Final Cruise Report
Dana 12-11, Reykjavik – Hirtshals
Benthic Research at Sea

Ship-board science party, RV Dana, September 2012
Edited by Hans Røy

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About the Cruise and the Course

The Danish Centre for Marine Sciences is a national office with the objective to stimulate and strengthen Danish marine research by improving researcher access to research vessels. The Centre supports state-of-the-art marine research, field-based training, networking and the development of synergies across the Danish marine research environments. The center has therefore made the transit legs between Hirtshals and Reykjavik in the summer of 2012 available for two PhD courses. A consortium from Aarhus University, University of Southern Denmark and GEUS responded to the call and organized the course "Benthic Research at Sea" on the return leg from September 24th to September 30.

The aim of the course is to train Ph.D. students and postdocs from Danish universities with little or no seagoing experience and to provide an interdisciplinary introduction to research on marine sediments. Projects on board have demonstrated how ship-based research is planned, organized, coordinated and executed, and thus prepared students for future research cruises. The cruise was structured like a research expedition with coordinated sediment sampling by gravity-corer, box-corer and CTD. The research topics addressed included 1) benthic zoology, 2) sedimentology and stratigraphy, 3) pore-water geochemistry, and 4) geomicrobiology. Formally, the course is organized under the Graduate School of Science and Technology (GSST) at Aarhus University.

As part of the educational activities of the course, this document has been authored by both the course participants and the teachers.

Acknowledgements

We thank the crew of RV Dana for welcoming us on board, for kind and efficient help in every aspect, and for making the cruise a most memorable experience. We thank the Danish center for Marine Research for financing the cruise and the Center for Geomicrobiology (Aarhus University) for supporting the scientific activities. In addition, we are indebted to Sven Nicolajsen (Department of Geoscience, Aarhus University) for logistical support. Dennis Lisbjerg, Helge Abildhauge Thomsen and Hans-Erik Mahnfeldt from DTU AQUA and Antoon Kuijpers from GEUS have all been most helpful and supportive.

Scientific Party

Cruise leader:

Hans Røy, AU	hans.roy@biology.au.dk

Curator:

Bente A. Lomstein, AU	bente.lomstein@biology.au.dk

Teachers:

Hans Røy, AU	hans.roy@biology.au.dk
Erik Kristensen, SDU	ebk@biology.sdu.dk
Marit-Solveig Seidenkrantz, AU	mss@geo.au.dk
Nils Risgaard-Petersen, CfG AU	nils.risgaard-petersen@biology.au.dk
Bente A. Lomstein, AU	bente.lomstein@biology.au.dk

Course participants

Alice Thoft	alice.thoft@biology.au.dk
Xihan Chen	xihan.chen@biology.au.dk
Nicole Posth	nicolep@biology.sdu.dk
Margrethe Thorup	margrethe.thorup@geo.au.dk
Ian Marshall	ianpgm@biology.au.dk
Henrik Christiansen	henriksvanebergchristiansen@hotmail.com
Elizabeth Robertson	robertson@biology.sdu.dk
Christof Pearce	christof.pearce@geo.au.dk
Andrea Torti	torti@biology.au.dk
Andrea Fischel	geoaf@geo.au.dk
Maja Nielsen	mnimajanielsen@hotmail.com
Chao Peng	p163c@163.com
Katy Hoffmann	katy.hoffmann@biology.au.dk
Marion Jaussi	marion.jaussi@biology.au.dk
Stefan Braun	stefanbraun_tt@web.de

Guest Researcher

Ruth F. Garcia	Ruth.Fernandez@snm.ku.dk

Instruments

Benthic samples were collected with a gravity corer and a box corer while pelagic samples were collected with a CTD rosette and small plankton nets. The gravity corer was supplied by the Center for Geomicrobiology, Århus University. It was equipped with 1000 kg of lead, brake plate, 6 meter steel tube with 130mm PVC liner, and a core catcher made of 0.35 mm stainless spring-steel. Identical corers are owned by GEUS, MPI-Bremen, University of Bremen and others. The box corer (*Brutalis*) was supplied by DTU AQUA and belongs to the standard equipment on RV Dana. It is equipped with a 500mm diameter cylindrical core barrel. Water samples and a CTD profile were collected by the ship´s CTD. Plankton nets were supplied by the users. The ship´s sub bottom profiler was not operational and site surveillance was therefore restricted to low-frequency echo sounding.

Narrative

Sep. 24: RV Dana left Reykjavik according to plans on September 24th 2012 at 15:00 taking course towards station one in the Iceland Basin. The target area was occupied by an atmospheric low pressure at the time of departure, but a high pressure was expected to move in from the North-West before Dana would commence science operations.

Sep 25: Dana arrived at station one at 09:00 and performed a one hour acoustic site survey. The station was fixed in a local depression at 2122m water depth on the position 61°37.04'N 20°43.26'W. The winds in the area were calm, but the swell made safe operations difficult. We retrieved one excellent gravity core, one acceptable box core, but damaged the box corer against the side of the ship on the second retrieval. As another low pressure was moving into the area rapidly, it was deemed too dangerous to attempt further casts with the gravity corer and the station was abandoned without a CTD profile to save time

During the night of the September 25th, it became clear that we could not reach the second planned station on time. It was also clear that safe and comfortable conditions could only be found if we could follow the high-pressure area we were in. It was therefore decided to skip the planned station for September 25 and press on westwards. The site for station 2 was chosen such that we would be ready for deck-operations at 08:00 on September 26.

Sep 25: Transit towards Station 2.

Sep 26: RV Dana arrived at station two in the channel on the west side of the Faero bank at 07:00. The general area is known for strong bottom currents due to flow across the Iceland-Faroe-Ridge. We hoped to find a sediment basin in the 750m deep area between the banks that reach up to only 100m from the surface. We performed a one-hour acoustic site survey from 07:00 to 08:00. The station was fixed in a flat area at 742m water depth on the position 60°46.94' N 009°47.62' W. The winds in the area were calm and the swell acceptable.

We retrieved one excellent gravity core and three excellent box cores. We had low success rate with the gravity corer due to strong currents and corals on the seabed. Since sampling at station one had shown that the science objectives could be met 100% with a single gravity core, we aborted further attempts with this instrument. We performed one CTD cast with water sampling near the bottom, below and above the thermocline and in the surface water. We sampled with plankton nets with various nets according to plan. We abandoned the station at 16:30 after a full program to press forward and keep ahead of the approaching storm.

The possibility to add a third station with only box coring in shallow water on either the Faroe or Scottish shelf was discussed. These plans were abandoned during the night and morning because a suitable station could not be found due to time pressure, sea cables, oilfields and lacking permission to work in British coastal waters.

Sep 27: Transit towards Hirtshals. The upcoming storm (Figure 2) threatened the possibility to enter the port in Hirtshals, if we should arrive later than midnight on September 29th. We therefore called an end to the scientific operations and sailed towards Hirtshals.

Sep 28: Transit towards Hirtshals.

Sep 29: Transit towards Hirtshals. The pier was reached at 21:00 right in time to see the wind turn from south to west and pick up to 18 m/s.

