Preface

The expedition ARK XIX/3 with the German icebreaking RV "Polarstern" was jointly organized between the Alfred Wegener Institute for Polar and Marine Research (AWI) and the Institut Français de Recherche pour l'Exploitation de la mer (IFREMER), the latter providing the unmanned deep-sea submersible "Victor 6000".

AWI and IFREMER offered this unique combination of infrastructure in 2003 to European scientists to permit access on advanced technology in marine research to a broader community. Therefore, this cruise was not only a milestone in the Franco-German cooperation but also an important contribution to the European marine research initiatives.

All still pictures and videos taken with "Victor 6000" during the expedition "VICTOR IN THE NORTH" are joint property of AWI and IFREMER with copyright by IFREMER. This material can be used for scientific purposes with the indication of IFREMER's copyright. It would be very much appreciated if the joint effort of AWI and IFREMER in organising the cruise ARK XIX/3 would be mentioned in the acknowledgements of any future publication written on the basis of material collected during the expedition. Any commercial or other than scientific use of either pictures or videos collected with "Victor 6000" needs the written formal approval of IFREMER.

The entire cruise report is also available in digital format on a CD-ROM attached to this booklet because many of the pictures and graphs are in colour. All hand written dive log files are permanently stored at the AWI. For a certain period of time the cruise diary will be still accessible via the internet at www.polarstern-victor.de.

Table of contents

Appendix

The ARK XIX/3 expedition

A. 1 Itinerary and summary ARK XIX/3
Klages, M., Thiede, J., Foucher, J.-P.

During the third leg of RV "Polarstern" expedition ARK XIX/3 the French deep-sea ROV (Remotely Operated Vehicle) "Victor 6000" was onboard. Shiptime demand was so high that the cruise leg was separated into three sublegs in order to make "Polarstern" and "Victor 6000" accessible to as many European research groups as possible. Three geographical areas with different scientific objectives were investigated: (i) the Porcupine Seabight and the Porcupine Bank southwest of Ireland with focus on deep-water corals(Fig. A1-1), (ii) the Håkon Mosby Mud Volcano (HMMV) northwest of Norway at about 1250 m water depth where the greenhouse gas methane enters the hydrosphere (Fig. A1-2), and (iii) the AWI long-term deep-sea station "Hausgarten" west of Svålbard at 2600 m water depth where causes and effects of physico-chemical gradients at the sediment-water interface are studied in detail with regard to biodiversity in Arctic deep-sea sediments (Fig. A1-3).

After departure from Bremerhaven in the early morning of the 23rd of May "Polarstern" headed to Brest harbour for installation of the ROV which lasted from 25th of May until 1st of June. The 43rd Board meeting of the AWI took place onboard "Polarstern" in transit to Brest. The first visit of "Polarstern" in Brest was used to introduce high delegates of the German and French ministries for science and technology into the results and perspectives of the French-German cooperation in the field of marine and polar research.

Over 40 marine scientists from institutions in Ireland, Belgium, the UK, France and Germany were participating the first cruise leg of this expedition. They have completed an intensive study program on Irish coral locations using “Victor 6000”, an unmanned deep-sea remotely operated vehicle that can dive to 6000 m water depth, weighing about 4.6 tons equipped with cameras and manipulators that allow the collection of samples and data with unprecedented precision.

It was cloudy and windy as "Polarstern" left the port of Brest early in the morning of the 2nd of June. While heading towards the first working area in the Porcupine Seabight some scientific instruments were activated for some trials and calibration. Soon after breakfast the new scientific party was introduced to the rules onboard and the working schedule of the next few days. After some discussions the laboratories onboard were allocated to different working groups and soon after the various researchers started to install and test their equipment, because first station work was scheduled for the morning of the day after.

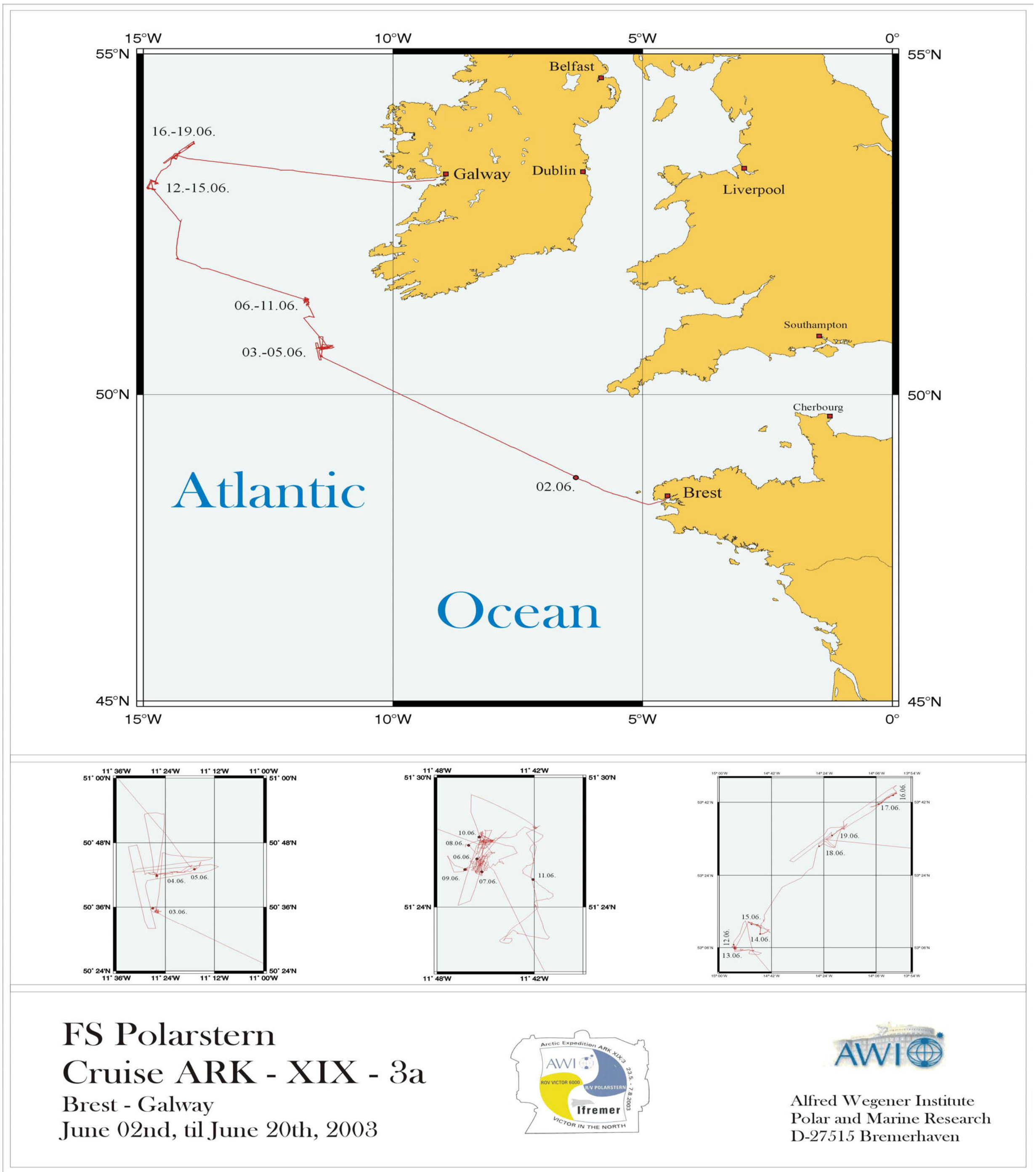


Fig. A1-1: Cruise track of "Polarstern" from Brest to the Porcupine Seabight and Porcupine Bank during ARK XIX/3a.

On the 3rd of June the first station work started. After a CTD profile was made, we deployed an underwater beacon at 1600 m water depth in order to calibrate our ultra short baseline navigation system "Posidonia". This system is necessary for precise positioning and navigation of the "Victor 6000" during the dives. In the afternoon the first two Multicorer stations were sampled.

In the early morning of the next day at about 4 am "Victor 6000" was deployed for the first time during our expedition. At 1600 m water depth a multibeam echosounder survey along a deep water canyon started. However, after several hours of proper operation the signal of the underwater beacon necessary for positioning failed and had to be replaced by a spare part. In the meantime we worked on further video guided multicorer casts. In the early evening the ROV was sent back to the canyon and started its mission. The positioning system worked properly and the hired multibeam echosounder produced good data.

During the morning the weather became as poor as predicted by the meteorologist onboard. Wind speed of about 8 Beaufort and a rough sea state forced us to recover the "Victor 6000" for safety reasons. At 1 pm an actual satellite photograph of our area showed us that it was unlikely to possibly deploy the ROV again within the next hours. Station work originally scheduled for the next days was therefore started. Work with the multicorer at various locations lasted the entire night.

At one of the first the regular scientific lectures onboard, scientists from Belgium and Ireland reported on our next area of investigation the Belgica mound province. It was intended to carry out a second multibeam survey in that area at a specific mound location, the so called "Moira mounds". The weather became better during the night allowing us to undertake the microbathymetry survey over the "Moira mounds". At 11 am "Victor 6000" was deployed and the multibeam echosounder installed on the vehicle sent back good data on seabed structure and morphology. In the afternoon the wind speed increased considerably up to 7-8 Beaufort. The track lines surveyed by "Victor 6000" were rather close together requiring similar small scale navigation of the "Polarstern" at the surface. The combination of low speed through the water, high wind speed and changing the position of the vessel in an area less than 2 square kilometres caused some problems. For about three hours the ship operated therefore in a so called station keeping mode and the multibeam survey was interrupted. In the meantime a video inspection of the seafloor and the benthic communities living at about 1000 m water depth was carried out. At 9 pm the wind speed was much lower than before and we proceeded with the multibeam survey again shortly before being interrupted due to strong bottom currents which hampered the "Victor 6000".

The microbathymetry survey of the "Moira mounds" was successfully completed on Saturday afternoon. Before the end of the dive a pre-site survey across the summit of the Galway mound was carried out in order to identify and select appropriate locations for a lander and several current metres to be deployed on Sunday morning. After deployment it was planned to use the ROV to locate them at the seafloor and to move them to different locations around the "Galway mound". Therefore, the module containing the multibeam sonar was disconnected from "Victor 6000" and another module allowing sampling and landing at the seabed was attached during the night. At the same time benthos samples were taken using the giant box corer, a heavy grab which takes a representative square sample of the seafloor of 50 by 50 cm. This was the first of a number of such samples and contained living corals, sponges, crustaceans and other invertebrates. Such single point samples will help the scientists, for example, to identify individuals observed in the video transects and still photographs to species level.

On Sunday morning the lander and current metres were deployed using the winches of "Polarstern". Subsequently, the ROV started to search for them which lasted less than one hour. After location pictures, showing the environment in which the lander was standing, were taken and the various current metres became distributed. During the night the wind increased again and it was decided to abort the dive. The final tracks for video surveying and mosaicking, the latter a technique were overlapping video images are overlain by computer software to get long stripes of seafloor images, was scheduled for Monday afternoon under the expected better weather conditions.

During the night of Sunday 8th June and all day Monday the box corer was used for an intensive quantitative sampling programme of preselected seabed sites. A selection of the live material from the box corer samples was immediately transferred to aquaria and placed in a cooled laboratory container onboard where the fauna was kept alive at about 8 °C water temperature until transfer into larger aquaria in Galway at the end of the cruise leg. In between box corer deployments several CTD casts were executed and the 38 kHz fisheries echosounder used to locate potential fish shoals which may aggregate above the mounds.

Soon before midnight the "Victor 6000" was sent down to the seafloor again to continue with the dive which had been aborted the previous day. Tuesday the 10th of June was fully occupied by this "Victor 6000" dive which lasted about 36 hours in total. After deployment during the night the ROV started with a video transect at around 900 m water depth. Flying at an altitude of about two meters above the seabed a predefined dive track was followed to obtain video material of the coral communities and reveal their patterns of distribution. Where animal aggregations of special scientific interest were encountered the ROV was directed closer to the seafloor to take high resolution digital still photographs. At the scientific lecture on Tuesday evening all participants of the cruise were informed that an estimated 60 percent of all deep-water corals occurring along the European continental margin are concentrated in Irish waters.

Before the end of the dive which had started in the early morning of June 10th the ROV was navigated towards the last few current meters waiting repositioning from the initial deployment site on the "Galway Mound". In order to navigate back to this site and locate the current meters the accurate underwater navigation systems of "Polarstern" and "Victor 6000" including the ultra short baseline system were put to the test and successfully demonstrated their ability to navigate to small objects such as these current meters on the deep seabed. The ROV proceeded to transport each current meter to its individual station around “Galway Mound”. These current meters were preprogrammed to do continuous measurements of current speed and direction around the mound until summer 2004. Scientists hope that this kind of data will help to answer open questions concerning mound formation and distributional patterns of the deep water corals.

Following recovery of the ROV at 1 pm on 11th of June we left the Porcupine Seabight and steamed to the next area of investigation, about 150 nautical miles to the northwest. During transit to the NW Porcupine Bank two further box corers were taken at 300 m water depth to ground truth existing data sets. We then proceeded to our next waypoint in the northwestern area of the Porcupine Bank at 53 ° North and 14° 48' West. In the early morning we passed through the outer edge of a deep where increased wind speed caused stronger pitch and roll movements of "Polarstern" than before.

Fishing vessels from various countries operate in the area of the Porcupine Bank and several of them were observed as echoes on the radar screens on the bridge, some were even close enough to be sighted by eye. The impact of this fishing activity was also being studied as part of the working programme of some of the Irish scientists onboard who are seeking to obtain quantitative data in this area on the effect of bottom trawling on the benthic communities.

After the last "Victor 6000" dive crossing the "Twin mounds" on Friday the 13th the vehicle was recovered in the morning. Biological samples taken during the survey with the manipulator arms of the ROV were successfully transferred into either a cooled laboratory container or dry labs as required. However, during the dive several alert messages had indicated an insulation problem with the "Victor 6000" so after recovery the engineers started to work immediately to identify the source of this problem. It was decided to change the tether cable which was the suspected cause of the problem. The spare cable was installed during the late afternoon; however, the following system check indicated that there was no communication between the ROV and the depressor. Since the tether cable has several fibre optic cables inside, the engineers switched the communication data link from one to the other. This time consuming procedure lasted until midnight. While repairing the "Victor 6000" system several CTD casts were carried out at stations along various mounds in the vicinity. Some complementary 38 kHz echo sounder profiles were also on our station list before the next dive of the ROV.

Another operation of the ROV took place at the so called "Giant Mound Cluster", a group of several mounds close together on the Porcupine Bank followed by a survey course over the "Scarp mounds" at about 800 m water depth. This microbathymetry survey at altitudes above seafloor of about 10 metres was from time to time interrupted by video surveying the seafloor at closer distance. The weather conditions were favourable to continue this dive from Sunday until Tuesday evening. Dive operations of about three days are possible without any problems with such a work-class ROV. This is one of the main advantages in using ROVs instead of manned submersibles in deep-sea research because manned vehicles are much more time limited in their operation.

Shortly after the end of the "Scarp mound" mission the wind increased considerably as predicted by the meteorologist onboard. Wind speed around 8 Beaufort would have caused severe problems during the recovery operation. Until 5 o'clock in the morning such wind speeds were measured – by far too high for save deployment and operation of a ROV. In order to complete our data set we decided therefore to operate other gears, used the ship borne multibeam and sediment profiling sonar system together with the ship borne fishery echosounder. At 4 pm – the wind speed did already decrease during the morning but the sea state needed some hours more to calm down – "Victor 6000" was deployed for the last dive at the "Hedge mounds" during this cruise leg. On Thursday the wind increased suddenly as the swell did. The recovery of "Victor 6000" from its last dive became rather difficult. Because of the experience of the 1st officer and his crew on deck, the well trained ROV pilots and the officers on the bridge we got the ROV safely out of the water.

On Friday morning the 20th of June we arrived in Galway and the first part of this cruise leg was finished. To present the preliminary results of this European expedition a press conference was held onboard "Polarstern" followed by a reception for invited guests some of them representing institutes having participants onboard.

Weather conditions over the last few weeks would have seriously curtailed the dive programme on a smaller ship. However, the "Polarstern" permitted a series of dives to take place. More than 100 hours of high-resolution video imagery have been shot on the seafloor and many samples collected over more than 100 km^2 of seafloor. Between dives systematic surveys have been conducted by means of grabs, multicorer (precision sediment sampler), CTD (water profiler) and ship borne sonar systems mounted on the "Polarstern".

Shortly after the last participants of the first cruise leg did leave "Polarstern" the work onboard went on and the first containers with the equipment of the new scientists expected to embark in Tromsø were opened after leaving Galway in the afternoon of 20th of June. The material was stored in various laboratories to ensure that the new scientific party can start to install its equipment soon after arrival.

In the early morning of Thursday 26th of June "Polarstern" reached the port of Tromsø (Norway). First action was the unloading of material of the French Polar Research Institute Emile Victor (IPEV) to be transferred further by a company to the IPEV Arctic station on Svålbard. The Norwegian research vessel "Lance" was also in Tromsø and preparation for a new expedition took place while we were about 100 m behind her at the pier. The first scientists of the cruise leg ARK XIX/3b arrived before lunch but the majority embarked around 5 pm in the afternoon. Just after dinner all new participants were introduced into the safety rules onboard. After customs clearance we left Tromsø for this short stop over in the early evening. Before midnight the last mountains along the Norwegian fjords disappeared behind the horizon and we headed directly to the Håkon Mosby Mud Volcano. Scheduled time of arrival was Friday afternoon which caused that many people worked until late in the night to get their laboratories and instruments ready.

The HMMV at about 72° N 14° E was first investigated during an international cruise with the Russian RV "Logachev" in 1996, and most recently by a joint AWI / IFREMER cruise with RV "L'Atalante" and the ROV "Victor 6000" in September 2001. It is the only mud volcano in a polar region that has been studied in greater detail by photo and video camera observation. The HMMV is situated on the continental slope northwest of Norway at a water depth of 1250 m. It has a diameter of about 2 km, with an outer rim populated by methane-depending, chemosynthetic communities and an inner centre of about 500 m diameter where fresh muds are expelled. Between the central plain and the outer rim, a complex topography of hills and depressions can be observed, derived from the transport of young sediments. Methane is rapidly oxidized with sulphate in the anaerobic sediments at temperatures close to the freezing point (-1°C), producing a source of sulphide to the extensive mats of giant, sufide-oxidizing bacteria surrounding the central area. Despite its rapid turnover in the sediments, large amounts of methane dissolved in the rising mud-volcano fluids are seeping to the hydrosphere. It is unknown how much of the methane is removed in the aerobic bottom waters and how much escapes to the water column. The HMMV represents an ideal model system to study methane fluxes in polar seas. So far, only few selected key locations have been sampled with the ROV (centre of the HMMV crater, the south and southeast of the crater and the surrounding area). For a 3-D modelling of methane fluxes and turnover rates at the HMMV as one geological model system representative of a focussed methane source to the sea, there is a need to accomplish a more thorough sampling. Complementary, intense geographical surveying of the different areas at the HMMV was planned for the coming weeks to estimate the aerial coverage of the different chemosynthetic communities around the centre with help of the mosaicking technology of "Victor 6000". Based on ROV video surveys and mosaicking technique the spatial distribution of key features at the HMMV should be identified and mass budgets about the distribution of bacterial mats could be established. Sediment and water samples taken with the ROV were intended to be used to further improve present knowledge on methane turnover and the distribution patterns of bacteria and archaea, as well as the rare methanotrophic-symbiont bearing tube worms. Measurements of natural radiotracers such as Radon, Radium and Helium can help to elucidate the flux and the fate of methane in the bottom water column. Sampling of carbonates was planned to investigate the contribution of methane turnover to carbonate formation (also an interest of GEOMOUND). Measuring microbial degradation of methane in water column and sediments using radio labelled tracers was intended for the second cruise leg as well as sediment samples to be taken with both, the multicorer and the giant box corer. Additionally, it was attempted to sample gas hydrates with deeper penetrating gravity corers. Water samples taken with two types of water samplers (rosette and horizontal water sampler) were proposed to investigate the spatial distribution of the methane plume in the water column. *In situ* experiments with micro-profilers measuring

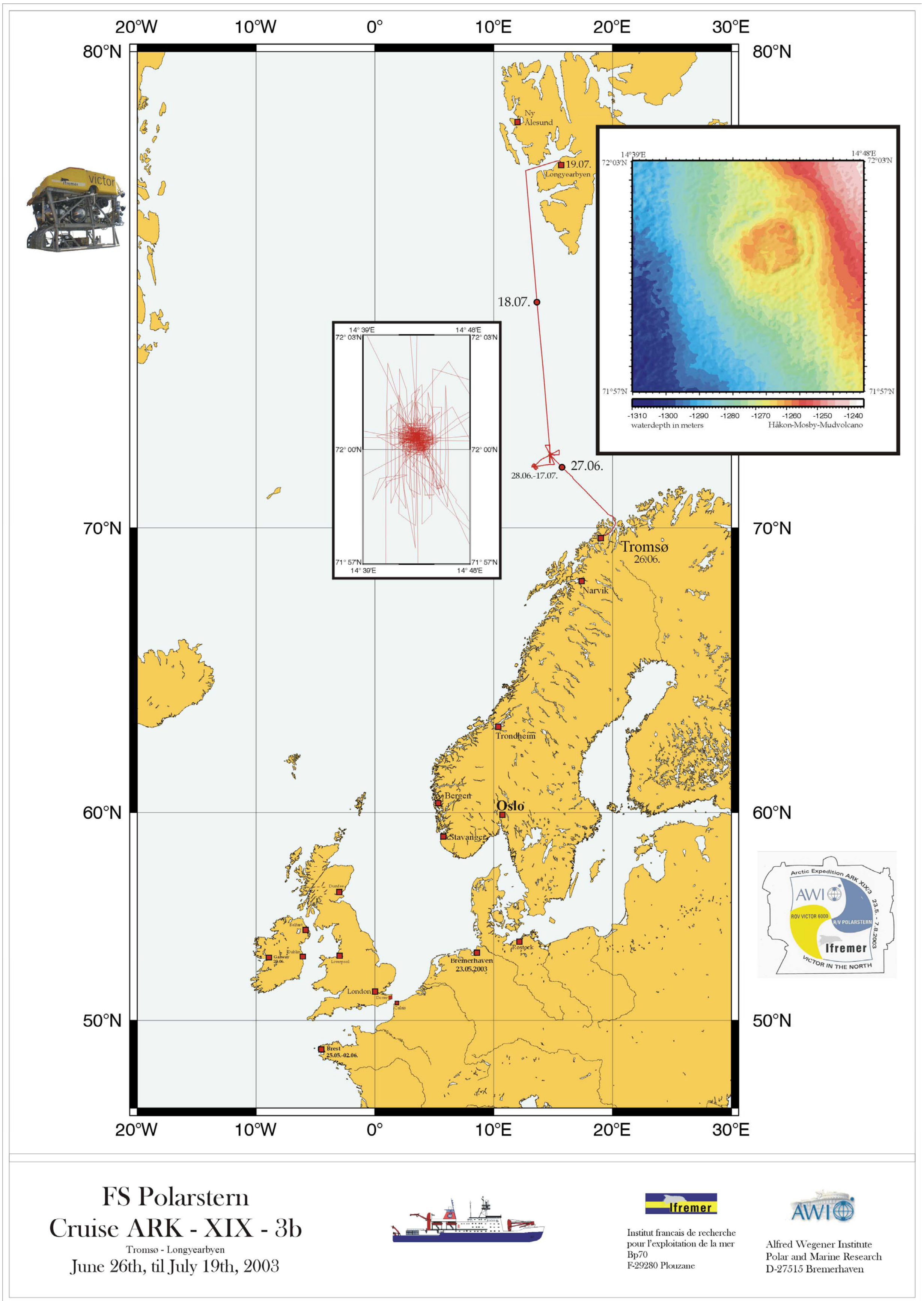


Fig. A1-2: The working area of the Håkon Mosby Mud Volcano (HMMV) during ARKXIX/3b.

pH, resistivity, oxygen and HS^- at the sediment-water interface were envisaged using the ROV to deploy the microprofiler at selected spots within the above mentioned key locations.

The first working day onboard was dominated by meetings and the assignment of laboratories. The working schedules of the next days were presented and instruments were tested. In the afternoon we reached our first station where the CTD was used to obtain information about water salinity and temperature at different depths. This data was necessary for the calibration of our sonar systems because among others the sound velocity in water is determined by temperature and salinity. Afterwards we worked the entire night on a small scale survey grid with the multi beam sonar system Hydrosweep, the sediment profiling sonar system Parasound and the 38 kHz echosounder. With the latter we obtained data where spots of high methane release were located. This kind of information allowed us to collect afterwards samples in the water column at high spatial precision.

On Saturday sediment sampling started by using the multicorer while in the evening two free falling lander systems were deployed and soon after the first ROV station started. At 1250 m water depth a video survey was carried out during the night and the information obtained by doing this was used on Sunday to select some sites of special scientific interest where sediments covered by white bacterial mats were sampled using plastic tubes (push corers) operated by the manipulator arms of "Victor 6000".

After the first succesful mission of "Victor 6000" at the Håkon Mosby Mud Volcano which was finished shortly before midnight on Sunday, we released the lander which was observed before by the ROV at more than 1200 m water depth. About thirty minutes later the lander was sighted about 100 m distance in front of "Polarstern". At this moment we had fog so the visibility was below 200 metres. However, the lander was equipped with a radio beacon and flash lights providing safety systems for localization under such conditions. After recovery of the lander we worked for about 12 hours on a heat flow measurement programme. Therefore, a temperature lance of three metres length was used with one of the ship‘s winches. The lance becomes rammed into the sediment and measures the temperature at different depth strata. This procedure was repeated along a given waypoint list. At the end of this work package we knew that the the temperature at about 3 metres below the seabed might be much higher (close to 20 °C) than on deck of

"Polarstern" (actual air temperature on 6th of July: 8,9 °C). Noteworthy, the water temperature close tot the seafloor was found to be around the freezing point.
On Wednesday the second "Victor 6000" dive during this cruise leg was finished after 37 hours. After safe position on deck the shuttle was released and recovered, a procedure being repeated for the lander soon after. The shuttle is, in principle, a metal frame equipped with two large plastic containers which can keep scientific instruments and sampling devices. After release of the shuttle it descends to the seafloor where "Victor 6000" docks on it, takes instruments out and put samples or other instruments into the shuttle. Afterwards the shuttle is released acoustically (like the landers) and becomes recovered by the ship's crew. In the meantime the ROV proceeds with its programme at the seafloor. Calm sea state and excellent visibility favoured most of these operations during the cruise leg.
While the engineers of Genavir changed the sampling module by the multibeam sonar module and working on their maintenance procedures the CTD was used. In parallel the gravity corer was prepared on the working deck, the sample tubes of the lander which was just before recovered were exchanged and the horizontal bottom water sampler was lifted in its position because it was the next gear to be used after the CTD. During the day all instruments were used succesfully, some of them even two times. By using the 38 kHz sonar system we were able to localize spots with high methane concentration in the water column so we positioned our sampling instruments as close as possible to centres of maximum activity. Exciting was the result of the gravity corer because we collected, unexpected at the specific sampling site, some pieces of gas hydrate. Early in the evening the temperature lance, way points were selected to cross the center of activity, was used again and conformed the previous finding of temperatures of about 20 °C at 3 metres depth below the seabed.
Thursday morning "Victor 6000" was deployed for a mission scheduled for about two days. The multibeam echosounder module was installed under the ROV for this programme the day before. During this operation the ROV followed given courses at constant altitude above the seafloor to collect data on the microbathymetry of the Håkon Mosby Mud Volcano. The data was transferred to the computers onboard "Polarstern" close to real-time allowing the scientist to verify the quality of data permanently.
On Saturday morning just one minute was missing and "Victor 6000" would have been for exactly two days underway. After safe position on deck the sonar module was disconnected and the sampling module attached to the ROV. In the meantime other

winch operated gears were used again. On Sunday morning we started our fourth dive operation with "Victor 6000" aiming at sampling sites close to the centre of the mud volcano. During a previous dive close to this position we observed gas bubbles coming out of the sediment. This location, easily to be revisited through the ultra short baseline navigation system installed onboard "Polarstern", was in the focus of scientific interest during this dive.

On monday evening at 9:30 the dive of "Victor 6000" did end. Shortly after recovery the shuttle was released and needed exactly 17 minutes for his way from 1250 m water depth to the sea surface. A lander, subsequently released, needed about 24 minutes for the same ascending. After all gears were safe on deck the huge sample material was distributed to the scientists involved in the respective missions. Another lander was deployed before midnight in the northern area of the mud volcano, followed by a CTD station and the horizontal bottom water sampler. At 3 o‘clock in the morning an intense sonar survey programme followed aiming at elucidating the influence of tidal cycles on methane release. On Tuesday, based on the sonar information obtained during the survey which started in the early morning, we knew much more about the spatio-temporal distribution of methane in the water column down to the seabed. Scientists onboard, while processing the data, were already discussing the preliminary results which afterwards had an influence on our further station planning.

In the early evening of Tuesday the shuttle, equipped with two autonomous instruments to be positioned later with the ROV, was deployed. About one hour later "Victor 6000" followed, this time for the last mission during the expedition ARK XIX/3 with one of the two multi beam sonar systems which were hired for this cruise from commercial companies. Final gaps in our data set on the microbathymetry of the HMMV had to be filled.

The very good cooperation between crew and scientists did help us on Saturday to finish all our station work in time. Therefore, "Victor 6000" was launched even earlier than scheduled for his pre-last dive at the HMMV. During this 48 hours dive we started in the south-east for some samples to be taken there, crossed then the centre to work finally in the more northern part of the crater. Because we used so many instruments we had to launch and recover the shuttle two times during the dive. However, for the first time during this cruise leg the weather influenced our operation: fog led to visibility below 100 metres. Because the shuttle is only equipped with a flag and an underwater beacon for position determination we decided to send the release command later. Since "Victor

6000" was still at depth "Polarstern" would have been hampered in search manoeuvres for the shuttle in the fog. The meteorologist onboard predicted better conditions for the next morning so the risk to loose the shuttle after release was not taken under these circumstances.

During the final days of the second cruise leg of the expedition ARK XIX/3 the water column above the HMMV was investigated with almost all instruments we had onboard. The CTD and water sampler, for example, were additionally equipped with a methane sensor and a camera. According to actual sonar data information we placed these instruments in different regions, either with high methane concentration, at borders and at such depth where no methane was acoustically detected.

Wednesday morning (16.07.2003) the last dive of "Victor 6000" during the second part of the cruise leg ARK XIX/3 started. Twenty minutes earlier the shuttle was send down to the seafloor – also its last launch. The shuttle was additionally equipped with a radio beacon. Because we had to leave our area of investigation on Thursday in time we could not risk that fog, which might have come up the next day, delays our departure. The final dive of "Victor 6000" was again used to work with autonomous instruments. Among a system which measures the exchange of solutes between sediment and the water column another system measuring the current speed was used to get data on fluid and gas release rates out of the sediment. Such data might help to estimate the amount of methane release at the Håkon Mosby Mud Volcano.

After safe recovery of "Victor 6000" and the shuttle on Thursday the research activities were stopped and "Polarstern" started to head northward to Longyearbyen on Svålbard, some 400 miles away. The last hours onboard were used to get all material stowed into the boxes and containers, final treatment of some samples, writing of the cruise report and the closing colloquium where all working groups presented their preliminary results.

At July the 19th the majority of scientists, technicians and all ROV pilots disembarked in Longyearbyen (Svålbard) while other personell came onboard for the final leg ARK XIX/3c. This leg was dedicated to work at the AWI long-term deep-sea station "Hausgarten" at 79 ° N and 4 ° E. First long-term experiments with special emphasis on Arctic deep-sea biodiversity and exchange processes across the sediment-water interface were already launched during the "Polarstern" expedition PS ARK XV/1 in 1999 using "Victor 6000" and two years later again with the ROV onboard the French RV "L'Atalante". Sampling of long-term experiments started during both expeditons, e.g. sediment sampling at exclosure experiments, retrieval of artificial hard-substrates, sampling of "mimics" being deployed in 2001 and sampling at a physically disturbed area was scheduled for 2003. Furthermore, new developed autonomous instruments such as microprofilers and current metres should be deployed by using the ROV at pre-selected areas at the seafloor to study processes and interactions at the sediment-water boundary layer fueling gradients in physico-chemical parameters.

After the departure from Longyearbyen in the early evening of the 19th of July the safety and other relevant instructions were given to all new scientists onboard. Most of them started the same day with the installation of their laboratories and continued to do so on Sunday while we had already first station work in the morning – a mooring was succesfully recovered after one year of continuous measurements. All instruments worked properly, thus another annual data set was collected which will help us on a long-term perspective to improve our understanding in whether changes of the system or natural variability causes some of the differences in organic carbon and particle flux, ice cover etc we observed in past years. In the late evening we started to work with different winch operated gears like the giant box corer.

The first mission of "Victor 6000" was scheduled for Sunday afternoon. Colleagues from Scotland failed in recovery of a free falling lander system in June last year and asked for some assistance. After some hours at the seafloor scanning the area of the suspected position of this instrument with the forward looking sonar of the ROV we finally stopped the dive because we did not find anything of the lander. We may speculate whether the information about the position was wrong or the lander surfaced in the meantime. If the latter should have happened during Arctic winter with ice cover there is probably little chance to find the system.

The second dive of "Victor 6000" started in the afternoon of 21st of July. Main objective was the localization of experimental setups launched in 1999. After some time of searching at the seafloor we were finally succesful. However, before starting with sampling an ice floe of several square kilometers approaching from the north forced us to move to a more southern position. Because this situation would not change within some hours it was decided to stop the dive and to leave three instruments which were deployed at the seafloor. The shuttle was recovered just in time as the ice edge was only some hundred metres north of its position. The next stations to be sampled with winch operated gears were more to the west at water depths between 3000 and 3500 m. Analysis of actual satellite images about the ice situation led to the decision to remove the ultra short baseline navigation antennae which are exposed to ice below the keel of the ship. Any damage by ice floes would cause severe problems for further "Victor 6000" dives. Indeed, some hours later we entered a large field of drifting ice floes which initiated some other activities onboard – nearly everywhere people were taking pictures. However, ice of this thickness is no problem for the vessel – without any special effort "Polarstern" passed through the ice to reach the next position. The deployment and recovery of winch operated gears at starbord side is also something like routine operation for the crew.

Saturday morning we intended to release one of our lander systems which were deployed in April this year at 2500 m water depth. After sending the acoustic release command to both of the releasers we waited for about 50 minutes that the system appears at the sea surface. But the instrument did not ascend and some of us immediately thought about our Scottish colleagues and the fate of their lander. But having a Remotely Operated Vehicle with us we decided to spend during one of the following days some hours to check the situation and the reason of this malfunction at the seafloor. However, shortly later our schedule was suddenly completely different – ice was again drifting towards our position so we decided to leave the area heading to the southeasterly position of the lander which was one nautical mile away. After arrival at the seafloor – the lander was clearly visible at a distance of 200 m in the forward looking sonar image – we could observe that the lander was still standing at the seafloor although both relasers were. A slight push with one of „Victor's" manipulator arms was sufficient enough and the lander started ascending to the surface.

After termination of the time and energy consuming icebreaking on Sunday evening the 27th of July we continued with station work at a more southern location. This sudden change in our programme did lead to another night for many of the scientists on the working deck and their laboratories. In the morning of the 28th we released another mooring like the one we recovered at the early beginning of this cruise leg. Because the top floater unit was only 200 metres below the sea level the expected time of arrival at the surface was only some minutes after the release code was transmitted but nothing happened. Therefore, a rubber boat was launched to try the release procedure again at a certain distance to "Polarstern". Surface vessels produce some underwater noise by their own sonar systems, the propellers and thrusters which might cause that the release command becomes not properly transmitted. However, soon after sending the command in this way the orange top unit appeared at the surface and the 2400 metres long mooring was succesfully recovered. Monday afternoon we reached our next location where the deep-sea research group of the AWI already worked with "Victor 6000" onboard the French RV „L'Atalante" in 2001. Experiments initiated two years ago were sampled during the night.

On Wednesday the 30th of July we started with the preparation of a rather ambitious project: the installation of a current flume in the Arctic deep sea. Two packages of compartments of this roughly 10 m long channel were deployed with the ship's winch and "Victor 6000" was subsequently send down to put them together. For one day the ROV-pilots were constantly working on this task and finally succeeded in the installation of the first current channel in the Arctic deep-sea to simulate and create gradients at the seafloor. Because of the shape of the flume the current speed should increase inside, thus causing different environmental conditions for the sediment inhabiting fauna, the settling regime for organic particles as well as alterations in exchange processes between sediment and water. The installation of such infrastructure at great water depth is only possible by using working class ROV's like "Victor 6000".

During the last dive of "Victor 6000" at the central station of the long-term deep-sea station at the beginning of the last week in July we had to recover the ROV very fast because another drifting ice field approached. The shuttle and two scientific instruments had to be left at the seafloor. During the following days "Polarstern" worked at other locations, the current flume was somewhat further in the south installed, but the ice situation was constantly evaluated according to actual satellite images provided by the meteorological service onboard. With regard to the end of the cruise leg and the termination of ROV operations some days in advance to ensure that everything of the ROV system is stored before arrival in Tromsø, our last chance to recover the instruments came on Friday. The ice was drifting further northeastward and the ROV was immediately launched under ice-free conditions to recover the instruments and to get some final samples.

After safe recovery of "Victor 6000" from its last dive during this expedition the final days of our cruise leg were used to work with winch operated gears, free falling lander systems and the deployment of moorings. In the meantime the ultra short baseline underwater navigation antenna was also removed from the ships's keel so that we were more flexible in our operation between floating ice.

In the early evening of the 4th of August all station work was completed and "Polarstern" started to head south to Tromsø where the cruise leg ARK XIX/3 c was terminated in the morning of August 7th.

