455.067334 N	02735.886981 E	336.81	05-Jun	Aug-72	76	56	2	2	8	0	
core (GC) 957 0.9 7457.647974 N 02737.9	27/05/15	10:06:47	7926.88	Foto START	**961**		0.9	7454.858376 N	02730.076512 E	333.78	05-Apr	Jul-45	89	33	2	2	8	0	
core (GC) 958 0.6 7457.507880 N 02740.43	27/05/15	11:51:31	7928.20	Foto STOPP	**961**		0.4	7455.387506 N	02732.304645 E	327.53	05-Apr	Aug-13	85	44	2	2	8	0	
START 959 0.7 7454.778253 N 02735.018	27/05/15	12:51:12	7931.02	Trekantskrape START	**962**		0.6	7454.963244 N	02731.439002 E	334.80	05-Mar	Jul-36	90	44	2	2	8	0	
STOPP 959 0.0 7455.066688 N 02735.883	27/05/15	13:04:44	7931.25	Trekantskrape STOPP	**962**		01-Jun	7455.188380 N	02731.513574 E	329.79	05-Apr	Aug-60	84	37	2	2	8	0	
orer START 960 0.2 7455.067280 N 02735.8	27/05/15	13:45:09	7932.61	Trekantskrape START	**963**		01-Mar	7455.666692 N	02732.973063 E	328.07	05-Apr	Aug-40	79	38	2	2	8	0	
orer STOPP 960 0.3 7455.067334 N 02735.8	27/05/15	13:57:49	7932.80	Trekantskrape STOPP	**963**		0.8	7455.672908 N	02733.654952 E	331.55	05-Apr	Jul-72	77	48	2	2	8	0	226.88
START 961 0.9 7454.858376 N 02730.076	27/05/15	16:09:35	7942.02	Multicorer START	**964**		0.4	7448.354095 N	02741.840922 E	349.51	04-Apr	Jul-63	84	52	2	2	8	0	
STOPP 961 0.4 7455.387506 N 02732.304	27/05/15	16:09:40	7942.02	Multicorer STOPP	**964**		0.3	7448.354252 N	02741.839336 E	349.76	04-Apr	Jul-28	84	55	2	2	8	0	
krape START 962 0.6 7454.963244 N 0273	27/05/15	16:46:46	7944.21	CTD uten vann START	**965**		0.4	7446.541955 N	02740.106110 E	354.28	04-Mar	Jul-23	88	61	2	2	8	0	
krape STOPP 962 1.6 7455.188380 N 0273	27/05/15	17:02:11	7944.43	CTD uten vann STOPP	**965**		0.9	7446.457000 N	02739.635992 E	354.60	04-Mar	Aug-24	83	57	2	2	8	0	-11.69
krape START 963 1.3 7455.666692 N 0273	28/05/15	14:02:58	8178.34	Trekantskrape START	**966**		01-Apr	7106.655508 N	02422.427157 E	174.06	05-Aug	May-91	93	65	2	2	8	0	
pe STOPP 963 0.8 7455.672908 N 02733.6	28/05/15	14:16:19	8178.73	Trekantskrape STOPP	**966**		01-May	7106.756659 N	02421.298073 E	150.10	6.0	05-Jul	93	71	2	2	8	0	