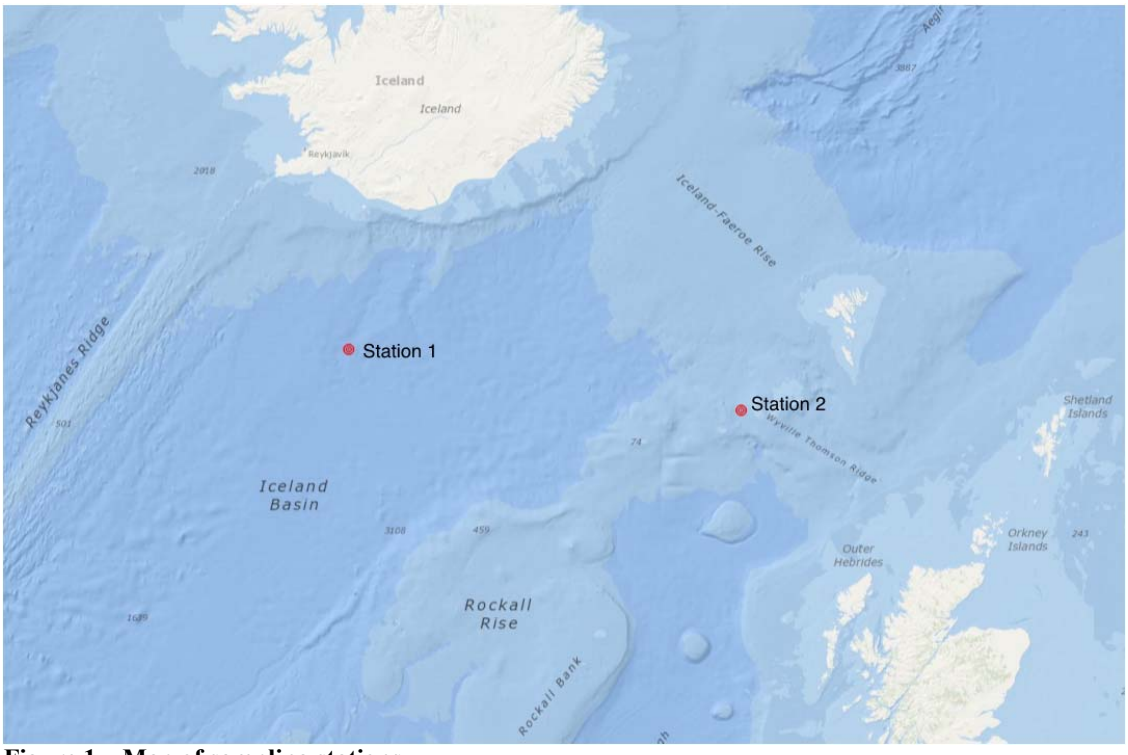


Figure 1 – Map of sampling stations

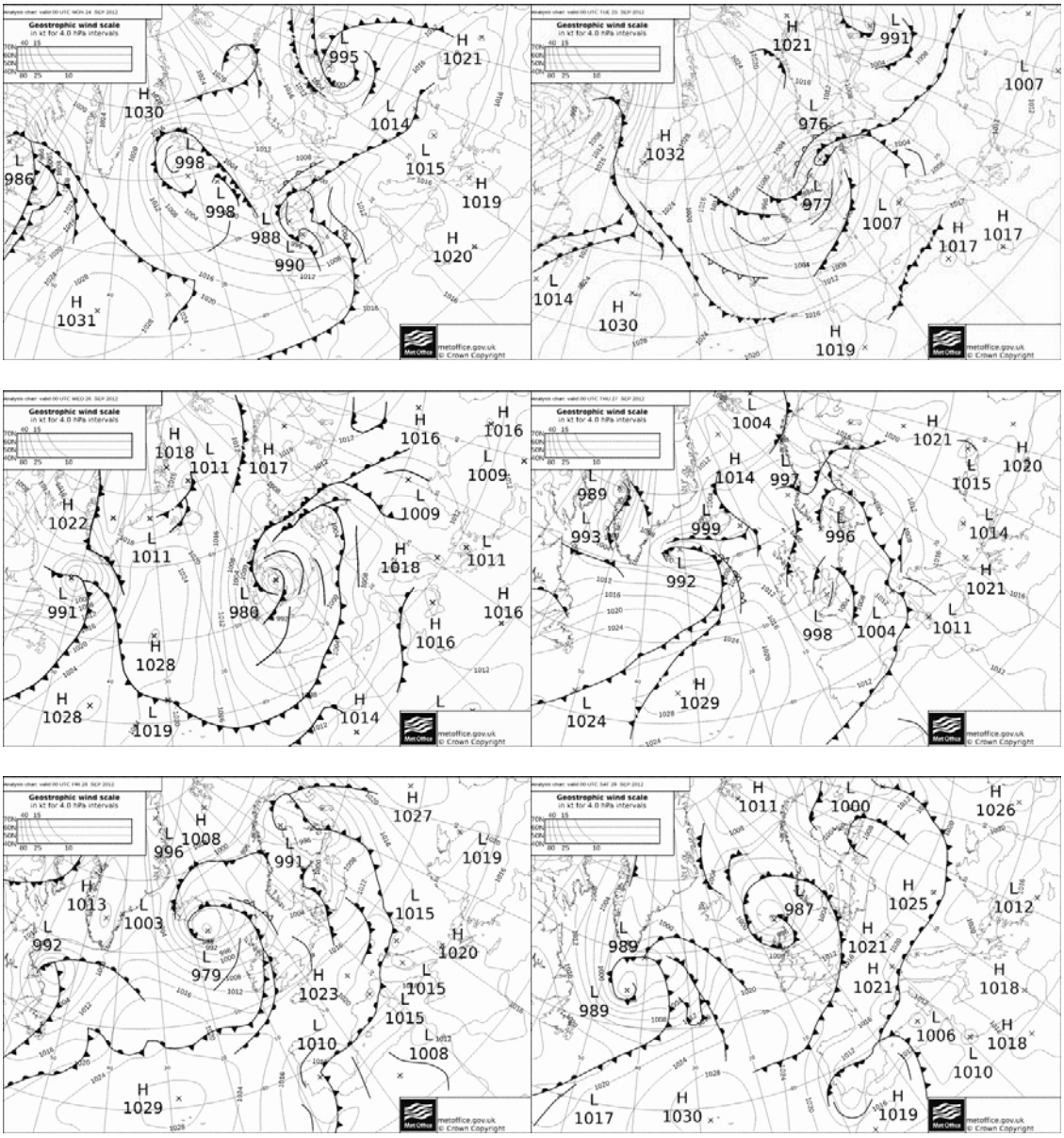


Figure 2 – Weather charts for each cruise day (upper left to lower right, September 24 to September 29, 2012).

Project Summaries

Geology

Contributors: Christof Pearce, Andrea Fischel, Margrethe Nielsen, Ian Marshall, Nicole Posth
Box cores: BRO1A, BRO1B, BRO4, BRO7
Gravity cores: GCO1, GCO3, GCO4.

Box cores

The box cores were logged and then stored in the plastic tubes they were sampled in.

Gravity cores

After extraction of pore water, biogeochemical, and microbiological sampling, each section of the two gravity cores was cut open and halved lengthwise. The section was then photographed.

One half (the archive half) was wrapped in plastic foil and plastic bags immediately and stored, while the other half (the working half) was left for several hours while being logged, before it was packed and stored.

Cores GCO1 and GCO3 were retrieved with 4.195 and 5.89 meters of sediment, respectively. GCO2 and GCO4 came up empty except for a few pieces of dead coral in GC04, indicating that a deep-sea coral mound was hit by the gravity corer.

Both the archive and working halves of gravity cores GC01 and GC03 are stored at 4˚C at the Department of Geoscience of Aarhus University. For access or sampling, contact Marit-Solveig Seidenkrantz..

Core Logging

The logging of the cores was based on eye estimation of grain size and color. Presence of shells, wood, drop stones etc. was noted in the logs. When present in large amount shells were taken out for ^{14}C-dating at various intervals in the cores.

Based on these logs it was found that only 1 cm of the top of the gravity core GC03 and 1-2 cm of GC01 was lost.

Logs are attached as appendices two and three.

Post-Cruise work

Three samples of Pteropod shells (Figure 3) from different depths in GC01 were analyzed for radiocarbon content. Based on a preliminary age-depth model, the age of the core spans from present to 12400 ± 1000 cal. years BP with a constant sedimentation rate of 33 cm / kyr. This means the core holds a continuous record of the entire Holocene and possibly a part of the Younger Dryas cold interval of the Late Glacial. The preliminary basal ages of the four visible tephra layers in the core are now 683 ± 354, 6834 ± 698, 10127 ± 324 and 11701 ± 922 cal. yrs BP. Once more radiocarbon measurements have been made on other samples, these tephra layers can potentially be used for correlation with other sediment archives in the area, both marine and terrestrial. No dates have been analyzed from core GC03 as of now.

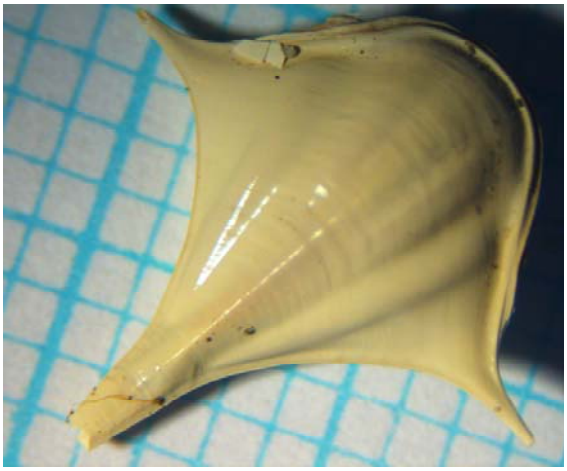


Figure 3 - Shell of Pteropod *Diacria trispinosa* from GC01, used for 14C dating (background raster size 1mm)

Gravity cores GC01 and GC03 were analyzed using an X-Ray Fluorescence (XRF) core scanner at the Department of Geoscience of Aarhus University to get a qualitative measurement of the elemental composition of the sediments. In core GC01, the visible tephra layers show up very clearly in the XRF profiles as elevated concentrations of Fe, Ti and Mn. The core scanner also provided high resolution photographs and radiographs of the entire sediment core.

For more information regarding the age-depth model or XRF results, please contact Christof Pearce or Marit-Solveig Seidenkrantz.

Subsurface Biogeochemistry

Contributors: Marion Jaussi, Stefan Braun, Katy Hoffmann, Andrea Torti, Xihan Chen, Peng Chao, Alice Thoft

The main purpose of this project is to study biogeochemistry and microorganisms in marine sediments of selected locations in the North Atlantic Ocean. Microorganisms in the seafloor affect biogeochemical cycles on a global scale, and vice versa. To study the interaction of both, we collected one gravity core from each of the two stations. Since the

upper few centimetres of sediment are potentially lost or strongly disturbed with the gravity corer, an additional box core was taken at each site (Table 1).

Samples for pore water were collected by rhizons to measure dissolved inorganic carbon (DIC), ammonium (NH_4^+), and sulphur species (SO_4^{2-} and H_2S). Solid phase samples were extruded from the core by using sterile cut-off syringes for different analyses, including density, methane, organic geochemistry (Table 1), sulphate reduction rate, cell counting, DNA, extracellular DNA, and RNA. Samples for methane concentration were only taken from the gravity core, while samples for extracellular DNA were only taken from the box core.

These different analyses will give us an overview of the different fluxes, microbial activities (e.g. sulphate reduction) and distribution of microorganisms within the sediment cores.

Station 1 (DA12_11_1)

Length of gravity core: 415 cm
Length of box core: 24 cm

For geochemical analyses, we obtained 1 gravity core (GC 01) and 1 box core (BR 01).

From the box core we took 8 samples for pore water and 7 for solid phase analyses. Samples for pore water were taken from 2 cm bsf in 2-cm intervals down to 8 cm bsf, then in 4-cm intervals down to 24 cm bsf (bottom of the core). For the solid phase we took samples at 2, 4, 7, 10, 15, 19 and 23 cm bsf. The overlaying bottom water was turbid and unclear.

The gravity core was cut in 4 sections of 1 meter plus a 15-cm-long section. We took 11 samples from 4.5 cm from the top of the core to 102.5 cm, in 10-cm intervals, then 16 samples from 107.5 to 407.5 cm in 20-cm intervals, for pore water and solid phase analyses.

An individual sample (approx. 100 mL) was taken from the gravity core from 92.5-102.5 cm sediment depth and stored at - 20°C for the development of a cell extraction method for biomarker analysis (Stefan Braun, Center for Geomicrobiology, Department of Bioscience, Aarhus University).

Station 2 (DA12_11_2)

Length of gravity core: 584.5 cm
Length of box core: 20 cm

For geochemical analyses, one box core (BR 04) and one gravity core (GC 03) were retrieved.

From the box core we took 6 samples for both pore water and solid phase analyses. Samples were taken from 2 cm bsf in 2-cm intervals down to 8 cm bsf, then in 4-cm

intervals down to 16 cm bsf (bottom of the core). The overlaying bottom water was clear (top sediment undisturbed). We didn't take samples for organic geochemistry and density from the box core, which was entirely composed of foraminifera.

The gravity core was cut in 6 sections of 1 meter each. We took 9 samples from 4.5 cm from the top of the core to 94.5 cm, in 10-cm intervals, then 22 samples from 114.5 to 534.5 cm in 20-cm intervals, for pore water and solid phase analyses. For the last 40 cm we collected samples in different intervals (see Appendix 3).

An individual sample (approx. 100 mL) was taken from the gravity core from 140-150 cm sediment depth and stored at -20 °C for the development of a cell extraction method for biomarker analysis (Stefan Braun, Center for Geomicrobiology, Department of Bioscience, Aarhus University).

Table 1 – Overview of sampling

	Parameters	**Purpose**	**Sampling size and preparation**	**Storage conditions**	**Remarks**
Solid phase	Density	SRR	3 cm^3 to cup	-20°C	
	CH_4	Chemical components profiles & microbial activity	0.5 cm^3 to 0.5 mL of NaOH	4°C	Collected only from gravity cores
	Cell counts	Total microbial abundance &SRR	0.2 cm^3, diluted 1:10 in 4 % PFA	4°C	Box core BR01 only 0.1cm3
	DNA/RNA	Microbial diversity, abundance & activities	Several cm^3	-80°C	
	Sulphate reduction rate	SRR	Several cm^3	Incubated anoxic at *in situ* temperature for 24h before radiotracer injection	Incubation with radiotracer 48h
	Organic geochemistry	D:L amino acids isomers, DPA & qualification of organic matter	Approx. 5 cm^3	-20°C	
	Extracellular DNA	Microbial diversity	> 2 cm^3	eDNA was extracted immediately and stored at -80°C	Only from the box cores
Pore water	Sulphate/ Sulphide	Chemical compounds profiles & SRR	300 µL sample into 300 µL of 1% Zn-Ac	-20°C	
	DIC	Chemical compounds profiles	Approx. 2 mL	4°C	In glass vials
	Ammonium	Chemical compounds profiles	1 mL	-20°C	

Abbreviations:
cm-bsf: centimetres below sea-floor

CH4: methane
DIC: dissolved inorganic carbon
DPA: dipicolinic acid
eDNA: extracellular DNA
PFA: paraformaldehyde
SRR: sulphate reduction rate

Results of chemical analysis performed to date

Analysis of ammonium concentration profiles and modeling of ammonium production rates have been performed for both gravity cores from GC01 (Figure 4) and GC03 (Figure 5).