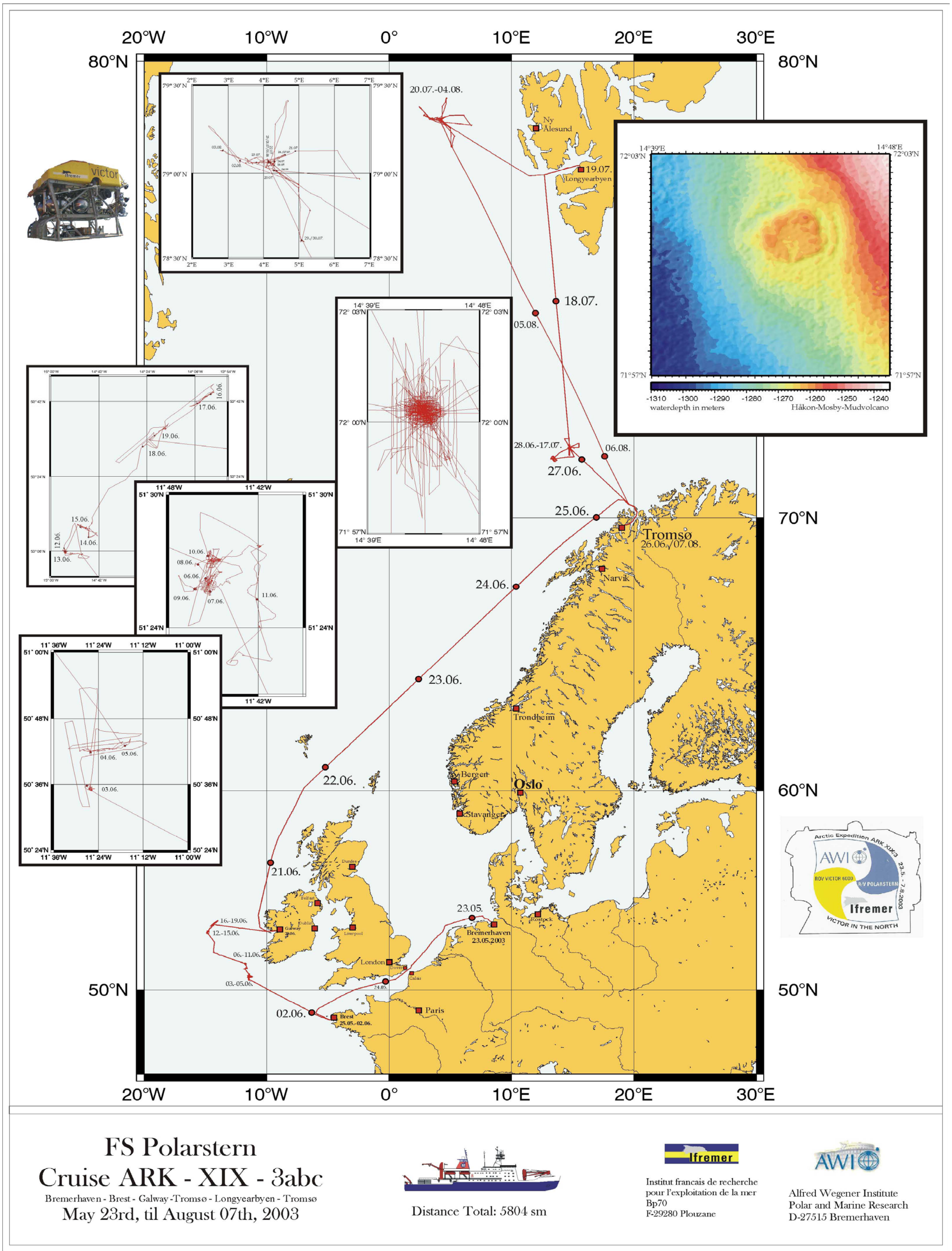


Fig. A1-3: Entire cruise track of RV "Polarstern" during ARK XIX/3 from Bremerhaven via Brest, Galway, Tromsø and Longyearbyen back to Tromsø.

A. 2 Meteorological observations

A. 2.1 Weather situation during the cruise leg ARK XIX/3a

Möller; H.-J.

Leaving Bremerhaven a warm front of a North Atlantic low crossed the East Frisian Islands with some rain, drizzle and poor visibility. Weather improved in English Channel rapidly and approaching Brest fine high pressure influenced weather was observed.

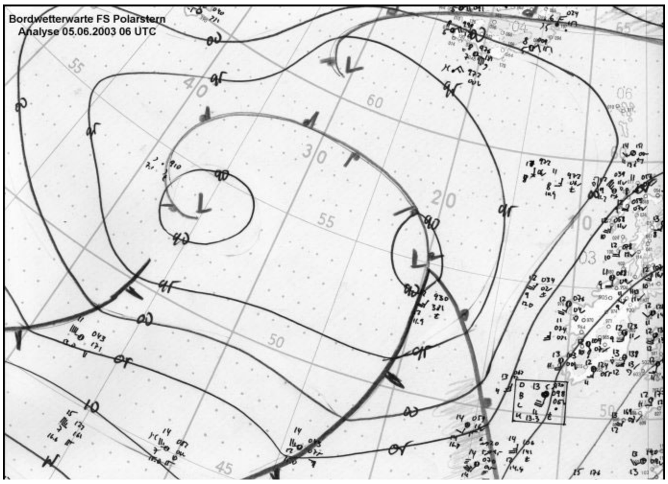


Fig. A2.1-1: Analysis from 2003-06-05 06 UTC

Settings sails at Brest on 2003-06-02 a great and stabile low had formed at the sea area between Iceland and Ireland. It influenced weather at Porcupine Sea Bight with mainly south-westerly winds about 5 Bft. But by passing of fronts, troughs or secondary lows wind changed to south and increased to 7 Bft with gusts up to 8 Bft. Then sea state grew up from 2 metres to 4 metres for a time.

Approaching Porcupine Bank on 2003-06-11 weather did not change fundamental. Again mainly south-westerly winds force 5 or 6 Bft with seas about 2 metres were observed. But on 2003-06-12 and 2003-06-14 wedges of high pressure crossed the area eastward with decreasing wind and sea state.

In the following a great cyclone formed south of Iceland and the well-known large-scale weather situation set in again. On 2003-06-17 a secondary low deepened to a gale centre in the central northern Atlantic. It moved to northeast quickly. Its fronts crossed to operation area of RV "Polarstern" in the following night with storm force south and southwest. The sea state up to 5 metres and wind force 8 Bft decreased slowly in the afternoon of the 2003-06-18.

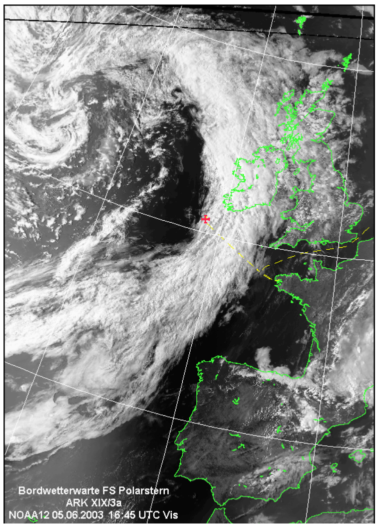


Fig. 2.1-2 : Satellite Image from 2003-06-03 16:45 UTC

At end of the leg pressure rising build up a high southwest of Ireland and weather improved while arriving at Galway on the 2003-06-20.

A. 2.2 Weather situation during the cruise leg ARK XIX/3b
Sußebach, J.

During the transit fom Tromsø to the research area above the Håkon Mosby Mud Volcano a small low north of the operation area caused southerly winds up to force 5Bft and some rain. Later in the afternoon the wind veered to Northwest.

From 28th until 30th high pressure influence caused weak winds and mainly misty or foggy weather. According to this situation the lines of temperature and dewpoint from the radio sounding of 28th 12 UTC show a significant low inversion with moist air below.

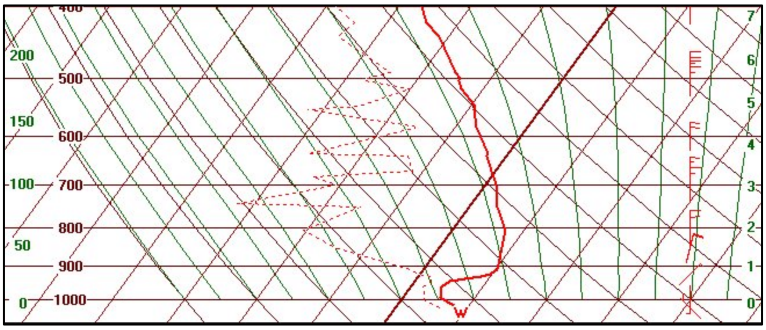


Fig. A2.2- 1: Radio Sounding 2003-06-28 12 UTC

On the first day of July a weak coldfront passed our area. In its rear unstable air with good visibilities, rapid change of cloud coverage and some showers dominated the actual weather.

The wind blew mainly weak out of various directions until 2003-07-06.

During the following days until 2003-07-10 small lows over the Norwegian Sea and the Greenland Sea caused sometimes wind force 5 Bft. Due to unstable air we had good to excellent visibilities interrupted by some showers.

During the next period until 2003-07-15 wind force 5 Bft was observed at the most. With it mild and humid air caused misty weather very often. In the afternoon and evening of 2003-07-12 and in the night to 2003-07-13 dense fog wrapped our ship.

After the passage of a cold front in the night to 2003-07-16 visibility improved. On 2003-07-17 we were between a high over the Norwegian See and a low over Northeast Greenland. This situation brought us increasing westerly winds up to force 6 Bft. In the late afternoon research work came to an end und we left the area. During our transit to Longyearbyen fresh to strong southwesterly winds were observed.

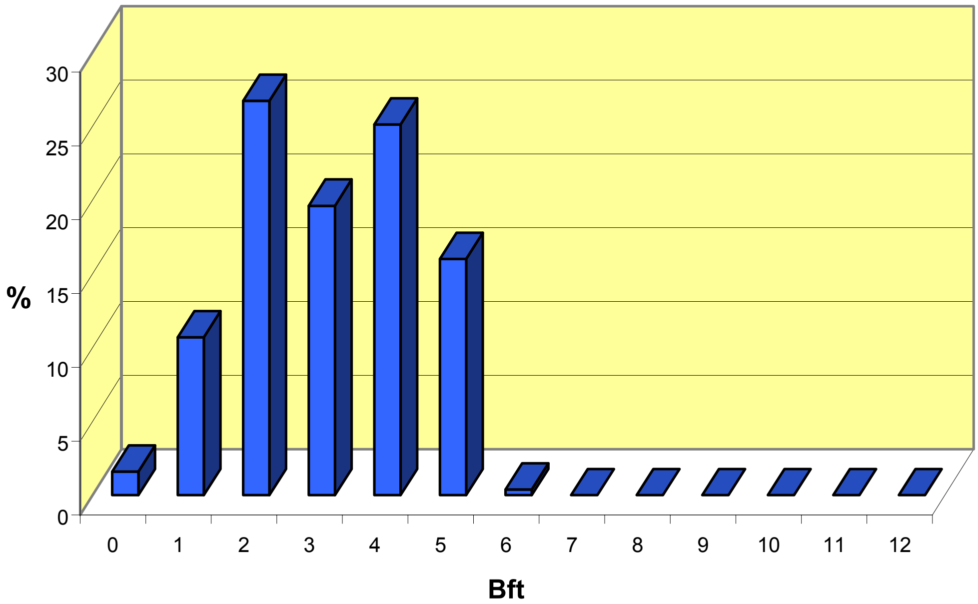


Fig. A2.2-2 Distribution of wind force

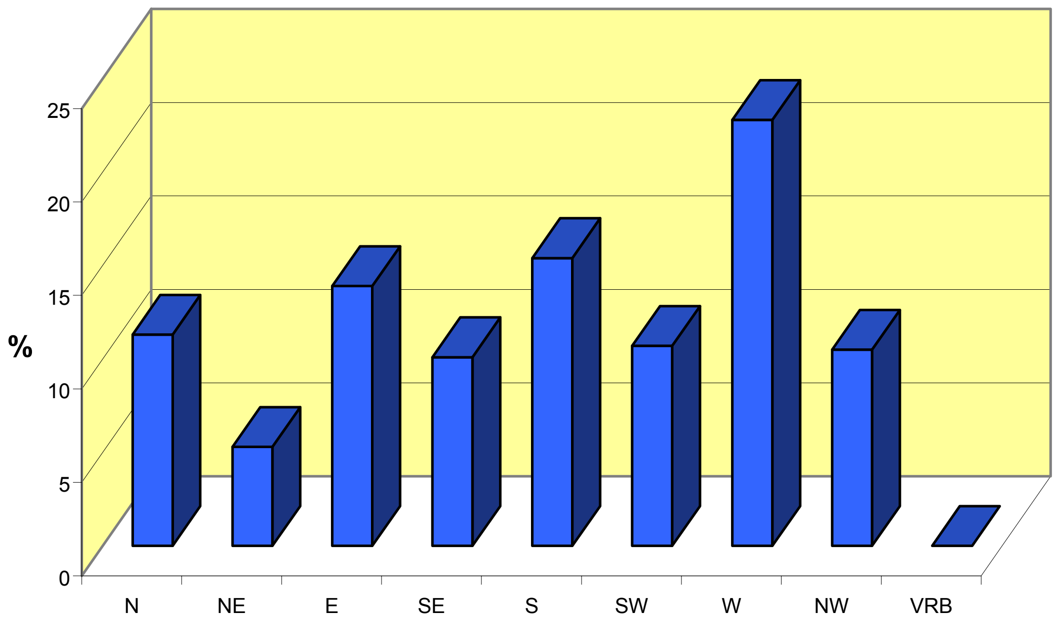


Fig. A2.2-3: Distribution of wind directions

The temperatures during the cruise varied between 6 and 12°C, the water temperatures between 8 and 11°C.

A. 2.3 Weather situation during the cruise leg ARK XIX/3c
Dittmer, K.

At the beginning of this leg a low pressure system over Spitsbergen moved eastwards slowly to the Barents Sea and later to Severnaja Zemlja. On July 20 in the rear of the low it was raining at first and for a short period the northwesterly wind increased to Bft 5-6, but then abated for a time, the visibility improved and the sky became sunny. Even on the next day, when the wind was backing to southwest and south and increased again to Bft 5-6, the research activities could be carried out in bright and sunny weather with excellent visibility.

Afterwards the typical “summerweather” of the arctic ice edge was encountered with low clouds and often poor visibility as well as fog banks. Southerly winds of Bft 4 to 6 caused this situation, which continued until July 23. The southwinds were produced by a high, which developed near Jan Mayen and moved across the Barents Sea to northern Siberia. On July 24th the wind became light and variable and in the ice-region it was very foggy.

On July 26th a new high pressure system had developed east of Svålbard. With simultaneous pressure falling over northern Greenland a warmfront crossed the Framstrait and it was raining. The southwind during the next night increased to 6 Bft accompanied by a sea of 2 meters. In the inflowing humid airmass wide-spread fog occurred. Two days later a second warmfront with rain was moving northward over the research area and on the next day a low approached from the south, moving in the same way, causing light and variable winds as well as fog in the Fram Strait. Due to stormy easterly winds in the Barents Sea a swell of 3 to 4 meter arrived at the ship´s position.

During the night from July 30th to 31st a new secondary depression developed over the Greenland Sea. In the rear of the low the maximum wind speed measured was Bft 7 (14 m/s) in the evening of July 31st.

On the first of August this low drifted into the North Polar Sea and the weather improved significantly: With southwesterly winds of Bft 5 the clouds disappeared and the visibility became very good. But this situation was not stable. In the evening stratus clouds approached from the ice in the west and during the next day the visibility was very poor due to shallow evaporation fog. Temperatures dropped to minus 3 ° C, which at that time was the lowest record on the northern hemisphere.

During the first days of August the steering low pressure system for secondary depressions between Iceland and the Kara Sea was situated in the vicinity of the pole. From there a Swedish ship sent regularly weather observations. From August 2nd to 3rd a couple of secondary lows moved from Jan Mayen to the northern Barents Sea. Thus the wind veered northerly and under few clouds the visibility became very good. Spitsbergen could be seen at a distance of about 130 km, at times associated with mirages. In the evening of August 4th the research activity ended and “Polarstern” headed towards Tromsø. During the transit winds came from south, later southwest to west for a time about Bft 5. The distribution of wind and visibility is shown in the following figures (Figs. A2.3.1-3).

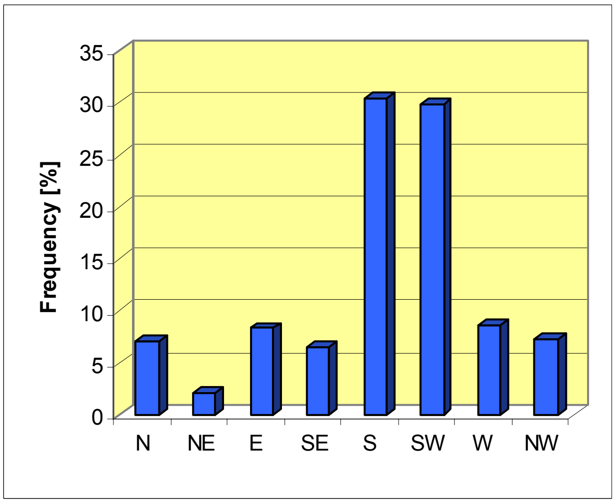


Fig. A2.3-1: Distribution of wind direction during ARK XIX/3c

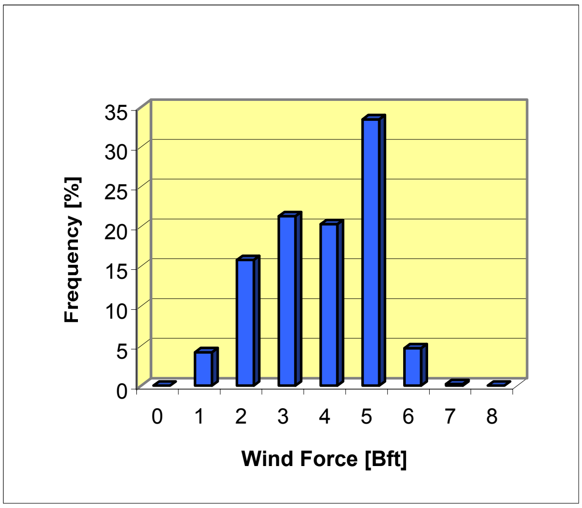


Fig. A2.3-2: Distribution of wind force during ARK XIX/3c

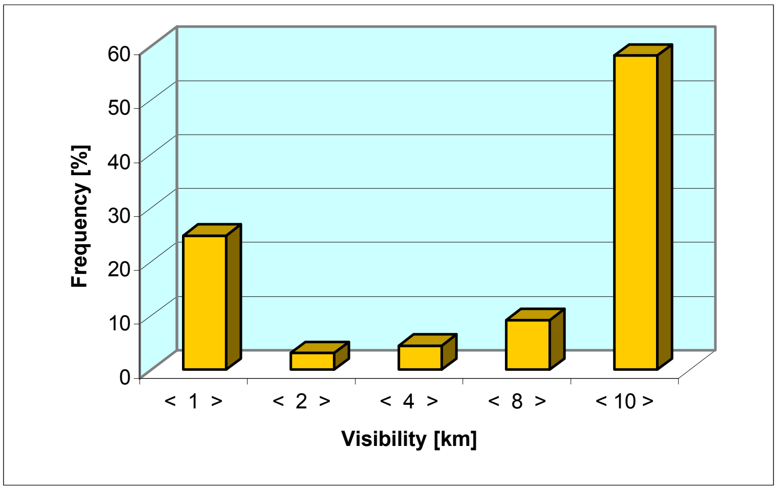


Fig. A2.3-3: Distribution of visibility during ARK XIX/3c

Most frequent wind direction was south and southwest, strong winds occurred in less than 5 per cent of the time. Due to the predominating southerly winds the visibility was often poor. Fog (visibility less than 1 km) was observed or measured in 25 per cent of time. The fog frequency corresponds to climatological values, the most frequent wind direction does it not. Normally there should be more northerly winds.

A. 3 The Remotely Operated Vehicle (ROV) "Victor 6000"

Christophe, A., Triger, P., Opderbecke, J.

During the expedition the Remotely Operated Vehicle (ROV) "Victor 6000" was used at all sites of scientific interest. This ROV, depth rated for 6000 m, is equipped with various instruments to be used for scientific operations in the deep sea such as two manipulator arms, seven digital cameras, water sampler, slurp gun and temperature sensors. The design of the ROV follows a modular concept based on two sub-systems: (i) the vehicle itself including servicing equipment (propulsion, video survey, lighting, remote control, navigation and miscellaneous services), (ii) the scientific module composed of a 0.7 m^3 structure placed under the vehicle in which the majority of scientific equipment, specific to the mission, is located. The "Basic Sampling Toolsled" was used during the expedition containing all necessary tools to collect samples (sediment, water, organisms, rocks, etc). Additionally, instruments and sensors placed elsewhere in the vehicle were also used, e.g. temperature sensor, slurp gun, release of passive markers etc. A schematic illustration of the system is given in Fig. A3-1.

Compared to the first expedition with "Victor 6000" to the Arctic in 1999 onboard the German RV "Polarstern" (Krause 1999; Soltwedel *et al.* 2000) some improvements concerning the following technical aspects were made. The navigation system was further improved by adding accurate position reckoning sensors —optic fibre gyro and Doppler log. The performance of the position reckoning sensors (drift <10 m per hour) combined with POSIDONIA positioning system precision (0.5% of water depth in standard acoustic environment), led to a quality in sensor trajectory measuring data suitable for map drawing.

Together with the installation of a high-resolution vertical camera aiming at providing high quality images of the seafloor new imaging software can be used to produce on-profile mosaic images from successive shots. Forward facing lights have been fixed on the bottom of the ROV to enhance optical contrast. Close to the main camera a high-resolution digital still camera (HYTEC VSPN3000, 3 Mpixels, autofocus, and optic zoom) was installed to allow scientists to take up to 200 high quality pictures appropriate for publication. Additionally, laser beams were placed around the main camera to have a scale for estimating distance and size of objects. Concerning handling and sampling operations, the MAESTRO slave/master arm has been improved with regard to both robotics and manoeuvring. A second grasping arm has been installed. Based on experiences with the manned submersible "Nautile" a shuttle was adapted to be used with the ROV. This prototype was tested and used to transfer equipment and samples from the seabed to the surface (and conversely) during dives. A total of 23 dives were carried out during the entire expedition.

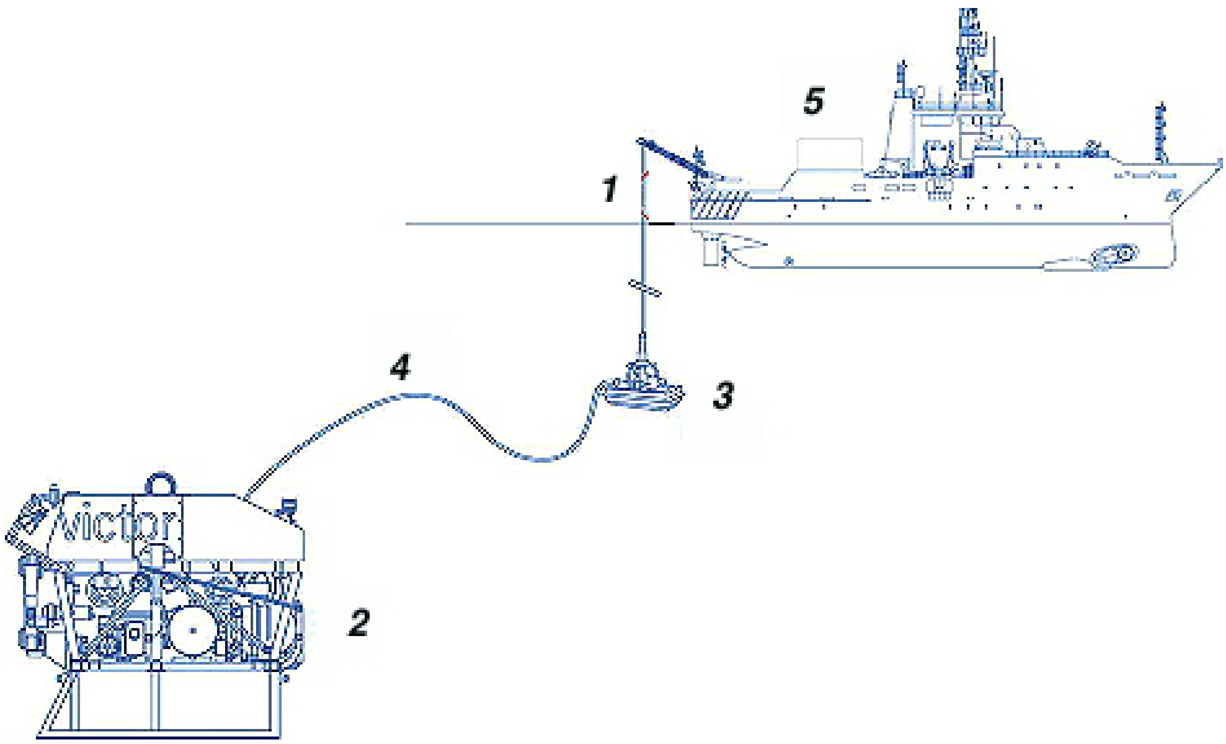


Fig. A3-1: Schematic illustration of the "Victor 6000" system with its main components: (1) Hydraulic direct coil winch, 8500-m 20-mm diameter umbilical cable; the total mass of this ensemble is 30 tonnes. (2) Vehicle 3.1 x 1.8 x 2.1 m, mass 4 tonnes + 600 kg for the module. (3) Depressor 1.5 x 0.8 x 0.5 m, mass 1.2 tonne. (4) Tether 100 to 300 m, 35-mm diameter. (5) Five 20-ft containers for power supply to vehicle, hydraulic plant for winch, command post, mechanics workshop, storage.

A. 3.1 High resolution seabed mapping with "Victor 6000"

Opderbecke, J.

On the cruise ARK XIX/3a-b, ROV-borne seabed mapping techniques were available. A high frequency multibeam echosounder allows high resolution, small scale bathymetric mapping. The sonar signal of this equipment gives backscatter information that can be associated with the measured depth profile.
Geo-referenced video mosaicing creates large seabed images with correct geographical orientation, positioning and sizing.

ROV-borne “Micro”-bathymetry

Two models of multi-beam echosounders are available for "Victor 6000", allowing the production of micro-bathymetric maps up to a resolution of 20cm. The systems used on the cruise were the SIMRAD EM2000 and the RESON Seabat-8125. The backscatter information was recorded from both of the two sonar models. The multibeam echosounder to be employed was mounted on "Victor 6000" in a special “seabed mapping module”, this means that dives were either sampling or mapping dives, depending on the module installed. Changing the modules is possible between two dives, but is constrained by convenient weather conditions and requires approximately 4 hours in addition to the 8 hours of normal reconditioning of the ROV.

Multi-beam echo-sounder	Max depth	N° of beams	Frequency	Angular resolution	Backscatter (sidescan)
Simrad EM2000	3000 m / 6000 m optional	111	200kHz	1.5° x 2.5°	Range/incidence compensated
Reson Seabat 8125	1500	240	440kHz	0.5° x 1.0°	Raw

Video mosaicing

Geo-referenced video mosaicing from a vertically mounted camera is possible with any of the two modules. The vertical camera has an opening angle of 60°, the footprint on a flat and parallel sea-bed is then the same size as the fly-height. For good quality colour video, the ROV should not fly higher than 3m above the seafloor.

Navigation

High resolution mapping is not possible without precise navigation information. The multibeam resolution (~10cm horizontally) and the one of video mapping (~1cm horizontally) ideally imply navigation data of the same level of accuracy.

Underwater positioning, with the absence of radio-electric signal transmission in seawater, is based on acoustic measurements with respect to reference transponders that are mounted under the vessel or moored on the sea-floor.

On the present cruise, "Victor 6000" was positioned by the USBL system "Posidonia" installed onboard "Polarstern" which yields a positioning accuracy of about 0.5% of the slant range – depending on ship noise, meteorologic conditions (turbulent water around the transducers, roll, pitch and heave dynamics), and system calibration 5-sonic velocity profile, geometric adjustment).

Acoustic positioning, which is not sufficient for map construction, is completed by "Victor’s” inertial navigation system. Using a 3D fibre-optic gyro and motion-sensor (Octans/Ixsea) and a Doppler Velocity Log (DVL - Workhorse600/RDI), this relative navigation technique integrates the displacements of the ROV in time, starting from a given USBL-position. The integration of measurement noises allows positioning error to drift, at a rate of less than 10m/hour.

The mapping procedures use the inertial gyro-Doppler navigation, which is reset on USBL-positions at given intervals (1-2 hours) before or after the individual survey lines. Reset of the gyro-Doppler navigation during a track line would lead to map distortions difficult to correct in post-processing.

Roll and pitch compensation is carried out with data from the Octans system, which measures these angles with an accuracy of 0.5mrad. The measurement of vehicle depth is obtained by a Digiquartz – Paroscientific piëzo-depth cell with an accuracy of a few centimetres. Tidal corrections can be carried out in post-processing, if corresponding tide estimations are available.

What can we expect from ROV-borne seabed mapping?

Compared to surface-borne mapping, mapping with an ROV increases the spatial resolution of the observations with high frequency bathymetry as well as sonar or video images. This gives an insight to the local morphology of the seabed, allowing recognition of structures with only a few centimetres of relief.

On the other hand, the accuracy of underwater navigation in the horizontal plane and in the vertical axis, is less accurate than at the surface. As an example, (D)GPS positioning at the surface is only one element in the measurement chain of underwater positioning – GPS, acoustic relative position, attitude compensation, sound-velocity linked refraction computation. Dead-reckoning induces a short term drift that builds up to a few meters during a 1km survey line. This means that the assembly of the map will show considerable artefacts between joining survey lines. Even slight variations in the vehicle depth may cause vertical shifts: a 10^{-5} scale error in the pressure-to-depth conversion would create 10cm residual artefacts.

One needs to keep in mind that the depth measurements building the map are the product of a complex measurement system including the acoustic soundings, navigation, heading and attitude, sonic velocity etc. The accuracy of the resulting map cannot be directly deduced from the technical specifications of the multi-beam echosounder. The sonar backscatter information will have to be analyzed in order to state it's potential for discriminating seabed characteristics.

Dive overview

Dive n° (Victor)	**Length hours/km**	**Date of start**	**Work zone**	**Module**	**Echosounder**	**Types of survey**
210	5/?	04/06	Gollum Channel	Mapping	Seabat 8125	(dive interrupted, navigation failure)
211	10/10	04/06	Gollum Channel	Mapping	Seabat 8125	Bathy transects & small grids
212	31/20	06/06	Moira mounds	Mapping	EM2000	Big grid
213	9/?	08/06	Moira mounds	Sampling	-	
214	35/27	10/06	Belgica mounds	Sampling		
215	17/10	12/06	Twin mounds	Sampling	-	
216	24/20	14/06	Giant mounds	Sampling	-	
217	42/25	16/06	Scarp mounds	Mapping	EM2000	Video transects & bathy grids
218	17/10	18/06	Hedge mounds	Mapping	EM2000	Video transects & bathy grids

A. 4 Cruise leg ARK XIX/3a

A. 4.1 Deep-water corals along the Irish continental margin: multidisciplinary studies on the Porcupine Seabight and Porcupine Bank – an introduction

Grehan, A., Wheeler, A., Unnithan, V

A series of ROV dives were undertaken in the Porcupine Seabight and Porcupine Bank to study various attributes of carbonate mounds that are colonised by deepwater corals. These represent unique habitats both in terms of biodiversity, as significant sinks for carbon and potential high resolution records of climate change. Understanding these unique environments is of recognised importance and has been the focus of numerous national and international research efforts including a former dive campaign of the ROV "Victor 6000" during an expedition with the Ifremer R/V "L'Atalante" in 2001 (CARACOLE).

The deepwater coral *Lophelia pertusa* (Linné) is widespread along the European continental margin and is often associated, although not exclusively, with coral mounds. Coral mounds in this context refer to positive topographic features that owe their origin, partially or entirely, to the framework-building capacity of deepwater corals and include reefs, banks, carbonate mounds and coral build-ups. These mounds vary in size and shape, ranging from small, low relief ovoid features a few metres high and tens of metres across to giant mounds hundreds of metres tall and a few kilometres across. The origin of these mounds has been related to hydrocarbon seepage or autogenic processes stimulated by high current speeds and food supply. Despite these debates on mound genesis, little evidence exists for the hydrocarbon seepage model whereas recent evidence suggests that hydrodynamic conditions have a strong influence on mound morphology and growth.

The results from CARACOLE demonstrated the power of the ROV "Victor 6000" in unlocking the secrets of these difficult to explore environments. This leg builds on those former studies and also explores new mound sites that offer greater insights into the functioning of deepwater coral-colonised carbonate mounds.

Between dives there were also additional non-ROV investigations using available winches. A number of boxcores were taken on previously unsampled mound sites, on baseline off-mound stations as well as detailed sampling, to complement prior studies.

The sampling campaign was also undertaken to address the primary aim of quantifying the biology of the mounds and assess inter-mound variation. As some mounds have already been previously sampled, these particular mounds were not resampled in order to conserve this habitat.

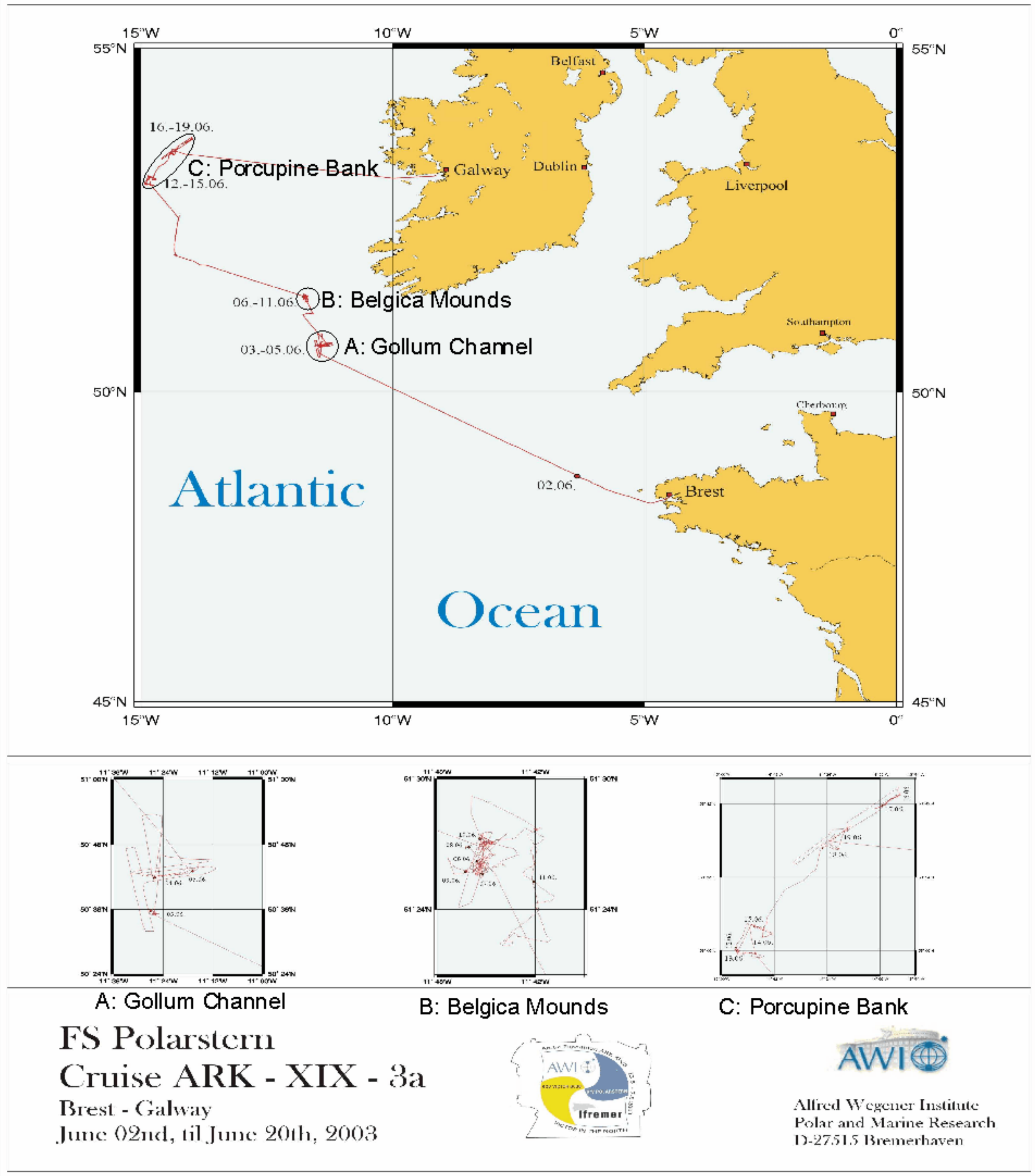


Fig. A4.1-1: General location mapping showing the main study areas

A number of CTD stations were also undertaken to quantify water mass characteristics and study short-time scale variations in water mass properties around mound features.

The geophysical mapping of mound area using the ROV based multibeam systems was also supplemented by a more analytical investigation of multibeam technology performed in the adjacent Gollum Channel systems.

In this context, this ARK XIX/3a report is separated into 3 study areas (Fig. A4.1-1): Gollum Channel (Porcupine Seabight) (section 4.2), "Belgica mounds" (Porcupine Seabight) (section 4.3) and the Porcupine Bank (section 4.4). Investigations from each of these areas are presented separately below followed by discussions of wider issues (sections 4.5-4.10).

A. 4.2 Microbathymetry surveys along deep-water canyons (Gollum Channel) in the Porcupine Seabight

Beyer, A., Krocker, R., Pokorna, M., Rathlau, R., Dabrowski, P.

Technical Aspects of the "Victor 6000" bathymetric system

Two modules are available on the ROV "Victor 6000" intended for sampling and micro bathymetry. On this cruise the micro bathymetric systems EM2000 (Simrad) and Seabat 8125 (Reson) were available for deployment.

The Reson Seabat 8125 multibeam system operates at 455 kHz. It has a swath width of 120 degrees. The beam spacing is 0.5 and 1 degree for the across and along track directions respectively. The maximum selectable range scale is 120m. Physical specifications of the sonar head allow this system to be deployed at depths down to 1700m water depth. Position is computed from inertial navigation systems of "Victor". Absolute positions (with respect to the vessel) and re-initialisation is determined using POSIDONIA at appropriate intervals. However, the bathymetric data is effected by navigation offsets which induce artefacts on the terrain model. These are mainly due to the pitch of "Victor" and navigation offsets.

Post processing of the recorded data can be caried out using the QINSY software. The data can also be exported in the XTF (Extended Triton Elics Format) for further processing utilizing different commercial hydrographic software.

Validation of angular backscatter measurements utilizing "Victor 6000" and video controlled sediment sampling

Multibeam systems are widely used to cover large seabed areas by bathymetric measurements in a comparatively short time. For this purpose, the multibeam system

Hydrosweep DS2 is installed onboard RV Polarstern. It operates at a frequency of 15.5kHz. In addition to depth measurements, echo amplitudes are recorded by the system. The amplitudes can be converted into multibeam sidescan and angular backscatter data. The main application of sidescan is to detect small scale features which cannot clearly be recognised in the bathymetry (e.g. shallow channels or iceberg plough marks). In contrast, angular backscatter shows the same resolution as the depth measurements but supplies additional information about physical properties of the seafloor (surface- and volume roughness) (Fig. A4.2.2-1).

Fig. A4.2-1: Angular backscatter curve for a) rough and b) smooth seafloor.

Therefore, the backscatter strength and its dependence on the incidence angle of the acoustic pulse onto the seafloor is considered. Using a terrain model and taking into account the effect of the water column as well as internal signal processing of the multibeam, the recorded amplitude values are transformed into angular backscatter strength. Maps showing the spatial extension of the backscatter data are used as a basis to segment the seafloor into regions of different backscatter characteristics. The segments are based on different echo levels and changing slope of the angular backscatter fall (dB per degree incidence angle). The combination of these maps with surface samples helps to determine different sediment properties in the segments and the spatial validity of surface samples can be extended from the sampling spot to the segmented areas. Thereafter, the sediment data can serve as input for seafloor classification.

The aim of this study is to investigate the link between seafloor properties and angular backscatter in order to use Hydrosweep bathymetric measurements for remote sensing of the seafloor. Sparsely distributed seafloor samples and related seafloor properties will be utilised to enhance interpretation of the entire area where backscatter data is available.

During the leg ARKXIX/3a ground truths for the backscatter analyses were collected at different sites along the eastern slope of the Porcupine Seabight southwest of Ireland. One site is located in the Gollum Channel system and a second area is situated south of the Belgica mound province (->reference to overview map). The locations have been determined based on bathymetry and backscatter data recorded during leg ANTVII/4. The sites were selected because of a significant change in backscatter characteristics. The changes within the Gollum Channel may be due to the flow regime in the channel that had driven the sedimentation. The segments south of the Belgica province are isolated areas and represent different seafloor facies, such as a depression area, a sloped area and a stripe of low backscatter indicating flowing activity. The focus of the cruise was to get a complete data set of the selected seafloor areas. It includes bathymetry, micro bathymetry and angular backscatter data, sediment samples and video observations.
The deployment of ROV "Victor" 6000 was realised in the northernmost Gollum Channel (Fig. A4.2.2-2). Using the multibeam module of the ROV the micro-bathymetry of that channel along with video observations and vertical images have been recorded to obtain information about the microstructure of the seafloor along the track lines.