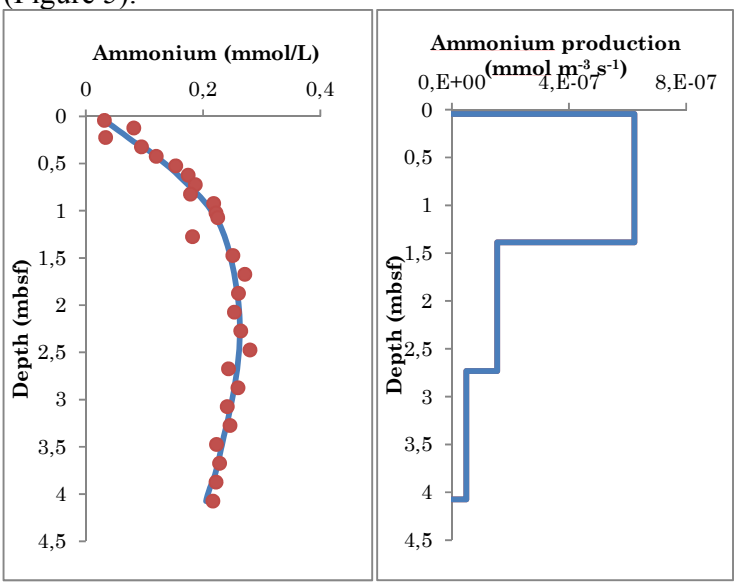


Figure 4 – Ammonium concentration profile and production rates for GC01.

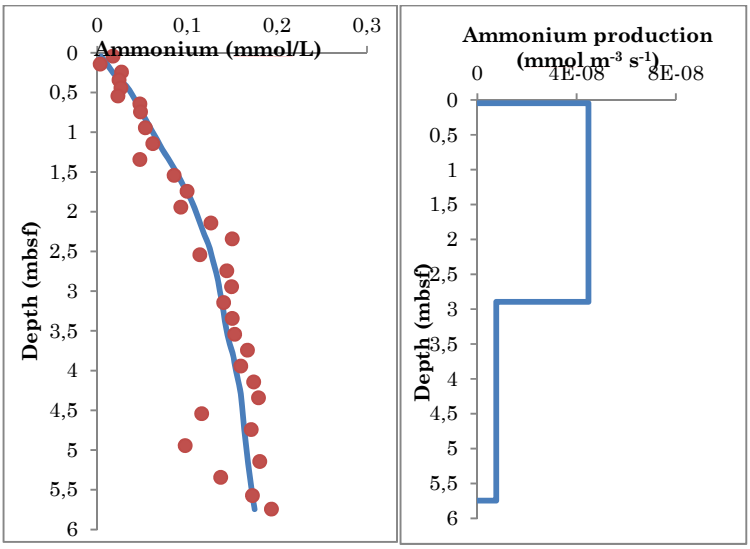


Figure 5 – Ammonium concentration profile and production rates for GC03.

Sulfate reduction rates were determined based on radiotracer incubation of ^{35}S-labeled sulfate. Unfortunately the concentration of radiotracer was lower than necessary for sufficiently sensitive detection of sulfate reduction rates, and thus sulfate reduction in the majority of samples is below the detection limit. Sulfate reduction rates are shown in
Figure 6.

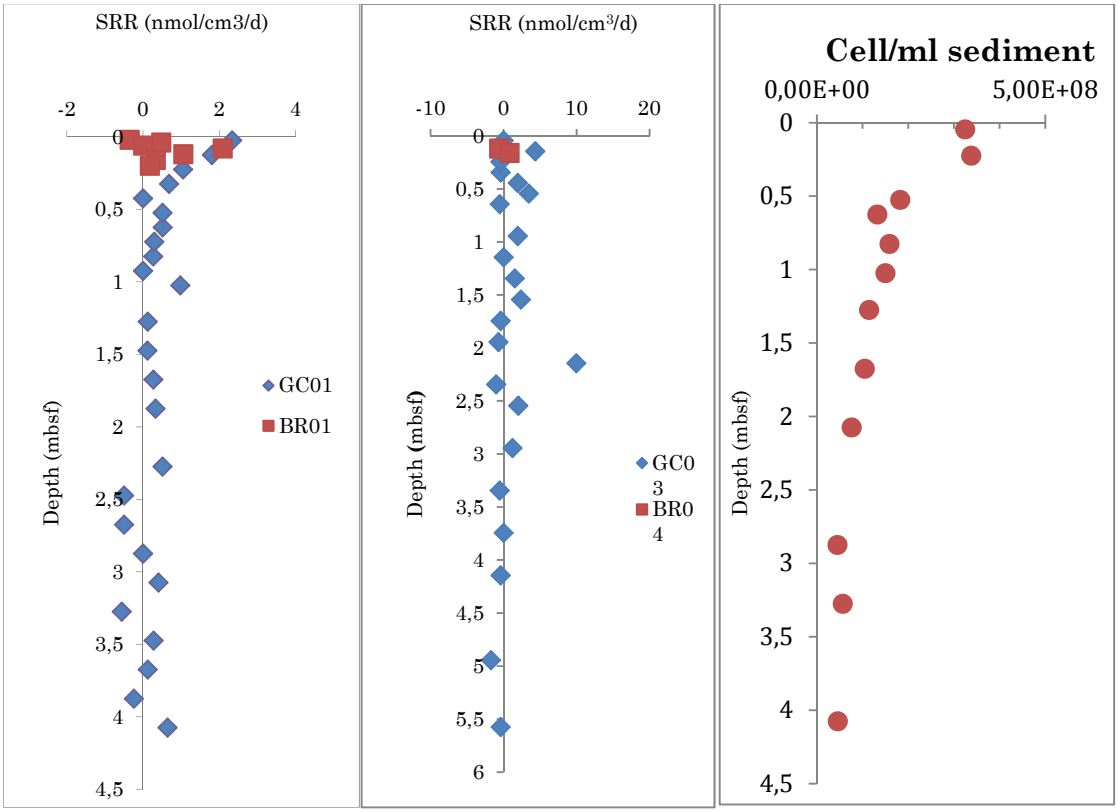


Figure 6 – 7. Sulfate reduction rates for station 1 (left panel) and station 2 (center panel). Cell counts for GC01 (Figure 7, right panel)

DAPI fluorescent cell counts have been completed for GC01 (**Error! Reference source not found.**). Sediment porosity has been measured for the two gravity cores and box core (Figure 7).

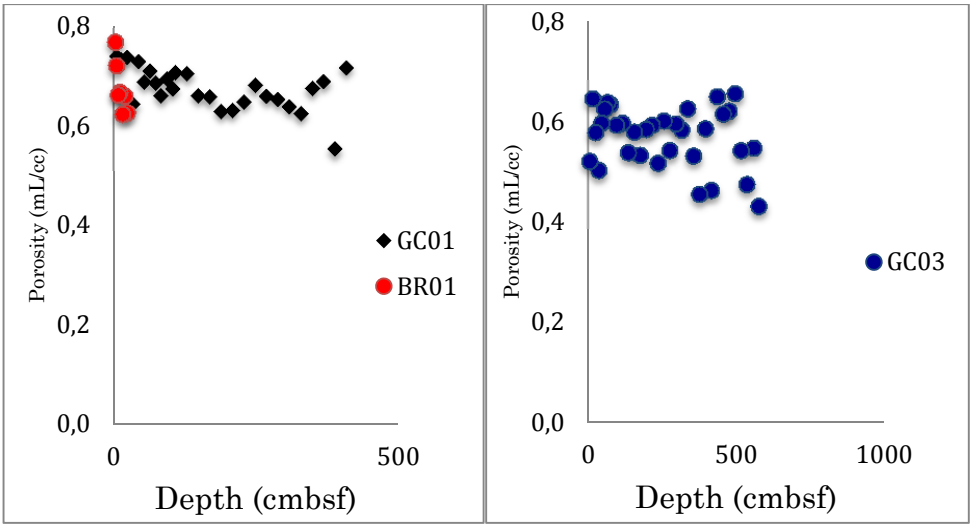


Figure 7 – Porosity measurements for station 1 (left) and station 2 (right).

Future work for subsurface geochemistry will include measurements of DIC, sulfate, sulphide (possibly), total carbon, and total nitrogen and cell counts for the GC03 core. This work will be carried out by Marion Jaussi and Bente Lomstein. There are also plans to extract DNA from the sediment for qPCR enumeration of genes associated with sulfate reduction (*dsrA*) and possibly further gene sequencing. DNA extraction will be carried out by Marion Jaussi and Ian Marshall.

Surface Biogeochemistry

Contributors: Elizabeth Robertson, Maja Nielsen

The fluxes of oxygen and CO_2 (as DIC) into and out of the sediments can be used to determine the activity of bacterial communities in surface sediment layers. Oxygen is the most energetically favorable electron acceptor for the oxidation of organic matter, thus oxygen is usually consumed rapidly in the surface sediment layers. During this cruise, depth profiles of O_2 concentration were measured with microsensors in intact sediment cores retrieved from box cores. The diffusive oxygen uptake and profiles of oxygen consumption were calculated from numerical modeling of the measured O_2 concentration profiles. The diffusion coefficients (D_s) used in these calculations were calculated from the sediment porosity (ϕ) and the diffusion coefficient for oxygen at infinite dilution (Do):

$$Ds = Do * \phi^2$$

Porosity was not measured during the cruise. It was assumed the porosity was 0.8 at station 1 (silty sediment) and 0.36 at station 2 (sandy sediment).

Below the depth of oxygen penetration a series of other electron acceptors is used to oxidize organic matter deposited on the sediment surface. The order in which these electron acceptors are used is determined by the energy gained from them when oxidizing organic substrates; typically in the sequence (after oxygen) NO_3^-, Mn^{4+}, Fe^{3+}, SO_4^{2-} and CO_2 in order of decreasing energy yield. The contribution of each of these to organic

matter remineralization in sediments varies widely between locations and depends on organic inputs from the water column, the activities of macrofauna and sediment characteristics (porosity, availability etc.) amongst other parameters. The understanding of the exchange of elements between different sediment types and the water column is a key factor in the estimation of global elemental budgets.

Station 1

Oxygen profiles

Three sediment cores were retrieved from BR01. They were kept at 2ºC during the experiment. The figure below shows a representative depth profile of measured O_2 concentrations from station 1. Oxygen penetrated around 1 cm into the surface sediment (Figure 8, left panel) with the highest consumption rate was calculated to be in the upper 0,6 cm of the sediment (Figure 8, right panel). The diffusive oxygen uptake was 3.65 mmol $m^{-2}d^{-1}$.