Due to bad weather conditions the planned transect could not be finished completely. Finally, a transect of the Channel and grid surveys at three selected locations were completed. The grid surveys were selected to investigate differences between the Polarstern Hydrosweep system (15.5kHz) and the Seabat 8125 micro bathymetric system (455kHz) in terms of accuracy and resolution of the depth measurements and backscatter data. The application of a shallow water echo sounder onboard "Victor 6000" establishes the opportunity of recording backscatter data in addition to the Hydrosweep data for comparison of areas.

The grids have a size of approximately 150 x 150m that corresponds to 3x3 footprints of the Hydrosweep system. Since the seafloor segments represent homogenous seafloor cover (based on the Hydrosweep backscatter data), results of the grids can stand for the entire segment. The data of the tracks between the grid sites are recorded to examine the backscatter and micro bathymetry change along the bottom of the channel. The flight height during the survey was 10m. Altogether approximately 7nm of micro bathymetry survey line have been recorded. The depths range from 1700m to 1300m.

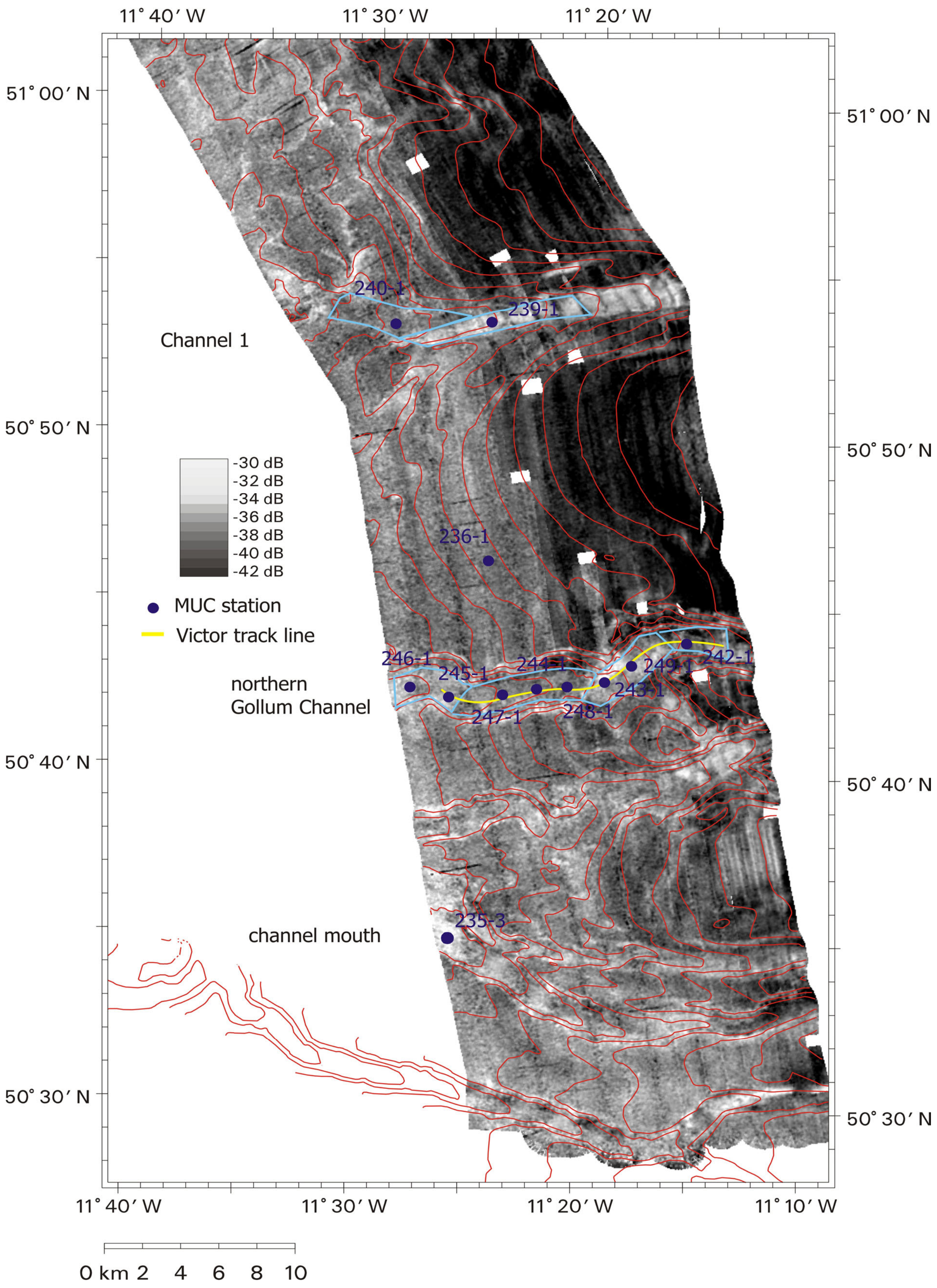


Fig. A4.2-2: Normalized backscatter of the Gollum Channel area indicating the targets of investigation utilizing multicorer and ROV "Victor". Different acoustic facies have been segmented based on the backscatter level.

First results show that the seafloor of the channel is flat on the micro bathymetric scale, i.e. no distinct features at the scale of some 10cm have been found in the preliminary processed data. However, height changes of a few meters are visible within the grid survey areas at the scale of >10m. The micro bathymetry data are clearly influenced by the movement of "Victor 6000" (Fig. A4.2.2-3). Insufficient pitch compensation of the ROV becomes particularly visible in the data set as a wave structure affecting the entire data set.

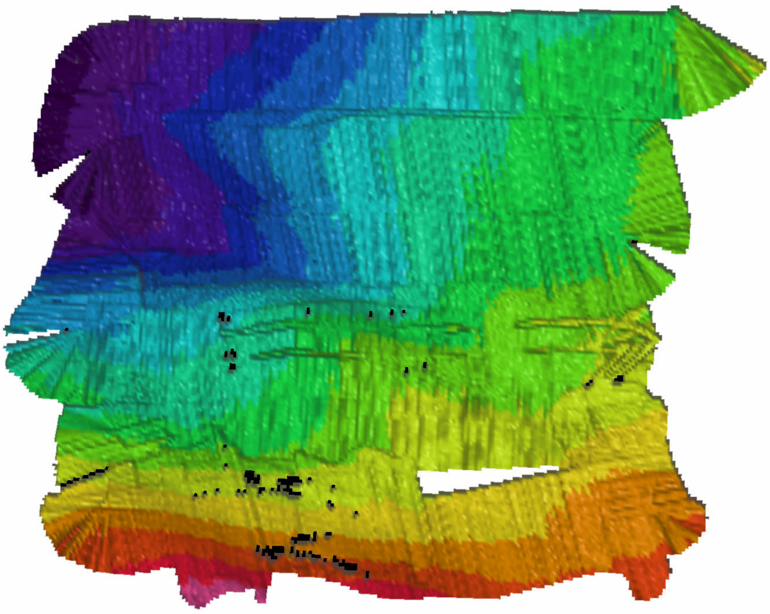


Fig. A4.2-3: Micro bathymetry recorded by Seabat 8125 mounted on "Victor 6000". The grid has a size of approximately 150m x 200m. The depth ranges between 1525m (blue) and 1520m (red).

The height of these waves was determined as approximately 6cm that is close to the Seabat accuracy. Navigation errors are also seen in the overlapping areas of adjacent track lines. Due to the low topographic variation of the seafloor at the channel bottom these artifacts are very pronounced and dominate the data set. The wavelength of the Hydrosweep acoustic pulse is approximately 10cm. Thus, surface topography of the size of the artificial waves can affect the backscattering of the pulse. In order to perform statistical analyses of the micro bathymetry, these errors first need to be removed from the data. To realize this process, thorough data analyses of the motion sensors of "Victor 6000" and other related navigation parameters need to be conducted. So far angular backscatter data of the Seabat System have not been processed.

In addition to the micro bathymetry data, video observations were conducted at each of the grid survey sites. The main focus concerned capturing the surface structure utilizing the vertical camera. The flight height during the video survey was 3m. Fig. A4.2.2-4 shows a vertical image of the seafloor of the western grid survey site. Main features are a flat seafloor with some holes that indicate some live faunal activity at the seafloor.

Fig. A4.2-4:Vertical image of the seafloor during the first grid survey at the west end of the northern Gollum Channel.

A second ROV dive was planned along the same track line to obtain detailed video observations and sediment samples. Due to unfavourable weather conditions, this dive was replaced by video guided multicorer sampling. Thus, seabed information regarding visual and sediment data was also collected.

Since the "Victor 6000" system is designed for long term dives of several hours, the multicorer was deployed for sampling the seafloor at selected sites. Altogether 15 stations have been sampled utilizing the multicorer. The attached video camera provides images from the seafloor that enhance the sediment interpretation. In particular current and particle flow, macro fauna and surface structures such as ripples or bumps have been found.The upper part of the sediment layer has been sampled since it is the predominant effect on the backscatter of the acoustic pulse. The cores were sampled in 1cm slices (from 0 to 10cm depth) and every second 1cm slice was sampled below 10cm. The description of the multicorer stations is given in Table A4.2.2-1.

Backscatter analysis

Angular backscatter data are difficult to display on bathymetric maps. Since the backscatter strength is mainly affected by the sonar beam angle, the images show artifacts parallel to the track lines. Therefore, the angular backscatter was processed and the mean angular dependence has been removed from the data. As a result normalized backscatter (grey level) is used for seabed analysis and represents the angular backscatter data as approximate values.

The backscatter grey level of the area shows a range of 12dB. The background sediments of the margin have backscatter grey levels of about -42dB. The area of the "Belgica mounds" reaches higher backscatter levels up to -35dB. The highest value of -30dB was found to exist at a strong slope of a depression area. The multicorer video deployment indicated corals on this slope.

For a preliminary investigation two channels have been selected for studying sediment (grain size, stratigraphy) and backscatter properties: channel 1 and the northern Gollum Channel.

Grain size analyses were carried out using a binocular and a 0.1mm surgical sewing thread as a reference scale. The classification of the sediments to sand, silt or clay was made visually. The sediment grain size of the selected stations is given in Table A4.2.2-2.

The southern part of the area of investigation including the channels is displayed in Fig. A4.2.2-2. The segmentation of the channels based on the backscatter grey level is also indicated. In Table A4.2.2-2 backscatter levels and sediment properties are given at the multicorer stations. At channel 1 we found that the higher backscatter in the eastern (upper) part corresponds to a low penetration of the multicorer. The upper part of that channel shows -36.6dB versus 26cm penetration compared to the western (lower) part which shows -39.5dB versus 16cm penetration. This situation also exists if one compares the background sediments with the mouth of channel area, i.e. -36.6dB / 28cm and -39.6 / 20cm, respectively.

The northern Gollum channel was subdivided into four segments which have an average backscatter value of -37.0dB, -38.9dB, -37.3dB and -41.2dB from west to east. In this channel the backscatter grey level also correlates to the penetration depth of the multicorer. However, the easternmost segment of the channel has the lowest dB value but also the lowest penetration.

In the channel segments 1, 2, and 3; 2, 3 and 2 samples were recovered respectively. From segment 4 one sample was recovered. The results of the penetration depth are similar in each of the segments. This shows that the segmentation was properly done and supports segmentation based on angular backscatter data. Fig. A4.2.2-5 shows the relation between backscatter and sediment properties. Different grain size is indicated by colour. Vertical changes in the sediment structure are indicated by a horizontal line. A line in the middle of the bar means a gradual change in the sediment.

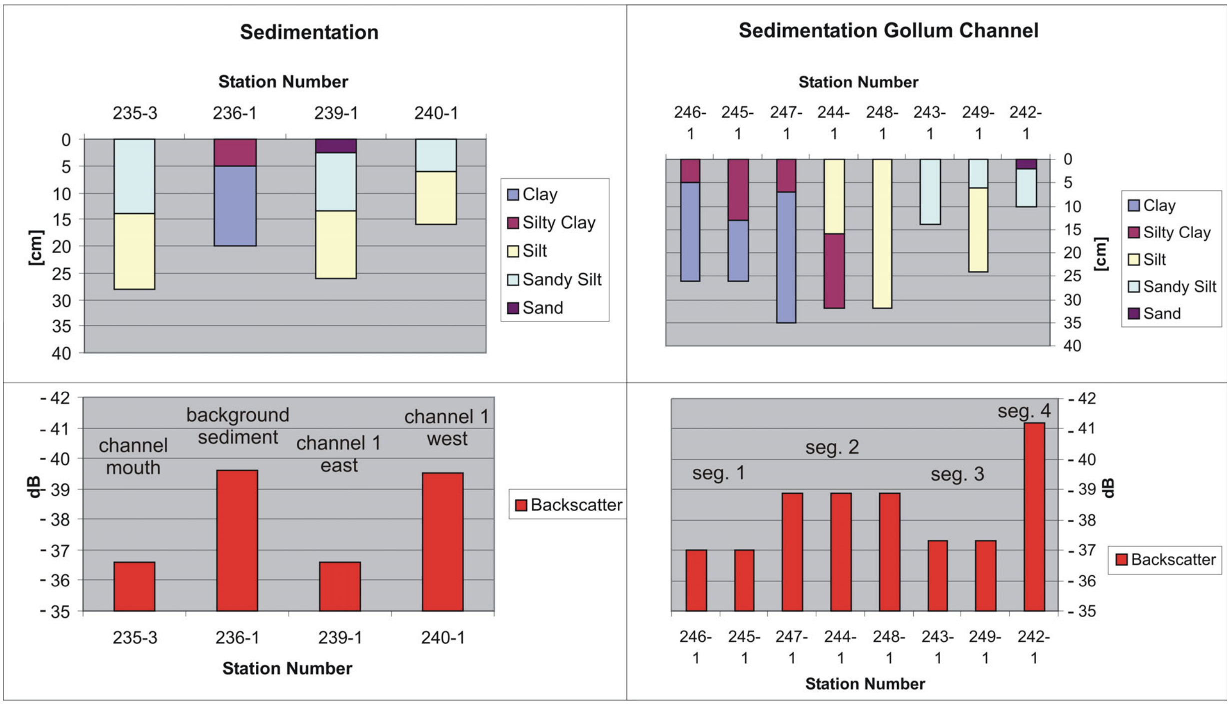


Fig. A4.2-5: Grain size and penetration depth at selected locations. Normalized backscatter and penetration show a clear correlation. Vertical changes in the sediments are indicated by a horizontal line. If the line is drawn in the middle of the bar, the sediment changes gradually.

Although this first analysis of the data did not show a close correlation between backscatter grey level and grain size, the lower dB level could be due to the coarser material in this shallower part of the channel (segment four). The grain size analyses indicate a change from coarser material (sand, sandy silt) in the shallower part to finer sediments in the deeper part of that channel (silty clay, clay). Hence, thegrain size distribution agrees with the assumption that coarser sediments are deposited first as the current runs down the channel and decreases in speed.

Since the penetration depth of the multicorer is mainly driven by the water content of the sediments. The results of this study indicate that a higher backscatter grey level is caused by a higher water content of the sediments. However, a distinct effect of the grain size variation of the fine grained seafloor sediments on the backscatter grey level are not evident in this investigation.

Shipborne Bathymetric surveys during the cruise ARKXIX/3a

Hydrosweep is capable of determining the mean sonic velocity that is required for refraction correction of the slant sonar beams. This technique is known as cross fan calibration. However, in order to apply a local water sonic velocity profile and to prevent data gaps due to the calibration mode, CTD profiles of the water column recorded at various locations during the cruise were processed and finally used during the data acquisition with Hydrosweep.

The Hydrosweep system recorded data during the entire cruise and provides detailed bathymetric data at the investigated locations. These locations are at the northernmost Gollum Channel and at the Belgica mound province at the eastern slope of the Porcupine Seabight, at the "Scarp" and "Hedge mounds" at the Porcupine Bank. Due to the slow speed during the operation of "Victor 6000" a gain in data quality is expected.
During the bathymetric survey of the northernmost channel of the Gollum Channel system 70nm survey line have been covered. The aim of this survey is to extend the existing Polarstern bathymetry and backscatter data of that area towards the mouth of the channels in the west and to check whether changes of the backscatter data have occurred with respect to the cruise ANTXVII/4. Due to the video system attached to the MUC it became obvious that this channel is not active. This indicates comparable backscatter data from the leg ANTXVII/4 and ARKXIX/3a.

Towards the end of the cruise a detailed survey of approximately 25nm was started closed to the "Hedge mounds". In this location there are channel heads cutting the continental margin. The data is appropriate for comparison with the Gollum channel bathymetry and angular backscatter data.

Table A4.2-1: description of the multicorer samples

Station number	Position Lat	Position Lon	Depth (m)	Penetration (cm)	Comment
PS64/235-3	50° 35.09' N	11°25.92' W	1686	28	sandy, soft, no stratigraphy visible
PS64/236-1	50°46.08' N	11°24.02' W	1021	20	muddy surface, thereafter more compact, anemone
PS64/239-1	50°53.28' N	11°24.64' W	1160	26	sandy top, soft, compact layer
PS64/240-1	50°53.30' N	11°28.95' W	1350	16	fine sand
PS64/242-1	50°43.99' N	11°15.69' W	1092	10	top fine sand with little clay, ripples
PS64/243-1	50°42.62' N	11°19.24' W	1341	14	sandy with little clay, macro fauna
PS64/244-1	50°42.45' N	11°22.32' W	1522	32	sandy, soft, probably organic rich
PS64/245-1	50°42.17' N	11°26.07' W	1674	26	mud, soft, no ripples
PS64/246-1	50°42.32' N	11°28.13' W	1730	26	mud, soft, no ripples, lebensspuren
PS64/247-1	50°42.15' N	11°24.10' W	1603	34	mud, soft, no ripples
PS64/248-1	50°42.46' N	11°21.07' W	1479	32	fine sand, soft, no ripples, unstructured
PS64/249-1	50°43.78' N	11°17.54' W	1191	24	fine sand, soft, no ripples, lots of macro fauna
PS64/250-1	51°10.40' N	11°47.09' W	1536	no recovery,	corals, strong current
PS64/251-1	51°12.11' N	11°40.78' W	1017	30	sandy, stepwise penetration
PS64/252-1	51°11.16' N	11°34.88' W	723	28	sandy, soft, ripples

Table A4.2-2: Physical and acoustic properties of selected sediment samples. The depths of the grain size estimation and sediment changes were determined visually. The backscatter value represents the segment in which the sample was taken.

station	Penetration (cm)	normalized backscatter (dB)	Grain size at sample depth
PS64/235-3	28	-36.6	2cm: sandy silt, 22cm: silt, smooth change
PS64/236-1	20	-39.6	5cm: silty clay, 15cm: clay, change at 5cm
PS64/239-1	26	-36.6	1cm: sand, 7cm sandy silt, 16cm: silt, change at 2.5cm, 11cm, 12.5cm
PS64/240-1	16	-39.5	3cm: sandy silt, 13cm: silt, change at 6cm, end of core
PS64/242-1	10	-41.2	1cm: sand, 6cm: sandy silt, change at 2cm, 9cm
PS64/249-1	24	-37.3	3cm: sandy silt, 18cm: silt, change at 6cm
PS64/243-1	14	-37.3	2cm: sandy silt, 14cm: silt, change at 5cm
PS64/248-1	32	-38.9	1cm, 8cm, 30cm: silt, change at 3, below smooth change
PS64/244-1	32	-38.9	4cm: silt, 14: silt, smooth change
PS64/247-1	34	-38.9	3cm: silty clay, 15cm: clay, 30cm clay, change at 7cm, below smooth change
PS64/245-1	26	-37.0	3cm: silty clay, 25cm: clay, smooth change
PS64/246-1	26	-37.0	2cm: silty clay, 13cm: clay, 23cm: clay, change at 5cm, below smooth change

A. 4.3 Sedimentary and hydrodynamic processes and interactions in the "Belgica Mound" province, Porcupine Seabight

Wheeler, A., Foubert, A., Dorschel, B., Gault, J., Kozachenko, M., Thomsen, L., Unnithan, V.

A. 4.3.1 Introduction to the "Belgica Mound" setting

Foubert, A.

The "Belgica mound" province is characterised by conical mounds asymmetrically buried along the eastern continental margin in the Porcupine Seabight (De Mol *et al.*, 2002; Van Rooij *et al.*, 2003). Multibeam imagery (Beyer *et al.*, 2003) revealed that this part of the basin is dominated by surface mounds and some buried mounds, with a north-south orientation at depths of 500-1000 m. These mounds can rise up to 300 m above the seabed and can measure up to a few km across. Some mounds are characterised by depressions at the steep downslope side of the mounds that are probably the result of strong bottom currents around the mounds (Van Rooij *et al.*, 2003).

De Mol *et al.* (2002) and Van Rooij *et al*. (2003) attributed the net south-north alignment of the coral banks to the presence of eroded ridges of an acoustically transparent unit of probable Miocene origin. Since corals grow preferentially in elevated locations (Frederiksen *et al*., 1992; Freiwald, 2002), the local morphological characteristics make this site attractive for deep-sea coral settling and growth. In the vicinity of these large coral mounds, small mounds (the "Moira mounds") exist (Wheeler *et al.*, subm).

As well as these mound structures, a multitude of channels are also observed in the area. A large, along-slope, north-south to northeast-southwest channel forms the western limit of the Belgica Mound province. Shallow south-west trending downslope gullies feed into the north-south channel (Van Rooij *et al*., 2003). Contourite drift systems dominate the sedimentological processes in the Belgica Mound area, shaped by the presence of giant carbonate mounds and channels (Van Rooij *et al*., 2003). Moreover, high resolution side-scan sonar imagery in inter-mound areas revealed the presence of extensive sand sheets with numerous bedforms (sediment waves, barchan dunes, gravel ridges, seabed striations) indicative of high benthic current strengths and active sediment transport (Wheeler *et al*.; 2000; Huvenne *et al*., 2002).

During this cruise, focus was placed on mound formation processes, mound dynamics and sediment interactions and biodiversity differences between mounds in the "Belgica Mound" province. Two dives were carried out with the ROV “Victor 6000” (Fig. A4.3.1-1):

- A reconnaissance video survey over numerous steep-flanked "Belgica mounds".
- A microbathymetric survey with the multibeam system SIMRAD EM 2000 mounted on the ROV over the "Moira mounds"

In addition, boxcores were taken for benthic analysis, seven current meters were deployed in S-N transect and W-E transect over Galway Mound, a Lander was placed on Galway mound and some CTD profiles were collected to give an overview of the influence of the different water masses in the Belgica mound area (Fig. A4.3.1-1).

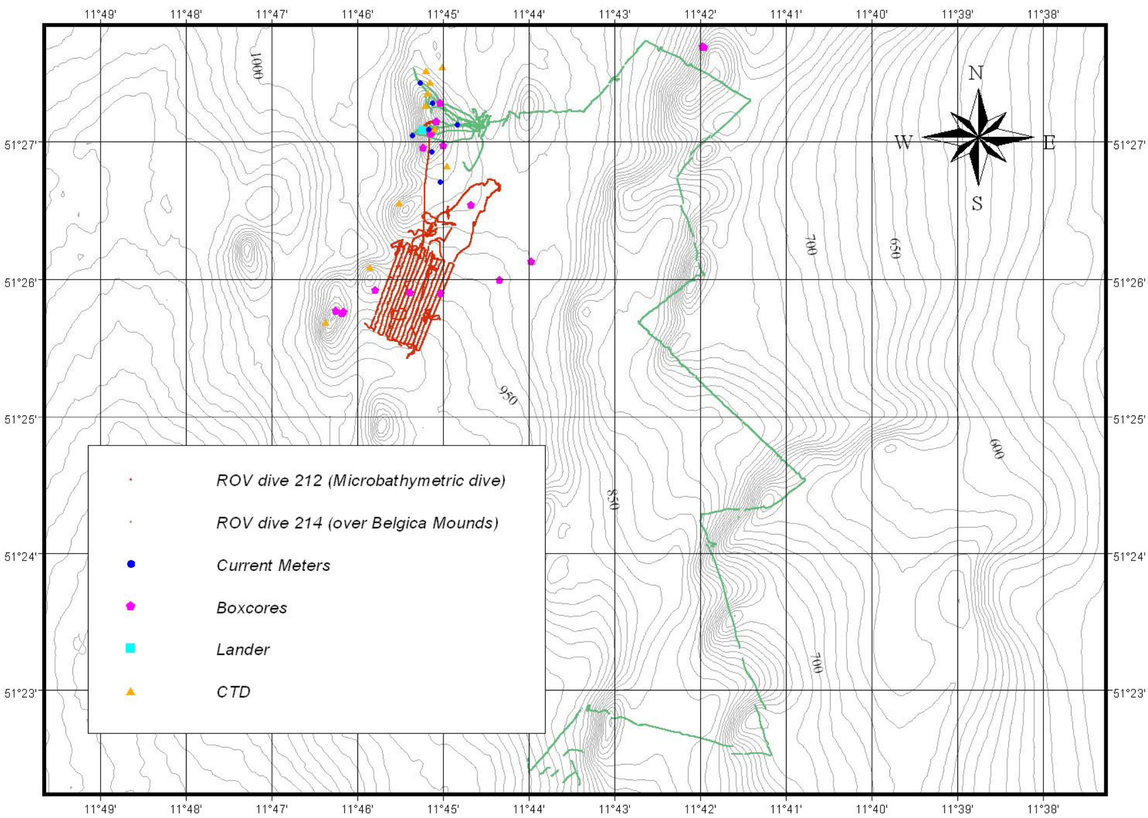


Fig. A4.3.1-1: Location of the boxcores, current meters, lander, CTD casts and ROV-dives in the "Belgica mound" Province

A. 4.3.2 Variation in sedimentary facies in the "Belgica mound" area

Foubert, A., Kozachenko, M., Dorschel, B., Wheeler, A., Gault, J.

Recent sedimentation in the Porcupine Seabight consists mainly of (hemi)pelagic and locally reworked successions. Previous studies showed that the uppermost sedimentary layer mostly consists of Holocene foraminiferal sands, representing the interglacial sedimentary environment, followed by several meters of silty clays deposited during glacial periods. There is also evidence for the presence of rock debris on the seafloor (Kidd & Huggett, 1981). These authors also reported a large amount of dropstones (clinker and coal residues) dumped from the steamships. Surprisingly, these residues are, in some locations, even more abundant than ice-rafted debris.

The sedimentary processes and the evolution of the sedimentation in the Belgica mound area was described recently by Van Rooij et al. (2003), followed by a more detailed study of the present-day sedimentary pattern and seabed features recognised on TOBI side scan sonar imagery (Huvenne, 2003; Wheeler et al., subm.). Present day environment of the "Belgica mounds" area was also detailed by mapping using high-resolution 100/410kHz side-scan sonar techniques during RV Discovery 248 cruise in July-August 2000 (Wheeler et al., 2001; Kozachenko et al., 2003).

Video imagery collected during ROV Victor dive 214 was the subject of facies analysis. This was performed in order to emphasise changes in the distribution and type of coral populations (e.g. live/dead; dense/patchy) on mounds and mound's flanks, and characterise types of seabed in the off mound areas (e.g. rippled/unrippled sands; dropstones). On the basis of video observations a number of facies characteristic for the study area were derived (Table A4.3.2-1). Each of the facies was given a code that was typed in the added column in the navigation file of the dive. Consequently this data was integrated within GIS using Arc View 3.2a and each facies was colour-coded, therefore giving a visual insight into seabed facies distribution in the surveyed area.

Table A4.3.2-1: Seabed facies classification used for the ROV Victor dive 214 video interpretation.

Facies No	**Facies name**
1	Dense coral coverage (live & dead)
2	Dense coral coverage (mostly dead)
3	Sediment clogged dead corals and/or rubble
4	Patchy mostly live corals on rippled seabed
5	Patchy mostly dead corals on rippled seabed
6	Patchy mostly dead corals on unrippled seabed
7	Dropstone (gravel and/or boulders) dominated seabed
8	Dropstones (gravel and/or boulders) - patchy distribution on unrippled seabed
9	Dropstones (gravel and/or boulders) - patchy distribution on rippled seabed
10	Rippled seabed with occasional dropstones
11	Unrippled seabed with occasional dropstones
12	Rock outcrops(?)

Figure A4.3.2-1 shows the interpretation – facies map of the "Belgica mounds" area that was surveyed during ROV "Victor 6000" dive 214. Dive track with colour-coded facies distribution is plotted on top of existing TOBI 30kHz side-scan sonar data (Henk de Haas et al., 2002). Figures 4.3.2-2 & 4.3.2-3 highlight different seabed facies.

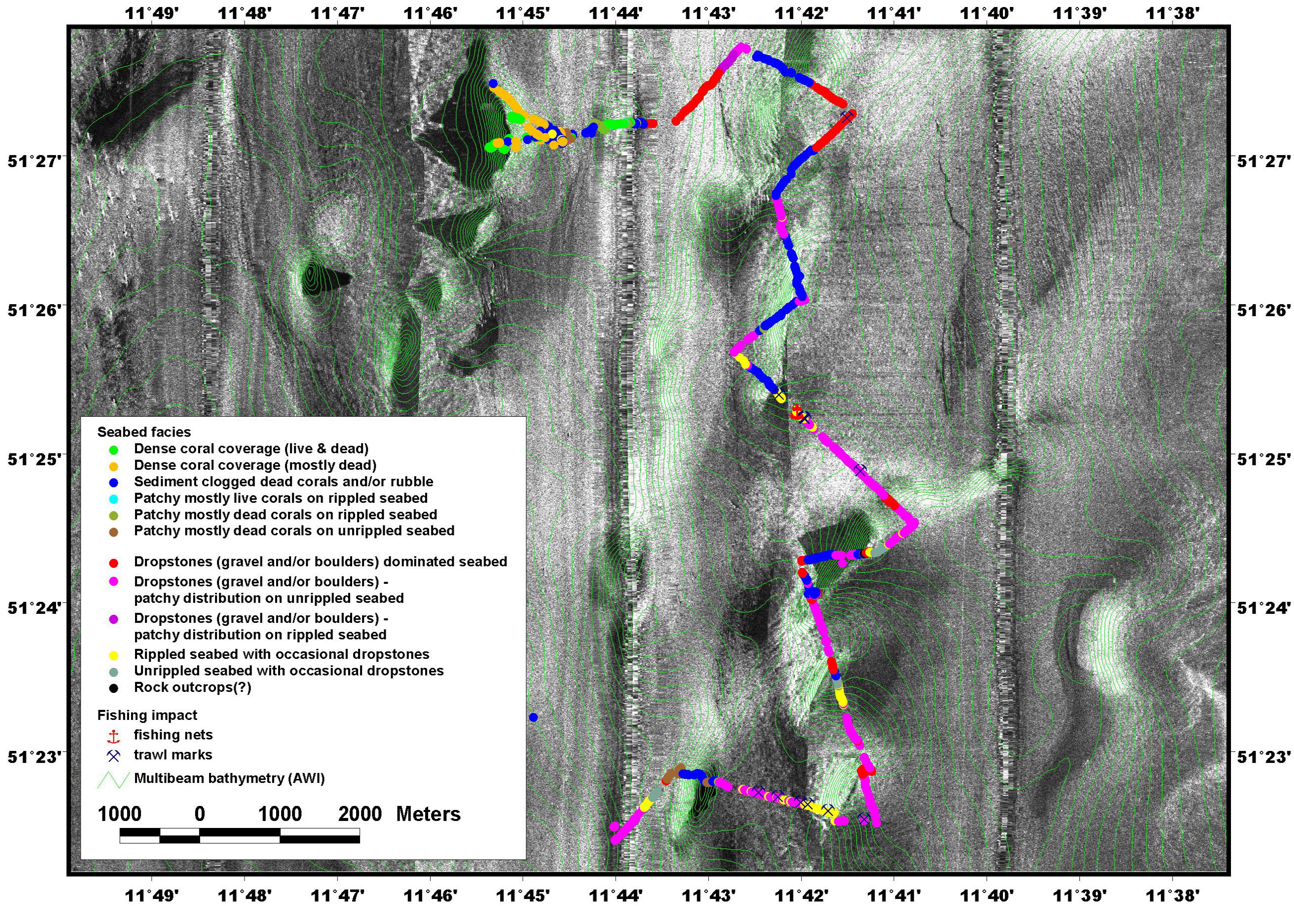
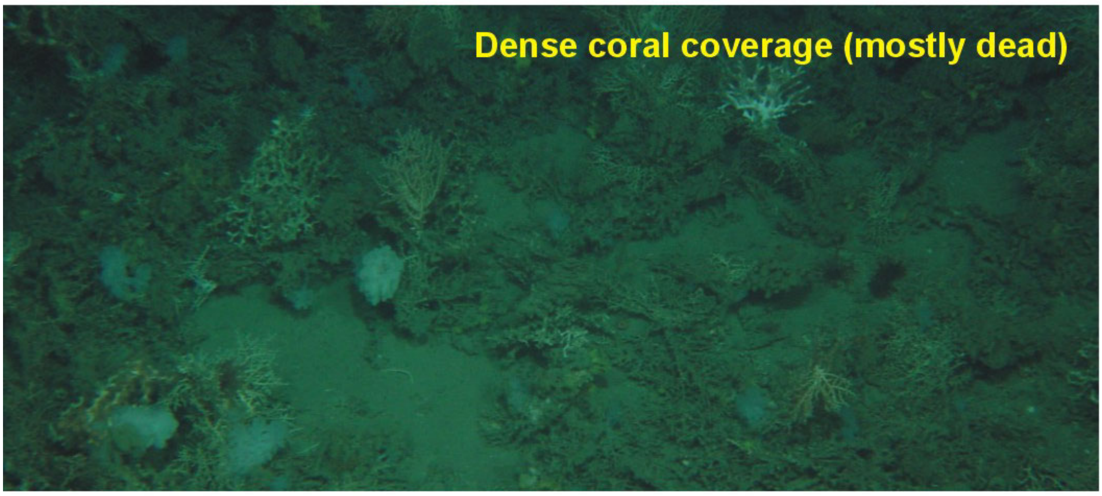


Fig. A4.3.2-1: Facies-interpretation of the ROV Victor dive over the "Belgica mounds"

Evidence of the deep-sea fishing activity in the study area were also documented during the dive, and are shown on Fig. A4.3.2-1



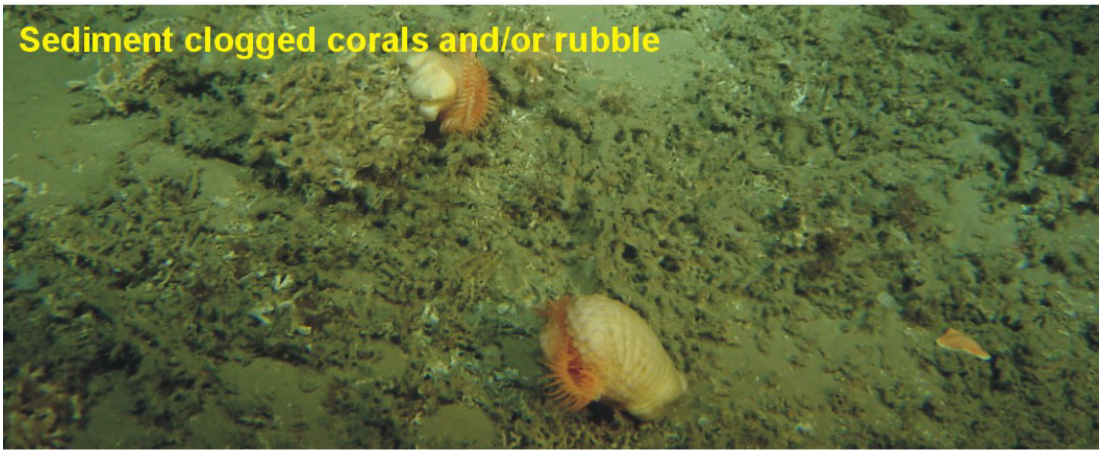


Fig. A4.3.2-2: Visualisation of different facies

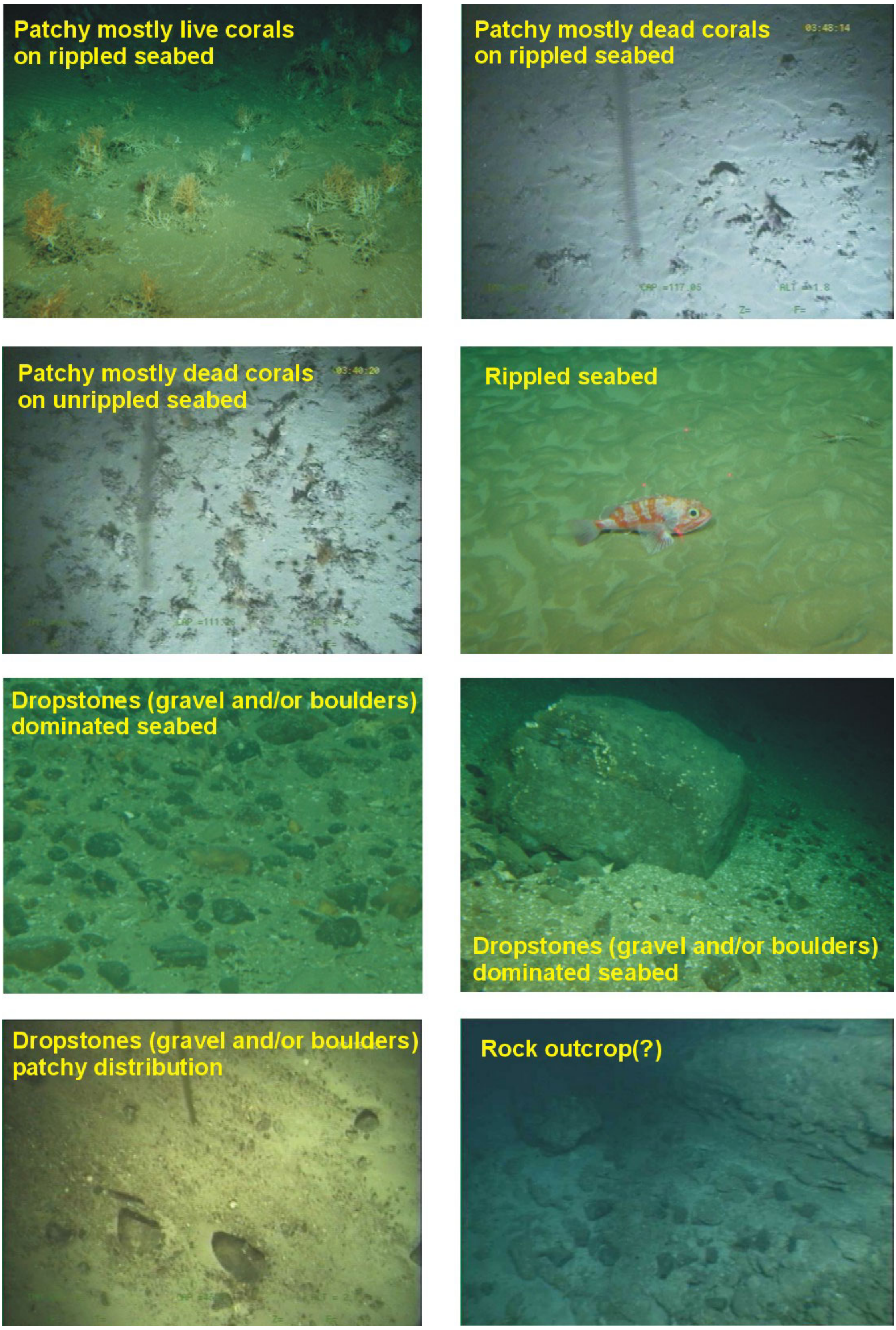


Fig. A4.3.2-3: Visualization of different facies

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It seems that all the mounds along the transect from "Challenger mound" to "Poseidon mound" are covered with dead coral and coral rubble, which means that this mound ridge can be interpreted as a dead ridge. Probably the present environmental conditions aren't that favourable for the growth of deep-water corals in this easternmost part of the "Belgica mounds" area. Only "Galway mound" and the small mound in between "Galway mound" and "Poseidon mound" were covered with a high amount of living coral. During the Caracole-cruise in 2001, ROV video imagery showed that "Thérèse mound" is also covered with a high amount of live coral. It seems that the present hydrodynamic conditions stimulate deep-water coral growth on these more westerly located mounds.
A whole range of local current effects and local current intensifications can be recognized between the mounds, expressed by the occurrence of coarser material. The finer fractions are winnowed away. The interaction between currents and local irregularities are responsible for the typical deposition of patches of very well sorted sands behind these obstacles and for the observed scouring marks.

The overall image of the sedimentary pattern and bedform occurrence fits very well with the general idea of a northerly directed slope current. However, the orientation of the sand waves and ripples on the flank of some mounds shows that downslope orientated transport plays also an important role in the interaction between mounds and alongslope sediment transport.

A. 4.3.3 Benthic Faunal Sampling in the Belgica mound province

Roberts, M.

The sampling objectives as outlined at the start of cruise ARK XIX/3a are given below. Copies of box core photographs listed by "Polarstern" station number were submitted to the Public file server at the end of the cruise.

Objective

To describe benthic infaunal and epifaunal communities both on and off carbonate mounds supporting cold-water corals. To collect live coral for laboratory study and calcareous macrofauna with potential for use as temperature proxies.

Hypotheses

H01: The presence of coral rubble habitat has no effect on the diversity of the associated community.

HA1: The presence of coral rubble habitat enhances the diversity of the associated community.

If evidence for bottom trawling is detected at some sites:

H02: Fish trawling has no effect on the community composition of fauna found in coral rubble or background sediment.

HA2: Trawling alters the community composition of fauna found in coral rubble and may increase the abundance of scavenging species.

Tasks

Collect samples of the seabed sediments both with and without coral rubble. This will mean locating suitable sampling sites from "Victor 6000" ROV surveys within areas of coral rubble and within areas where there is no rubble present, i.e. both on mound and off mound. The areas should be broadly comparable in terms of depth, temperature, current etc. If possible this process should be repeated in areas that have been affected by bottom fishing activity (assuming that the other samples are from unfished areas). Samples were taken by box corer.

Preferred locations

To be amended on basis of "Victor 6000" dive information.

1) On "Galway mound" 800m depth, 51° 27' 5.2" N 11° 45' 8.8" W, 3 coral-rich cores needed.

2) Off "Galway mound" 910m depth, 51° 26' 33.17"N 11°44' 42.49" W, 3 coral-free cores needed.

3) On "Moira mound", 51.4333548 N -11.7570262W

Methodology

- Overlying water passed through 250 μm sieve
- Once the core is recovered, the surface is photographed and notes taken
- Live coral may be transferred to aquaria and notes documenting this taken

- Visible calcareous fauna removed (bivalves etc.) and noted – both number of individuals and species
- Delicate epifauna picked off
- If possible the core is sliced to separate the upper 10cm from the lower portion of the core. The two sections will be processed separately and we may only process the upper 10cm.
- Samples then sieved using filtered seawater through stacked sieves (1000, 500 & maybe 250 μm)
- The sievings are then stored in separate sample buckets with 10% formalin (equivalent to 4% formaldehyde) borax-buffered filtered seawater containing rose bengal for 24 hours minimum giving:
    - coral rubble
    - 1000 μm sieving
    - 500 μm sieving
    - ?250 μm sieving
- Then transferred from formalin, washed in filtered seawater and preserved in 95% ethanol 4% glycol (if sufficient ethanol is available).

Sampling sites for biological box cores

"Moira mound" (x1 exploratory core + 2-3 later)
"Galway mound" (x3 on mound), sediment waves (x3 off mound)
" Thérèse mound", on mound (x2), off mound (x2) if time – focus on collecting live coral
"Twin mounds" (Porcupine Bank – see section 4.4.2), untrawled on mound (x3), trawled on mound (x3), off mound (x2)
This gives a total of up to 22 box cores of which 14 would be fully processed for benthos.

Box Core Stations

The box core sampling stations are summarised in the following log sheets and plotted in Figs A4.3.3-1 & A4.3.3-2.

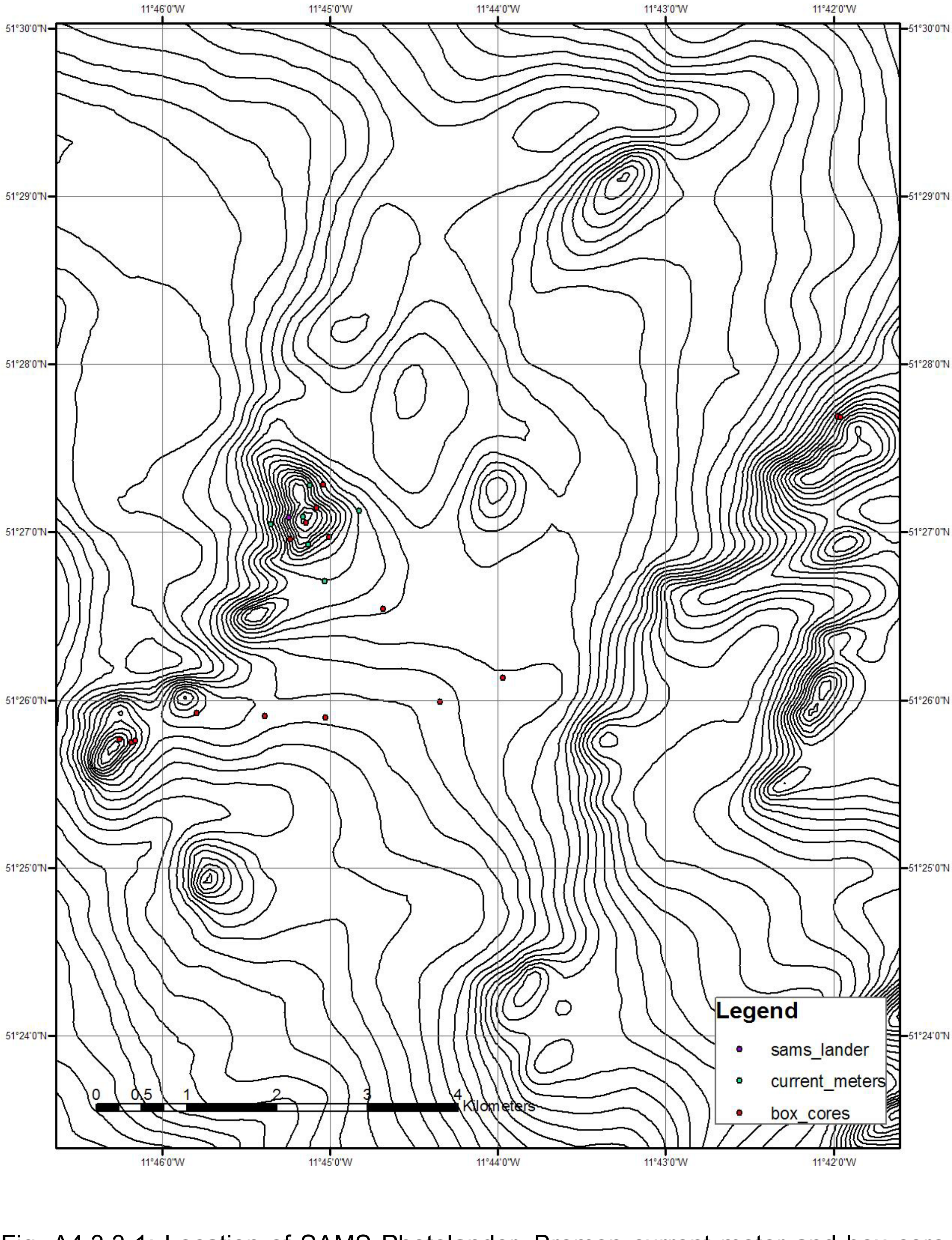

Fig. A4.3.3-1: Location of SAMS Photolander, Bremen current meter and box core sampling stations in the Porcupine Seabight.

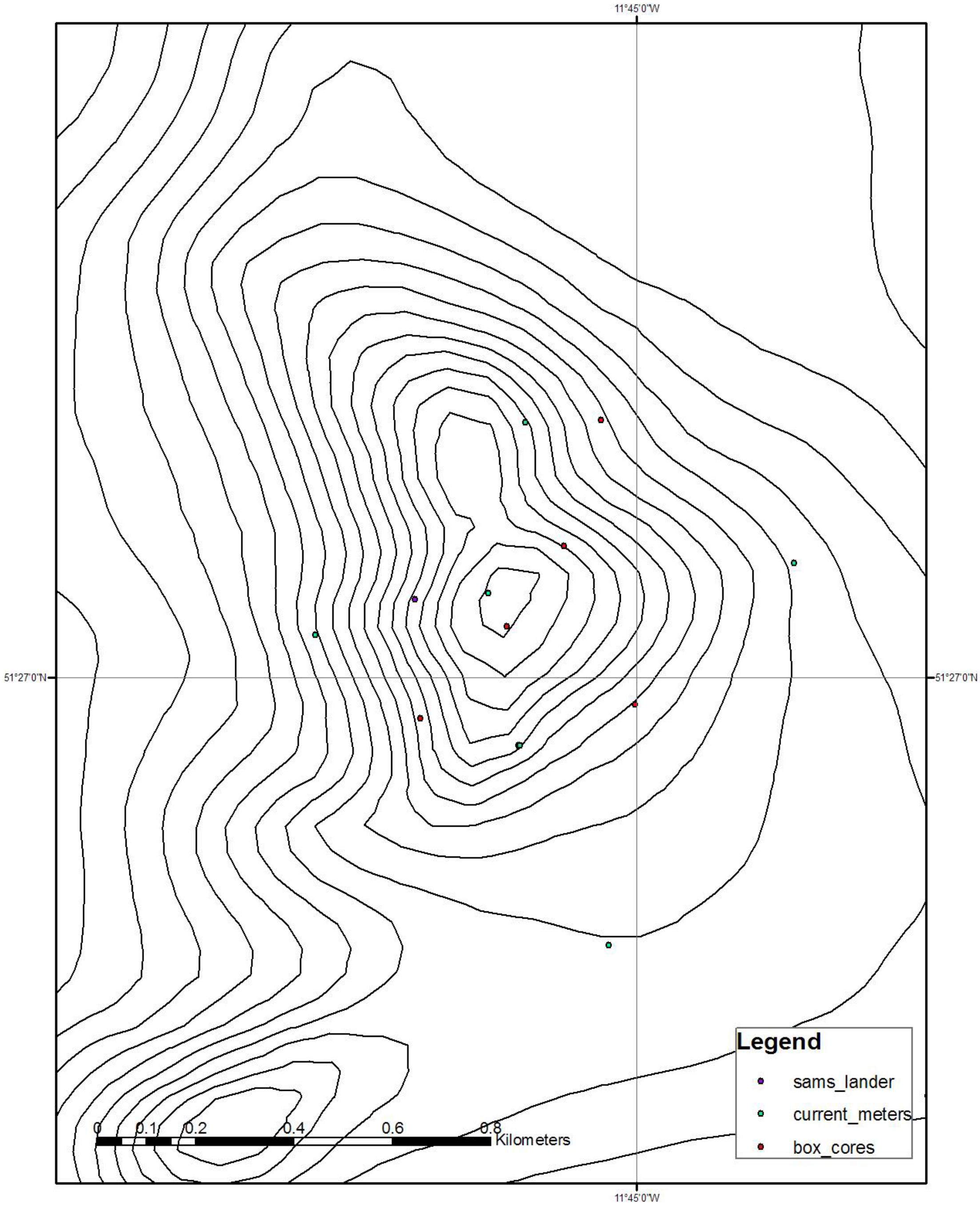

Fig. A4.3.3-2 Location of SAMS Photolander, "Bremen current meters" and box core stations on the "Galway mound".

Box Core Sample Log Sheet

Station No.	PS64/254-1	Date	7 June 03
Box Core No.	1	Time of sample (UTC)	2105
SAMS Station No.	973	Depth (m)	857
Position	51° 26.970N 11° 45.002W	Operator	O Pfannkuche

Sample Description
Core target, 'on Galway Mound'.
Core washed on recovery (not quantitative). Contents dominated by *Madrepora oculata* some *Lophelia pertusa* and glass sponges (*Aphrocallistes*). Coral rubble and live coral present, the latter and Eunicid polychaetes transferred to running seawater tank on deck with a subsample transferred to cold room at 9°C.

Depth core penetration	n/a Core washed

Depth from surface of core	Sieve mesh size	Surface area core sieved
	1000	Whole sample
	500	Whole sample
	250	subsample

Sample removed	No. individuals / No. sub-cores	To whom?
Lophelia pertusa	2	J Hall-Spencer
Madrepora oculata	2	J Hall-Spencer
Bivalve	1	J Hall-Spencer

Box Core Sample Log Sheet

Station No.	PS64/254-2	Date	7 June 03
Box Core No.	2	Time of sample (UTC)	2307
SAMS Station No.	974	Depth (m)	852
Position	51º 27.144N 11º 45.079W	Operator	O Pfannkuche

Sample Description
Core target, 'on Galway Mound'.
Core approximately half full of coral, sediment in lower portion. Core not intact, not quantitative.
Madrepora oculata dominant, glass sponges common, some live *Lophelia pertusa* present.
Live material transferred to running seawater tank on deck. Initial sorting separated in glass sponge, delicate fauna, *Madrepora* and *Lophelia*.

Depth core penetration	n/a Core washed

Depth from surface of core	Sieve mesh size	Surface area core sieved
	1000	Whole sample
	500	Whole sample
	250	subsample

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/254-3	Date	8 June 03
Box Core No.	3	Time of sample (UTC)	0008
SAMS Station No.	975	Depth (m)	875
Position	51º 27.282N 11º 45.039W	Operator	O Pfannkuche

Sample Description
Core target, 'on Galway Mound'.
Core washed out only retaining one sizeable *Lophelia* colony and a few *Madrepora* fragments (all live) with attached hydroids and bryozoan on the older skeletal parts. Placed in aquarium on deck with subsample to cold room.

Depth core penetration	n/a Core washed

Depth from surface of core	Sieve mesh size	Surface area core sieved

----

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/257-2 (repeat 254-3, labelled as 254-4)	Date	8 June 03
Box Core No.	4	Time of sample (UTC)	0337
SAMS Station No.	976	Depth (m)	798
Position	51° 27.056N 11° 45.142W	Operator	T Beck

Sample Description
Core target, 'on Galway Mound'.
Core washed, not quantitative. Living *Madrepora*, dead *Lophelia*, *Bathynectes*, *Pandalus*, many hydropolyps, *Aphrocallistes* and fine coral debris. Subsample of live *Madrepora* transferred to running seawater on deck. Sediment taken for SAMS photolander instrument calibration.

Depth core penetration	n/a Core washed

Depth from surface of core	Sieve mesh size	Surface area core sieved
	1mm	Whole sample
	0.5mm	Whole sample
	0.25mm	Sub-sample

Sample removed	No. individuals / No. sub-cores	To whom?
Unprocessed sediment	1 litre	JM Roberts

Box Core Sample Log Sheet

Station No.	PS64/258-1	Date	8 June 03
Box Core No.	5	Time of sample (UTC)	0435
SAMS Station No.	977	Depth (m)	910
Position	51° 26.541N 11° 44.681W	Operator	T Beck

Sample Description
Core target, 'off Galway Mound'.
Small living *Madrepora* colony attached to dead coral fragment with small green branched hydroid. Two large *Pliobrothus* sp. colonies, one with gastropod attached (*Pedicularia*). Cm-dm of dead coral. *Aphrocallistes* fragments (old). Abundant pteropod shell on surface. *Cidaris* spines, medium to coarse sand.

Depth core penetration	11cm

Depth from surface of core	Sieve mesh size	Surface area core sieved

---

Sample removed	No. individuals / No. sub-cores	To whom?
Madrepora oculata	?	T Beck
Pliobrothus	2	T Beck
Stylasterids (*Pliobrothus*)	2	J Hall-Spencer
Stylasterids (*Pliobrothus*)	2 fragments	JM Roberts

Box Core Sample Log Sheet

Station No.	PS64/259-1	Date	8 June 03
Box Core No.	6	Time of sample (UTC)	0542
SAMS Station No.	-	Depth (m)	942
Position	51º 25.903N 11º 45.387W	Operator	J Gutt

Sample Description
Core target, summit Moira Mound. Core missed target and was not processed.
No information recorded on log sheet, but this core corresponds to photograph labelled 263-1, Box 6, 942m.

Depth core penetration	Not recorded

Depth from surface of core	Sieve mesh size	Surface area core sieved

---

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/263-1	Date	9 June 03
Box Core No.	7	Time of sample (UTC)	0014
SAMS Station No.	978	Depth (m)	921
Position	51° 26.130N 11° 43.970W	Operator	O Pfannkucke A Grehan

Sample Description
Core target, 'off Galway Mound'.
Dropstones between 1 and 30cm, rounded pebbles/lag. Live sea urchin, hydroids, ?sponge, 7 octocoral colonies (JMR note, this could refer to the 7 hydrocoral *Pliobrothus* colonies visible in the photograph), brachiopods, shell debris, small dead Lophelia. Coarse sandy sediment, brown in colour.

Depth core penetration	37-44cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
0-5cm	1, 0.5, 0.25mm	Whole cored, with subsample of 0.25mm fraction
5-10cm	not recorded	

Sample removed	No. individuals / No. sub-cores	To whom?
3 small dropstones and *Pliobrothus*	3 stones and *Pliobrothus*	J Hall-Spencer
Pliobrothus	2 colonies preserved in ethanol	JM Roberts

Box Core Sample Log Sheet

Station No.	PS64/263-2	Date	9 June 03
Box Core No.	8	Time of sample (UTC)	0115
SAMS Station No.	979	Depth (m)	927
Position	51º 25.990N 11º 44.346W	Operator	A Grehan

Sample Description
Core target, 'off Galway Mound'.
Dropstones 1-10cm diameter, rounded and angular, pebbles/lag. Brownish sandy sediment (medium). Pteropod shell fragments, gastropods, Pliobrothus (Stylasterid). Polychaete tube (terebellid) shell encrusted. Top 10cm coarse with fragments shell etc., fine below, brown colour.

Depth core penetration	22cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
0-5cm	1, 0.5, 0.25mm	Whole core, subsample 0.25mm fraction
5-10cm	1, 0.5mm	

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/263-3 *	Date	9 June 03
Box Core No.	9	Time of sample (UTC)	0213
SAMS Station No.	980	Depth (m)	942
Position	51º 25.895N 11º 45.025W	Operator	A Grehan

Sample Description
Core target, 'off Galway Mound'.
* Note core originally mislabelled as 213-3.
Sand with shelly material, small pebbles. Some well eroded fragments of *Madrepora.* Many small stones (<5cm) at top, coarse sand with shell etc. fragments in top 10cm, muddy clay-like layer below, brown colour.

Depth core penetration	15cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
0-5cm	1, 0.5, 0.25mm	Whole core, subsample 0.25mm fraction
5-10cm	1, 0.5mm	

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/270-1	Date	9 June 03
Box Core No.	10	Time of sample (UTC)	0901
SAMS Station No.	981	Depth (m)	942
Position	51º 26.955N 11º 45.237W	Operator	O Pfannkuche

Sample Description
Core target, summit of Moira Mound.
Good recovery box core with live *Madrepora oculata* colonies (10cm diameter), live coral at top with dead bases buried in sand. Sediment is medium grained sand with forams, minor coral debris, small shell fragments. Barnacle (?*Bathalasma* sp.), *Clio* sp., *Diacria*, glass sponge (*Aphrocallistes* sp.) growing on *Madrepora*, bivalve (*Clamis sulcata*), fragment of *Delectopecten vitreus*. Sides of core slumped when removed from corer, therefore the central portion of the core was sieved.

Depth core penetration	14cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
0-5cm	1, 0.5, 0.25mm	0.0625m^2
5-10cm	1, 0.5, 0.25mm	0.015625m^2

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/271-1	Date	9 June 03
Box Core No.	11	Time of sample (UTC)	1029
SAMS Station No.	-	Depth (m)	900
Position	51° 25.750N 11° 46.180W	Operator	Not recorded

Sample Description
Core target, live coral at summit Thérèse Mound.
No description recorded.

Depth core penetration	Not recorded

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Gorgonian	Fragment preserved in ethanol	JM Roberts
Misc. epifauna	Fragments	JM Roberts

Box Core Sample Log Sheet

Station No.	PS64/271-2	Date	9 June 03
Box Core No.	12	Time of sample (UTC)	1140
SAMS Station No.	-	Depth (m)	919
Position	51º 25.766N 11º 46.253W	Operator	Not recorded

Sample Description
Core target, live coral at summit Thérèse Mound.
Lophelia pertusa rubble with a spectacular array of epibionts including some live Scleractinia and glass sponges. Small samples pickled e.g. Polychaeta.

Depth core penetration	Not recorded

Depth from surface of core	Sieve mesh size	Surface area core sieved

---

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/271-3	Date	9 June 03
Box Core No.	13	Time of sample (UTC)	1251
SAMS Station No.	-	Depth (m)	910
Position	51° 25.760N 11° 46.160W	Operator	Not recorded

Sample Description
Core target, live coral at summit Thérèse Mound.
No description recorded.

Depth core penetration	Not recorded

Depth from surface of core	Sieve mesh size	Surface area core sieved

---

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/274-1	Date	9 June 03
Box Core No.	14	Time of sample (UTC)	1645
SAMS Station No.	-	Depth (m)	929
Position	51° 25.921N 11° 45.792W	Operator	JM Roberts

Sample Description
Washed core containing 5 *Aphrocallistes* glass sponges, small ?*Munida* crustacean, dead *Madrepora*, 1 ?*Lophelia* recruit.

Depth core penetration	n/a

Depth from surface of core	Sieve mesh size	Surface area core sieved
n/a		

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/276-1	Date	9 June 03
Box Core No.	15	Time of sample (UTC)	2013
SAMS Station No.	-	Depth (m)	704
Position	51° 27.687N 11° 41.970W	Operator	JM Roberts / T Beck

Sample Description
Core target, top of Propeller Mound.
Desmophyllum and fossil *Madrepora* with *Cidaris* sea urchin

Depth core penetration	35cm (bit half washed)

Depth from surface of core	Sieve mesh size	Surface area core sieved
Whole core	1mm	50%
Whole core	0.5mm	50%

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/276-2	Date	9 June 03
Box Core No.	16	Time of sample (UTC)	2107
SAMS Station No.	-	Depth (m)	727
Position	51° 27.690N 11° 41.975W	Operator	JM Roberts / T Beck

Sample Description
Core target, top of Propeller Mound.
Fossil *Desmophyllum*, *Madrepora*, sparse epifauna e.g. sponge, echinoid.

Depth core penetration	19cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
Whole core	1mm	50%
Whole core	0.5mm	50%

Sample removed	No. individuals / No. sub-cores	To whom?
Coarse sample	50%	T Beck

Box Core Sample Log Sheet

Station No.	PS64/276-3	Date	9 June 03
Box Core No.	17	Time of sample (UTC)	2155
SAMS Station No.	-	Depth (m)	737
Position	51° 27.685N 11° 41.960W	Operator	T Beck

Sample Description
Core target, top of Propeller Mound.
Fossil *Desmophyllum* and *Madrepora* with sponges and *Cidaris*. *Lima marioni* shells.

No photograph taken.

Depth core penetration	18cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
Whole core	1mm	50%
Whole core	0.5mm	50%

Sample removed	No. individuals / No. sub-cores	To whom?
Coarse sample	50%	T Beck

A. 4.3.4 Influence of mound topography on water masses

Thomsen, L., Unnithan, V., Roberts, M., Dorschel, B.

As carbonate mounds are obstacles for the prevailing currents, small-scale current regimes have been established around these mounds. As hydrodynamic factors are expected to be actively controlling the shape and facies of mounds (e.g. Freiwald 2002), detailed information about these current regimes is essential for a better understanding of the processes active at the mounds.

Sand-waves and ripples commonly found in areas adjacent to mounds accentuate the influence of near seabed currents on sedimentation and sediment preservation. The influence of local currents on biology may be even more pronounced, as for example, the purely filter feeding ahermatypic cold water corals preferentially occur in high-current areas with enhanced turbulence such as ridges and crests (Freiwald et al. 1999).

These numerous aspects connected to small-scaled current regimes, indicate the importance of local hydrography in terms of what makes the mounds grow. Therefore better information of the near bottom currents in particular is essential for a better understanding of the various geological and biological processes active on carbonate mounds. To address these processes a set of near bottom current data will be collected by seven current meters at "Galway mound", "Belgica mound" Province in the Porcupine Seabight within the next year (Fig. A4.3.4-1).

During leg 3a of the cruise ARK XIX seven sensor packages including an inductive current meter unit and a CTD were deployed successfully with the ROV "Victor 6000" on transects over Galway Mound. For deployment a north-south transect, parallel to the dominant current direction had been chosen, with current meters up- and down-stream at the mound base in 890 m water depth and at mid-slope (840 m water depth). A fifth current meter was located at the summit. Additionally two current meters were located in the east and in the west, again at 890 m water depth for 3-dimensional resolution.

The current meter will be recovered in approximately one year from now. In the meantime they will analyse every current intensity and direction as well as salinity, temperature and density of the ambient water mass every 15 min for 20 sec..

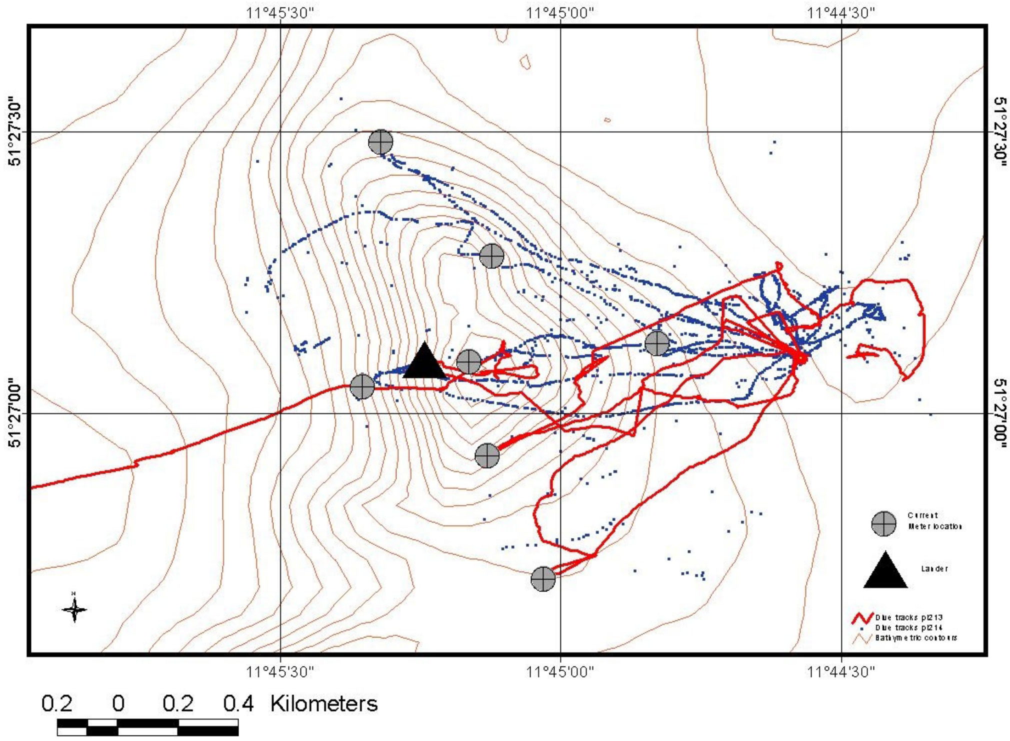

Fig. A4.3.4-1: Lander and current meter locations

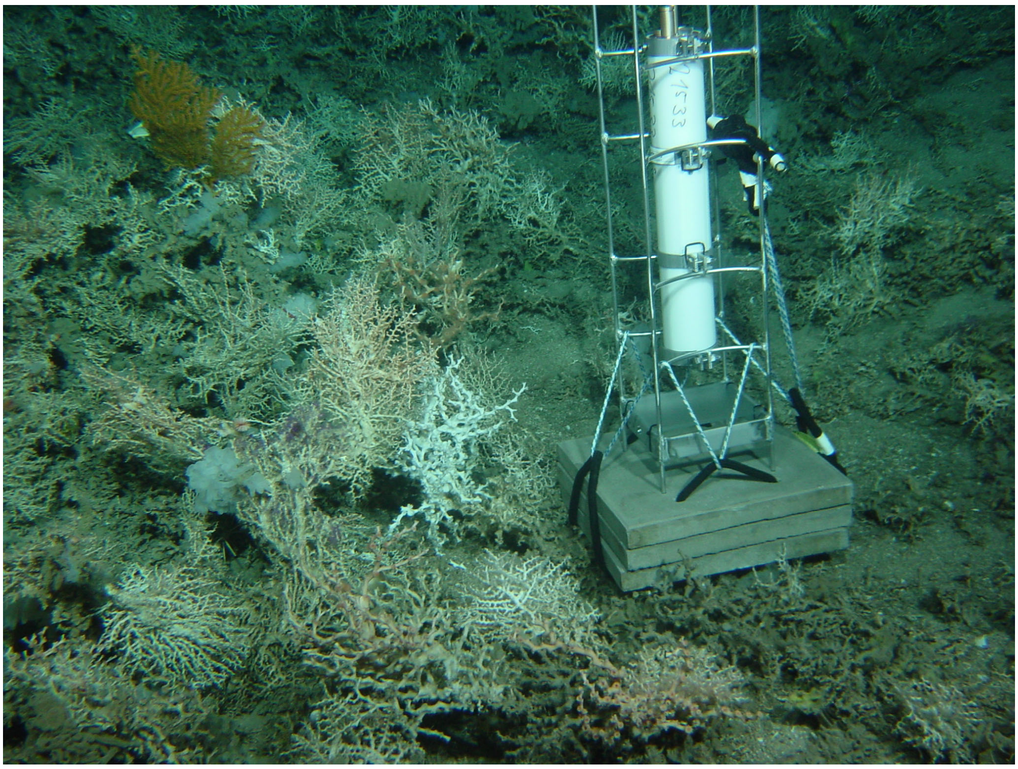

Fig. A4.3.4-2. Current meter deployed on the "Galway mound"

A. 4.3.5 Photo lander deployment on the "Galway mound"
Roberts, M.

Corals such as *Lophelia pertusa* and *Madrepora oculata*, both of which have widespread distributions in the NE Atlantic are commonly referred to as deep-water or cold-water corals. These terms distinguish them from tropical corals that are in large part restricted to shallow, well-lit waters and can develop to form tropical coral reefs. To date, the vast majority of scientific research has concentrated on the shallow-water tropical corals that often contain algal symbionts (zooxanthellae). The inaccessibility of deep-water azooxanthellate species means that little is known about their basic biology and inferences about their environmental sensitivity are often drawn from studies of shallow-water tropical zooxanthellate species. Historically, the greatest research effort on cold-water corals has been in the north-east Atlantic where one species, *Lophelia pertusa*, appears to be the most significant in terms of its occurrence in some areas as sizeable reef-like structures. Indeed, when compilations of its distribution are produced, most records of *L. pertusa* are from the north east Atlantic, probably reflecting the intensity of research work in this area (Roberts et al. 2003, Rogers 1999). However, recent results from the Porcupine Seabight show that the scleractinian fauna on some carbonate mounds is dominated not by *L. pertusa* but by *M. oculata*.

In the last ten to fifteen years, hydrocarbon exploration and production in deeper shelf edge waters has driven discoveries of cold-water coral provinces. For example, in Norway Statoil’s Haltenpipe development project laid a pipeline through areas supporting cold-water coral reefs. These have been mapped (Hovland et al. 1994a) and several ROV surveys of the reefs and their megafaunal community completed while pipeline inspection work was carried out (Mortensen et al. 1995). In the UK, a joint industry wide area environmental survey of the Atlantic Margin discovered an area of seabed mounds and tails colonised by corals, the "Darwin mounds" (Masson et al. 2003). Between 1997 and 2000, a UK partnership of scientific research councils and oil companies commissioned a series of projects under a Managing Impacts on the Marine Environment (MIME) initiative. One of these focussed on the distribution and potential environmental sensitivity of cold-water corals (Roberts 1997). In the last two years, European research effort on these communities has developed under the

EU 5th framework programme. This has supported a suite of projects in the deep waters of Europe's Atlantic margin including the Atlantic Coral Ecosystem Study (ACES) as well as two projects researching the formation and structure of deep-water seabed mounds (ECOMOUND and GEOMOUND).

A second major driver for research into cold-water coral habitats has been growing evidence of damage by deep-water trawl gear. Recent surveys by the Institute of Marine Research in Bergen have shown that 30-50% of Norway's cold-water coral reefs already show signs of damage (Fosså et al. 2002). Around Tasmania, corals and other sessile suspension feeding organisms have been removed by trawlers from seamounts (Koslow et al. 2001). The evidence has provoked debate on whether such areas should be protected. Indeed in both Norway and Tasmania several areas have now been designated as marine protected areas and closed to any trawl gear.

The overall objectives of the lander development described here have been to produce a simple, robust and flexible platform to deploy a variety of cameras and other sensors to record both the environmental dynamics and the behaviour of the benthic biological community. This equipment was developed by the Scottish Association for Marine Science in collaboration with Oceanlab at the University of Aberdeen. To date it has completed two offshore deployments at 300m water depth by the Sula Ridge reef complex. The present Porcupine Seabight work represents the deepest deployment to date and, given the availability of the "Victor 6000" ROV, the first opportunity to target the complex topography inhabited by live cold-water corals.

It was decided to make the lander deployment on the "Galway mound" within the "Belgica mound" province.

Photolander design and research objectives

An existing benthic lander design from Aberdeen University was adapted to provide a tripod frame giving a stable platform for time-lapse photography on the rough substrata found in and around cold-water coral reef areas. The SAMS Photolander was deployed with the following payload:

- Benthos 5010 digital stills camera, adapted for mass picture storage
- CAMEL Camera Alive film camera

- UMI data logger controlling a transmissometer, light scattering sensor and fluorometer
- 3-D FSI recording current meter with CTD
- 150Khz narrow band workhorse ADCP

The overall objective of the photolander is to relate the activity of benthic organisms, here focusing on live coral and associated fauna, in relation to the prevailing hydrography and near-bed particle regime. Steel ballast giving a 90 kg total hold-down weight was attached at each of the three legs while a syntactic foam buoyancy sphere containing the ADCP is held above the tripod frame forming a single module mooring. The recording current meter is placed in this mooring line and the three optical instruments are secured 0.5m above the bed.

Deployment details

In order to decide on a suitable site on the Galway Mound to deploy the SAMS Photo, a video transect was run across the mound by the "Victor 6000" ROV (part of Dive No. 212) at the end of a microbathymetry survey of the "Moira mounds". A representative image of this area is shown in Fig. A4.3.5-1.

The lander was deployed by lowering to within 20m of the seabed on the ship's wire. When in position the mooring was released using a Posidonia release. The lander station number was PS64/261-1. Two and a half hours after release, the lander was inspected during "Victor 6000" dive No. 213. A photograph of the lander *in situ* is shown given in Fig. A4.3.5-2 and an image of the fauna surrounding the lander deployment site is shown in Fig. A4.3.5-3.

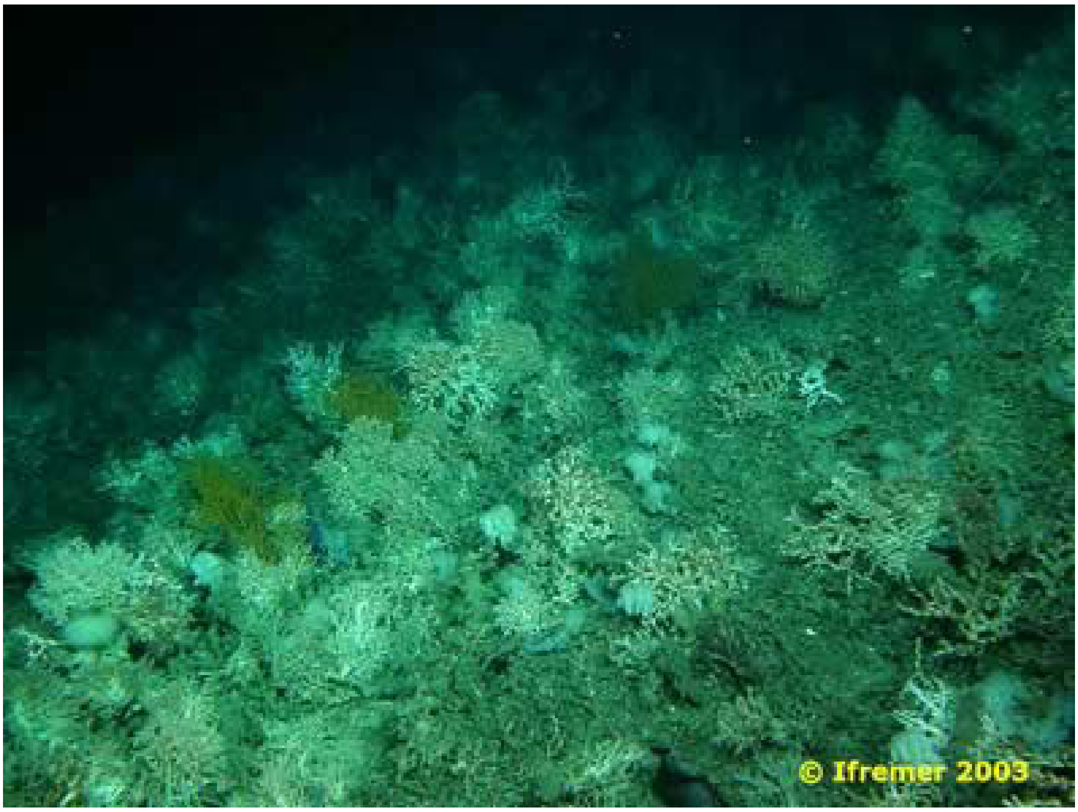

Fig. A4.3.5-1. View of the coral fauna adjacent to the lander deployment site. Live colonies of the coral *Madrepora oculata* and dead coral rubble can be seen across the bed. The yellow-orange coloured gorgonian coral visible in the photograph may be *Acanthogorgia* cf. *armata* (pers. comm. A Freiwald) and the glass sponge *Aphrocallistes* is present in the centre of the image.