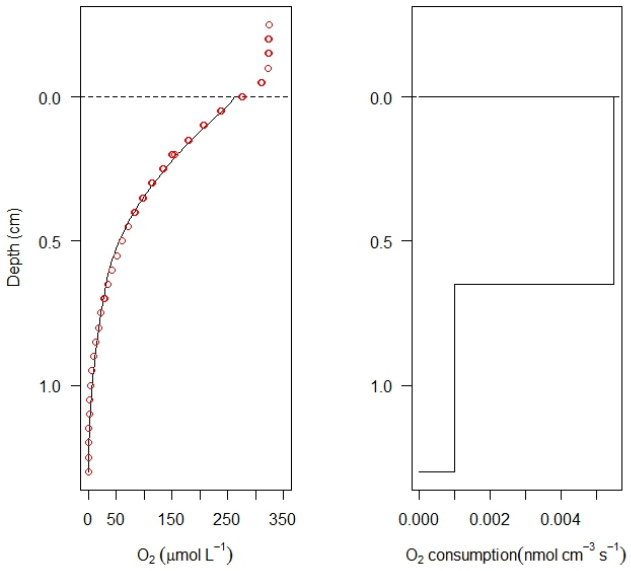


Figure 8 – Station 1 O_2 profile and modeled O_2 consumption rate.

The cores were sliced in the following sections 0-3 mm, 3-6 mm, 6-9 mm, 9-15 mm, 15-21mm, 21-27 mm, 27-34 mm, 34-51 mm, 51-63 mm and centrifuged for 5 min at 3000 rpm. The extracted porewater was used to take samples for the estimation of ammonium concentrations and reduced iron species. For the estimation of the total cell counts 100 µL of sediment was added to 900 µL PFA in Eppendorf tubes and stored at 4 ºC for further analysis. For the estimation of the content of reduced iron species 200 µL pore water was added to 500 µL 0.5 M HCl in Eppendorf tubes and stored frozen until further analysis. Remaining porewater was stored in Eppendorf tubes at 4 ºC for later analysis of nutrients.

Flux experiments
Three 8 cm cores from Brutalis deployment BR01 were used in flux experiments; a magnetic stirrer bar was fitted inside the core liners and initial oxygen measurements and DIC samples were taken. DIC samples were stored in 12 mL Exetainers at 4 ºC until being measured by titration with 0.01 M HCl onboard (Table 2). The cores were sealed with rubber stoppers for 27 h at 2 ºC next to an external rotating magnet to ensure movement of the water phase and maintain a diffusive boundary layer. The height of the water phase above the sediment was also measured for later flux determination. At the termination of the experiment, stoppers were removed and the final oxygen concentration was measured in the overlying water. DIC samples from the water were also taken and treated as before.

Due to the resuspension of sediment observed in the water phase when the box core was retrieved, a parallel experiment was conducted to determine the changes in DIC and oxygen concentrations in the turbid overlying water. Initial oxygen was measured and DIC samples taken before the water was incubated for ~64 h. Final oxygen measurements and DIC samples were taken and stored as before.

Table 2 – Fluxes calculated from whole-core experiments

	Average DIC flux out of sediment mmol/m^2/day	Average O_2 flux into sediment mmol/m^2/day
Station 1	1.998	-2.438
Station 2	8.135	-6.794

Jar incubations
Following termination of the whole-core experiment, the sediment from cores 1 and 2 were extruded and specific depth intervals collected; 0-2 cm, 4-6 cm, 8-10 cm, 12-14 cm. The sediment between 0-4 cm was characterized as being fluid mud and as solid silt from 4-14 cm depth. Sediment was mixed with a small volume of overlying water for ease of sampling. Sediment was packed into 20 mL glass jars on 26.09.2012 (21.00) without headspace in order to later determine rates of anaerobic respiration processes occurring over the depth intervals. Samples were sealed with a plastic lid and stored at 2 ºC for later analysis.

Additional surface sediment (top 5 cm) remaining from BR01 was taken by E. Robertson and stored in a plastic container in the dark at 2 ºC for later processing at SDU, Odense, Denmark.

Station 2

Oxygen profiles
The microprofiling was carried out on one core from BR04 previously used for the flux experiment (see below). The results are shown below (Figure 9). The sediment was more sandy compared to station 1 and the diffusive uptake was estimated to be 0.24 mmol m^{-2}

d^{-1} ; considerably lower than at station 1. Oxygen penetrated more than 6 cm in the sediment with the highest activity in the upper part of the sediment (2.1 cm). The cores were sliced in the following sections: 0-1 cm, 1-3.5 cm, 3.5-6 cm and homogenized in separate bowls using a spoon. For the total cell counts 100 µL sediment was added to 900 µL PFA in Eppendorf tubes and stored at 4°C for further analysis.

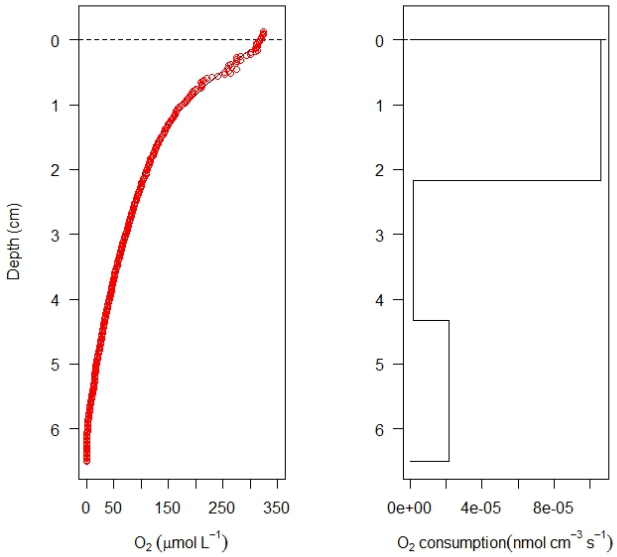


Figure 9 – Station 2 O_2 profile and modeled O_2 consumption rate.

Flux experiments

Three 8cm cores from Brutalis deployment BR04 were used in flux experiments; a magnetic stirrer bar was fitted inside the core liners and initial oxygen measurements and DIC samples were taken. DIC samples were stored in 12 mL Exetainers as at station 2. The cores were sealed with rubber stoppers for ~25 h as for station 1. The height of the water phase above the sediment was again measured for later flux determination. At the termination of the experiment, stoppers were removed and the final oxygen concentration was measured in the overlying water. DIC samples from the water were also taken and treated as before.

Jar incubations

Following termination of the whole-core experiment, the sediment from cores 1 and 3 were extruded and specific depth intervals collected; 0-2 cm, 4-6 cm, 8-10 cm, 12-14 cm. The sediment between 0-6 cm was a sand composed of foraminifera and solid clay from 6-14 cm depth. Sediment was mixed with a small volume of overlying water for ease of sampling. Sediment was packed into 20 mL glass jars on 28.09.2012 (16.00) without headspace in order to later determine rates of anaerobic respiration processes occurring over the depth intervals. Samples were sealed with a plastic lid and stored at 2 ºC for later analysis.

From a later deployment of the Brutalis box corer (BR07), three 5-cm cores were subsampled for E. Robertson. Cores were sealed without headspace and stored in the dark at 2 ºC until later analysis of nitrogen cycling processes at SDU, Odense Denmark. Any additional surface sediment (top 5 cm) remaining from BR01 was taken by E. Robertson and stored in a plastic container in the dark at 2 ºC for later processing at SDU, Odense, Denmark.

Post-cruise results

(Data from Erik Kristiansen and Elizabeth Robertson)

Surface sediment metabolism

Anaerobic jar incubations of surface sediment (up to 12 cm depth) were returned to SDU. Jars were opened and the contents centrifuged to extract porewater from the sediment. Porewater constituents were then analysed. Depth-integrated rates were also used to calculate fluxes from each site which can be compared to data from whole-core experiments. Results indicate higher reactivity at Station 1 than Station 2 (Figure 10 and Figure 11). The ammonium production and sulfate reduction rates are low and are similar to those measured in the subsurface. Anomalies in CO_2 production (i.e. low CO_2 production when compared to the measured diagenic processes) may be due to loss of CO_2 into air space within the jars.

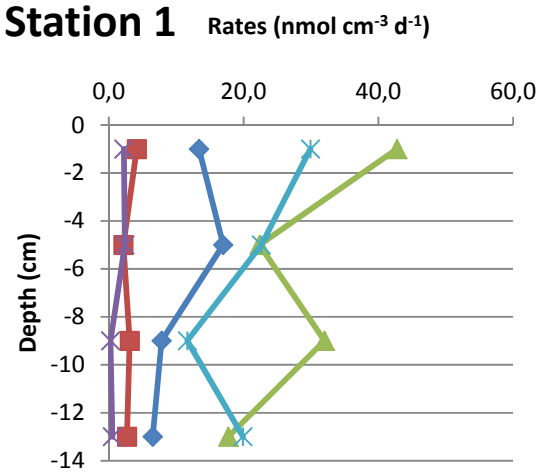


Figure 10 – Metabolite consumption rates for station 1 – see Figure 11 for legend.

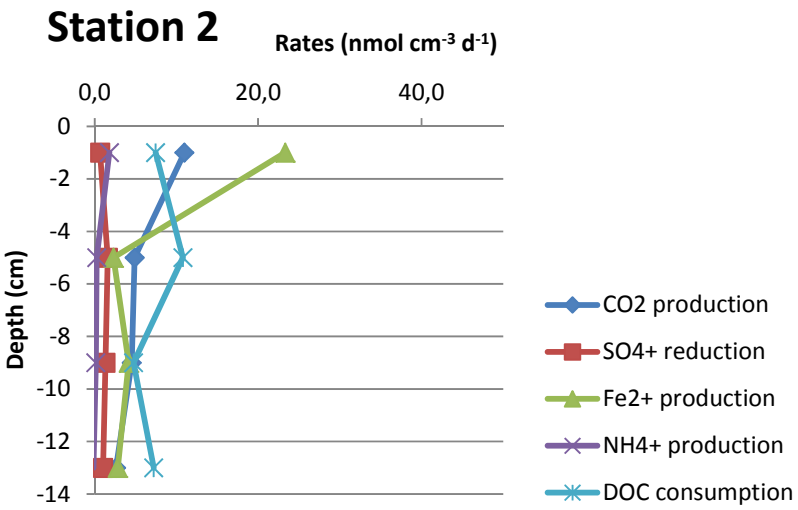


Figure 11 – Metabolite consumption rates for Station 2.

Oxygen microsensor profile repeat (Station 2)

Cores (sealed with overlying water) collected from station 2 were stored in a cold room (~5 ºC) at SDU and used to repeat oxygen profiles (and fluxes) measured on board (Figure 12). It was again shown that oxygen penetrated several centimeters in the sediment and fluxes were shown to be in a similar order of magnitude to those measured on board. The surface 1 cm was again shown to be the most active site.