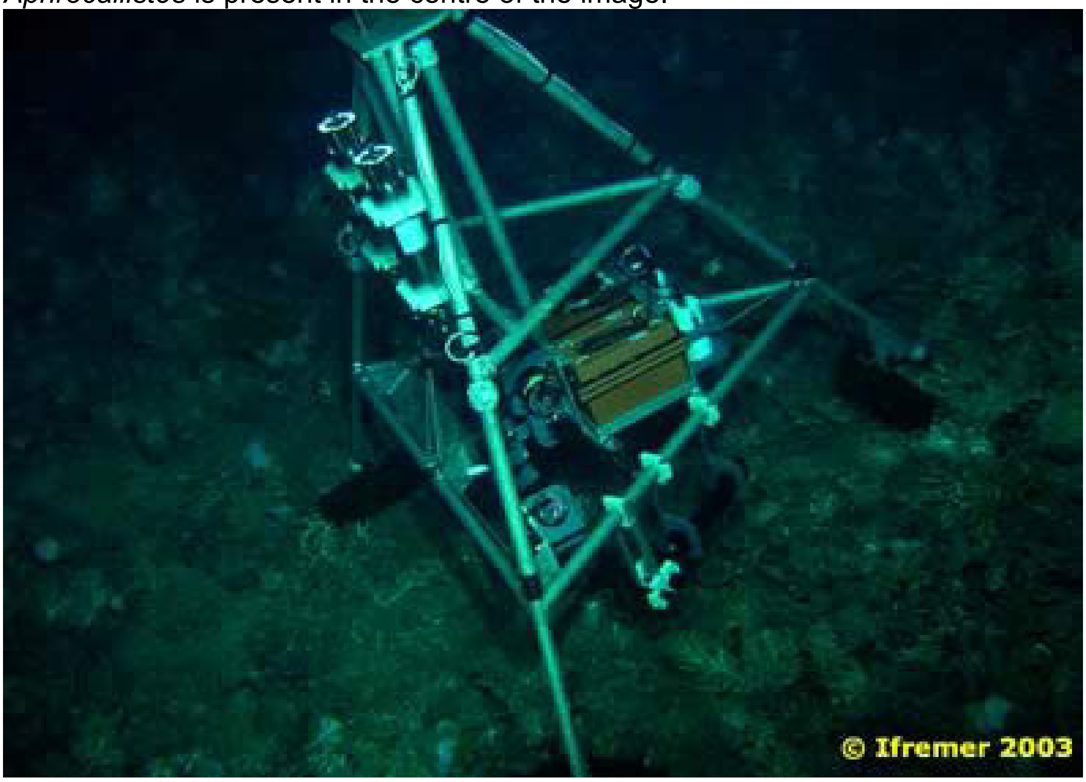

Fig. A4.3.5-2. SAMS Photolander deployed on the Galway Mound.

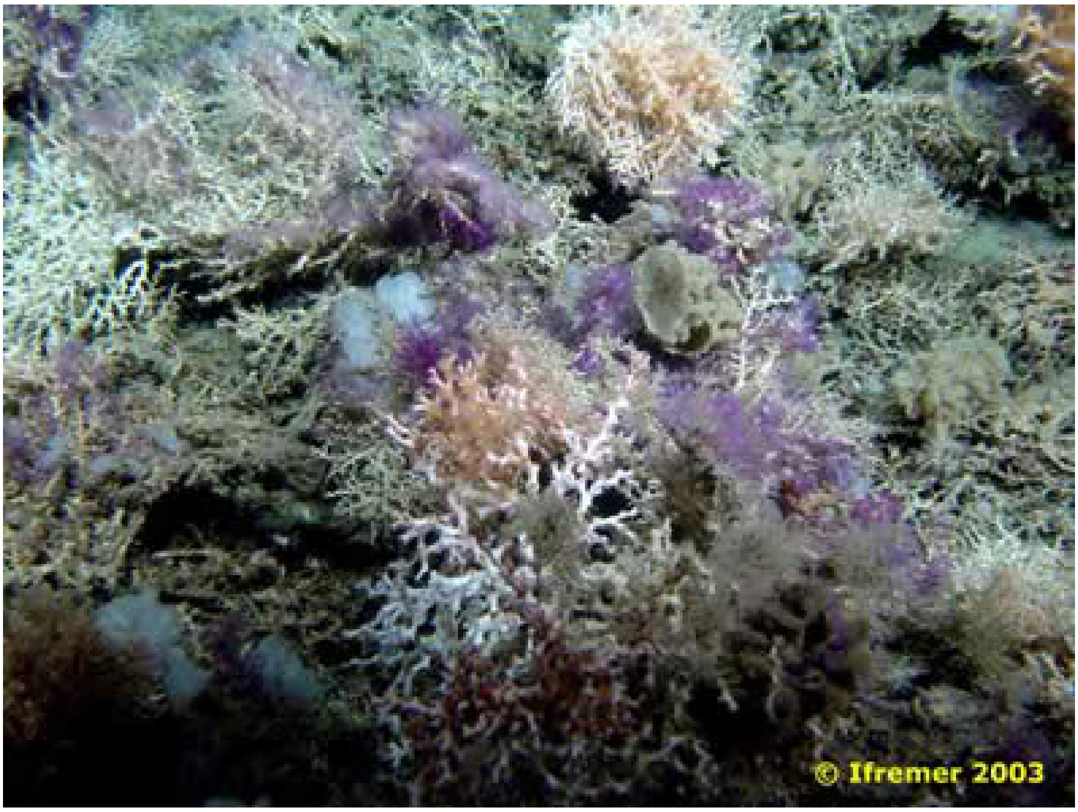

Fig. A4.3.5-3. Close-up view of the fauna near the lander deployment site. The scleractinian corals are dominated by *Madrepora oculata*, the purple octocoral is likely to be *Anthotela grandiflora* (pers. comm. A Freiwald) and glass sponges (*Aphrocallistes* sp.) can be seen.

Work programme, post ARKXIX/3a

The SAMS Photolander was collected by the RV "Celtic Voyager" in mid-July 2003. Data were downloaded film from the cameras developed. The following data were recorded:

- Film camera, 124 images
- Digital camera, 400 images
- Optical instruments, full data set
- FSI current meter, full data set
- ADCP, no data (instrument flood)

Early analysis of results from the third deployment of the photolander on the "Galway mound" showed an even more intense current regime with a maximum recorded velocity of 70cm s^{-1}. Here the residual current flow of 13.6cm s^{-1} was to the north-west and speeds exceeded 50 cm s^{-1} on all diurnal tidal cycles 2-3 days either side of spring tides (pers. comm. M White). The maximum mean daily currents occurred at diurnal spring tides and the minimum at neap tides. Similar observations have been recorded to the north of the Galway mound by Pingree and LeCann (1989, 1990). Full analysis of this and other datasets is on-going.

A. 4.3.6 Influence of hydrodynamics on sedimentary processes: "Belgica mounds" and "Moira mounds"

Foubert, A., Wheeler, A.

The "Moira mounds" are identified in the "Belgica mound" Province (Fig. A4.1-1) and were first imaged on 100 and 410 kHz sidescan sonar (Wheeler *et al.*, 2000). These are small mounds up to 5-10 m high and 15 to 40 m across. The mounds include isolated examples although most occur in swarms or clusters (Wheeler *et al*., subm.). The "Moira mounds" located to the east of "Thérèse mound" were investigated using the ROV "Victor 6000" (Olu-Le Roy et al., 2002). These video dives and sidescan sonar images showed that the "Moira mounds" occur in areas of active sediment transport on rippled sand sheets in areas of sediment wave development (Wheeler *et al*., subm.). A rippled sand facies with occasional dropstones and isolated coral patches is present in between the mounds. The flanks of the mounds are characterised by patches of live coral coverage in a rippled sand facies. Towards the centre of the mounds the coral framework becomes denser (Wheeler *et al*., subm.). The "Moira mounds" are confined to the present-day seabed surface with no seismic evidence for buried components. This implies that the "Moira mounds" are probably a recent feature (?Holocene).

The use of the multibeam echosounder SIMRAD EM2000 mounted on the ROV "Victor 6000" made it possible to map the "Moira mounds" by producing a very high-resolution microbathymetric grid with a pixel size corresponding to 20 cm. All the data were recorded and processed in Qinsy (Fig. A4.3.6-1). The microbathymetric grid helps a lot by interpreting the hydrodynamic setting of the "Moira mounds". Sandwaves up to 50 cm high and with a wavelength of 15 to 20 m, are visualised and seem to be aligned E-W. They demonstrate the presence of strong northerly-directed benthic bottom currents.

Lineated features are present NE of this sandwave-field and can be interpreted by palaeo-features, aligned N-S and having a length about 200 to 250 m and possibly formed by (helicoidally) strong currents.
The Moira-mounds themselves are clustered in front of and on these lineated features offering a hard surface suitable for coral settlement and attachment.

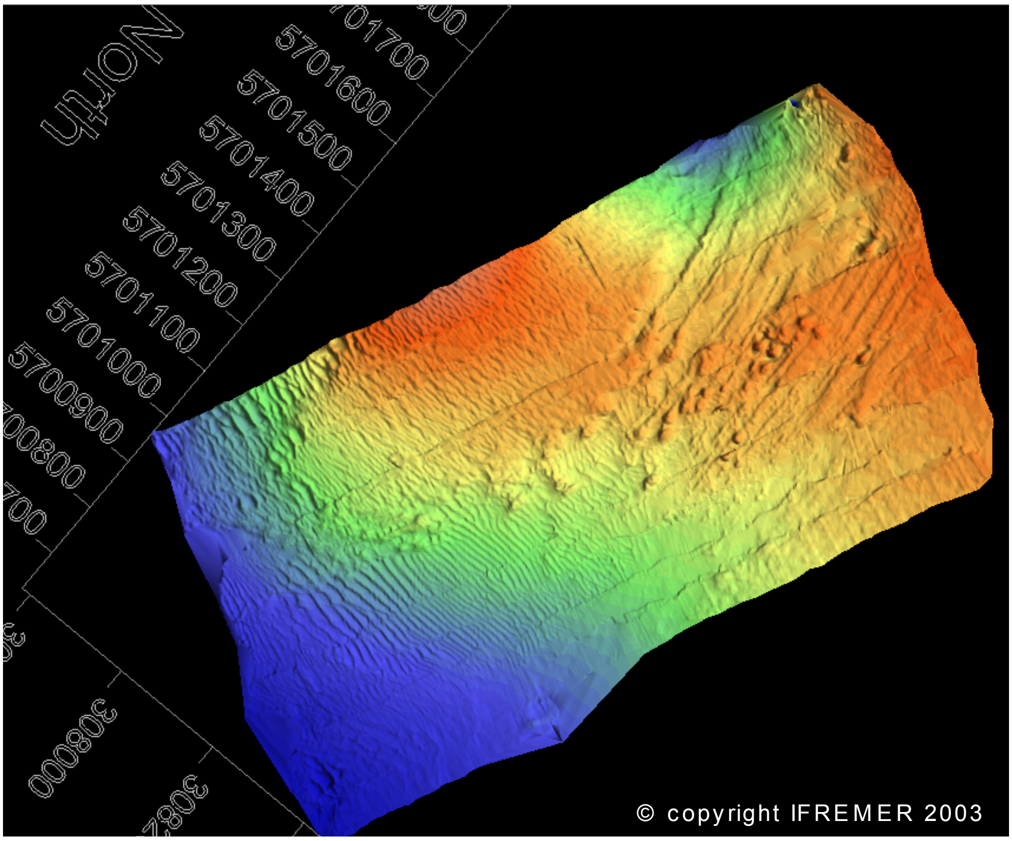

Fig. A4.3.6-1: Microbathymetric grid over "Moira mounds"

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A. 4.4 Mound development on the Porcupine Bank: the influence of hydrodynamics on geological and biological processes

Wheeler, A., Berov, D., Dorschel, B., Foubert, A., Gault, J., Grehan, A., Kozachenko, M., Monteys, X.F., Roberts, M., Unnithan, V.

A. 4.4.1 Introduction to the carbonate mounds on the Porcupine Bank

Wheeler, A.

Four ROV dives, box-cores, CTD stations, sub-bottom profiler lines, fisheries echosounder lines and a multibeam data were collected from the upper north-west margin of the Porcupine Bank.

The Porcupine Bank (Fig. A4.4.1-1) is an upstanding block between the Rockall Trough (to the west) and Porcupine Seabight (to the east) formed during Mesozoic rifting associated with the opening of the proto-Atlantic (Naylor & Mounteney, 1975). The northeastern bank is connected to the continental landmass by onlapping western Irish continental shelf sediments. The banks northern western flank overlies the Macdára Basin and basin boundary faults. Lower slopes (>1000m water depth) on the margin are typified by submarine canyon systems and feeder systems (Fig. A4.4.1-1). Carbonate mounds exist between 500-1200m water depth. These occur predominantly on bank sub-parallel topographic ridges that overlie boundary faults (Croker *et al*., 2003) and are interpreted as fault scarps (de Haas *et al*., 2002). Headwall scars due to submarine slides are also evident. Upslope areas (<500m water depth) are dominated by iceberg ploughmarks (de Haas *et al*., 2002). The western margin of the Bank is subject to very strong currents with more southerly locations characterised by vertical bedrock scoured by erosion.

A large number of carbonate mounds have been identified on existing side-scan and multibeam data being predominantly 100 - >300m across and ranging in height up to *c*.200m. Seismic investigations suggest that this may in part be due to the longevity of the carbonate mounds in this region with examples on the Porcupine Bank initiated on common erosion surfaces tentatively dated as late-early Pliocene (Kenyon *et al*. 2003; van Weering *et al*., 2003a; 2003b). Previous studies (Kenyon *et al*., 1998; de Haas *et al*., 2002; Akhmetzhanov *et al*., 2003; Kenyon *et al*. 2003; van Weering *et al*., 2003a; 2003b) also note that the Porcupine Bank carbonate mounds ("Pelagia mounds") are relatively isolated, discrete mounds existing in a strong current regime with intermediate nepheloid layers (Dickson & McCave, 1986; Kenyon *et al.* 2003) providing an abundant food supply.

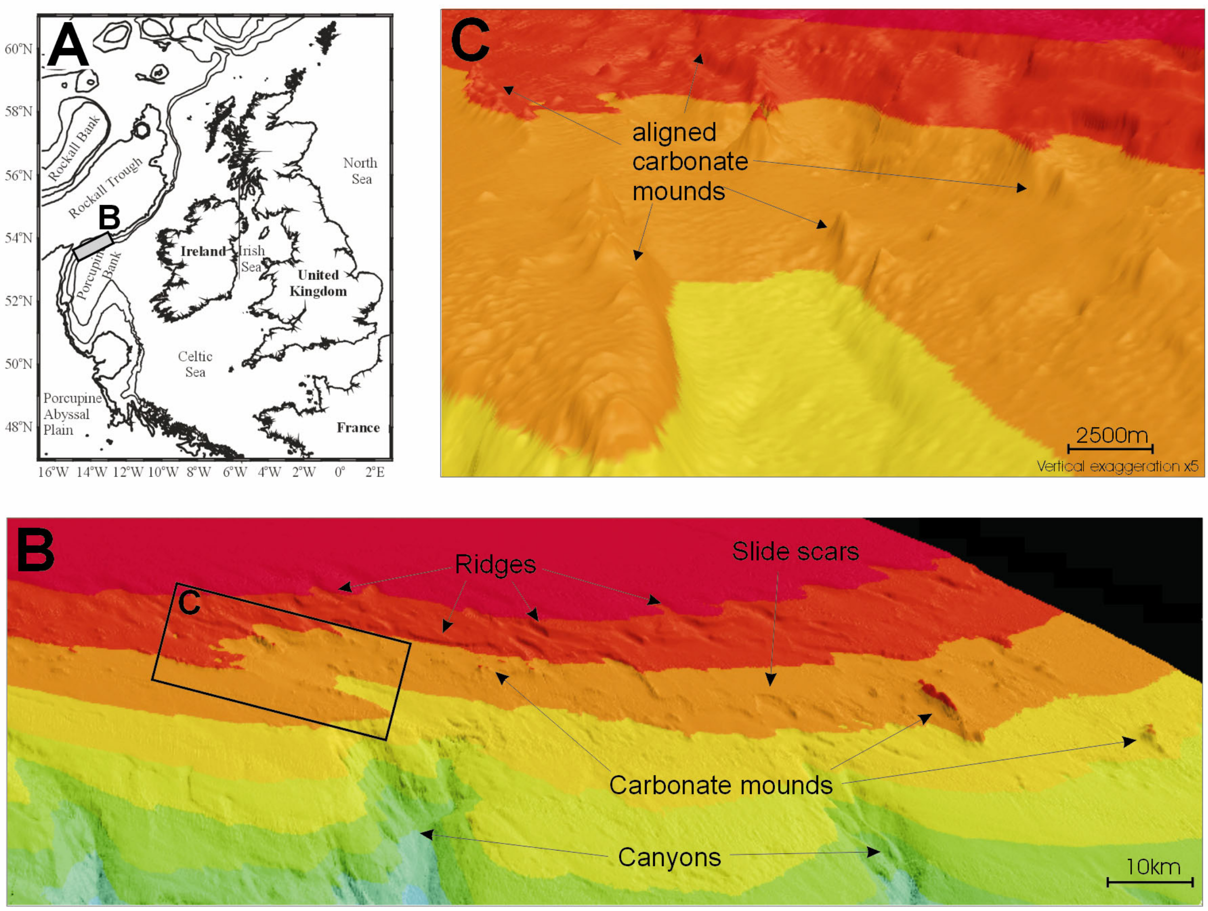

Fig. A4.4.1-1. Carbonate mounds on the Porcupine Bank (from Wheeler et al., in press). Topography courtesy of the Geology Survey of Ireland.

The Porcupine Bank carbonate mounds occur as both isolated features and in association with the scarps. Mound shapes range from ovoid, to ridge-shaped running sub-parallel to the isobaths, to complex forms. Some of the mounds, especially those occurring as groups, are also surrounded by zones of high backscatter seabed that represents erosion of unconsolidated material exposing the underlying lithified sediment.

There is a clear tendency for some mounds to be aligned along scarps (Fig. A4.4.1-1) and topographic highs. These scarps have a slight topographic rise upslope and a steep scarp-face downslope. The shape and down slope acoustic facies suggest that these are not major slope failures but represent either the edges of erosional scours where shallow bedding planes are exposed or fault scarps. Comparable exposures of consolidated sediment exposures have been identified in this area during the CARACOLE cruise with RV L'Atalante" and the ROV "Victor 6000" in 2001 and previously imaged on high-resolution side-scan sonar. The scarps run sub-parallel to the isobaths and are more dominant in mid- to upslope areas.

It has been speculated that this is probably the result of a combination of suitable substrates for mound growth (formed by erosion of exposed high relief areas) as well as high current speed accelerating over the topographic obstacle generating an increased biological food flux.
An alternative hypothesis is that these alignments are tectonically controlled with carbonate mound growing along fault scarps. Croker *et al*. (2003) suggested that a spatial relationship between boundary faults, fault scarps and carbonate mound occurrence might imply a cold seep origin to these mounds due to thermogenic hydrocarbon seepage (*sensu* Hovland *et al*., 1994) from underlying hydrocarbon reservoirs in the underlying Macdára Basin. Gas seepage from underlying hydrocarbon reservoir (in the Macdára Basin) along boundary faults thus providing a food sources for primary components of an ecosystem encompassing deep-water corals.
Also studied on the Porcupine Bank is an anomalous mound ridge that runs perpendicular to the isobaths (at 90° to other mound alignments) and is 2-3 times higher than other mound features (Giant Mound). This, like some of the other mounds exists upslope of a submarine canyon (be it a minor one). Another site of paired mounds ("Twin mounds") was also studied where fishing impacts were previously reported.

Fig. A4.4.1-2 shows the location of the "Twin", "Giant", "Scarp" and "Hedge mounds" which are presented below (section A. 4.4.2- A. 4.4.5 respectively).

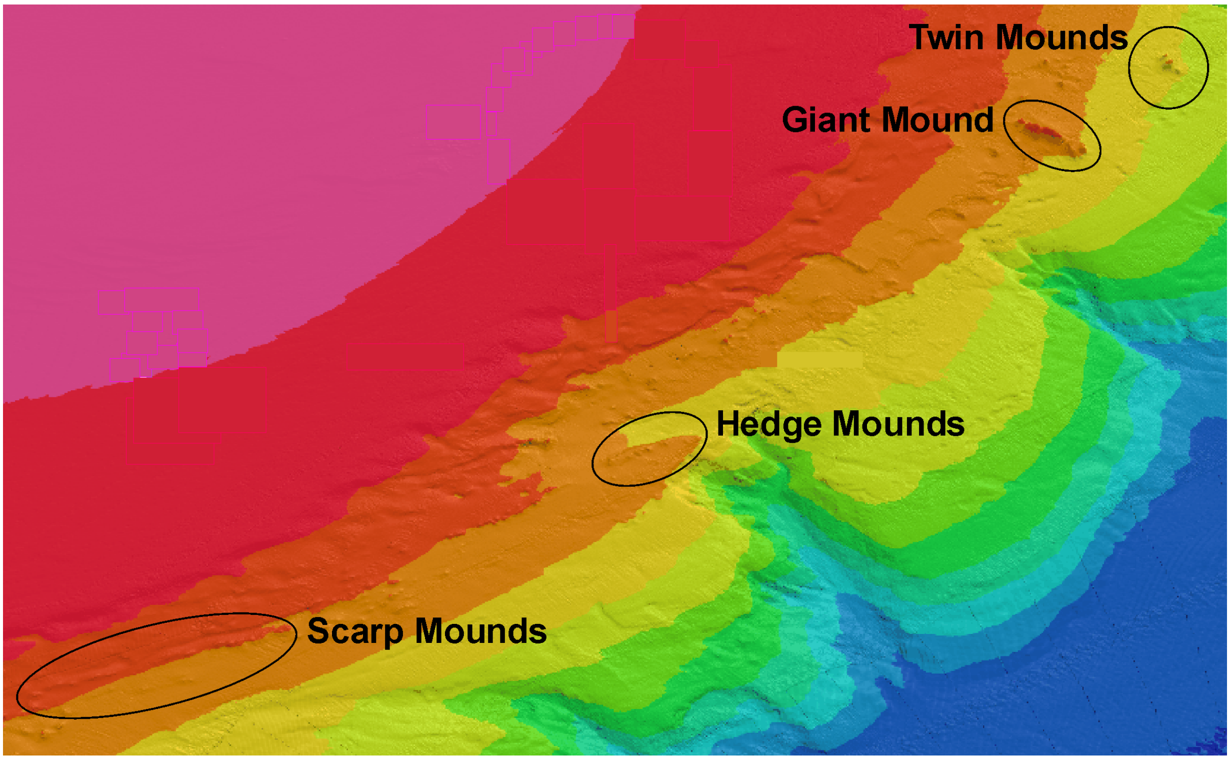

Fig. A4.4.1-2. Location of main study sites on the Porcupine Bank. Topography courtesy of the Geology Survey of Ireland.

The studies on the Porcupine Bank were undertaken to address the following research questions.

- To what extent are carbonate mound growth processes influenced by hydrodynamic processes?
- What is the extent of biotic heterogeneity between carbonate mounds?
- Do we find evidence of deep water trawling activity damaging the coral ecosystem?
- Are the ridges on which carbonate mounds are located a focus for thermogenic hydrocarbon seepage.

This last objective drew a negative conclusion. Despite 88 hours of dedicated dive time on carbonate mounds, no gas bubbles, authigenic carbonate crusts, bacterial mats, chemosynthetic fauna (e.g. tube worms, pogonophorans or distinct molluscs species), pockmarks or any other evidence of cold seepage were found (see Dando & Hovland, 1992; Sibuet & Olu, 1998).

A. 4.4.2 Biogeoprocesses along the "Twin mounds" transect
Wheeler, A., Roberts, M.

An ROV dive and box-core sampling were performed (Fig. A4.4.2-1) to compare deep-water coral habitats that have been trawled and untrawled.

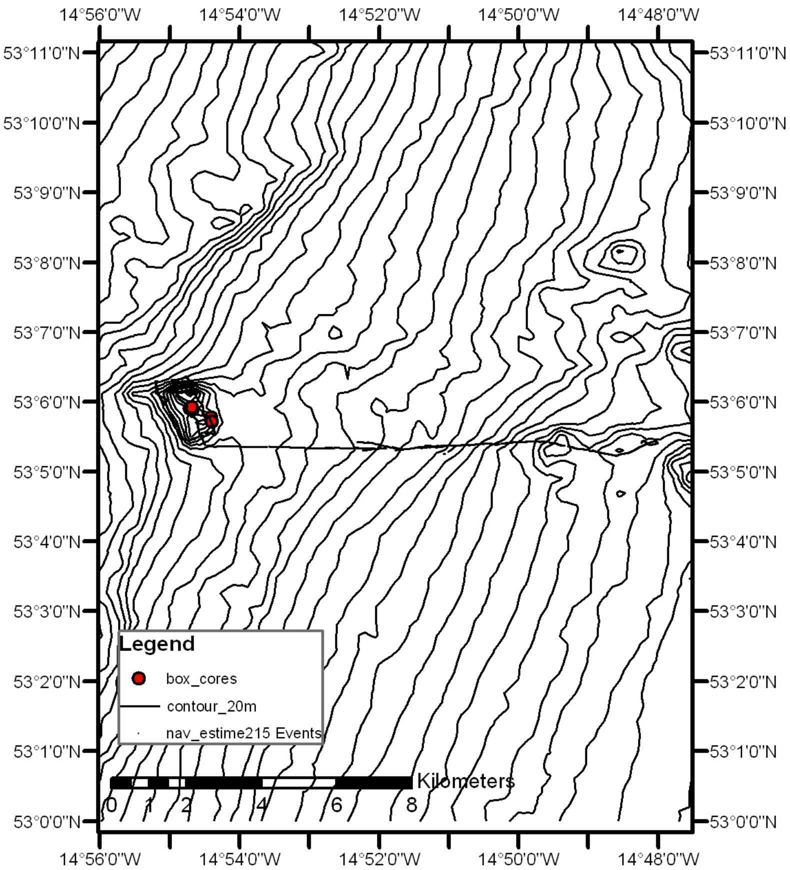

Fig. A4.4.2-1. Location map showing the ROV dive track and location of box-cores.

The dive transect covered 3 small untrawled upslope carbonate mounds. A significant area of background seabed was then surveyed in transit to the "Twin mounds" to facilitate on-mound and off-mound biological comparisons. Detailed ROV coverage was then performed on the "Twin mounds" with abundant evidence of trawling damage (see section A. 4.8). Box-cores logs are presented below.

Box Core Sample Log Sheet

Station No.	PS64/282-2	Date	13 June 03
Box Core No.	20	Time of sample (UTC)	1152
SAMS Station No.	-	Depth (m)	988
Position	53º 05.904N 14º 54.707W	Operator	O Pfannkuche

Sample Description
Core target, "Twin mounds".
Crinoids, small cm-dm size eroded coral fragments. Many ophiuroids on coral fragments. Aphrocallistes fragment. Medium to coarse sand. Many gastropods.

Depth core penetration	18cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
0-5cm	2, 1, 0.5mm	
5-10cm	2, 1, 0.5mm	

Sample removed	No. individuals / No. sub-cores	To whom?
Crinoid, coral fragments		A Grehan

Box Core Sample Log Sheet

Station No.	PS64/282-3	Date	13 June 03
Box Core No.	21	Time of sample (UTC)	1250
SAMS Station No.	-	Depth (m)	1003
Position	53º 05.955N 14º 54.714W	Operator	L Thomsen

Sample Description
Core target, "Twin mounds".

No sample recovered.

Depth core penetration	

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/282-4	Date	13 June 03
Box Core No.	22	Time of sample (UTC)	1338
SAMS Station No.	-	Depth (m)	1001
Position	53º 05.887N 14º 54.670W	Operator	L Thomsen

Sample Description
Core target, "Twin mounds". Wrongly labelled as 282-3.
Coarse medium sand, cm-dm fragments of dead coral, abundant living ophiuroids on surface, large crinoid, small galatheids. Shell hash, lots of brachiopods, bivalves. Core partially washed-out on either side.

Depth core penetration	Not recorded

Depth from surface of core	Sieve mesh size	Surface area core sieved

Sample removed	No. individuals / No. sub-cores	To whom?
Washed-out parts	Not recorded	T Beck
Desmophyllum	2	J Hall-Spencer
Caryophyllidae	3	H Hall-Spencer
Piece of carbonate hard ground for dating		A Wheeler

Box Core Sample Log Sheet

Station No.	PS64/282-5	Date	13 June 03
Box Core No.	23	Time of sample (UTC)	1432
SAMS Station No.	-	Depth (m)	1008
Position	53º 05.922N 14º 54.680W	Operator	L Thomsen

Sample Description
Core target, "Twin mounds". Wrongly labelled as 282-4.
Coarse to fine-grained sand, dead coral fragments (5-10cm), 4 crinoids, several surface-living ophiuroids, *Stylaster* cf. *norvegicus*, carapace of *Bathynectes*, *Aphrocallistes* fragments, brachiopod shells.

Depth core penetration	

Depth from surface of core	Sieve mesh size	Surface area core sieved

---

Sample removed	No. individuals / No. sub-cores	To whom?
Madrepora, dead	1	J Hall-Spencer
Caryophyllid, dead	1	J Hall-Spencer
Stylasterid, dead	1	J Hall-Spencer

Box Core Sample Log Sheet

Station No.	PS64/283-3	Date	13 June 03
Box Core No.	24	Time of sample (UTC)	1831
SAMS Station No.	-	Depth (m)	973
Position	53º 05.777N 14º 54.399W	Operator	JM Roberts A Grehan

Sample Description
Core target, "Twin mounds".

No sample.

Depth core penetration	

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/283-4	Date	13 June 03
Box Core No.	25	Time of sample (UTC)	1940
SAMS Station No.	-	Depth (m)	930
Position	53° 05.721N 14° 54.396W	Operator	JM Roberts

Sample Description
Core target, "Twin mounds". Wrongly labelled as 283-3.
Soft unconsolidated mud with dm sized coral fragments. No surface biology.

Depth core penetration	30cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
0-5cm	1, 0.5mm	Not recorded
5-10cm	1, 0.5mm	Not recorded

Sample removed	No. individuals / No. sub-cores	To whom?

A. 4.4.3 Biogeoprocesses along the Giant Mound transect

Berov, D., Wheeler, A., Roberts, M.

One of the small mounds up slope from the "Giant mound" directly overlies a boundary fault and, on the basis of information from the Petroleum Affairs Division of the Irish Department of Communication, Marine and Natural Resources, was the most likely mound to show evidence of gas seepage. On inspection this was not the case. In contrast, this mound showed evidence of seabed erosion. The summit of the mound was dominated by a hardground on which various fauna were living. Strong current activity had eroded away the soft sediment on top of the mound until it had reached the hard lithified (cemented) layers beneath. There was also evidence that erosion had continued with some less well cemented layers eroded, causing the overlying hardground to topple. This chaotic seabed provided a number of holes and crevasses in which fish were hiding. In order to find out the age of these hardgrounds, a large section (63cm long x 46cm wide x 13cm thick) was recovered by "Victor 6000" and brought back to the surface.

This recovered specimen was examined and found to be composed of heavily bored and cemented marl with numerous organisms encrusting the surface. A small live *Lophelia* colony was recovered with several sponges attached at the base of the coral. Also present was an erect stylasterid as well as several soft bodied anemones. molluscs occurred, hiding in the burrows in the hardground.

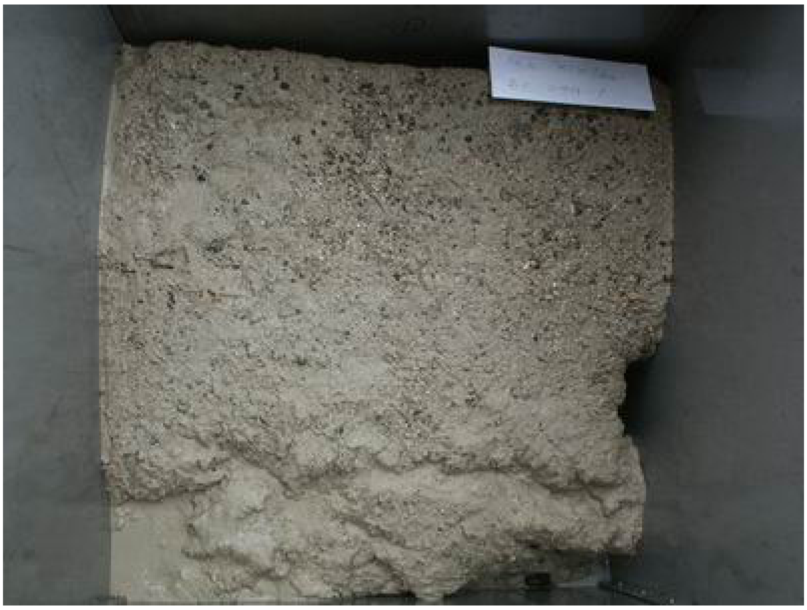
Box-cores

A series box-cores were also collected from the site for sedimentological analysis and are logged below.

Box Core Sample Log Sheet

Station No.	PS64/294-1	Date	15 June 03
Box Core No.	26	Time of sample (UTC)	1036
SAMS Station No.	-	Depth (m)	915
Position	58º 11.551N 14º 48.615W	Operator	O Pfannkuche

Sample Description
Carbonate-rich sediment on the surface with shell fragments, small gravel (approx. 5mm), particle size muddy sand.



Depth core penetration	24cm on side 10cm the other

Depth from surface of core	Sieve mesh size	Surface area core sieved

Sample removed	No. individuals / No. sub-cores	To whom?
Push cores	2	A Wheeler (UCC sediment analysis)
Sieved sediment		T Beck

Box Core Sample Log Sheet

Station No.	PS64/295-1	Date	15 June 03
Box Core No.	27	Time of sample (UTC)	1125
SAMS Station No.	-	Depth (m)	815
Position	53º 11.980N 14º 48.336W	Operator	O Pfankuche

Sample Description
Carbonate-rich sediment covered in coral rubble from the surface (mostly *Madrepora*), also shell fragments some bioturbation by worms. Live *Madrepora* and a spiral-shaped antipatharian colonies present.
0-5cm layer light brown
5-20cm grey with oxidised layers

Depth core penetration	19-21cm

Depth from surface of core	Sieve mesh size	Surface area core sieved

----

Sample removed	No. individuals / No. sub-cores	To whom?
Push cores	2	A Wheeler (UCC sediment analysis)
Live *Madrepora*	1 colony (aquarium)	JM Roberts
Antipatharian	1 colony (preserved)	JM Roberts
Sieved sediment		T Beck

Distribution of Benthic Fauna on the Giant Mound area in the Porcupine Bank

During the "Polarstern" ARK XIX/3a expedition the morphology and biology of several coral mounds in the Porcupine seabight and Porcupine Bank were studied. Studies from this and previous cruises obtained with the ROV "Victor 6000" suggested a correlation between carbonate mounds and *Lophelia* coral reefs. However, during dive 216 a mound was studied that had far less coral reefs in comparison with other carbonate mounds in the area. By mapping the distribution of benthic communities on the mound and relating these results to some environmental factors, the possible reasons for difference in *Lophelia* coral reefs are studied in this report.

Materials and methods

The mapping of the benthic communities on the "Giant mound" was done based on data provided by the "Victor 6000" dive 216 from "Polarstern" cruise ARK XIX/3a. The dive started at 07:30 on 14.06.2003 at N 53,1737167 W 14,723346 and ended at 09:51 on15.06.2003 at N 53,2063783 W 14,8305867. During the dive the video stream from the central 3CCD camera, from the vertical high resolution camera and from the pilot camera, was recorded continuously on DVDs. These DVDs, however, were not used for the creation of the current map as the access to them was limited.

Low quality snapshots were taken through the vertical camera whenever a change in the bottom morphology was observed. High resolution photos of benthic fauna and geological features were taken through the 3CCD camera. The photos were uploaded via the optic cable connection and stored in a database onboard "Polarstern". A database of the position of the ROV every 5 seconds was also kept. Later, with the help of the Adelie software, these two datasets were combined and a map of the exact course of the ROV was created. The map included a set of photos taken throughout the dive. This map was used for the complete description of the benthic communities on the seafloor throughout the dive. The log sheets with the observations of the responsible scientist that were monitoring the dive were also used (log sheets from dive 216 were available on the "Polarstern" intranet for usage by scientists onboard).

Based on similarities in species and morphology of the seabed several categories of benthic communities were created. The observed benthic communities were included in the database with the exact position of the ROV throughout the dive. With the help of the ArcView software, maps of the benthic community distribution were created (Fig. A4.4.3-2/3). The percentage distribution of the different communities was also evaluated (Fig. A4.4.3-1).

During the dive several samples of benthic fauna were taken, which included a *Lophelia* and a gorgonian. These samples were classified. The fauna observed on the still images and video stream were classified based on catalogue of benthic fauna provided by the ROV team and on a zoology book (Storch & Welsch.1997).

Results

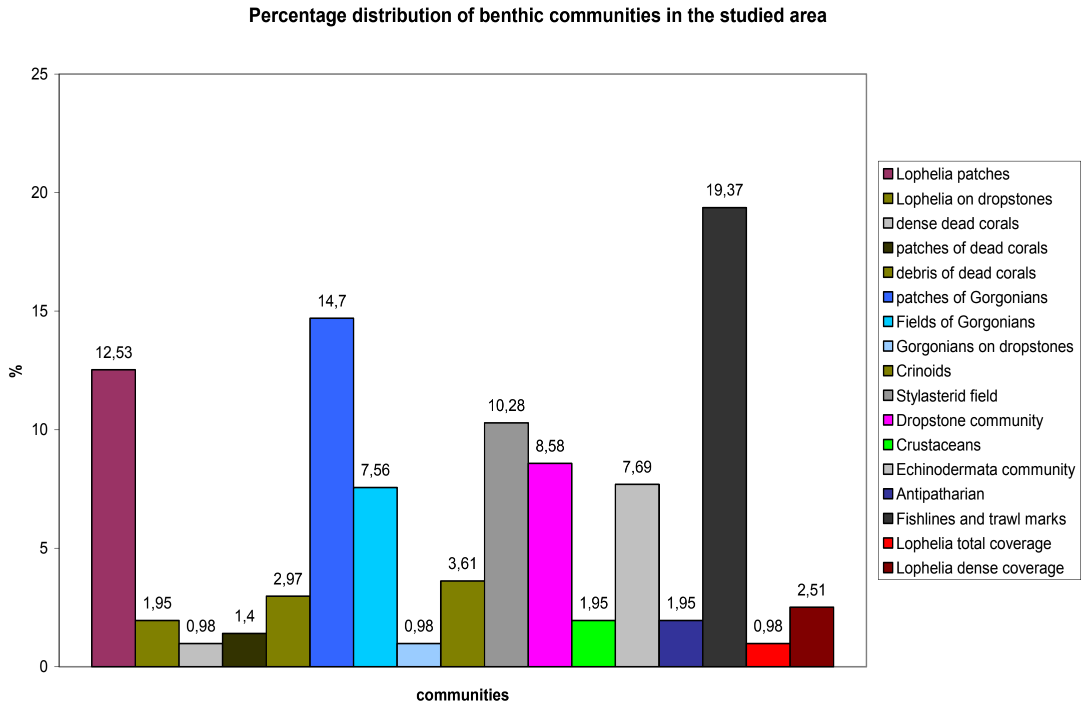


Fig. A4.4.3-1: Percentage distribution of observed benthic communities

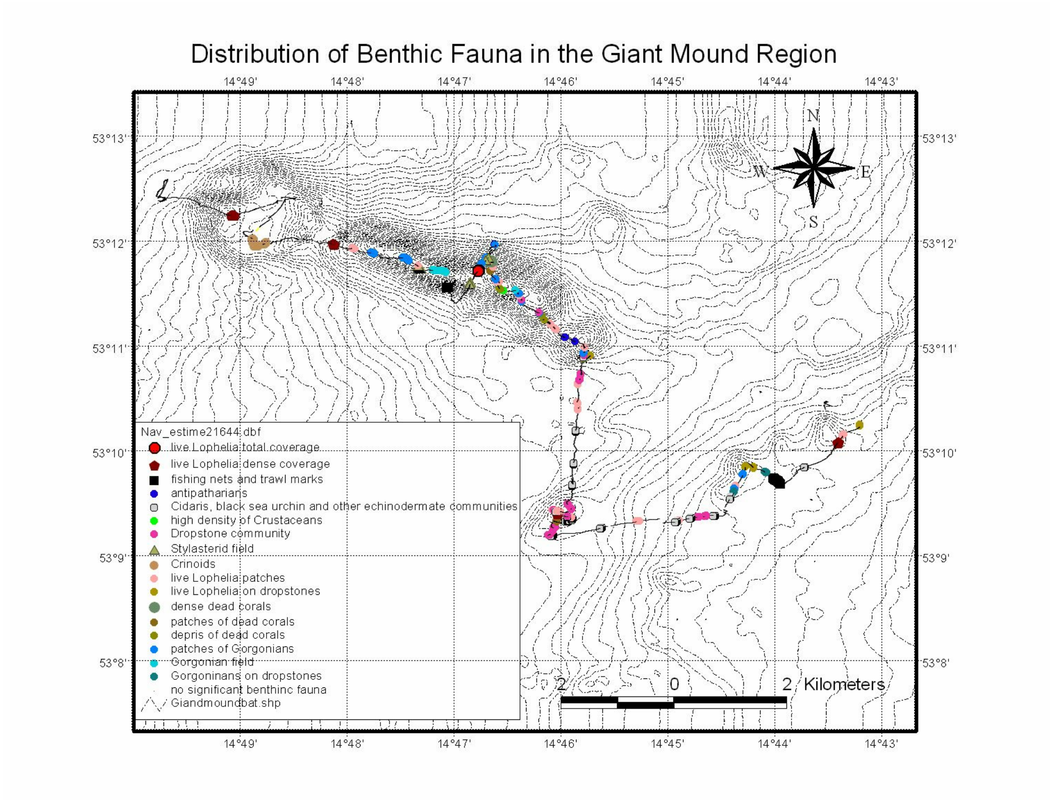


Fig. A4.4.3-2: Distribution of benthic fauna in the Giant Mound region

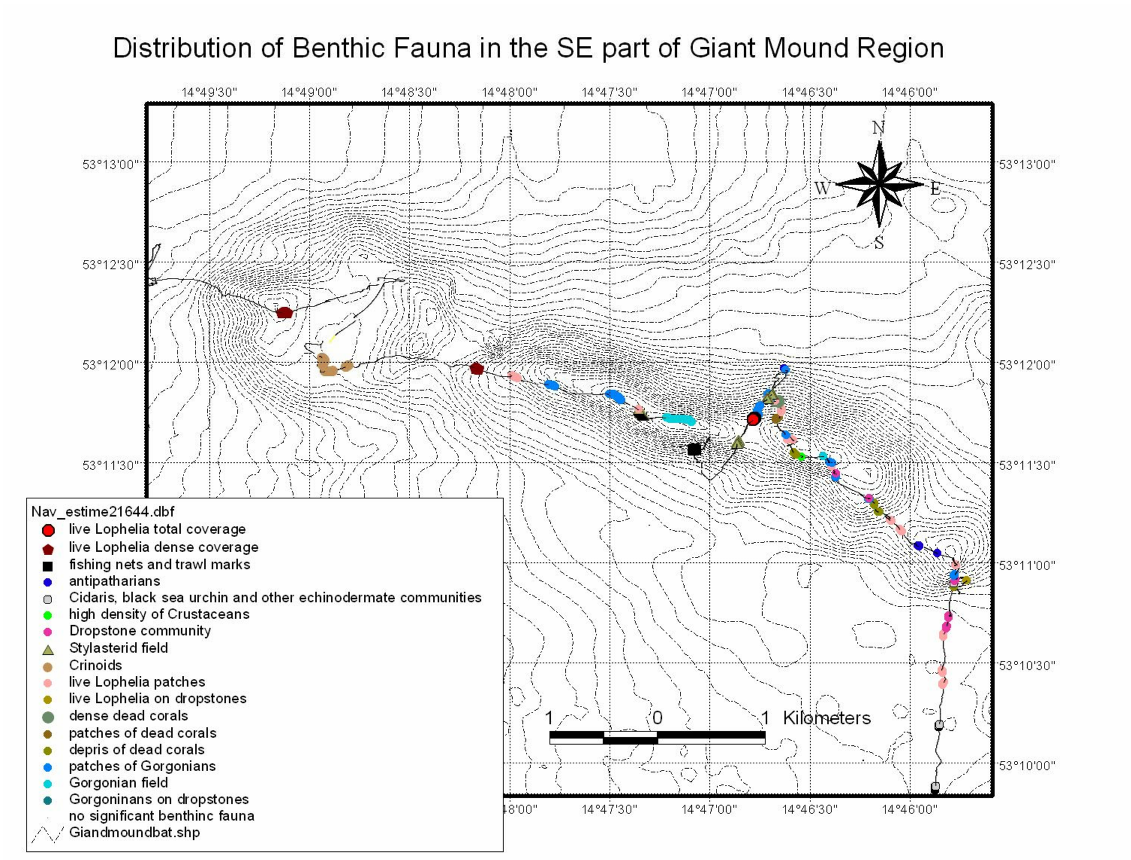


Fig. A4.4.3-3: Distribution of benthic fauna in the SE part of the Giant Mound region

The areas with significant benthic communities consist 11,78% of the total points included on the database. For the rest of the track, no significant benthic fauna was observed, or no information was available (DVDs were not used for the mapping, only snap shots).

The following benthic communities were mapped:
Communities with predominant *Lophelia*:

- ***Lophelia* total coverage** is present only at one spot in the central part of the Giant Mound. This community characterized by dense live and dead Lophelia coral structures that cover the sea bottom. The alive polyps grow on top of the dead structures of the old corals, thus ensuring the continuous growth of the coral reef. *Madrepora* was often present among the *Lophelia* corals and seems to be a secondary coral building species. Suspension feeders such as gorgonians, anemones and other anthozoans, crinoids also occur here. Abundant numbers of fish were observed in the vicinity of the coral reefs, which indicate the importance of these structures for the fish populations.
- ***Lophelia* dense coverage and *Lophelia* patches** were observed throughout the track. The former formation is present at elevated areas on mounds and the latter at almost any place where hard substrate for the *Lophelia* growth is present. The dense coverage covers 40-60 % of the sea bottom and has similar characteristics to the total coverage. The patches of Lophelia are on isolated spots and don't appear to create a large structure that can maintain a diverse benthic community.
- ***Lophelia* on dropstones** is a distinct form, which is characterized by polyps growing on dropstones. As dropstones are the only hardgrounds in sandy areas, the corals make use of this and grow there. No large structures can grow on dropstones, as the space is limited. However, it was noted that such corals serve as hideout for small fish and crustaceans from predators and strong currents.

Other benthic faunal communities:

- **Gorgonian fields** are areas where gorgonians are the predominant benthic species. Such formations were observed at several locations at the highest parts of the central mound, indicating the need of these suspension feeders for high current speeds.

- **Patches of gorgonians** consist of single gorgonians growing on a hard substrate away from the moving sediments on the bottom, but without being abundant. Such formations were observed on the mounds as well as off mound, indicating that the gorgonians tolerate diverse environments.
- **Gorgonians on dropstones** are another distinct form in which this group of substrate feeding octocorals is present. Single gorgonians attach and grow on dropstones that provide hard substrate and elevation above the sandy bottom.
- ***Stylasterid* fields** occur at the central area of the ridge, a peculiar formation that was not observed in any of the previous dives. The observed stylasterids were quite large indicating that they are old.
- ***Cidaris cidaris,* black sea urchin and other mobile echinodermates –** this diverse community was observed on sandy tracks of the dive where there is no hard substrate that allows the growth of nekton fauna. The predominant species is *Cidaris cidaris*, with occurrences of black sea urchins, different astrozoans and other mobile echinodermates. The mobility of these species allows them to change their position and react to the rapid changes on the seabed that occur because of sediment transport.
- ***Crinoides* communities** – suspension feeding nekton echinodermates that are found in large quantities in one area on the western side of the mound.
- ***Antipatharia* communities** consist of hexacorals (they are not reef builders) that are attached to the hardground at a few spots on the eastern side of the mound.
- **Crustaceans high concentration** – in one area of the mound high concentrations of crustaceans were observed. The same place is mapped as an area with the occurrence of *Lophelia* on dropstones, the crabs use the corals as shelter.
- **Dropstone communities** – a term that is used to describe a diverse group of nekton fauna that grows on dropstones throughout the area. This includes *Lophelia* and *Madepora,* gorgonians, different species of sea urchins, anemones etc. This community supports a variety of deep sea fish and crustaceans that use the nekton and the dropstones as a hideout from

predators and strong bottom currents. The nekton species themselves grow only on dropstones, but not on the sandy sediments that surround it. The dropstones are an ‘oasis’ that provides a hard substrate and also elevate the substrate feeders over the bottom, thus protecting it from the damaging influence of the sand particle transport that occurs near the surface.

- **Fishing lines and trawl marks** – this category includes areas on the seabed where evidence of fishing impact on the benthic communities was observed. Fishing lines lying on the bottom of the sea with coral debris and even live corals (as it was in the center of the mound) , plough marks from the trawling and other damage on the seabed was observed in there areas. In some cases the fishing lines provided a hardsubstrate for different nekton species that grow on top of them, creating an artificial habitat. This indicates the flexibility and readiness of the studied benthic fauna to use new habitats.

Percentage distribution of benthic communities

The high percentage of fishing line and trawl marks in the diagram (Fig. A4) is due to the long time that the ROV spent in the area where these artifacts were. If a percentage distribution based on the actual territory of the different categories was made the weight of this category would be much less, probably smaller than that of the major benthic communities in the diagram. Such a diagram would require more advanced data processing that cannot be performed for now.

The predominant communities are that of patches of *Lophelia* (12,5%) and gorgonians (14,7%), followed by the stylasterids field (10,3%) and the dropstone communities (8,6%). The dense and total coral coverage that were so typical in previously studied mounds on the "Polarstern" XIX/3a cruise, such as the "Belgica mounds", are underrepresented on this mound – total coverage is 0,98% (one occurrence on the S - slope of the mound), dense coverage – 2,5%. This result indicates that the environmental conditions on the Giant Mound are not suitable for *Lophelia* growth. The high percentage of gorgonian fields 7,6% implies that the mounds provide more suitable conditions for the growth of this suspension feeder. A comparison of the ecological requirements of *Lophelia* and gorgonians can provide some explanations for why *Lophelia* is so scarce on the "Giant mound".

Lophelia reef occurrence in the area

Environmental factors such as current system, water masses in the area and depth can also be a reason for the poor occurrence of *Lophelia* on this mound. The mean depth of the track is 717 m, which is probably lower than that of the "Belgica mounds" for example. At approximately 800 m salty Mediterranean deep waters and North Atlantic overflow water meet (with lower salinity), creating a pycnocline where organic particles coming from the surface are accumulated (presentations during cruise XIX/3a). A *Lophelia* coral at this depth would receive much less organic particles input as compared to a coral at depth of 800 m.

There is a clear influence on the current system on the distribution of benthic communities on the mound. *Lophelia* dense coverage and gorgonian fields are concentrated on the S slope of the mound where they are under the influence of the dominant northerly currents in the area. This holds true also for the small mound structure in the beginning of the track, where dense *Lophelia* coverage is present on the southern slope of the hill.

It was suggested that the "Giant mound" was more active in the past and supported large *Lophelia* colonies (presentation during XIX/3a cruise). Indications for this are the large amounts of coral debris and rubble observed on top of the mound (5,3% of the communities) and the presence of hardground that could be formed by calcified coral rubble. If the mound was biologically more active in the past, palaeontological studies of samples taken in the area can indicate which environmental factors changed over time and lead to an alteration in the benthic diversity patterns.

Conclusion

The distribution of benthic organisms in the benthic mounds is different from that in mounds studied in previous dives during the XIX/3a "Polarstern" cruise. The main difference is the lack of large *Lophelia* reefs on the mound. In order to confirm this difference similar mapping as done here has to be done on a second carbonate mound. The reasons for this lack of *Lophelia* can be local hydrographic conditions, the depth of the coral mound and its interaction with the water masses in the area and others. It is possible that in the past *Lophelia* corals were present in the area and after a change in environmental factors the mound reached its present state of benthic faunal distribution. Palaentological studies that can reveal the changes in environmental conditions such as current systems and interaction of different water masses in the area can indicate which the main factors that influence *Lophelia* abundance are. A comparison between *Lophelia'*s optimal environmental conditions and that of the gorgonians found on the mound (which seem to be quite abundant here) can provide further indications to what are the reasons for the poor *Lophelia* coral presence in the area.

A. 4.4.4 Biogeoprocesses along the "Scarp mounds" transects

Wheeler, A., Roberts, M.

On the longest dive of the cruise (Fig. A4.4.4-1), "Victor 6000" surveyed one of the main points of interest for the cruise – a scarp that runs for a distance of 21 km (although intermittently in places as we discovered) at around 53 43.7'N 13 59'W. Former acoustic surveys (TOBI side-scan sonar and Geological Survey of Ireland multibeam echosounder bathymetry) had thrown-up questions as to the origin of this scarp. The coincidence of the scarp with Rockall Trough boundary faults implied that it maybe of tectonic origin. If so, then it was tantalising to assume that the carbonate mounds that are imaged on this mound may be related to hydrocarbon seepage along these boundary faults. A particular objective of this dive was therefore to assess the interplay between coral communities, potential hydrocarbon seeps and the bedrock geology of the area. Using "Victor 6000" we were able to film this enigmatic yet impressive geological feature for the first time.

Although the scarp continued for several kilometres it varied in height from a few metres to over 10 metres in height. In some places it was terraced whilst in others it was vertical or very steep. Carbonate mounds were also associated with the scarp in places although were relatively inactive (dormant) at present although some isolated coral, and other suspension feeding communities were present.

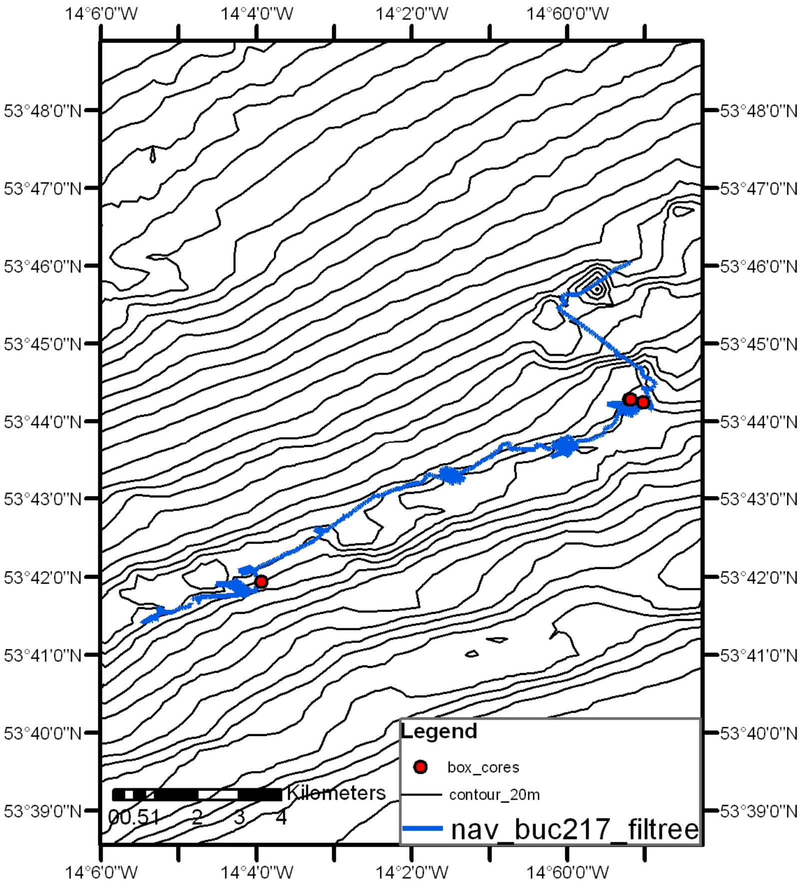


Fig. A4.4.4-1. Location map showing ROV dive route and sample stations

In one location, erosion of the carbonate mound was observed revealing a vertical section of several 10s of metres through the mound. This section was recorded in close detail with the cameras and will be logged. Initial observations show layers of coral framework alternating with dropstone dominated layers. This section may prove to be very useful in studying the rate of shutdown and start up of the carbonate mounds.

Figure A4.4.4-2 shows the upper part of the scarp revealing a 10 cm capping-layer of hard rock protecting softer carbonate-rich rocks below. This rock layer was collected using the manipulator arm of "Victor 6000" for analyses in the laboratory. Initial examination on the surface implies that it is a limestone hardground coated with a very thin precipitate of manganese (or other metal) oxide. Similar precipitates have been found at this water depth on the western side of the Rockall Trough. The scarp mantle rocks predate the last glaciation, since ice-rafted dropstones litter the upper level of seabed. The formation of the metal precipitate also suggests that this rock has been exposed at the seabed for a considerable period of time.

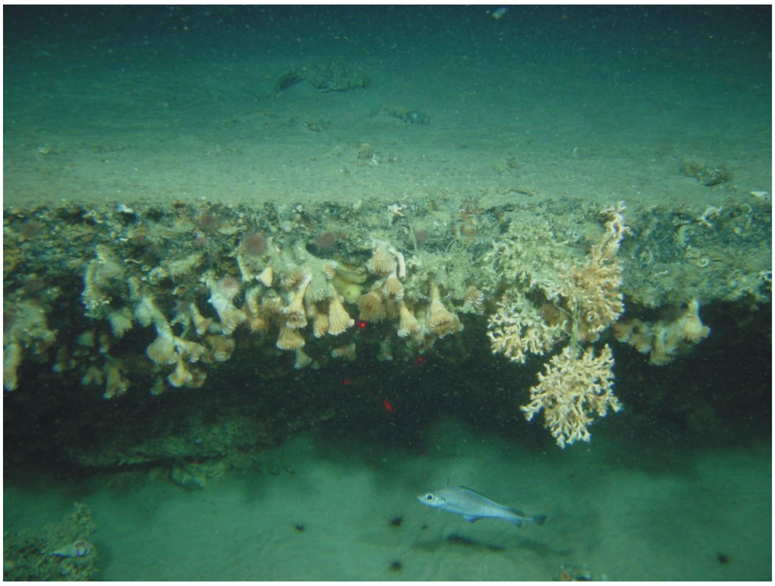


Fig. A4.4.4-2 Mantle of sand-covered black rock at the top of the Porcupine Bank scarp. Note the association of *Desmophyllum cristagalli, Madrepora oculata* and fish (*Lepidion* sp.) in the overhang. This scarp was mapped in detail and dropped away for a further 10 m below.

However, despite the presence of this upper rock, video examination of lower sediment layers show the rocks to be relatively soft and are interpreted as being Quaternary in age. A lack of neotectonic activity along these boundary faults suggests that these scarps are not of tectonic origin but are formed by seabed erosion. The edge of the scarp clearly shows evidence of active erosion. Currents are strong in the area, as evidenced by mobile sand lying on the comparatively level plains of the upper and lower margins of the exposed rockface. There is a paucity of sessile fauna on the scarp top, although large anemones were an exception and appear to be well-adapted to these conditions. In places, the cliff was >10 m high and undercut or vertical. This provided an oasis of hard substrata for saxicolous organisms including sponges, anthozoans, scleractinians, gorgonians, serpulids, sabellids, brachiopods and ascidians. Of note were dense stands of *Desmophyllum cristagalli* on overhangs and in fissures. These scleractinian corals were seldom found in the other facies studied, yet thrived along the scarp where they were protected from sand-scour.

It now seems unlikely that hydrocarbon seepage is involved with this feature, which appears to be being actively eroded by the fast currents. We have been able to complete a series of photomontages and photoquadrats with excellent optical resolution. These will be used to accurately map the geology as well as the zonation of saxicolous organisms along the scarp face. We hope to provide a detailed description of the scarp feature based on this extensive acoustic and photographic data-set. One area of concern was that although Monkfish (*Lophius*) were common on ledges along the scarp, lost fishing gear and other plastic waste were common. Despite the remote location of this dramatic shelf-slope feature, man is already affecting the ecology of the spectacular marine community.

Box-cores and multibeam coverages

A number of box-cores were also taken for sedimentological sampling and the following logs presented. High resolution multibeam coverages were also performed to quantify the topographic and morphological context and the scarp and associated carbonate mounds sited on this feature.

Box Core Sample Log Sheet

Station No.	PS64/298-1	Date	17 June 03
Box Core No.	28	Time of sample (UTC)	1949
SAMS Station No.	-	Depth (m)	627
Position	53º 44.241N 14º 59.020W	Operator	JM Roberts

Sample Description
Core target, Scarp Mound.
Core washed out, a small amount of sediment in box (5-7cm) containing coral rubble, some dropstones, one large gastropod, *Astarte* and *Limopsis* present.

Depth core penetration	n/a

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Sieved sediment		T Beck
Whole sediment		A Wheeler (UCC sediment analysis)

Box Core Sample Log Sheet

Station No.	PS64/298-2	Date	17 June 03
Box Core No.	29	Time of sample (UTC)	2033
SAMS Station No.	-	Depth (m)	685
Position	53º 44.281N 13º 59.207W	Operator	L Thomsen, T Beck

Sample Description
Core target, Scarp off mound.

Core failed to fire, repeat station.

Depth core penetration	n/a

Depth from surface of core	Sieve mesh size	Surface area core sieved

----

Sample removed	No. individuals / No. sub-cores	To whom?

Box Core Sample Log Sheet

Station No.	PS64/298-3	Date	17 June 03
Box Core No.	30	Time of sample (UTC)	2114
SAMS Station No.	-	Depth (m)	681
Position	53º 44.276N 13º 59.184W	Operator	T Beck

Sample Description
Core target, Scarp off mound.

Sandy surface medium to coarse, few dropstones. Several pteropods, gastropods (*Amplissa*), bivalves (*Limopsis*). Sampled with push core. Note some photographs incorrectly labelled as 298-2.

Depth core penetration	18cm

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Push core	1	A Wheeler (UCC sediment analysis)

Box Core Sample Log Sheet

Station No.	PS64/299-1	Date	18 June 03
Box Core No.	31	Time of sample (UTC)	0028
SAMS Station No.	-	Depth (m)	658
Position	53º 41.940N 14º 03.930W	Operator	T Beck

Sample Description
Core target, Scarp mound.

Partly washed-out, fine-medium sand, few dropstones, living bivalve.

Depth core penetration	

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Sediment in bags	5	A Wheeler (UCC sediment analysis)

Box Core Sample Log Sheet

Station No.	PS64/302-1	Date	18 June 03
Box Core No.	32	Time of sample (UTC)	0726
SAMS Station No.	-	Depth (m)	710
Position	53° 35.526N 14° 16.896W	Operator	B Dorschell

Sample Description
Core target, Scarp mound.

Surface well-sorted silty sand, brownish in colour. Live Cidaris sea urchin, transferred to running seawater on deck. Change in lithology seen in core at 5-10cm, upper layer brown well-sorted sand, then a thin layer of coarser material followed by a siltier layer (grey in colour). Core slumped.

Depth core penetration	15cm

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Push core	1	A Wheeler (UCC sediment analysis)

Box Core Sample Log Sheet

Station No.	PS64/302-2	Date	18 June 03
Box Core No.	33	Time of sample (UTC)	0804
SAMS Station No.	-	Depth (m)	707
Position	53° 35.672N 14° 17.336W	Operator	B Dorschell

Sample Description
Core target, Scarp mound.

Surface well-sorted silty sand, brownish-grey in colour. Upper 3-7cm light brown in colour silty sand, 3cm layer of grey silty sand followed by light brown material.

Depth core penetration	14-17cm

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Push core	1	A Wheeler (UCC sediment analysis)

Box Core Sample Log Sheet

Station No.	PS64/303-1	Date	18 June 03
Box Core No.	34	Time of sample (UTC)	0937
SAMS Station No.	-	Depth (m)	746
Position	53º 30.792N 14º 20.451W	Operator	O Pfannkuche

Sample Description
Core target, Scarp mound.

Core washed-out, a medium-coarse sand with coral rubble and shell fragments.

Depth core penetration	

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Sample bag	1	A Wheeler (UCC sediment analysis)

A. 4.4.5 Biogeoprocesses along the "Hedge mounds" transects
Wheeler, A., Roberts, M.

An ROV transect and sampling campaign was undertaken to assess a series of aligned mounds that exist at the head of a canyon system (Fig. A4.4.5-1). The ROV was operated in both video and multibeam mode. The survey revealed that the mounds are eroded in places with excessive current speeds inhibiting dense colonisation by suspension feeders although isolated communities were present. This highlights that, as in the general for the Porcupine Bank, the current regime at present is not conducive to dense coral cover although isolated example of importance may exist. The carbonate mounds on this margin are often eroding, a paradoxically providing hard substrates for colonisation, although significant growth of carbonate mounds must have occurred under former less rigorous current regimes.

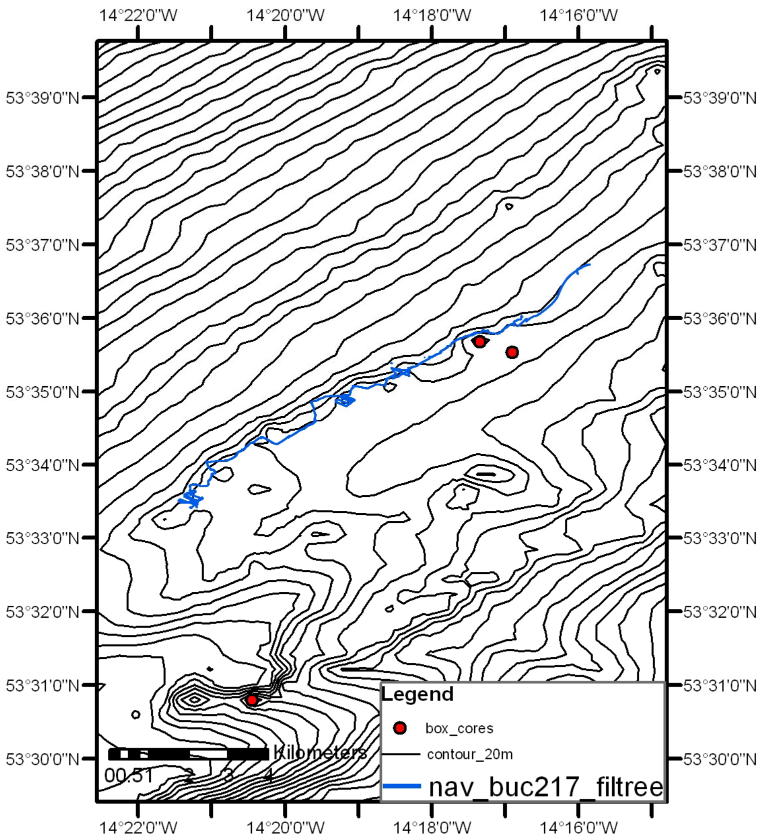

Fig. A4.4.5-1. Location map showing the ROV dive track and box-core stations.

Box-core logs are presented below.

Box Core Sample Log Sheet

Station No.	PS64/304-1	Date	18 June 03
Box Core No.	35	Time of sample (UTC)	1039
SAMS Station No.	-	Depth (m)	823
Position	53º 32.385N 14º 23.678W	Operator	O Pfannkuche

Sample Description
Core target, Canyon.

Muddy sand, brownish grey. 2 worms. Core washed out.

Depth core penetration	

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Sample bag	1	A Wheeler (UCC sediment analysis)
Whole sediment		T Beck

Box Core Sample Log Sheet

Station No.	PS64/305-1	Date	18 June 03
Box Core No.	36	Time of sample (UTC)	1133
SAMS Station No.	-	Depth (m)	820
Position	53º 31.104N 14º 25.550W	Operator	O Pfannkuche

Sample Description

0-5cm light brown carbonate-rich sediment with abundant coral rubble, bioturbated by worms.

5-15cm grey more lithified sediment with shell fragments, some dropstones coral rubble less abundant.

Depth core penetration	15cm

Depth from surface of core	Sieve mesh size	Surface area core sieved

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Sample removed	No. individuals / No. sub-cores	To whom?
Push core	1	A Wheeler (UCC sediment analysis)
Sediment in bags	2	A Wheeler (UCC sediment analysis)
Whole sediment		T Beck

A. 4.4.6 Biological and geological processes shaping the Porcupine Bank north-west margin

Wheeler, A.

The above results highlight many of the significant findings that have been made concerning the environmental dynamics on the Porcupine Bank margin and the influences and controls that these exert on biological and geological processes. Prior to these studies, the scientific community had a limited understanding of the nature of the seabed in this area. The area had been mapped extensively with seismic lines, regional side-scan sonar and multibeam echosounder but these data sets only reveal the morphology and location of interesting structures and tell us little about the reality on the seafloor. An exception to this is side-scan sonar backscatter that reveals areas of high backscatter suggesting a hard rough seabed possibly as a result of either extensive erosion and/or biological growth. It was therefore from this basis that the dives and deck operations were planned in a successful attempt to understand the meaning and significance of these key features on the Bank.

Two major conclusions can be drawn from these studies. Firstly, that the detailed morphology and seabed features imaged on the Porcupine Bank by "Victor 6000" reveal a story of seabed erosion. This erosion story has not only been active over geological timescales but is also ongoing under contemporary conditions. The high current speeds encountered by "Victor 6000" are testament to this.

Secondly, these high current speed are probably at the upper tolerance for *Lophelia* at present times. Numerous, often isolated, although impressive communities of *Lophelia,* as well as other suspension feeding megafauna, were encountered and documented. However, it was obvious that there is not rigorous growth of *Lophelia* at present on the Bank although exposed seabed remains and the exposed internal fabric of the carbonate mounds suggests that this was not always the case. It is suggested here that in the geological past, under more favourable conditions, this Bank was teeming with life, similar to the lower "Belgica mounds" at present imaged earlier in the cruise, but in contemporary times, the carbonate mounds are largely in a dormant phase. One notable exception to this is the "Twin mounds" that do show signed of recent rigorous growth of deepwater coral although this mound has been heavily trawled. The targeting of this mound by fishermen is probably not coincidental and is probably a reflection of the abundance of life form here (and now largely destroyed).

The other important discovery that deserves a special mention is the nature of the numerous scarps that are found along this margin. These have been imaged both on TOBI side-scan sonar and by the Geological Survey of Ireland multibeam dataset. These scarps extend for 10s of km and often feature the growth of carbonate mounds. The coincidence of these scarps with boundary faults and hydrocarbon reservoirs has lead to the speculation that these may be the sites of cold seeps that have developed into carbonate mounds. As a result of this cruise we can now dismiss this hypothesis. The scarps are obviously erosional features with scarp faces revealing consolidated Quaternary sediments that has then become colonised by suspension feeders. There was absolutely no evidence of hydrocarbon seepage. Furthermore, where carbonate mounds grow on this scarp they grow on the tops of the scarps, due to enhanced hydrodynamics and not from the base up due to a process of feeding by cold seeps. Although this is a negative conclusion, in many senses this is one of the most significant finds of the entire cruise.

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A. 4.5 Box-coring suspected carbonate mound targets
Monteys, F.X.

Two additional boxcores were taken in transit from the Porcupine Seabight to the Porcupine Bank to groundtruth anomalies on the Geological Survey of Ireland National Seabed Survey multibeam coverage. These were potential carbonate mounds although box-coring found no evidence to support this and both appear covered by hemipelagic muds.

Box Core Sample Log Sheet

Station No.	PS64/279-1	Date	11 June 03
Box Core No.	18	Time of sample (UTC)	2345
SAMS Station No.	-	Depth (m)	305
Position	52º 03.718N 14º 17.964W	Operator	T Beck

Sample Description
Core target, summit of seamount in a newly discovered cluster.
Sandy with a Thalassinid burrow. High silt content and numerous polychaetes and amphipods. Coarse fraction (>1mm) quite shelly. Shrimp.

Depth core penetration	18cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
0-10cm	1mm	50%
10-18cm	1mm	50%

Sample removed	No. individuals / No. sub-cores	To whom?

Live fauna		X Monteys
Sediments		X Monteys
Live fauna and sediments		T Beck
Push core (18cm)		X Monteys

Box Core Sample Log Sheet

Station No.	PS64/280-1	Date	12 June 03
Box Core No.	19	Time of sample (UTC)	0330
SAMS Station No.	-	Depth (m)	281
Position	52º 36.713N 14º 15.311W	Operator	X Monteys

Sample Description
Core target, high point on newly discovered circular feature on Porcupine Bank.
Sandy sediments with dropstones. Small dropstones from mm to 2cm. Burrows present. High fraction of small dropstones, gravel-size. Very large and numerous polychaetes and amphipods. Core slumped.

Depth core penetration	8cm

Depth from surface of core	Sieve mesh size	Surface area core sieved
0-5cm	1mm	50%

Sample removed	No. individuals / No. sub-cores	To whom?
Live fauna		X Monteys
Sediments		X Monteys

A. 4.6 Hydrodynamics and coral communities
Thomsen, L., Wheeler, A.

The Porcupine Seabight and Porcupine Bank are areas of enhanced productivity, and biologically-mediated transport of matter within the benthic boundary layer [BBL] may be large. The BBL at continental margins is in the order of 5 to 50 m thick and the roughness of a natural sea floor is affected by benthic organisms structuring the microtopography of the sediment surface. However at the investigated coral reef sites, the geological bottom topography strongly influenced the BBL processes with only a minor impact on the flow field by the living coral communities and a major impact produced by sediment ripples, sand-waves and the hill shaped carbonate remains of former corals (carbonate mounds) The benthic organisms at the study site rely on advective processes for their food supply. The BBL was loaded with large particles transported within the bottom currents. Generally the majority (usually 80% or more by numbers and taxa) of benthic animals at the continental margins are deposit feeders that substantially modify sediment structure via bioturbation. However, while the macrobenthic community seems to be depth-related, the coral reefs in the Porcupine Seabight again reveal that the hydrodynamic conditions at this continental margin strongly influence benthic community structure. Very often a peak in density and biomass of interface feeders (ie. those animals, which are able to switch between passive filter feeding and surface deposit feeding) between 800 and 1500 m water depth coincide with strongest changes in sediment structure and bottom current regime at the European continental margin. Suspension-feeding animals that rely on labile organic carbon are dominant on the shelf and upper slope areas, interface feeders are found primarily at the more highly energetic mid-slope sites, and deposit feeders which feed on carbon of much lower nutritional value dominate the lower slope and continental rise. By using the preliminary data on BBL dynamics one can identify those oceanic regions where strong mean flow and strong eddy variability occurs. This is in particular, the case for continental margin environments, where boundary currents, internal waves and tides can create shear stresses exceeding the threshold needed to erode the sediments. Advective near-bed fluid flow imports particles from sources upstream and serves as food for benthic communities. Generally, sediments at the continental slopes consist of a thin surface layer that is resuspended as aggregates (mean diameter 100- 5000 µm) and is covered by a bacterial flora. These aggregates, which occurred in high abundances at the study sites can subsequently be transported in the tide-related resuspension-deposition loops over long distances and are expected to scavenge almost all small particle <= 5 µm in diameter. Total clearance of bottom nepheloid layers can thus occur during times of transport of large aggregates and can prevent the feeding guilds of the corals from clogging.

Rough estimates of BBL dynamics during the "Victor 6000" dives revealed flow velocities of 5 to 50 cm/s at c.2 m height above bottom with currents mainly directed to SE, S or SW. Most of the coral reefs were located at water depths ranging from 600 to 900 m and are therefore exposed to internal wave turbulence at the boundary between Mediterranean Outflow waters and the North Atlantic current. Abundant coral assemblages were mostly located above the mudline, eg in water depth where sand is the dominant grain size.

As the transport of both lithogenic sediments and organic material is enhanced and controlled by local topography and hydrography around the coral mounds, particle input to the sediments is strongly related to sediment-transport processes around the mounds. For at least two study sites there was a correlation between coral mound shape and the dominant bottom current direction, as indicated by ripples and sand waves. The mounds were elongated in the general flow direction and the live corals were more abundant at the steeper slopes of the mounds were current velocities are expected to be enhanced. At the last study site, terrace like carbonate structures with overhangs of several tens of centimeters created turbulent flow fields which were characterized by local eddies at the edges of the terraces (Gutt, pers. observation). Here the live corals accumulated and created a diverse habitat for planktonic organisms. As turbulence is an irregular rotational motion, and dissipates away from the seafloor, these structures located at 1 – 2 m height above the next terrace or seafloor below created ideal feeding conditions for the filter feeding coral communities. At these heights mostly high organic/low inorganic aggregates are transported due to their lower excess densities. At several locations during the cruise the CTD was additionally equipped with a fluorometer to detect Chlorophyll a as an indication of fresh phytodetritus. As the particles occurred in form of large aggregates the data from the fluorometer were analysed for peaks and spikes as indicators of single large aggregates passing the fluorometer. Despite high abundant aggregates in the BBL there were generally slightly higher Chl a signals detected in the BBL at the coral sites and in downstream (southward) direction of the coral mounds. However the signals were not strongly enhanced which lead us to conclude that the increased amount of particulate carbon was of already inferior nutritional value. That indicates that the flux of carbon in the BBL at the coral sites was high, but it mostly refers to less labile refractory carbon which has already passed many resuspension loops. In order to investigate the particles transported in the BBL, bottom water was sampled by a multicorer and a box corer and the sediment surface was carefully resuspended in order to sample recently settled material. The samples will be transferred to the laboratory for the determination of settling velocities, critical shear velocities and bioavailability.

A. 4.7 Water mass properties and intra-province variation

Unnithan, V., Dorschel, B., Thomsen, L.

The Porcupine Seabight and Rockall Trough (of which the Porcupine Bank forms an eastern margin) are situated along on the NE Atlantic margin. The Porcupine Seabight represents an enclosed basin in which the hydrography differs distinctively from the Rockall Trough. The latter is closely linked to the Atlantic thermohaline circulation. The investigated areas are separated by the Porcupine Bank over which water shallows to less than 300m.

On the basis of earlier investigations (White, 2001, New, 2001), the deeper water masses in the Rockall Trough and Porcupine Seabight are broadly sub-divided into:

1) The ENAW that originates in the Bay of Biscay and is composed of mixed water masses and extends down to 750m from the surface waters.
2) The MOW flows out of the Strait of Gibraltar and one arm flows northward along the eastern margin of the Atlantic. This water mass occupies the intermediate waters and is characterised by high salinity, low oxygen core and higher temperatures (?)
3) The Labrador Sea water is a cold, low salinity, high oxygen water masses occupies the intermediate to deep parts of the water column.

4) The NSOW has similar water mass characteristic but originates from the Norwegian Sea. The origin and importance of this water mass in the Irish context is currently disputed

5) The AABW occupies the deepest section of the water masses. It is characterised by low oxygen, high Si and low temperatures. It is found only in the deepest parts of the Rockall Trough and Porcupine Abyssal Plain.

The circulation pattern in the Porcupine Seabight and Rockall Trough is controlled by the NE drift of the Gulf Stream and associated eddies which are formed by wind shear. The ENAW and MOW are generally northward flowing, and in enclosed basins such as the Porcupine Seabight and restricted Rockall Trough form counter clockwise gyres. Strong contour currents along the eastern margin of both basins are responsible for sediment mobilisation (in the east) and (re)deposition (in west).

Other important phenomena are internal waves and tidal currents that are responsible for resuspension, creation of nepheloid layers and water motion up and down the slope. Over Porcupine Bank a seasonal Taylor Column can be observed causing local algae blooms that can also be observed in the shipboard fluorometer data.

Objectives

Keeping the literature observation in mind, several CTD-casts have been carried out, investigating the hydrography especially in the mound areas in the eastern Porcupine Seabight and the eastern Rockall Trough. Therefore, primarily salinity and temperature have been analysed up and downstream as well as on the summits of carbonate mounds (Fig. A4.7-1).