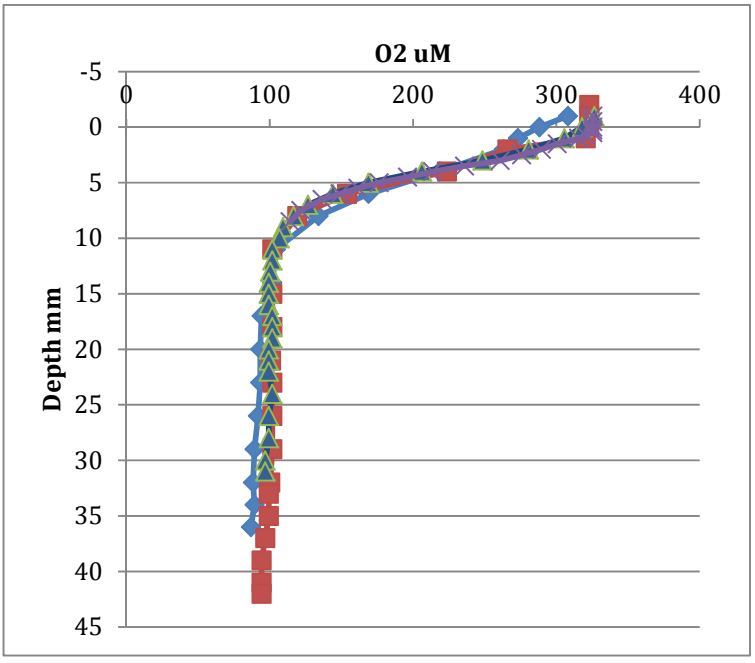


Figure 12 – Replicate microsensor O_2 profiles for Station 2 box core.

Nitrogen loss processes (Station 2)

At SDU, the cores from station 2 were sectioned (0-3cm and 3-6cm depth intervals) and sediment was packed into flow-through cores in order to determine the kinetics of denitrification as a function of nitrate concentration. Cores were sequentially flushed with seawater containing several concentrations of $^{15}NO_3^-$. Due to low permeability and activity of the sediment, the water flow rate was kept low and experiments were run for 24h (rather than 2-3h in previous studies). However, the resulting denitrification rates did not fall onto the expected Michaelis-Menten kinetics curve. It has been speculated that this is due to a shift in microbial community due to longer-term exposure to nitrate leading to great efficiency in nitrate use. It was clear, however that the surface 0-3cm had a greater potential denitrification activity.

Evidence of DNRA (about 1% of total $^{15}NO_3^-$ concentration added) was observed from the production of $^{15}NH_4$ during incubations, however this further complicates conclusions that can be drawn with regards to the partitioning between denitrification and anammox in N_2 production.

Benthic Fauna

Contributor: Henrik Christiansen

Quantifying the fauna

Several samples were taken from box cores retrieved from two stations in order to quantify the fauna.

The samples from the box cores were filtered through a 1 mm filter and all living fauna collected and roughly identified. Fauna samples were first conserved in formalin (4%), before being transferred to ethanol (70%) after 24 hours. All samples are stored for a more thorough identification at a later date.

From the box core BR01 (diameter 50 cm.) we took out two smaller cores (diameter 8 cm.) and filtered their contents through a 1 mm filter. All living fauna was collected and identified. From box core BR04, one core (diameter 8 cm) was sampled and filtered for living fauna. The entire box core BR05 was filtered for living fauna. From box core BR07, three smaller cores (diameter 8 cm) were taken and filtered for living fauna.

Station 1

Boxcore BR01
Raspailia sp.(porifera)
unidentified egg

Station 2

Boxcore BR04
Mysidae (perhaps *Hemimysis lamornae*)

Boxcore BR05
Dentalium Antalis entalis

unidentified Amphipod
3 *Ophelia limacina*
Polchaete (*Terebellinae*)
Notomastus latericeus
Nematoda
2 unidentified polychaetes
1 juvenile brittlestar
Linopsis aurita (bivalve)

Boxcore BR07
Core 1:
unidentified worm
unidentified thread
Core 2:
2 unidentified polychaetes
Core 3:
unidentified polychaete tube

Figure 13 - Left: *Antalis entalis*. Middle: *Mysidae*(maybe *Hemimysis lamornae*). Right: unidentified egg(Foto:Henrik Svaneberg Christiansen)

Figure 14: left: juvenile brittlestar Middle: unidentified worm. right: unidentified worm(Foto:Henrik Svaneberg Christiansen).

Figure 15:Left: unidentified polychaete tube. Middle: *Raspailia* sp.(*Porifera*).Right: unidentified polychaete.(Foto:Henrik Svaneberg Christiansen)

Benthic Fauna- Post-Cruise work

Contributor: Henrik Svaneberg Christiansen

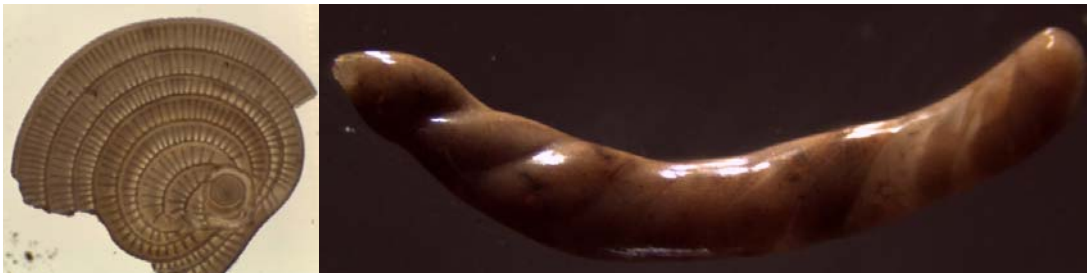
Identification of the fauna

Hyperammina elongata.

In the boxcore from both St.1 and 2 we found a quantity of 1-3cm. long tube-shaped structures, with a ball-shaped structure at one end. It seemed that they were constructed of sticky sediment from the surrounding area and it was not immediately possible to determine whether they contained any biological material. It has, on examination proved that it is species of Foraminifera ,*Hyperammina elongata.*
The classification is based upon: Loeblich, A.R., Jr., and Tappan, H., 1988, Foraminiferal genera and their classification. Van Nostrand, Reinhold Co. New York, Plate 32 Fig. 7-9.

Figur 1 *Hyperammina elongata* Brady, 1881.Foto:Henrik Svaneberg Christiansen

The specimen shown to the left in the photograph(Figur 2)below were also found at st. 1 and identified as foraminifera, the species *Discospirina italica* (Costa, 1856). The specimen shown to the right were found at st. 2 and also identified as Foraminifera, the species *Laevidentalina sp.*



Figur 2. left: Discospirina italica (Costa, 1856) Right: *Laevidentalina sp.* The classification is based upon: B. Brady et al . 1884: Report on the Foraminifera dredged by H.M.S. Challenger during the Years 1873-1876. .Foto:Henrik Svaneberg Christiansen

Unidentified egg found at st.1 Boxcore BR01.

Dissection of the unidentified egg found at st.1 Boxcore BR01 revealed an unidentified gastropod (Figure 3). The egg is 11.64 mm. long, 6.36 mm. thick. The gastropod shell is 6.67 mm long and 4.85 mm thick. The egg has a smooth surface without any identifiable structure, a transparent white / yellowish color. Despite the see-through appearance, the content could not be determined without dissection. The gastropod shell is white with a yellowish tinge. The gastropod is white and orange / yellowish and the shell is dextral and slightly damaged, probably during dissection. It has orthostrophic coiling with 4

coils, the last of which is approx. 2/3 of the height. The gastropod shell has faint stripes across the coiling, a relatively long thin keel and a opercula.

Figure 3 unidentified egg and gastropod found at st.1 Boxcore BR01. Photo: Henrik Svaneberg Christiansen

Foraminifera - st. 2

Of the top 6 cm of sediment core, samples were taken in every centimeter. These samples were sub sought under the microscope. The focus has been on the state of foraminifera, living, dead or fossil and the diversity and distribution in the different layers. The bulk of the sediment comprises of foraminifera tests. Three species of foraminifera seemed to be dominant. The most abundant of the three being Globigerina sp (Figure 4Figure 5).
A few specimen of *Ammomassilina* sp., *Psammosphaera* sp., *Brizalina sp. and Vaginulinopsis sp.(?)*were found (Figure 7). The foraminifera were clearly more degraded in the lower layers. The majority of foraminifera in the bottom layer were fragmented and partially covered by a reddish coating (Figure 6).

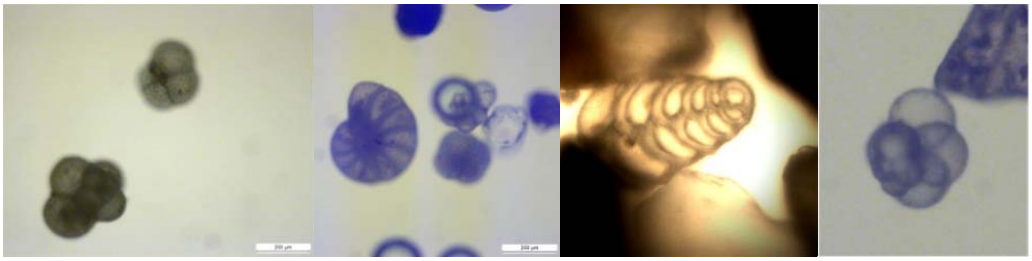


Figure 4pictures of foraminifera found in the sediment core at st. 2. pic1 &4 : *Globigerina sp.* Pic 2: *Polystomammina sp.*pic3: *Bolivina sp?* Photo: Henrik Svaneberg Christiansen

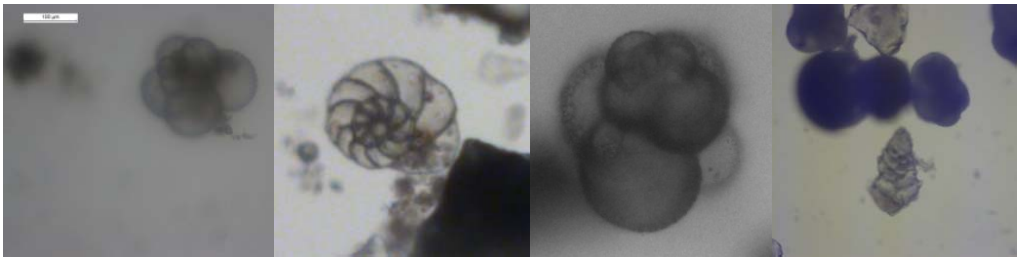


Figure 5pictures of foraminifera found in the sedimentcore at st. 2. pic1 &3 : Globigerina sp. Pic 2: *Polystomammina sp.* pic 4: *Bolivina sp?* the second photo from the left shows the reddish coating. .Photo: Henrik Svaneberg Christiansen

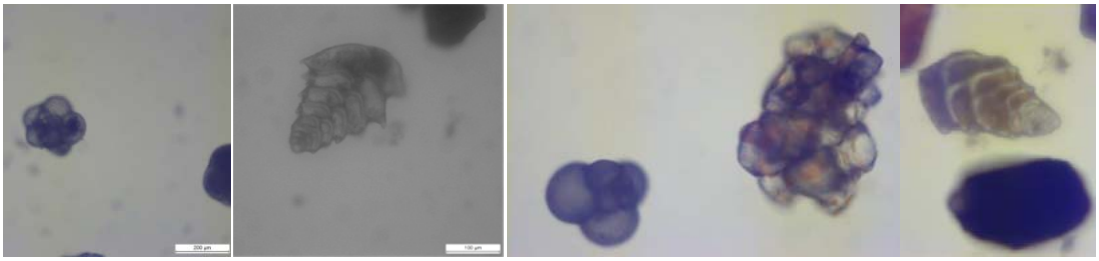


Figure 6. pictures of foraminifera found in the sedimentcore at st. 2. pic1 &3 : Globigerina sp. Pic 2 & 4: *Bolivina sp?* . the last two fotos from the left shows the reddish coating. Photo: Henrik Svaneberg Christiansen.