Further objectives were to supply background information data for the current meter and lander deployments at Galway Mound and to provide a better understanding of the role of mound structures in the local hydrodynamics of the region (indications of turbulence).

Results

21 CTD-casts were obtained during the ARK XIX/3a cruise with the RV "Polarstern" to the Porcupine Seabight and Rockall Trough. For locations see station list in the appendix.

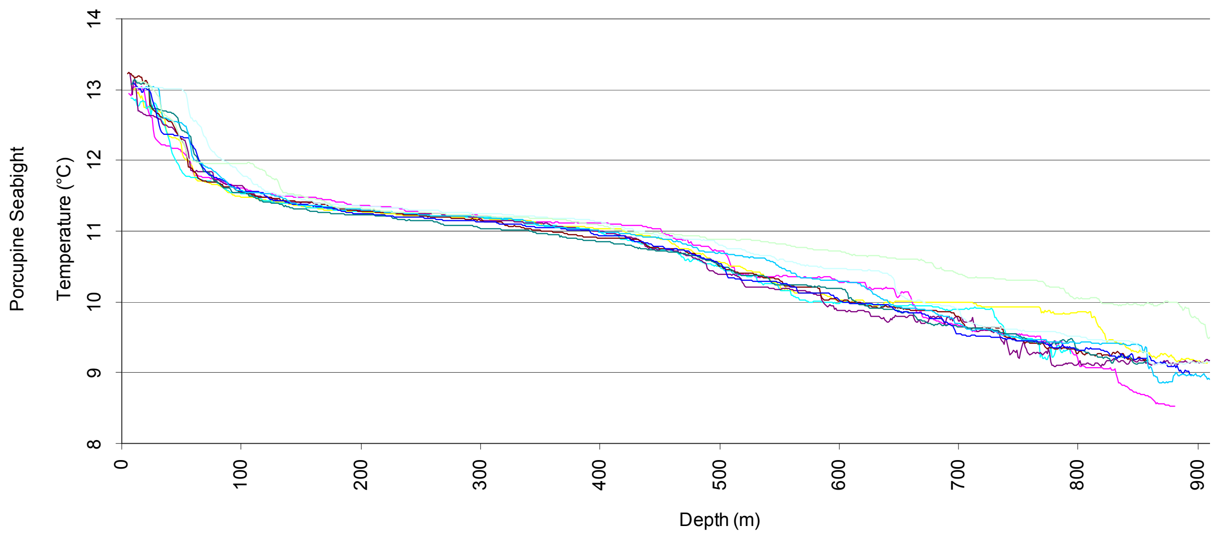

Fig. A4.7-1: Plot of all temperature data in Porcupine Seabight

Temperature and salinity profiles obtained from the CTD-casts reveal distinct differences between the Porcupine Seabight and the eastern Rockall Trough. The thermocline in the Rockall Trough is at approximately 60m and at approximately 90m in the Porcupine Seabight.

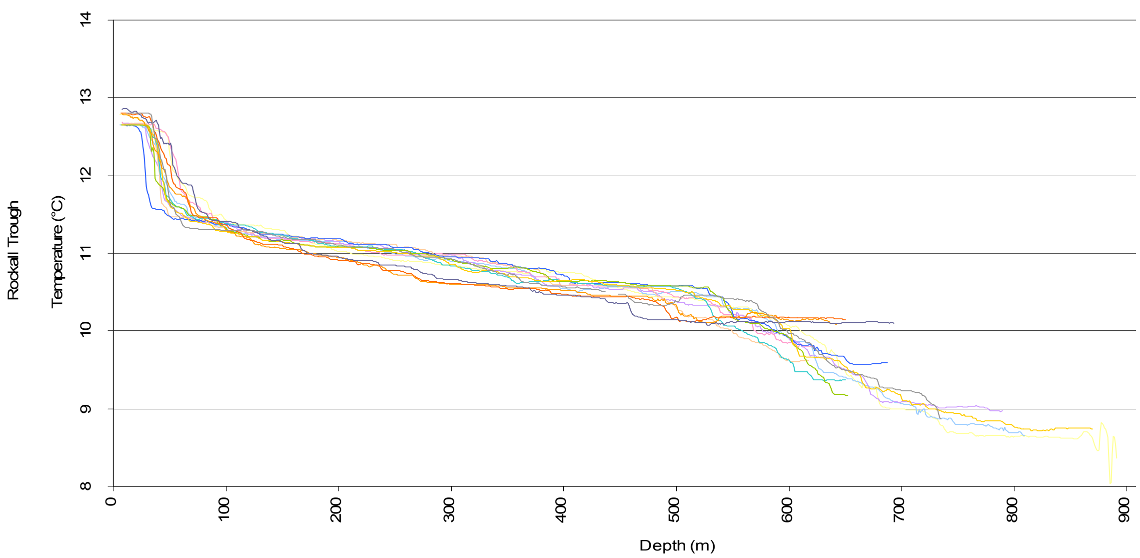

Fig. A4.7-2: Plot of all temperature data in Rockall Trough

The Porcupine Seabight thermocline is less well developed. The intermediate water masses are more variable in the Rockall Trough, while in the Porcupine Seabight they only occur below 500m water depth.

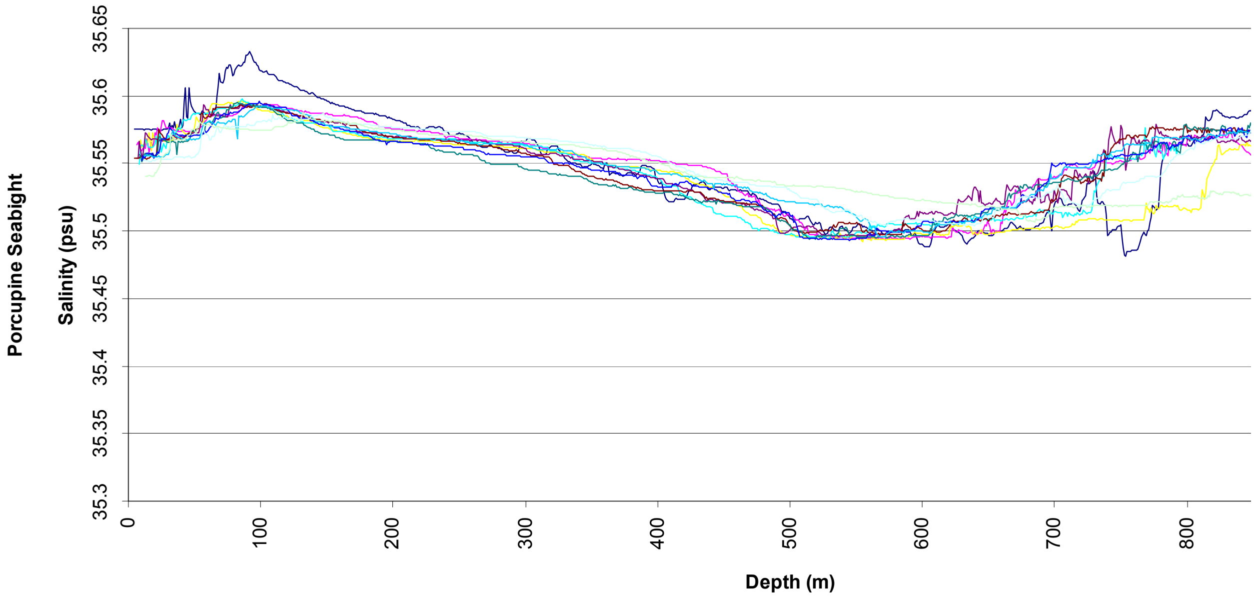

Fig. A4.7-3: Plot of all salinity data in Porcupine Seabight

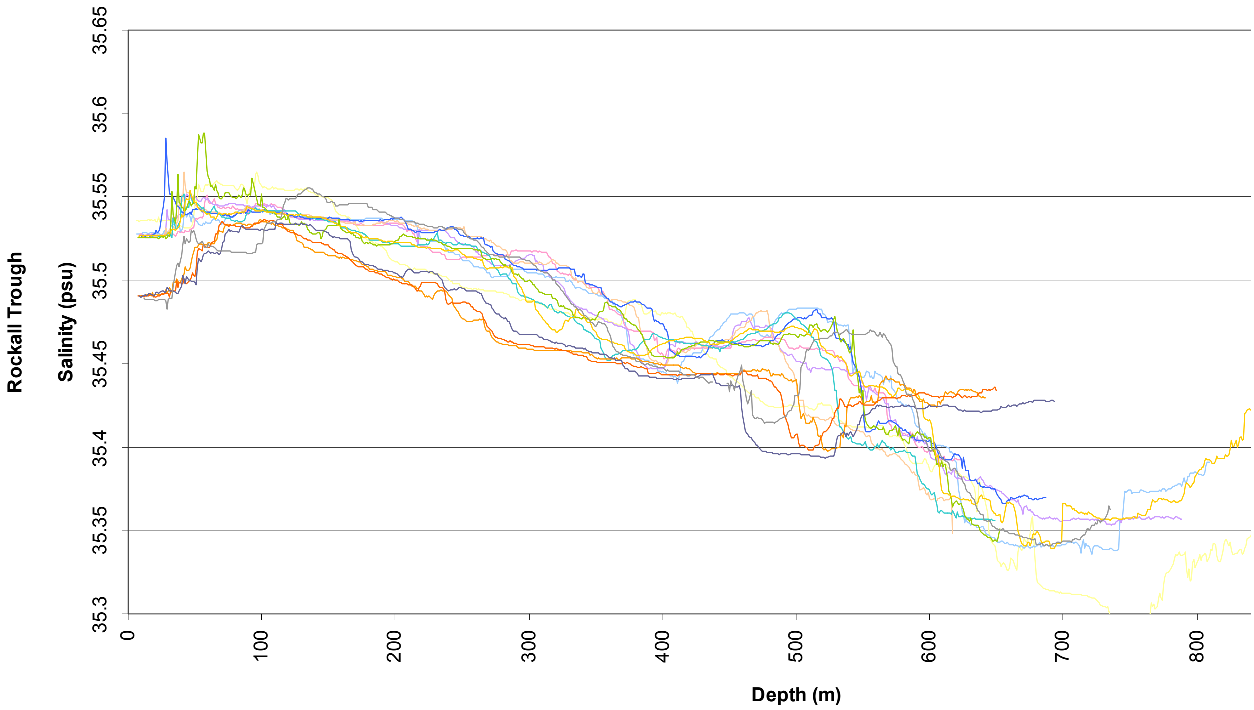

Fig. A4.7-4. Plot of all salinity data in Rockall Trough

There is also greater variability in the salinity with respect to the Rockall Trough. Generally the salinity decreases constantly below the thermocline in the Rockall Trough while the Porcupine Seabight profiles clearly show an increase in salinity below 550m water depth. This trend is particularly pronounced in the T-S plot (Fig. A4.7-5).

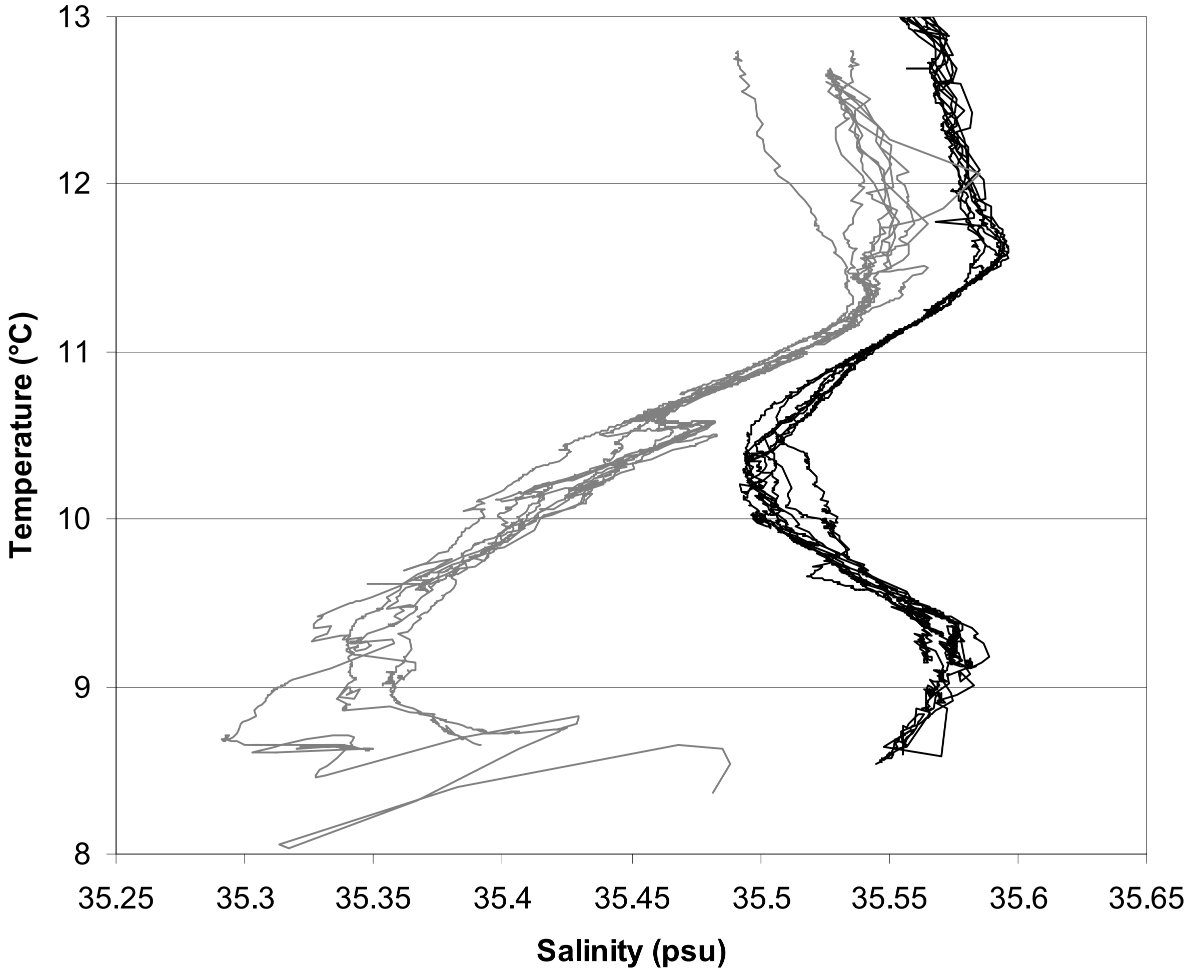

Fig. A4.7-5: T-S plot Rockall Trough (grey graphs) and Porcupine Seabight (black graphs)

The increase in salinity in the lower part of the T-S plot for the Porcupine Seabight could be interpreted as the MOW which has already been reported in previous work and seems to play a key role in the development of carbonate mounds and their associated fauna in the Porcupine Seabight (Freiwald 2002). In the T-S plots from the Rockall Trough these patterns cannot be identified.

Further investigations will attempt to link the hydrographic data to video observations carried out on this cruise, trying to find a connection between water mass properties and coral occurrences.

A. 4.8 Deep water coral ecology and fisheries impact in the Porcupine Seabight and NW Porcupine Bank

Grehan, A., Unnithan, V., Wilson, M., Guinan, J., Beck, T., Foubert, A. Wheeler, A.

A. 4.8.1 Living deep-water coral distribution patterns in the Porcupine Seabight and NW of Porcupine Bank

Unnithan, V., Grehan, A., Guinan, J., Wilson, M., Beck, T., Foubert, A., Wheeler, A.

The living deep-water coral distribution observed on the dives of the "Victor 6000" in the Porcupine Seabight and Porcupine Bank during the Polarstern ARK XIX/3a Cruise, show a remarkable patchiness. The dives on the "Moira mounds" show that live *Lophelia* and *Madrepora* are present in rather isolated colonies interspersed throughout the region, with general colonisation on hard substrates such as dropstones, concretions or dead coral fragments. The dive to the "Galway mound" showed some of the highest concentrations of living coral observed on a mound. On this mound both *Lophelia*, and *Madrepora* are equally abundant. This mound is additionally characterised by a diverse fauna including glass sponges, gorgonians, and crabs. The dives on the "Belgica mounds" were surprisingly devoid of large patches of living *Lophelia*. The only exception was a small area around the Poseidon Mound. This mound consists primarily of dead *Madrepora* and very isolated colonies of both living *Madrepora* and some *Lophelia*. During this dive it was observed that the shallower mounds appear to have less living coral coverage than the deeper ones such as "Thérèse" or "Galway mounds". This suggests perhaps a bathymetric or hydrodynamic control on the occurrence of living *Lophelia* or *Madrepora*.

In this short introduction to the distribution of coral, soft bodied coral such as gorgonians, antipatharians etc have been excluded and the focus has been on *Lophelia*, *Madrepora*, *Desmophyllum* and stylasterids.

The Porcupine Bank

As observed on the previous "Victor 6000" CARACOLE cruise in 2001, the distribution of living coral in the Rockall Trough margin is very different to that observed in the Porcupine Seabight. The Rockall Trough has perhaps a more active and dynamic contour current system along with internal waves and tides which enhance resuspension of sediments. The living coral distribution on the twin mound was difficult to map as extensive areas have been destroyed by trawling and finding pristine coral growth was difficult. On the giant mound however, in addition to the living coral observed on dropstone “gardens”, living coral, lophelia, some madrepora and giant stylasterids were observed on the northward facing slope of the mound. There was just one transect in this region. In addition to the abundant stylasterids, large red gorgonians were also common.

The scarp and the "Hedge mounds" are typically characterised by patchy growth which can be locally very luxuriant. In the "Hedge mounds" there are densely populated lophelia colonies that have the same shape and dimensions of big boulders. Another characteristic or favoured location for living coral seems to be ledges, scarps or protruding hardground in a favourable orientation with respect to the currents. Lophelia and desmophyllum are quite common, while stylasterids are rare and quite small.

Further Work

Some of the interesting points that will be answered in the course of future work will be

- why do such regional variations occur ?
- is it possible to use the four species as a proxy for environmental conditions (we know that *Lophelia* grows on hostile environments such as oil rigs) ?

A. 4.8.2 Alcyonacean forests of Ireland’s continental margin

Hall-Spencer, J., Brennan, C.

Overview

This project rides on an international surge of research efforts to unravel the geological and ecological complexities of the astonishing biogenic habitats formed by cold-water corals at high latitudes. Here we briefly summarise our observations on the ecology and distribution of deep-water alcyonaceans (also known as octocorals as the polyps have eight feeding tentacles). These organisms are amongst the largest and most obvious sessile organisms so far found associated with extensive scleractinian communities along the NE Atlantic seaboard. We list brief descriptions of the samples and video observations made. On return to the Plymouth Laboratories the main objectives of the project will be:

1) identify the sampled Alcyonaceans through microscopic techniques, including preparations of their skeletal spicules
2) review known biogeography and ecology of these species
3) identify and enumerate small fauna associated with sampled Alcyonacea
4) identify and enumerate large fauna associated with Alcyonacea on "Victor 6000" films, particularly in relation to their provision of 'Essential Fish Habitat'
5) estimate alcyonacean age through banding techniques
6) use video transects to provide an overview of their distribution and abundance around Ireland's recently surveyed coral provinces.

In addition, specimens have been preserved in alcohol and will be used to carry out molecular genetic comparisons with west Atlantic populations and carry microprobe geochemical analyses of skeletal bands to ascertain the hydrographic history of the Belgica (Porcupine Seabight) and Scarp and Hedge (Porcupine Bank) coral zones.

Results

Alcyonaceans were seen on dives 3-8 using "Victor 6000". They were first seen on the "Moira mounds", which are low relief, relatively small mound communities inundated by sand. The conspicuous species observed was orange in colour forming planar fans, similar to *Paramuricea* sp., up to 30cm tall. In places the denuded stems of these seafans were lying loose on the hard coral matrix. These orange gorgonians were then encountered in abundance on the large Galway Mound, part of the Belgica Mound complex to the north. Extensive video observations were taped during lander and current meter deployment over the mound. If these instruments work as planned this will become the best-studied deep-water coral reef in the world, yielding useful information about the rich alcyonacean habitat. Between "Victor 6000" dives three box-cores were taken on "Thérèse mound" to provide live specimens for aquaria, these 50 x 50 cm cores yielded live and dead specimens of the orange planar gorgonian (Fig. A4.8.2-1).

The "Thérèse mound" specimens were preserved along with their associated fauna, which included zoanthids, abundant amphipods and what looked like a naked mollusc species coiled around the branches (to be confirmed). The manipulator arm on "Victor 6000" was used to collect Alcyonacea on "Victor 6000" dives 6 and 7.

Fig. A4.8.2-1: Top left) Box core 271-1 "Thérèse mound" 51° 25.75'N 11° 46.18'W 900m orange planar gorgonian attached to the dead part of a live *Madrepora oculata* colony. Top right) Box core 271-3 "Thérèse mound" 51° 25.76'N 11° 46.16'W 910m gorgonian skeleton. Lower left) Close-up of orange planar gorgonian shown in upper left corner with associated fauna. Lower right) Close-up of gorgonian remains (shown in upper right) with hydroids.

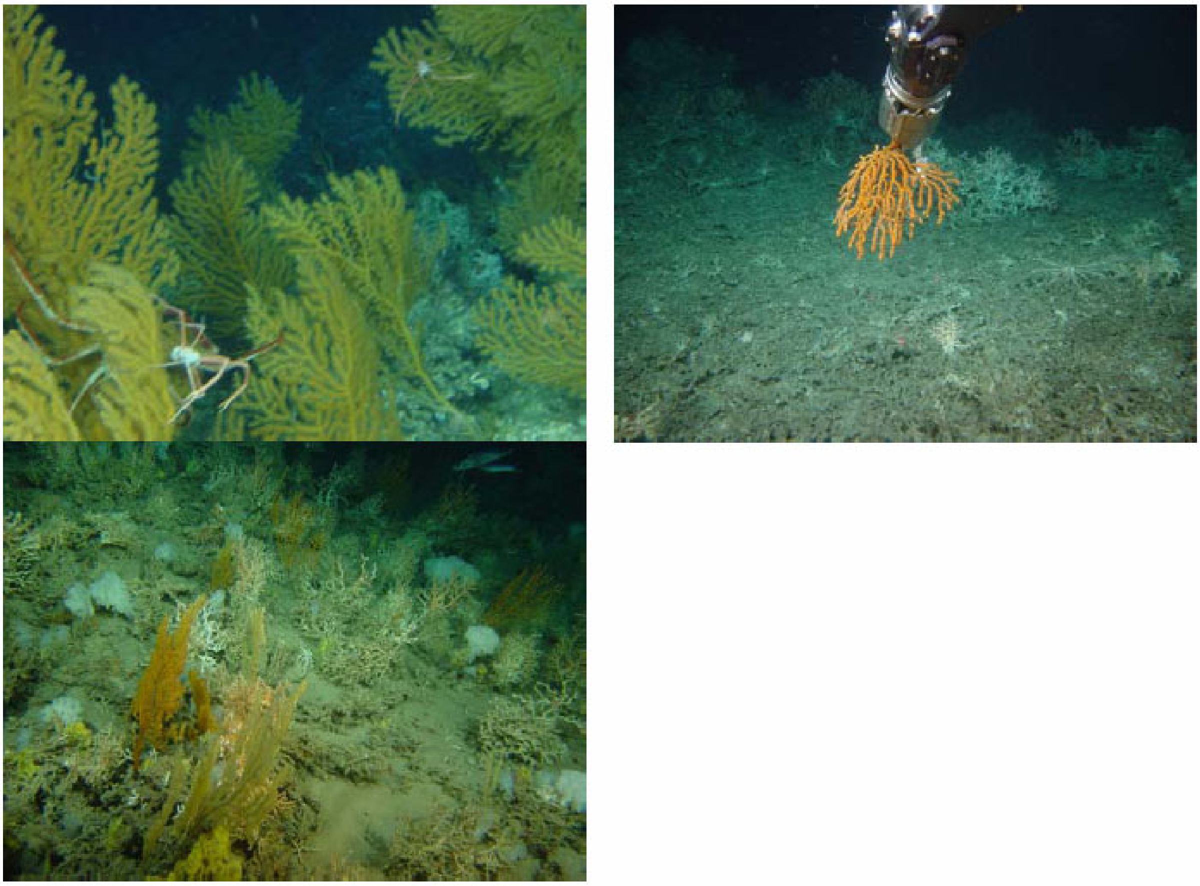

Fig. A4.8.2-2: This orange, planar gorgonian appears to be the commonest Alcyonacian in the Belgica coral province (Porcupine Seabight) Top left) dense grove of large specimens with three *Munida*? clinging on near the summit of the "Giant mound" on the Porcupine Bank, 14.6.03 Top right) "Victor 6000" sampling of a small colony on the "Twin mounds" on the Porcupine Bank,12.6.03. Lower left) high densities of mature colonies with delicately branched *Madrepora oculata* and glass sponges at the "Twin mounds" on the Porcupine Bank, 12.6.03.

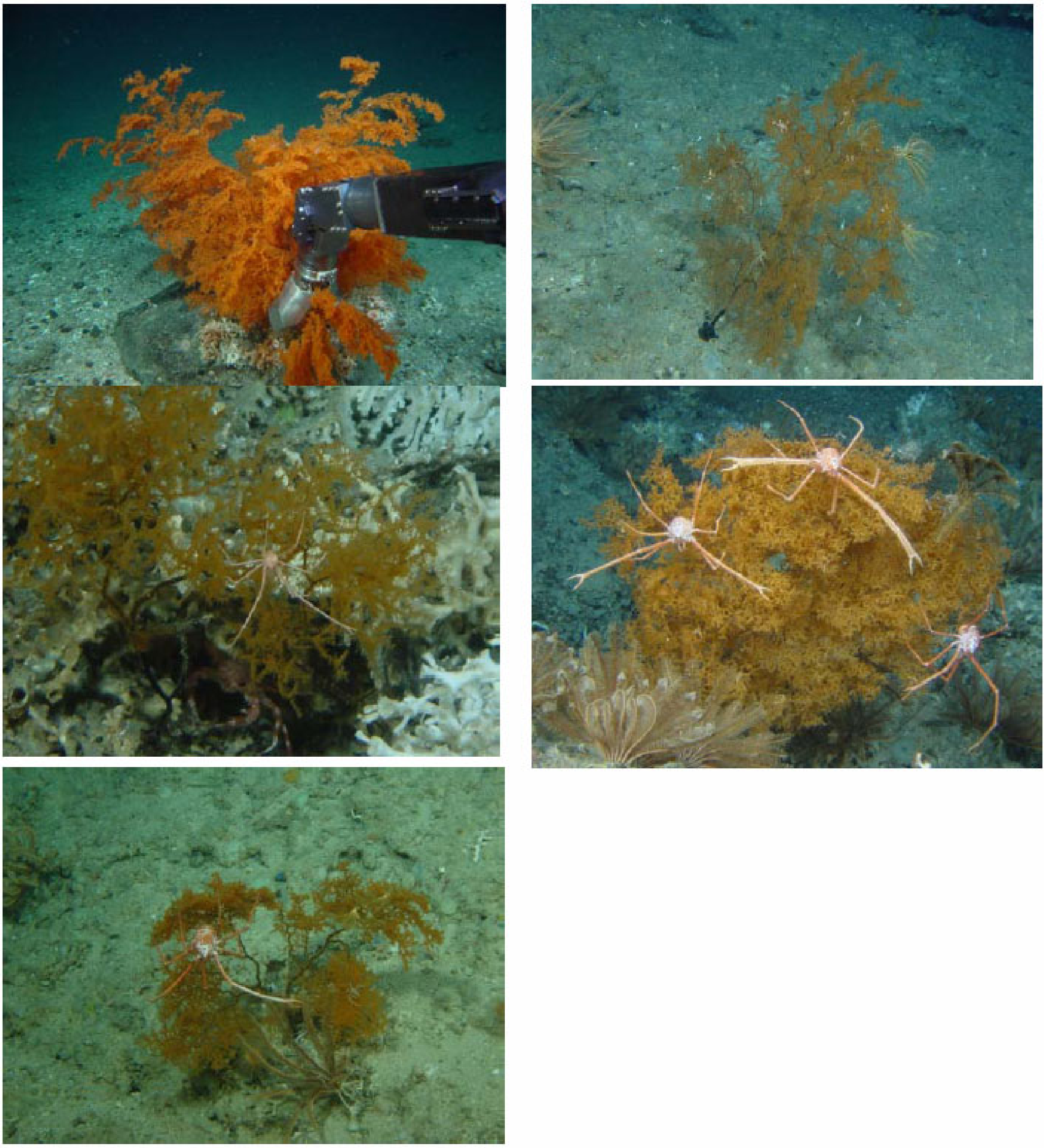

Fig. A4.8.2-3 Orange bushy alcyonacean colonies. Top left) "Victor 6000" subsampling whole colony estimated to be 150 cm in height, sampled near the "Twin mounds" on Porcupine Bank, 12.6.03. Top right) small colony with attached crinoids and small spider crab, "Giant mound" on Porcupine Bank, 14.6.03. Middle left) small colony attached to *Lophelia* rubble with one *Munida*? And a swimming crab sheltering below, "Giant mound" on Porcupine Bank, 15.6.03. Middle right) large colony with three ? *Munida* crustaceans attached and filter-feeding crinoids in foreground at the "Twin mounds" on Porcupine Bank, 13.6.03. Bottom left) small colony with attached ?*Munida* crustacean and crinoid on rock at the "Twin mounds" on Porcupine Bank, 13.6.03.

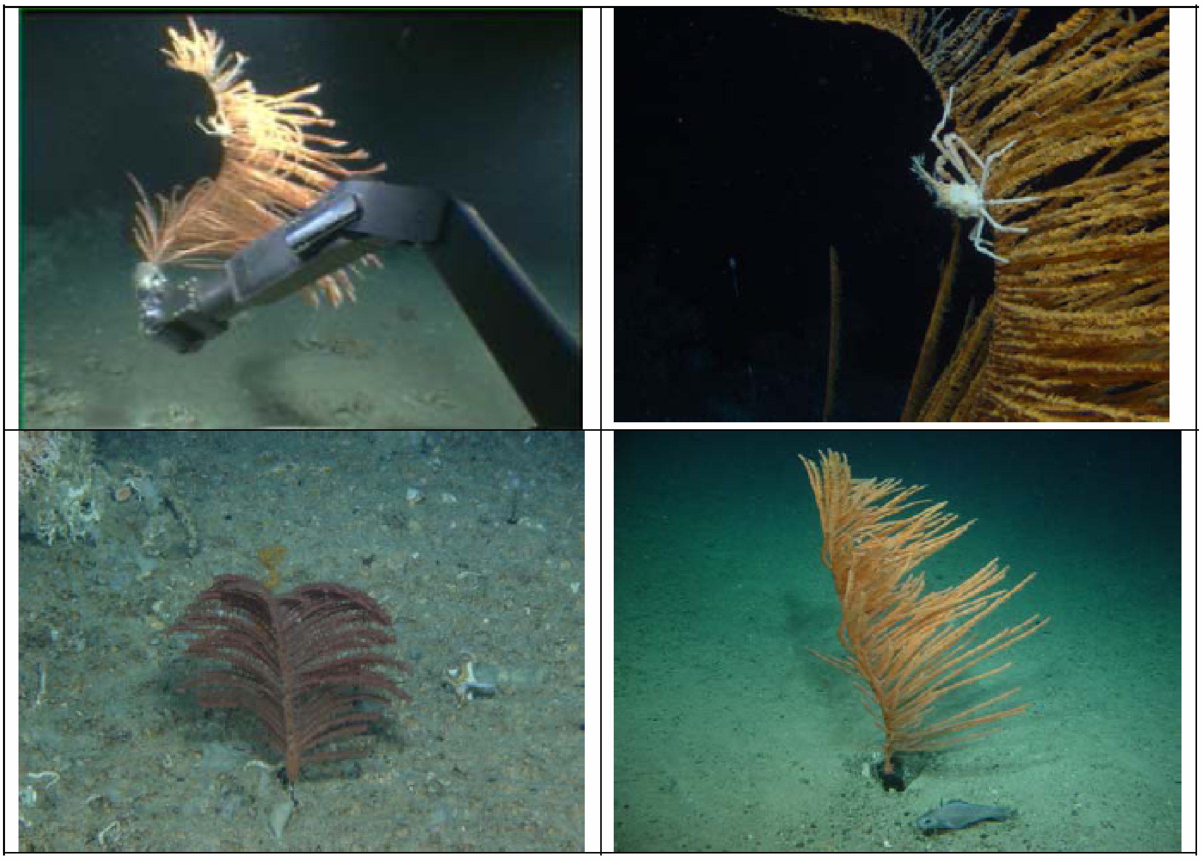

Fig. A4.8.2-4: Feather-shaped alcyonacean. Top left) "Victor 6000" collected large colony attached to small dropstone near "Giant mounds" on the Porcupine Bank, 14.6.03. Top right) Spider crab attached to large colony near "Giant mounds" on the Porcupine Bank, 14.6.03. Lower left) Small colony attached to eroded carbonate rock with a seawhip alcyonacean in background at "Giant mounds" on the Porcupine Bank, 14.6.03. Lower right) Large colony attached to small dropstone, providing a refugia for a *Lepidion* (fish) on sand plain near the "Twin mounds" on the Porcupine Bank, 12.6.03.

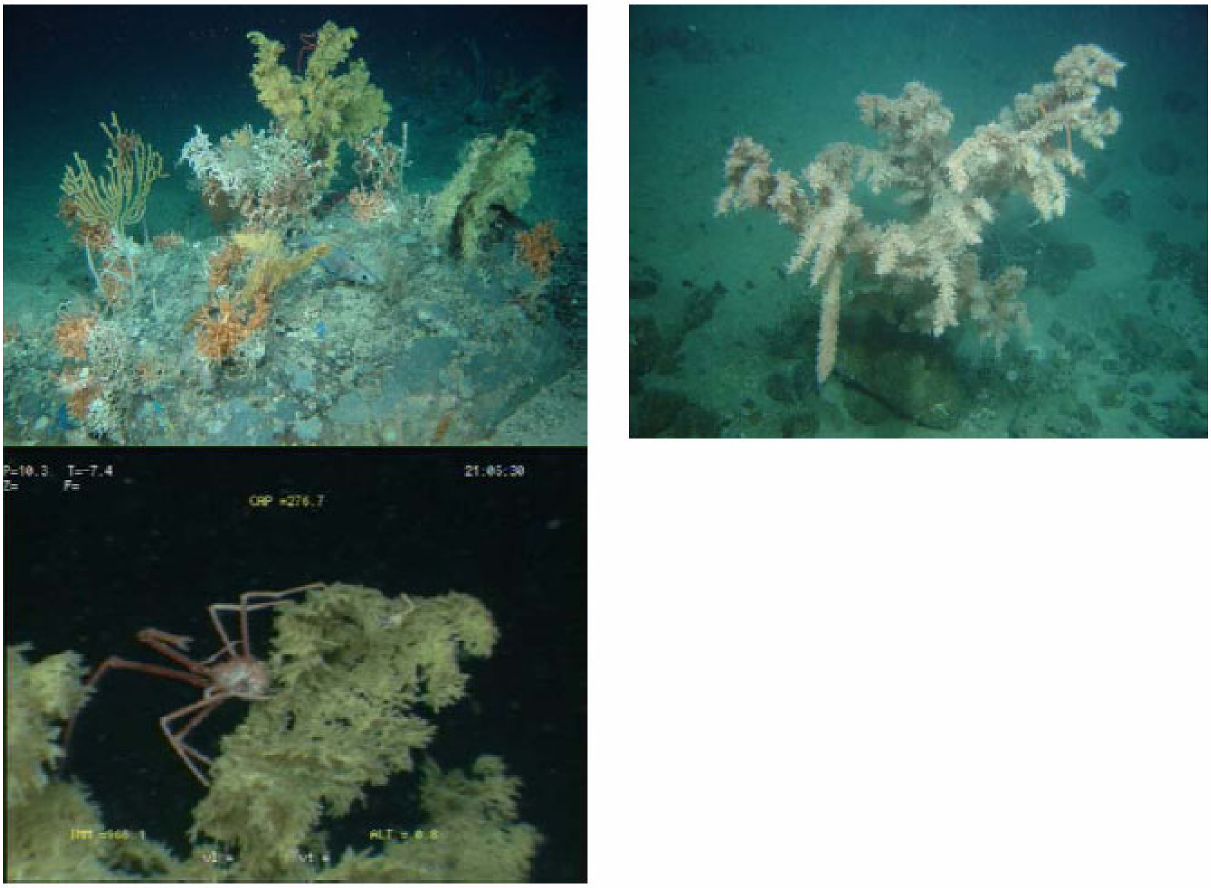

Fig A4.8.2-5 White bushy alcyonacean. Top left) Two large colonies amongst orange planar gorgonians on large dropstone with with the scleractinian *Madrepora oculata* and a sheltering fish, *Lepidion* sp. "Twin mounds" on Porcupine Bank 12.6.03. Top right) Single large colony on small dropstone near the Scarp on Porcupine Bank 16.6.03. Lower left) Detail of colony with *Munida*? attached, 966m "Twin mounds" on Porcupine Bank 12.6.03.

Fig. A4.8.2-6 Purple irregularly branched alcyonarian. Left) large colony on gravely sand with *Cidaris cidaris* in backgound near the "Giant mounds" on the Porcupine Bank, 14.6.03. Right) small colony with pink cushionstar in foreground near the "Giant mounds" on the Porcupine Bank, 14.6.03.

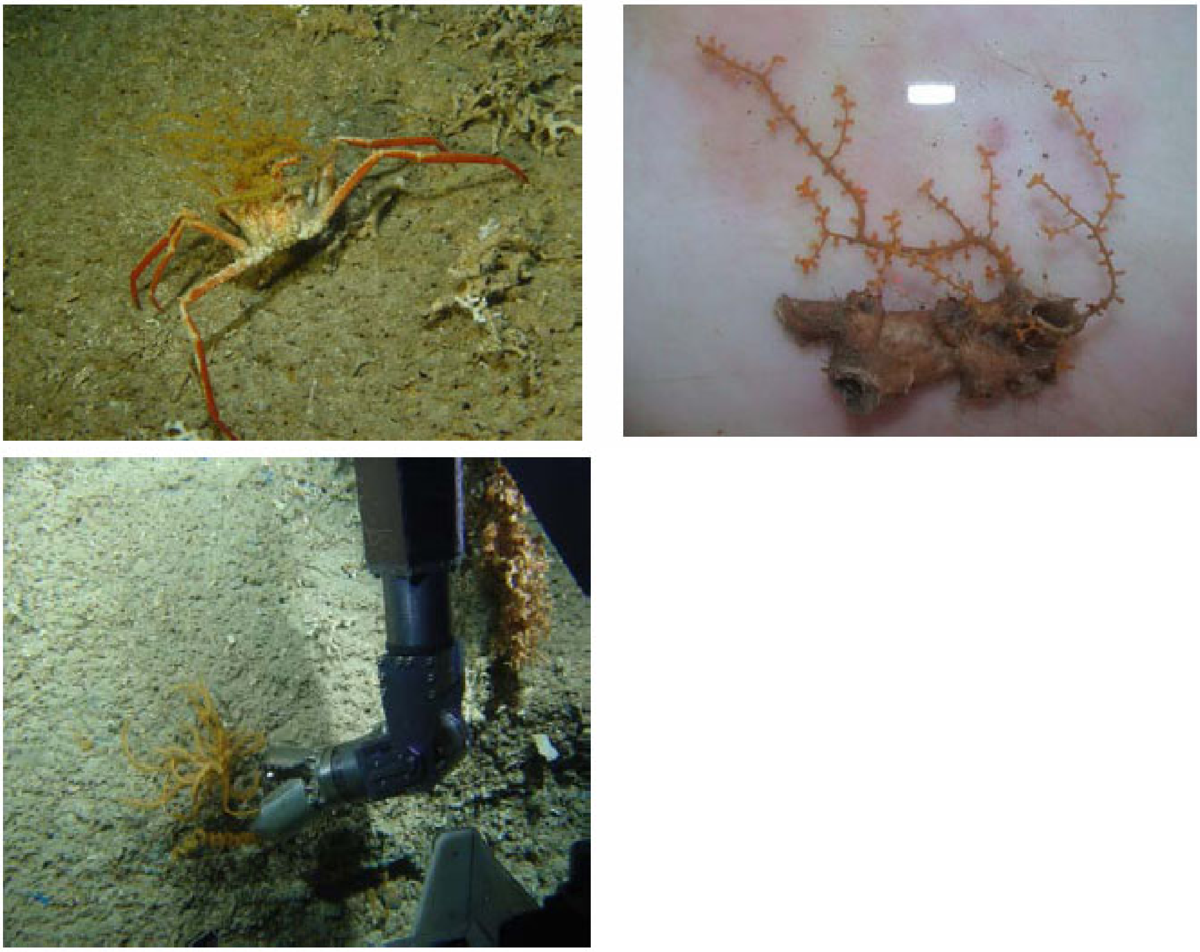

Fig. A4.8.2-7: Top left) Yellow alcyonacean with thin irregular branches attached to crab carapace near the "Giant mounds" on the Porcupine Bank, 14.6.03. Top right) sample from box-core 271-3 "Thérèse Mound" 51° 25.76'N 11° 46.16'W; 910m. Lower left) Yellow, curly branched Alcyonarian A) "Victor 6000" removing whole colony from eroded carbonate rock near the "Giant mounds" on the Porcupine Bank, 14.6.03.