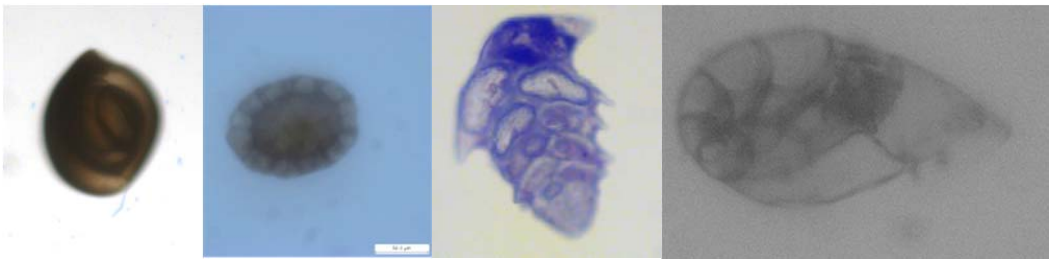


Figure 7. 1.Ammomassilina sp. 2.Psammosphaera sp. 3. *Brizalina sp* .(Brady, 1881) 4. *Vaginulinopsis sp. ?* Photo: Henrik Svaneberg Christiansen

The classification of the foraminifera are based upon: B. Brady et al . 1884: Report on the Foraminifera dredged by H.M.S. Challenger during the Years 1873-1876.

Biomass

The biomass of the following boxcores were determined:

Station 1-Boxcore BR01

Station 2-Boxcore BR04, BR05, BR07- Fauna core 1,2,3

In addition the biomass of *Hyperammina elongata.stuktures* were determined.

Future work

The identification of the rest of the samples, some are not possible because parts of the animals are missing and some demand a more thorough study (Figure 8).

Figure 8 some of the unidentyfied specimens. Photo: Henrik Svaneberg Christiansen

Figure 9 some other interesting finds, fish otoliths. Photo: Henrik Svaneberg Christiansen

Literature

Brady et al . 1884: Report on the Foraminifera dredged by H.M.S. Challenger during the Years 1873-1876.
Loeblich, A.R., Jr., and Tappan, H., 1988, Foraminiferal genera and their classification. Van Nostrand, Reinhold Co. New York, Plate 32 Fig. 7-9.

Marine Mammals

Contributor: Ruth F. Garcia

Standard methodology for marine mammal sightings was used while the RV DANA was in transect (at approximately constant bearing and constant speed). One experienced observer recorded data on cetacean presence at a height above sea level of between 14 and 16 metres. Periodic scans of the horizon were carried out with naked eyes and with the help of binoculars (8X42) covering an angle of approximately 90º from the bow to each side of the vessel. Environmental conditions were recorded every 15 minutes.

A total of 27.41 hours of effort were dedicated to the marine mammal survey. From these, 18.8 hours (~68%) corresponded to sea states above Beaufort 4 (~11-16 knots of wind), which has greatly compromised sighting conditions during the survey, specially during the three last days of the cruise (27th-29th September).

A total of 23 cetacean sightings and 38 individuals were recorded on-effort. These corresponded to at least 4 different species, as in one case positive identification of the species was not possible (Figure 16). In addition, three opportunistic sightings (off-effort) were recorded (Figure 16). These corresponded to a probable Minke whale (N61.01178, W15.22495), a probable group of white beaked dolphins (N61.00599, W15.0444) and a fin whale (N60.78333, W9.80000; corresponding to multi-core sampling station 2).

The most abundant species recorded was the fin whale (N=17, on-effort), with sightings of 1 to 3 individuals concentrated in deep waters between Iceland and Scotland. Fin whales produce high blows of up to 8m high what facilitates its localization at sea. Pods of killer whales were observed twice; in deep waters surrounding Iceland and around Shetland where it is a relatively common species. Common dolphins were recorded in one occasion during this cruise, in waters that due to their temperature represent the northern limit for their distribution. Minke whales were observed twice in Faxaflói Bay (Iceland) were they are present all-year-round.

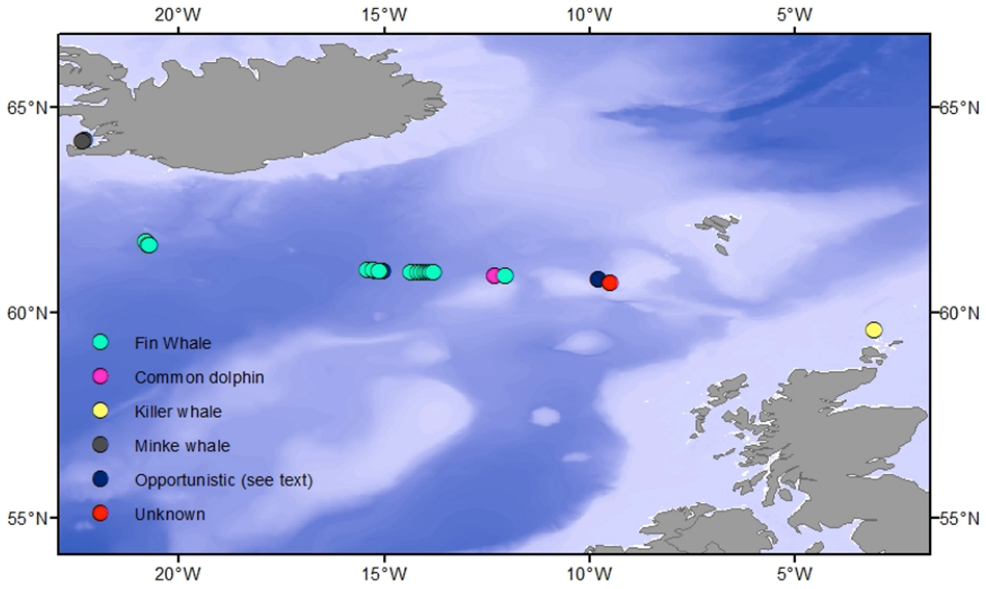


Figure 16 – Marine mammal sightings during the Dana 12-11 cruise.

Water Sampling, CTD, Plankton Nets

Contributors: Andrea Fischel, Ian Marshall, Christof Pearce

Pelagic Water Sample Collection

Although the focus of the Dana 12-11 cruise was the study of marine sediments, several pelagic water samples were also collected in order to survey live plankton communities, including diatoms and foraminifera. Furthermore, water samples were filtered for the extraction of DNA from pelagic prokaryotes.

At station 2, a conductivity-temperature-depth (CTD) device was cast from the surface to a depth of 742 m. The ocean floor was at a depth of 746 m. Water temperature varied from approximately 10.8ºC at the surface to 8.1ºC at 742 m, with a thermocline at the 90 - 110 m depth interval. Molecular oxygen concentrations ranged from approximately 5.8 mL/L at the surface to 5.2 mL/L at 742 m depth, with a sharp drop at the thermocline. Salinity was around 35.2 PSU throughout the water column, with a slight increase in salinity at the thermocline.

Water samples were collected at depths of 10 m, 80 m, 120 m, and 742 m. Sampling depths were chosen to represent the euphotic zone (10 m), just above and below the thermocline (80 m and 120 m) and bottom water, albeit high enough from the bottom to avoid sampling resuspended sediment (742 m). One liter from each sampled depth was collected for DNA extraction and nutrient analysis. 2.5 L was taken from the 10 m and 120 m samples for analysis of diatoms and plankton. 12 L was taken from the 742 m sample for analysis of foraminifera.

Samples for DNA extraction were stored in a refrigerator (~4ºC) and filtered within 12 hours of collection. Samples were filtered onto a 25 mm diameter 0.2 µm pore size GTTP filter. Water was filtered through the membrane either until the membrane clogged or 500 mL had been filtered. Duplicates were filtered for each sample with the exception of sample 2 (80 m depth) where, due to the relatively small volume filtered before clogging, a third filter was used to make the total volume filtered similar to the other samples (Table 3).

Table 3 – Pelagic Water Samples Collected for DNA Extraction

Sample	Depth	Replicate	Volume Filtered (mL)
1	10 m	1A	350
		1B	360
2	80 m	2A	220
		2B	260
		2C	240
3	120 m	3A	320
		3B	340
4	742 m	4A	500
		4B	500

Filters were stored at -20ºC immediately following filtration. Additionally, duplicate 2 mL subsamples of each depth were syringe-filtered through a 0.2 µm pore size filter and immediately stored at -20ºC.

Plankton Net

A plankton net survey was applied at Station 2 (DA12_11_2/2, water depth 742 m) to collect living marine microplankton. The aim of the study is the qualitative and quantitative analysis of living planktic foraminifera in the North Atlantic.

The plankton net (Figure 17) (diameter 25 cm, length 50 cm, mesh size 60 µm) was deployed in four different water depths: 20 m (Core ID: WP2_1), 60 m (Core ID: WP2_2), 150 m (Core ID: WP2_3) and 300 m (Core ID: WP2_4). The sample depths were defined based on the CTD profile from station 2.

Figure 17 – Plankton net deployment

Connected to a wire the plankton net was lowered to the desired water depth and pulled up to the surface after 30 seconds. The net was equiped with extra weight (5 kg) to support the vertical sinking in the water column. However, strong winds made vertical sampling difficult, so absolute water depth may vary +/- 10 m. Back on the surface the net was cleaned after every catch by washing the material out of the net with sea water. The sample material from each water depth was kept in filter paper and air-dried on board after sampling. The vertical water column was sampled from the surface to the end depth of the plankton net station. Each plankton net station consists of one to multiple catches in the same water depth: In the sample depth range of 0-20 m four catches were conducted. The material of the sample station in 0-60 m water depth consists of two catches, whereas the sample station in 0-150 and 0-300 m water depth consists of only one catch.

Plankton slides with material from each station were prepared on board the research vessel and briefly analysed with a light transmitting microscope. Diatoms, dinoflagellates, copepods, and foraminifera could be distinguished.

The samples will be analysed at Aarhus University, Department of Geoscience after the cruise. Foraminiferal abundance and faunal composition in surface water masses will be projected from the sample WP2_1, 0-20 m water depth. The faunal composition of subsurface water masses is presented in the sample 0-60 m (WP2_2). The assemblage for thermocline waters will be defined in sample material from 0-150 m water depth (station WP2_3). Intermediate water mass fauna is preserved in the material from sample station WP2_4, 0-300 m water depth. Additionally, the faunal composition living in the bottom water is represented in the material filtered from 12 L bottom water. This was collected with the CTD at Station 2, at a depth of 742 m.

Appendices

Appendix 1: Stations and Positions

			At sea level		At bottom		Water depth	UTC		CTD cast	Status
Station	Date	Core i.d.	Latitude	Longitude	Latitude	Longitude	m	At sea level	At bottom	ID	
Da 12_11_1	250912	BR 01	61.37.040 N	020.43.266 W	61.37.344 N	020.42.685 W	2122.0	09:25:47	10:07:10	None	Success
Da 12_11_1	250912	GC 01	61.36.952 N	020.43.316 W	61.36.536 N	020.42.164 W	2120.3	13:25:39	14:20:18	None	Success
Da 12_11_1	250912	BR 02	61.37.084 N	020.43.522 W	61.36.633 N	020.42.478 W	2130.6	15:17:02	15:58:53	None	Failed
Da 12_11_2	270912	BR 03	60.46.754 N	009.47.948 W	60.46.897 N	009.47.923 W	743.2	06:06:39	06:19:08	CTD 01	Failed
Da 12_11_2	270912	BR 04	60:47:070 N	009.47.826 W	60.47.217 N	009.47.750 W	747.5	06:33:58	06:46:04	CTD 01	Success
Da 12_11_2	270912	CTD 01	60.46.702 N	009.48.051 W	60.47.191 N	009.47.431 W	746	07:13:51	08:16:52		Success
Da 12_11_2	270912	GC 02	60.46.837 N	009.47.961 W	60.47.050 N	009.47.647 W	744.2	08:33:17	08:46:00	CTD 01	Failed
Da 12_11_2	270912	GC 03	60.46.708 N	009.47.931 W	60.46.943 N	009.47.624 W	742.4	09:18:47	09:36:41	CTD 01	Succes
Da 12_11_2	270912	BR 05	60.46.751 N	009.47.846 W	60.46.921 N	009.47.591 W	741.8	10:35:50	10:48:59	CTD 01	Success
Da 12_11_2	270912	BR 06									Failed
Da 12_11_2	270912	BR 07	60.47.091 N	009.46.994 W	60.47.193 N	009.46.833 W	744.4	11:43:17	11:56:07	CTD 01	Success
Da 12_11_2	270912	GC 04	60.46.786 N	009.47.724 W	60.46.842 N	009.47.697 W	741.3	12:24:43	12:38:02	CTD 01	Failed
Da 12_11_2	270912	WP2_1	60.46.880 N	009.47.685 W	60.46.796 N	009.47.778 W	741.3	13:03:52	13:20:45	CTD 01	Success
Da 12_11_2	270912	WP2_2	60.46.788 N	009.47.798 W	60.46.840 N	009.47.937 W	742.1	13:22:16	13:34:55	CTD 01	Success
Da 12_11_2	270912	WP2_3	60.46.854 N	009.48.109 W	60.46.883 N	009.48.23 W	744.8	13:43:50	13:50:07	CTD 01	Success
Da 12_11_2	270912	WP2_4	60.46.852 N	009.48.317 W	60.46.850 N	009.48.868 W	745.6	13:52:52	14:16:34	CTD 01	Success

BR: Brutalis Boxcorer

GC: Gravity corer

CTD: Conductivity, Temperature and depth

WP2: Plancton net for collection of live copepods WP2

Appendix 2: Box Core Descriptions

Core: DA 12-11/1 BRO1, Tube A

Location: N/61.37.344 W/020.42.685

UTC: 25-09-12 10:07:10

Water depth: 2122.0 m

Core lenght: 0.24 m

Depth (m)	Colour	Description
0.00-0.04		Oxidized layer. Iron.
0.04-0.24		Olive grey silty clay

Core: DA 12-11/1 BRO1, Tube B

Location: N/61.37.344 W/020.42.685

UTC: 25-09-12 10:07:10

Water depth: 2122.0 m

Core lenght: 0.24 m

Depth (m)	Colour	Description
0.00-0.03		Oxidized layer.
0.03-0.24		Olive grey silty clay

Core: DA 12-11/2 BRO4

Location: N/60.47.217 W/009.47.750

Water depth: 747,5 m

UTC: 27-09-12 06:46:04

Core lenght: 0.26 m

Depth (m)	Colour	Description
0.00-0.08		Foram ooze
0.08-0.16		Bioturbated: mixed clay and ooze
0.16-0.26		Reddish clay

Core: DA 12-11/2 BRO7

Location: N/60.47.193 W/009.46.833

Water depth: 744,4 m

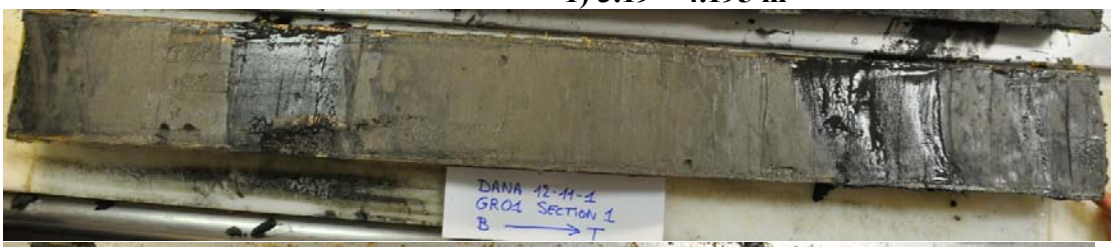
UTC: 27-09-12 11:56:07

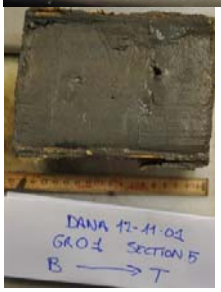
Core lenght: 0.20 m

Depth (m)	Colour	Description
0.00-0.08		Foram ooze
0.08-0.16		Bioturbated: mixed clay and ooze
0.16-0.20		Reddish clay

Appendix 3: Gravity Core Descriptions

Core: DANA 12-11-1 GC01
Location: 61.36.536 N/ 020.42.164 W (61.6089333,-20.7027333)
Water depth: 2120.3 m
UTC: 25-09-2012 14:20:18
Core lenght: 419.5 m **Sections:** **5) 0 – 0.16 m**
4) 0.16 – 1.17 m
3) 1.17 – 2.18 m
2) 2.18 – 3.19 m
1) 3.19 – 4.195 m





Core:DANA 12-11-1 GC01

Location: 61.36.536 N/ 020.42.164 W

Water depth: 2120.3 m

UTC: 25-09-2012 14:20:18

Core lenght: 419.5 m
Sections: 5) 0 – 0.16 m
4) 0.16 – 1.17 m
3) 1.17 – 2.18 m
2) 2.18 – 3.19 m
1) 3.19 – 419.5 m

Section	Depth (m)	Colour	Description
5	0.00-0.02 cm	4/2	Oxidised layer, fine clay – silt Very soft mud, much higher water content
	0.02-0.155	3/1	Homogenous clay-silt, small black particles near surface + small spot of oxidation near the oxidised layer
	0.155-0.16	2.5/1	Fine clay-silt, slightly darker layer
4	0.16 – 0.27	2.5Y – 3/2 very dark greyish brown	Silty clay
	0.27 – 0.34	2.5Y – 3/2 and 2.5Y – 2/2 (black)	Silty clay with black patches of siltier clay (pattern suggests bioturbation)
	0.34 – 0.415	2.5 – 2/2 black	Silty clay (ash layer?) Tephra particles visible in microscope
	0.415 – 0.785	2.5Y – 3/2 Very dark greyish brown	Silty clay with darker patch at 0.45m: inclusion of ash material? Bioturbation?
	0.785 – 0.88	2.5Y – 3/2 and 2.5Y – 2/2 (black)	Silty clay with black patches Bioturbation?
	0.88 – 1.17	2.5Y – 3/2 Very dark greyish brown	Silty clay Some tephra particles visible Forams sampled at 1.01

3	**1.17- 1.65**	**3/1**	**Homogenous clay-silt**
	1.65 – 1.735	**3/1**	**Homogenous clay-silt** **2-3 cm wide patches Fe/Mn**
	1.735 – 1.87	**3/1**	**Homogenous clay silt**
	1.87 – 1.94	**3/1**	**Shell layer mixed into clay-silt** **Shell sample taken at 1.93 – 1.94 m**
	1.94 – 2.01	**3/1**	**Homogenous clay-silt with long (8cm) Fe/Mn mark**
	2.01 – 2.15	**3/1**	**Homogenous clay-silt**
	2.15-2.18	**3/1**	**Homogenous clay-silt with small Fe/Mn mark**
2	**2.18 – 2.28**	**2.5Y 2/0**	**Olive grey silt with fine sand**
	2.28 – 2.37	**2.5Y 2/0**	**Same with layers of white shell fragments**
	2.37 – 2.43	**2.5Y 2/0**	**Same with shells and dark ash**
	2.43 – 2.49	**5Y 2.5/1 darker**	**Dark grey grading to black ash layer with striations**
	2.49 – 2.55	**Olive gray**	**Clayey silt** **2.51 sample taken for microscope (diatoms present)**
	2.55 – 2.57	**Olive grey**	**Clayey silt with shell fragments in single layer**
	2.57 – 2.90		**Same with dark patches, bioturbation?** **Forams visible**
	2.90 – 3.02		**Reworked, bioturbated dark lense of ash (confirmed in microscope)**
	3.02 – 3.19	**Olive grey**	**Silty clay with one darker layer at 3.12 (bioturbation?)**
1	**3.19 – 3.33**	**Dark grey 5Y 4/1 with darker areas**	**Olive dark silty clay intercalated with darker dots, bioturbated?** **Small white dots, shell? Especially at 3.3 and 3.19**
	3.33 – 3.47	**Black to very dark grey 5Y 2.5/1 Lighter grey 5Y 4/1 and 5Y 2.5/1**	**Black silt laminated with lighter grey, silt clay** **Turns darker downcore, silt to fine sand** **Black** **ASH LAYER**
	3.47 -3.79	**5Y 4/1**	**Mainly homogenous olive grey silty clay with slightly darker spots in the entire section** **3.56 a yellowish band with small with dots scattered, little bioturbation**

	3.79 – 3.90	**Dark grey 5Y 4/1 with darker areas**	**Pronounced intercalation of black and grey Bioturbation Silty clays Black seems coarser Grey seems brighter downwards as the black stuff becomes more prominent**
	3.90 – 3.99	**Black 5Y 2.5/1**	**Homogenous silty black layer with ash shards Silty to fine sand black layer ASH LAYER**
	3.99-4.12	**Dark grey to olive 5Y 4/1**	**Generally homogenous dark grey layer which looks like a silty clay Sparse black dots and lines**
	4.12 – 4.195	**Olive grey 5Y 4/1 at top turns darker to black 5Y 2.5/1 at bottom**	**Silty clay with larger grains, bioturbated grey and black intercalated.**

Core: DANA 12-11-2 GCO3
Location: 60.46.943 N/ 009.47.624 W (60.7822383,-9.79366666)
Water depth: 742.4 m
UTC: 27-09-12, 09:36:41
Core length: 5.89 m
Sections: 6) 0.0-0.84 m
5) 0.84-1.855 m
4)1.855-2.865 m
3) 2.865-3.87 m
2) 3.87-4.88 m
1) 4.88-5.89 m

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3) 2.865-3.87 m
2) 3.87-4.88 m
1) 4.88-5.89 m

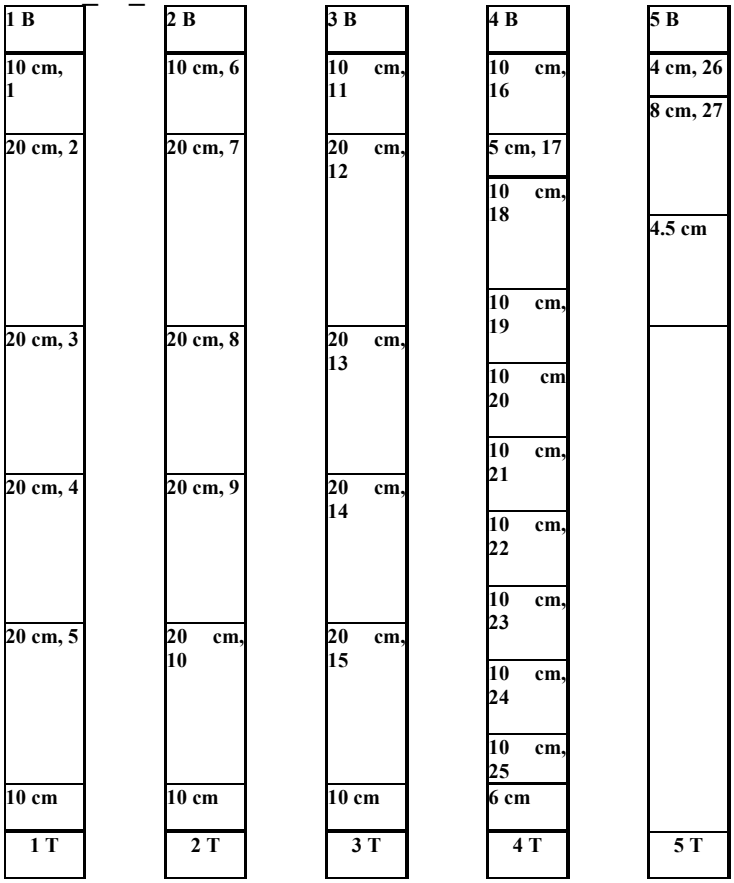
Section	Depth	Colour	Description
6	0.0-0.07	2.5y-7/2 (yellow-grey) 5y-7/1 (light grey) 5y-4/1 (dark grey)	Forams, grey with dark grey lenses, numerous broken shell fragments
	0.07-0.16	10yr-5/2 (reddish grey – at bottom) 10 yr-5/1 (grey-at top)	Silty clay with burrows (containing forams)
	0.16-0.84	10yr-4/1 (dark grey)	Homogenous silty clay, dropstone at depth 0.34 m, 12 cm long
5	0.84-1.855	10yr-4/1 (grey)	Silty clay with coarse grains, shells at 1.46 m and 1.36 m, small shell fragments throughout core
4	1.855-1.975	10yr-4/1 (grey)	Silty clay
	1.975-1.995	10yr-5/1 (light grey)	Silty clay (contains calcium carbonate?)
	1.995-2.115	10yr-4/1 (grey)	Silty clay
	2.115-2.135	10yr-5/1 (light grey)	Silty clay (calcium carbonate?)

	2.135-2.865	**10yr-4/1 (grey)**	**Silty clay**
3	**2.865-2.895**	**10yr-4/1 (grey)**	**Silty clay with some sand**
	2.895-2.985	**10yr-4/1 (grey)**	**Silty clay**
	2.985-3.00	**10yr-4/2 (brownish grey)**	**Silty clay**
	3.00-3.55	**10yr-4/1 (grey)**	**Silty clay with small shell fragments and wood/coal at 3.31 m (single chunk broken into pieces in place)**
	3.55-3.78	**10yr-4/1 (grey)**	**Silty clay, coarsening downwards (with fine sand) and shell fragments**
	3.78-3.87	**10yr-5/1 (light grey)**	**Silty/sandy clay(fine-grained sand), with darker patches and many shell fragments**
2	**3.87-3.91**	**10yr-4/1 (grey)**	**Silty clay with sand**
	3.91-3.93	**2.5y-5/2 (greenish grey)**	**Silty clay**
	3.93-3.95	**10yr-4/1**	**Silty clay with sand and shell fragments**
	3.95-4.0	**10yr-5/1**	**Silty clay with sand and shell fragments**
	4.0-4.36	**10yr-4/1**	**Silty clay with shell fragments, rock at 4.32 m depth**
	4.36-4.42	**10yr-5/1**	**Silty clay with sponge material**
	4.42-4.60	**10yr-4/1**	**Silty clay with sponge and shell fragments, alternating clay/sponge layers**
	4.60-4.66	**10yr-4/1**	**Silty clay with medium-grained sand**
	4.66-4.88	**10yr-4/1**	**Silty clay with sponge at 4.71-4.73 m**
1	**4.88-4.89**	**10yr-4/1**	**Silty clay**
	4.89-4.93	**2.5y-5/0**	**Sponge with clay and shell fragments with high water content**

	4.93-4.935	**5G-6/2**	**Silty clay**
	4.935-5.035	**10yr-5/1**	**Silty clay with sparse shell and sponge fragments**
	5.035-5.195	**5Y-6/1**	**Silty clay with abundant sponge material, shell fragment, and some sand**
	5.195-5.30	**5Y-5/1**	**Sandy, silty clay with shell fragments**
	5.30-5.38	**5Y-7/1 (light grey)**	**Silty clay with some sand and shell fragments**
	5.38-5.43	**5Y-7/1, 5GY-4/1**	**Bioturbated at top with previous light grey layer, clay**
	5.43-5.83	**10YR-5/1**	**Silty clay with shell fragments, coarse-grained layer at 5.48 m, dropstones at 5.72 m, 5.74 -5.77 m**
	5.83-5.89	**2.5y-5/2**	**Clayey sand with shell fragments**

Appendix 3: Subsurface Biogeochemistry Sampling Scheme

Da 12_11_1 GC 01



Stipulated lines indicate depth of porewater and solid phase sampling. Total length of core 415 cm.

Station: Da 12_11_1 GC 01

Comment:

Length of core: 415 cm	Bottom temp: n.d.

Bag#	Depth, cmbsf
1	407.5
2	387.5
3	367.5
4	347.5
5	327.5
6	307.5
7	287.5
8	267.5
9	247.5
10	227.5
11	207.5
12	187.5
13	167.5
14	147.5
15	127.5
16	107.5
17	102.5
18	92.5
19	82.5
20	72.5
21	62.5
22	52.5
23	42.5
24	32.5
25	22.5
26	12.5
27	4.5

Da 12_11_2 GC 03

1 B	2 B	3 B	4 B	5 B	6 B
10 cm, 28	10 cm, 33	10 cm, 38	10 cm, 43	10 cm, 48	10 cm, 53
17 cm, 29	20 cm, 34	20 cm, 39	20 cm, 44	20 cm, 49	10 cm, 54
					10 cm, 55
23 cm, 30	20 cm, 35	20 cm, 40	20 cm, 45	20 cm, 50	10 cm, 56
					10 cm, 57
20 cm, 31	20 cm, 36	20 cm, 41	20 cm, 46	20 cm, 51	10 cm, 58
					10 cm, 59
20 cm, 32	20 cm 37	20 cm, 42	20 cm, 47	20 cm, 52	10 cm, 60
					4.5 cm
10 cm	10 cm	10 cm	10 cm	10 cm	
1 T	2 T	3 T	4 T	5 T	6 T

Stipulated lines indicate depth of porewater and solid phase sampling. Total length of core 584.5 cm. Section 5 was dropped on floor after windows were cut, but it looked fine and undamaged when sampled.

Station: Da 12_11_2

GC 03

Date: 270912	Water depth: 742.4 m

Length of core: 584.5 cm	Bottom temp: ca. 7.6°C

Comments to solid phase subsampling:

Bag#	Depth, cmbsf	Specific	CH4 bubbled	Sediment text	Other
28	574.5	CH4 0.20 cc		very dry	
29	557.5	CH4 0.45 cc		very dry	
30	534.5			very dry	
31	514.5			dry	hairy stuff = sponges
32	494.5		+	less dry	hairy stuff = sponges
33	474.5		+	nice mud	hairy stuff = sponges
34	454.5		+	nice mud	hairy stuff = sponges
35	434.5		+	nice mud	hairy stuff = sponges
36	414.5		+	nice mud	
37	394.5	Density with air	+		
38	374.5		+		
39	354.5		+	nice mud	
40	334.5		+	nice mud	
41	314.5		+	nice mud	
42	294.5		+	nice mud	
43	274.5		+	nice mud	
44	254.5		+	nice mud	
45	234.5		+	nice mud	
46	214.5		+	nice mud	
47	194.5		+	dryer sed	
48	174.5		+	nice mud	
49	154.5		+	nice mud	
50	134.5		+	nice mud	
51	114.5		+	nice mud	
52	94.5		less	nice mud	
53	74.5		-	nice mud	
54	64.5		+	nice mud	
55	54.5		+	nice mud	
56	44.5		+	nice mud	
57	34.5		+	nice mud	
58	24.5		+	more clayish	
59	14.5		+	foram layer	
60	4.5		+	foram layer	

Box Core BR01 Sampling Scheme

Surface sediment

	Da
Station:	12_11_1
Date:	250912

	ID
RL:	
Brutalis:	**01**

#	Pore water Depth, cm	Solid phase Depth, cm	Remarks
108	2	2	
107	4	4	
106	6	7	
105	8	10	
104	12	15	
103	16	19	
102	20	23	
101	24		0.5 cm away from stopper - sampling not possible for solid phase, but pw sampled

Box Core BR04 Sampling Scheme

Surface sediment

Station: Da 12_11_2

Date: 270912

	ID
RL:	
Brutalis:	04

#	Depth, cm	Remarks
114	2	AS surf, cell counts+RNA/DNA in eppendorf tubes
113	4	Cell counts+RNA/DNA in eppendorf tubes
112	6	Cell counts+RNA/DNA in eppendorf tubes
111	8	Cell counts+RNA/DNA in eppendorf tubes
110	12	Cell counts+RNA/DNA in eppendorf tubes+SRR
109	16	Cell counts+RNA/DNA in eppendorf tubes+SRR

Appendix 4: CTD Profiles