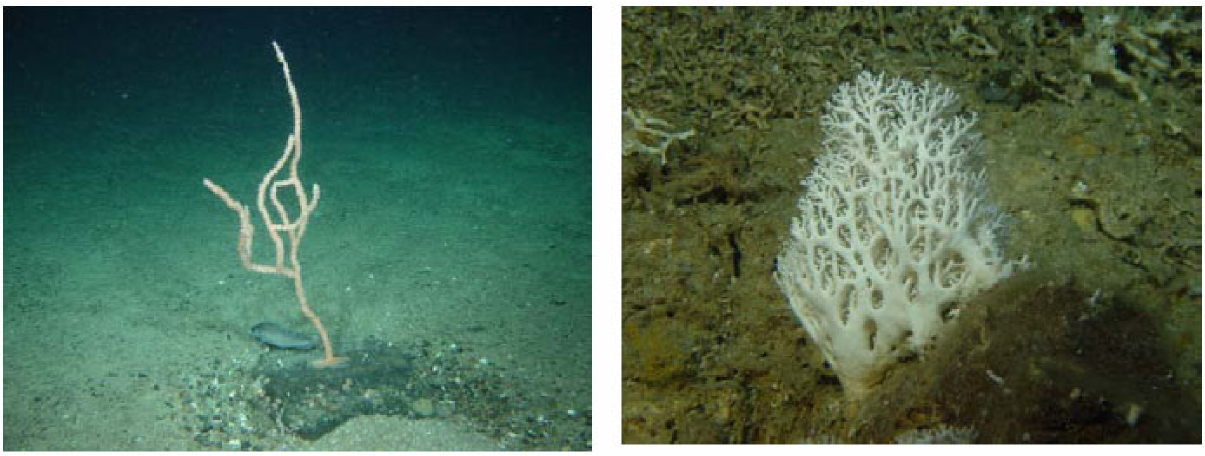

Fig. A4.8.2-8 Less commonly observed Alcyonacea from the W Irish continental shelf-break area. Left) Pink, sparsely branched gorgonian attatched to a dropstone, note the *Lepidion* fish sheltering. Right) Heaviliy calcified white Isididae colony amongst coral rubble.

Fig A4.8.2-9 Curly, unbranched antipatharian collected in Box-Core 295-1 ‘on mound’ Giant Mound on Porcupine Bank. This small species may be inconspicuous on video but was taken in two box cores, so may be more abundant than the video suggests.

Discussion

The Irish continental margin lies in the cold temperate biogeographic region of the NE Atlantic where 21 species of Alcyonacea are known to occur. These include 1 Acanthogorgiidae, 3 Alcyoniidae, 1 Anthothelidae, 3 Crysogorgiidae, 2 Clavulariidae, 3 Isididae, 4 Nephtheidae, 1 Paragorgidae, 1 Plexauridae and 2 Primnoidae. Some of these species attain large sizes, with banded skeletal tissue that is amenable to geochemical studies of past hydrographic conditions. In Irish waters shallower than 50 m only one sea fan, *Eunicella verrucosa*, is able to survive the variable environmental conditions. We have recorded at least 9 species from depths of 650-1200 m on the present cruise. At these depths key environmental factors such as temperature and salinity are less varied, yet strong currents and a rich supply of food allow suspension-feeding alcyonaceans to thrive so long as hard substrata are present.

Hopefully with help from taxonomic specialists specimens collected on this cruise will be identified and added to reference collections at the British Natural History museum. Whilst it is too early to say which species we have recorded, we can say that alcyonaceans are a diverse and abundant group in the deep-water coral provinces off the Irish west coast. The Alcyonacea occurred on hard substrata in greatest densities on topographically high hard substrata such as on coral rubble, large glacial boulders and on eroded carbonate rock. They were scarce in areas disturbed by strong sand scour or demersal trawling. The group was of ecological importance in terms of providing a habitat for other invertebrates (e.g. amphipods, crabs, crinoids) as well adding structural complexity to the seabed as ‘essential fish habitat’ for fish such as *Lepidion* which associated with the large gorgonians and antipatharians. We will investigate whether the "Victor 6000" video shows statistically more fish near large Alcyonacea than on surrounding low-relief sediment. We are fortunate to have been able to see and collect specimens from areas that have not yet been impacted by trawling activity. Most marine studies are carried out in areas that are heavily modified by fishing due to a lack of pristine reference sites. Perhaps we are just in time, given the extent of trawling damage to the "Twin mounds" region where the coral has been reduced to rubble and no large, erect epifauna remain.

A. 4.8.3 Scientific Fisheries Echosounder Survey

Guinan, J., Grehan, A.

During the second half of cruise ARK XIX/3a, a fisheries survey was carried out covering mound locations in the Porcupine Seabight and west of the Porcupine Bank (Fig. A4.8.3-1) using a Simrad EK60 Scientific Echosounder.

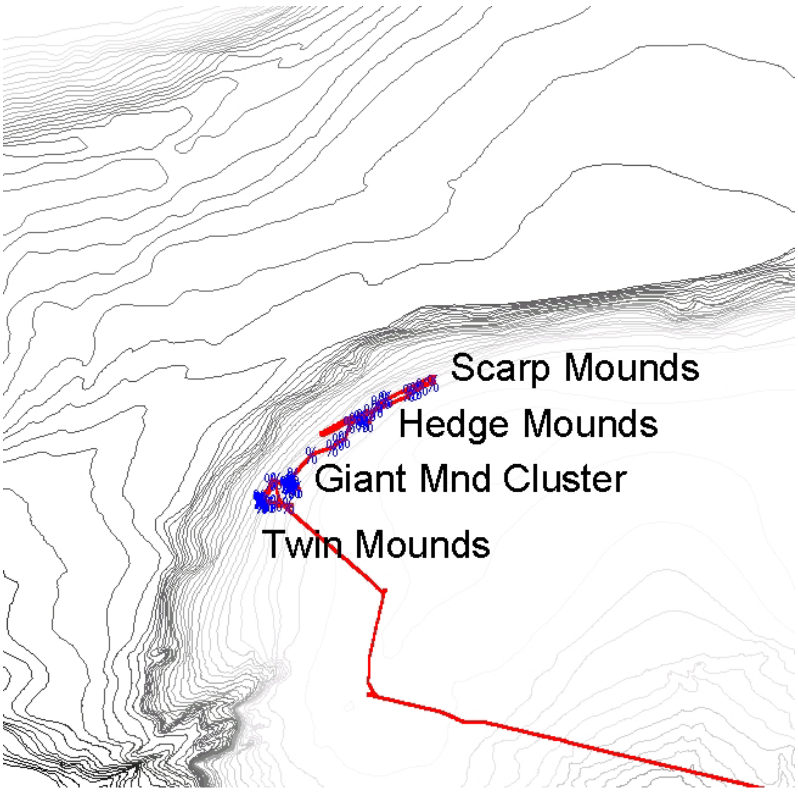

Fig. A4.8.3-1: Fisheries survey transect over the four study locations (indicated by the blue clusters) on the western Porcupine Bank.

The echosounder provides information on fish distribution, which is fundamental to understanding, and defining target areas where commercial fishing activities occur. The primary objective of this survey is to use data from the echosounder to investigate the relationship between mound features on the seabed and fish distribution. Certain deep-water fish such as the orange roughy (*Hoplostethus atlanticus*) are thought to aggregate in areas of high topographical relief where current activity is high. In addition, the data collected from this survey will determine if fish aggregation on mounds is related to the occurrence of coral on such mounds, either living or dead coral.

Methodology: EK60 Echosounder

The EK 60 echosounder is designed for fishery research and uses the Microsoft Windows display interface. The standard system consists of one or more transducers, a General Purpose Transceiver (GPT) and a Processing Unit (desktop computer). The GPT contains transmitter and receiver electronics and can be configured for single or split beam operation. The split beam configuration was used throughout the fisheries

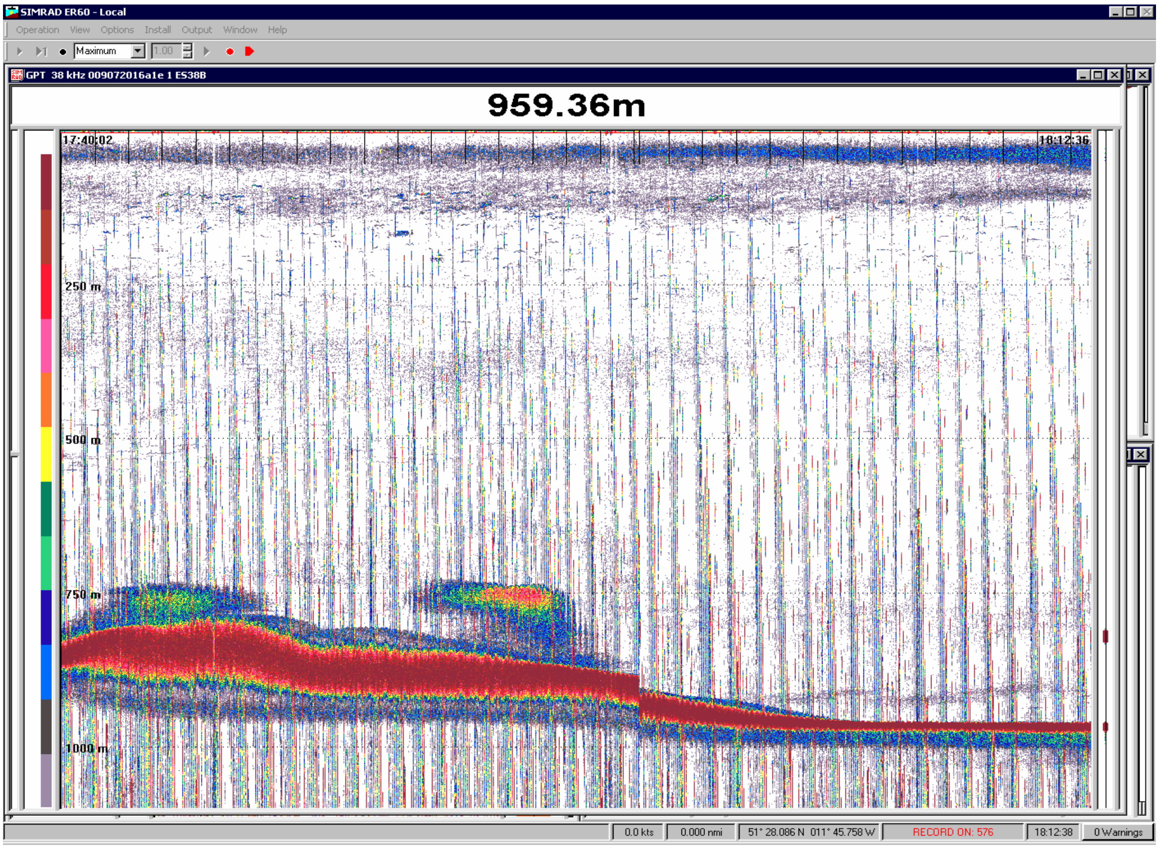

Fig. A4.8.3-2: Echo frame with strong reflection above seabed indicating a fish shoal in the region of the "Twin mounds".

survey at frequencies of 38, 70, 120 and 200 kHz. Depth ranges between 5 and 15,000m and ping rate is adjustable with maximum ping rate of 10 pings per second).

Data is displayed as an echogram (Fig. A4.8.3-2), which contains information about the acoustical value. The range is used to specify the range used in the echogram field and can be modified according to the bottom related echogram. To link acoustical data with navigational data, the EK60 receives data from a Global Positioning System (GPS) or another positioning system.

Results

Preliminary results from the survey are based on echogram observations logged during the individual surveys and require further analysis and interpretation when the data set is investigated in full. In general, a consistently strong signal reflection was observed at 10-125m depth throughout the survey, suggesting that plankton exist in this upper region of the water column. Fish aggregations were observed in particular at both the Twin and Giant Mound areas of the survey track at depths of more than 750m. In particular, fish shoals were more common at the "Twin mounds" where a fishing vessel was recorded in the area at the time of the survey, suggesting that the "Twin mounds" are a target area for commercial fisheries. This was later confirmed by video observations from the "Victor 6000" ROV when evidence of fishing gear and nets were discovered on the seabed confirming these grounds are actively fished.

Discussion

A fisheries survey has provided information on the nature and distribution of deep-sea fish in the Porcupine Bank area. Fish activity in mound areas is clear from first observations. However, further investigations of the data will help quantify the relationship between fish aggregations and mound features on the seabed and answer questions relating to whether the nature of the mounds (live or dead) has an influence on fish distribution.

A. 4.8.4 Fisheries Impact Studies on the Porcupine Seabight and Bank

Grehan, A., Unnithan, V., Guinan, J., Wilson, M.

Previous detailed ROV surveys conducted during 2001 at mound sites in the Porcupine Seabight and the Rockall Trough revealed limited evidence of fisheries impacts in areas where there were corals (Grehan et al. 2003). Lost static gears were imaged in the Belgica and Pelagia mound province.

The more extensive surveys during ARK XIX/3a particularly along the western edge of the Porcupine Bank of "Twin mounds", "Giant mounds" and "Scarp mounds" have for the first time demonstrated that destructive trawl damage to corals does occur in Irish waters. A recently lost trawl was imaged at "Giant mounds" full of coral and associated fauna. Some specimens of *Lophelia* were clearly still alive attesting to the recent nature of the impact. Areas of the "Twin mounds" appeared heavily trawled. This was evident not only from lost nets, but also from scar marks left by the passage of trawl doors. A number of box cores were taken at this site to assess impacts on biodiversity. There were numerous examples of lost static gear all along the scarp face snagged on corals and other protrusions. These did not in most cases appear to have been dragged but may have been sweep over the ledges by the strong bottom currents in the area.

References

Grehan, A. J., Unnithan, V., Olu, K. and Opderbecke, J. 2003. Fishing impacts on Irish deep-water coral reefs: making the case for coral conservation. In: J. Thomas & P. Barnes (eds) Proceeding from the Symposium on the Effects of Fishing Activities on Benthic Habitats: Linking Geology, Biology, Socioeconomics and Management, American Fisheries Society, Bethesda, Maryland, USA.

"Belgica mounds" – Porcupine Seabight

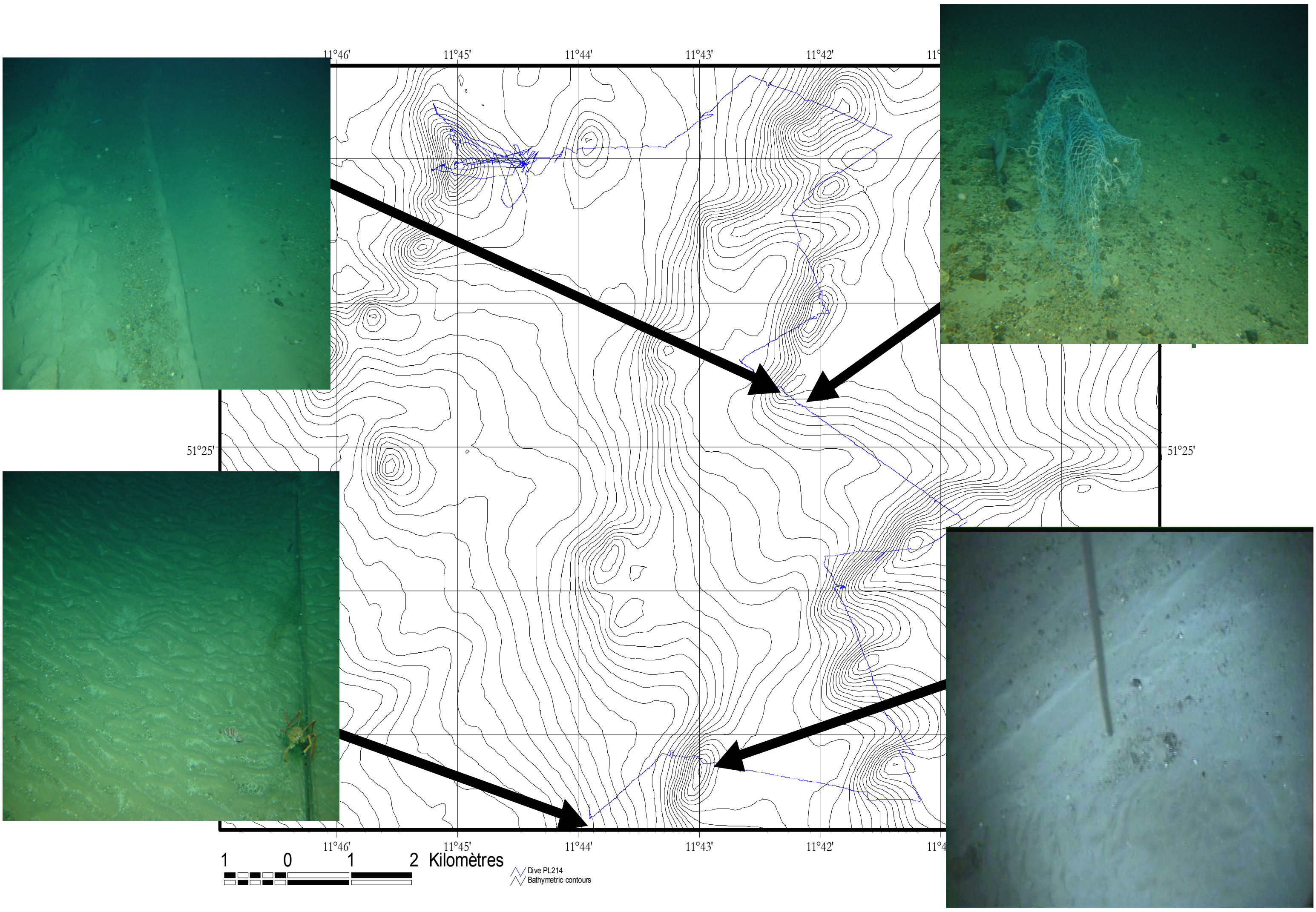

Fig. A4.8.4-1

"Giant mounds" – Porcupine Bank

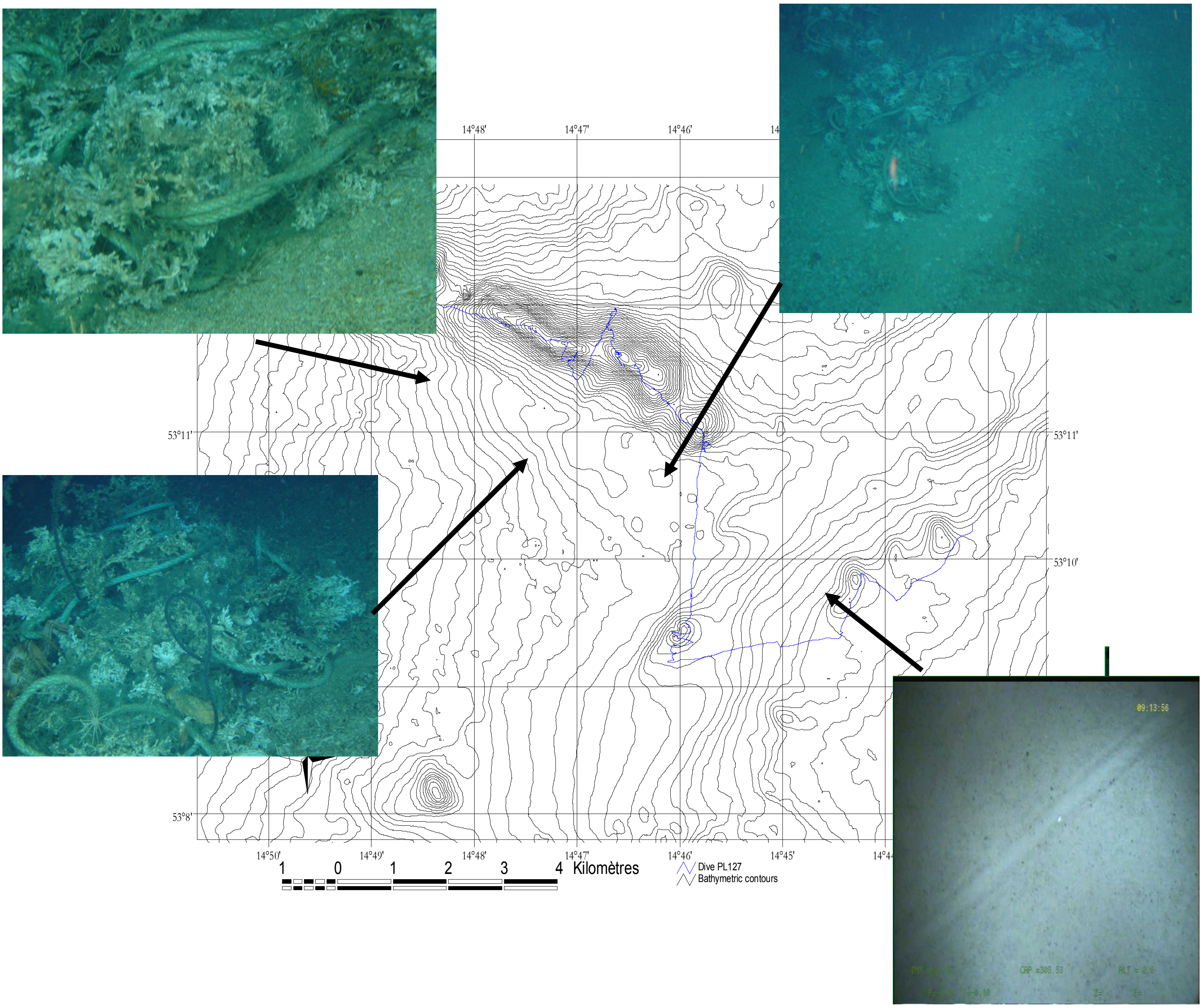

Fig. A4.8.4-2

"Twin mounds" – Porcupine Bank

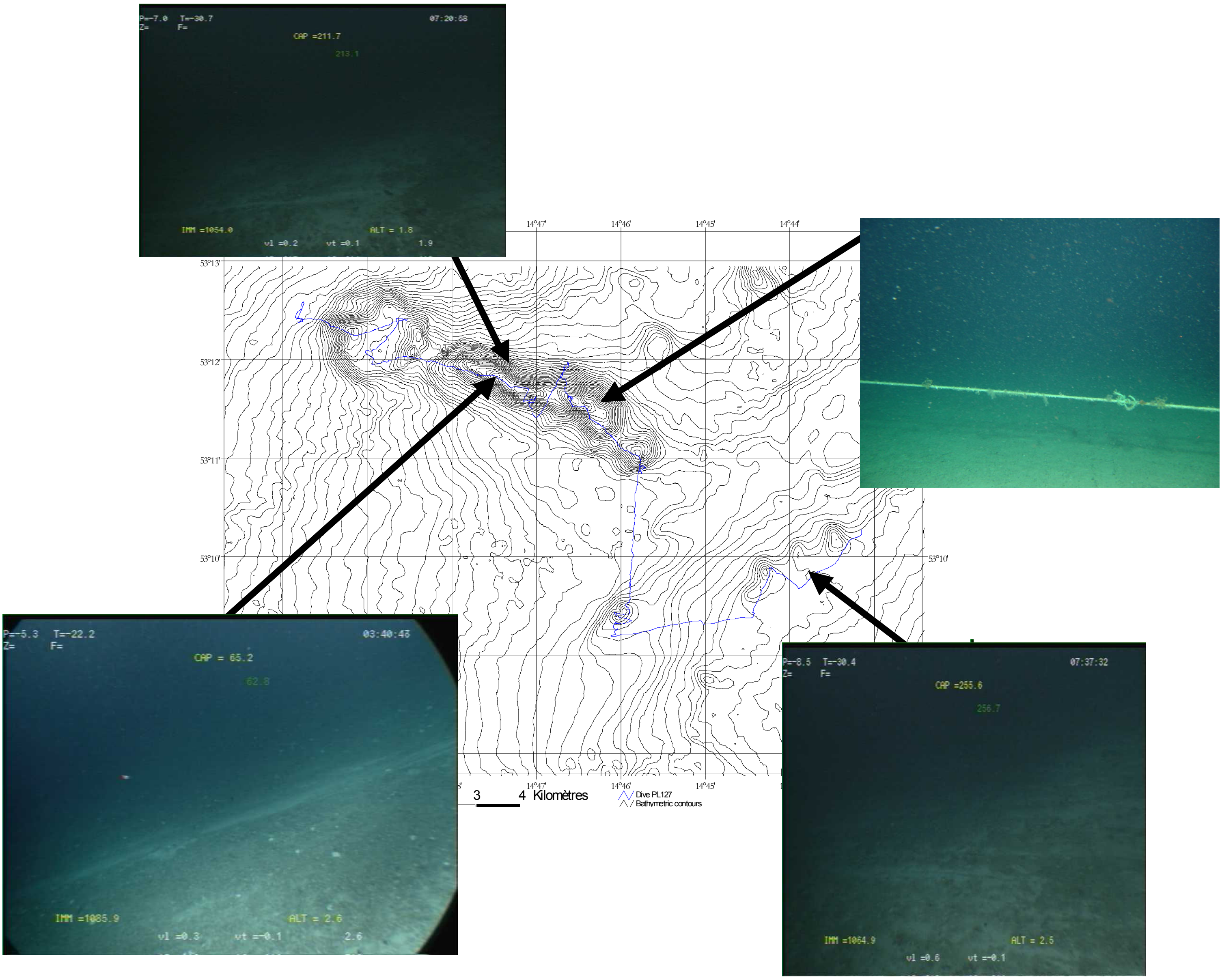

Fig. A4.8.4-3

A. 4.9 Modelling biodiversity patterns and dynamics in coral assemblages: a feasibility study
Gutt, J.

Objective

In the area of investigation, bio-geological long-term processes such as the origin, succession and death of deep-water coral reefs are superimposed by local devastation from commercial trawling. *Lophelia pertusa* colonies and other cold-water corals with carbonate exo-skeleton obviously play a key ecological role since they significantly contribute to the structure of the mound habitats. Consequently, their mechanical destruction seriously effects the entire assemblages. The question that arises from this observation is whether heavily impacted reefs can recover at all, and if so, under which conditions do they recover most successfully. Direct observations of the faunal succession demand long-term monitoring and will consequently yield comprehensive results only after decades. Therefore it should be tested whether a spatially explicit model can help understand major ecological pathways. An additional aspect would be to decipher driving forces behind the naturally patchy occurrence of coral colonies. Two hypotheses need to be investigated. Specific geological structures, e.g. terraces or single scarps generate hydrodynamic turbulences in the nepheloid layer so that plankton communities locally establish, maintain and fuel macrobenthic assemblages. Alternatively, the small-scale near-bottom current at these topographic features provides optimum advection of biogenic food particles, dead or alive, for suspension and plankton feeders. In the same area environmental conditions are less suitable around other hard substrata such as boulders.

Work at sea

All information on ecologically relevant physical parameters provided by the video-transects, should be used to parameterise the disturbance architecture in coral assemblages. Biological variables as well as inter and intra species interactions as well as between animals and their environment can be obtained from detailed biological analyses and from previous work. Single parameters should be modified in the model to evaluate their relevance for the presence of characteristic species or for the coexistence of species leading to specific diversity patterns. A key area to analyse the above mentioned faunal patchiness could be the slope of the "Scarp mounds" at station 217, e.g. between 05:45 and 05:57 or 14:45 and 15:10 hours. Here almost all

corals were alive, relatively abundant and associated with the solitary coral *Desmophyllum* and other cnidarians at the margin of a marked scarp, whilst they were absent in the close neighbourhood on other hard substrata such as dropstones. Several mobile animals such as various life forms of fish, squids, crabs, and shrimps were also present. Macro-zooplanktonic organisms, despite the fact that they cannot be identified in detail, were found in an obvious concentration at station 217 between 14:45 and 15:10 hours during stationary observations. The specimens remained within a small area only a few centimetres above the sediment, close to small-scale cliffs or beneath overhangs excavated by erosion and did not drift constantly and straight through the video image. They consisted of chaetognaths, copepods and gelatinous organisms.
The modelling concept needs to start with a simple simulation. The availability of more data from future expeditions and integration with results from previous cruises will help to target more detailed aspects modifying deep-water coral biodiversity patterns.

A. 4.10 Feasibility study on live ROV video transmission
Tseu, G.

Objective

The object of taking part in this expedition was as part of a research into a project that involve the development of a system to transmit live video from a remotely-operated vehicle (ROV) via satellite (subject to connection delays) to schools (distant learning) in order to bring awareness and to enhance interests in the field of marine sciences. The system used for the tests was the "Polarstern" Inmarsat-B 64 kbps satellite link.
The tests planned were:

1) to determine the speed of the satellite communication link
2) to test the reliability of the satellite link
3) to test the different protocols involved in data transmission
4) to test a video stream

Introduction

The Renard Centre of Marine Geology, University of Gent, Belgium, is carrying out a project to develop a system to transmit live video stream from the field directly to schools and academic institutions in order to promote and enhance interest in Marine Sciences, or simply, distant learning. Communications will be via satellite as this is the only available means currently for such a transmission to be feasible on board a vessel.

This project is on its initial stage hence the requirement to collect as much data on the factors governing such a transmission.

Several tests were already carried out a few weeks earlier on the research vessel Belgica and further testing were planned on this expedition on board the FL Polarstern.

An Overview of Satellite Communication

Satellite communications may be classified into three types, according to their orbits:

1) Geostationary earth orbit – GEO
2) Mid-Eath Orbit – MEO
3) Low Eath Orbit – LEO

GEO satellites are located about 36,000 km in space, with MEO and LEO situated around 10,000 km and less than 1,000 km altitude respectively. Unlike terrestrial transmission, signals transmitted cannot be refreshed along the way in order to maintain the signal integrity hence the transmission system for satellite communication has high power consumption. Systems can only withstand a finite power and excess power will burn a system out. This same fact also applies to satellite transmission systems; therefore, with the lack of signal refresh along the signal path, satellite signals are generally weak when received. This weak signal and the noise that is picked up along the way, degrading the signal even further, and the earlier factors, make satellite link an expensive means of communication and is also generally considered as unreliable.

The development of internet access via terrestrial optical fibre has enabled high data transmission but in the case of satellite communication, access to the internet via satellite is still a relatively new development hence access is still slow as problems have to be overcome. High speed optical transmission by optical fibre has also led to the development of video streaming. However, to perform such an operation via a satellite link will require a need to optimize transmission to overcome the slow speed and weak signals.

Network Setup for Tests

The setup for the network envisaged to perform the tests on this expedition is as shown in Fig. A4.11-1 whereby data packets of known size are transmitted and video streamed from the ship. The results of this are then used to develop an optimized satellite transmission system.

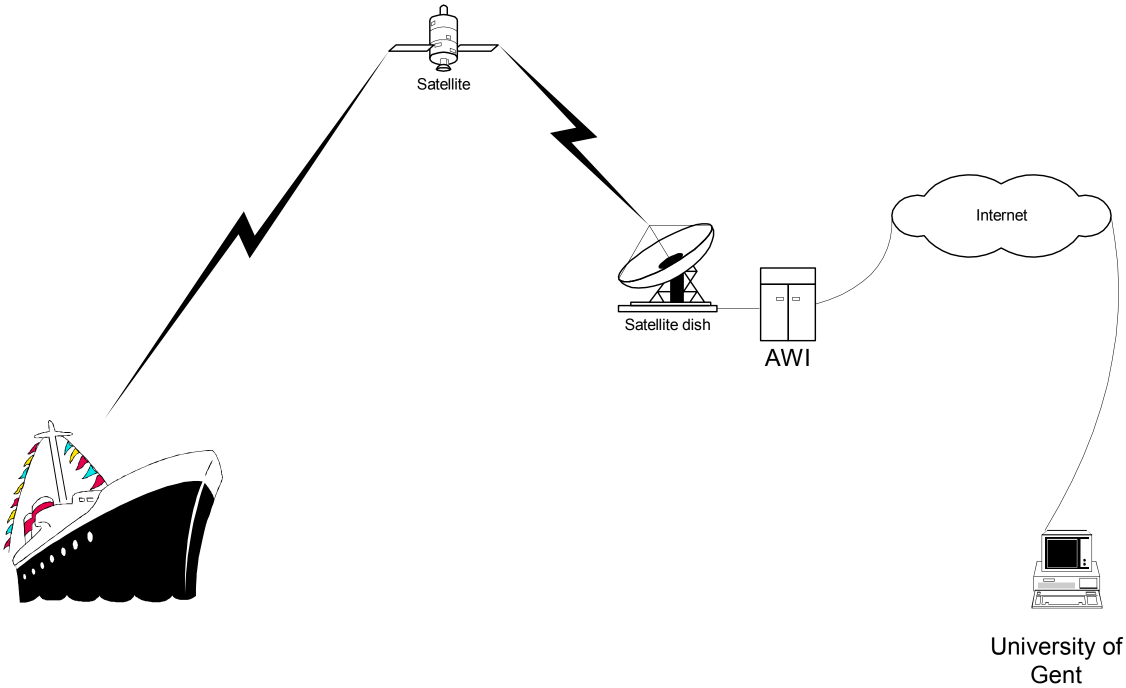

Fig. A4.10-1: Planned Network Setup.

However, the actual network setup was different from the one expected whereby a firewall at the AWI blocks data from accessing the internet (Fig. A4.10-2). This was unforeseen hence the tests were modified.

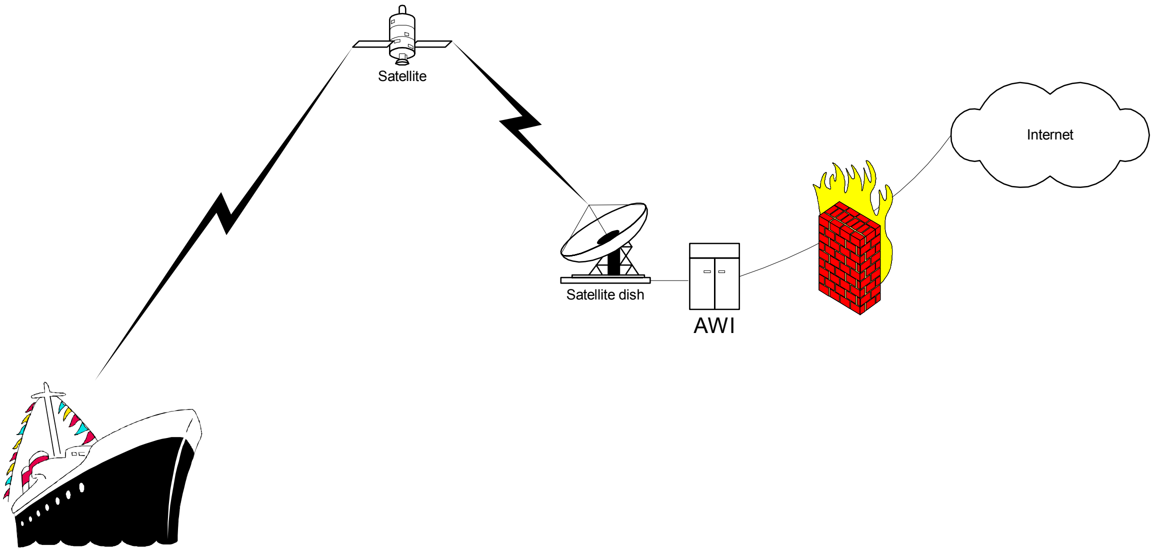

Fig. A4.10-2: Actual Network Setup.

Test and Results

A series of 64 bytes packets were sent to the AWI internet protocol (IP) address in Bremerhaven in order to test the round trip time (RTT) from the RV "Polarstern" research vessel to Bremerhaven and back. The test will also determine the reliability of the satellite link and can also be used as an initial rough guide to the speed of the transmission. The result will not determine the exact speed of the transmission due to the asymmetry in satellite communication links.

The results obtained for the tests showed a RTT of an average of 753 ms with a minimum 753 ms and a maximum time of 758 ms. This worked out at around 680 bps transmission speed, a very slow speed. The results do not concur with the results of earlier tests, therefore further testing are required.

The success rate for the tests was only 43 %, verifying the general acceptance that satellite links are unreliable. However, further tests are again required in different conditions as there are too many factors that may cause a data packet to be dropped.

Conclusion

The tests performed on this expedition have shown that the constraints to the final objective of this project will be the speed and the reliability of the satellite link. These are only initial testings and much more testing is required in order for the project to be realized.

Results from this expedition, together with the results from the earlier campaign, have contributed greatly to the initial test phase.

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B. 1 Cruise leg ARK XIX/3b: An introduction into multidisciplinary investigations on methane fluxes and related processes at the Håkon Mosby Mud Volcano

Boetius, A., de Beer, D., Foucher, J.-P., Kaul, N., Schlüter, M., Witte, U., Usbeck, R. and shipboard scientific party

Mud volcanoes are very interesting habitats, both from the biological and geological perspective. The rising mud and gas represents a window between the deep geosphere and the biosphere, which consists of highly specialized chemosynthetic communities and associated benthic and deep water fauna. If they are active, mud volcanoes, with laterally fast varying properties from the young subsurface muds rising from depth to the stabilized outer rim, can be used as a natural laboratory to test hypotheses on the development on biogeochemical gradients, microbial communities as well as benthic ecosystems. Most often, mud volcanoes are a source of methane, which is emitted to the hydrosphere. With regard to the global climate change, the study of gas seeps at continental margins is an important contribution to our understanding and quantification of the methane cycle. Also, knowledge of how life can be based on methane as energy source is important for our understanding of the evolution of the earth's atmosphere, which was rich in methane and poor in oxygen for the longest time. Hence, the geological, chemical and biological investigation of gas seeps in polar regions and other areas of the world`s ocean is a focus of research at the AWI, carried out in cooperation with several other national and international institutions. IFREMER develops a similar programme that is focussed on mud volcanoes and pockmarks of the Eastern Mediterranean and West-African margins but also includes the HMMV in partnership with the AWI.

Mud volcanoes like the HMMV are present at tectonically active or inactive areas of continental margins. Mud volcano ecosystems can be very similar to those found at hot vents, but they occur independently of volcanic sulfide and heat. At mud volcanoes, sediment pore water, gas and mud is expelled by a deep pressure source forming mounds and crater at the sea floor. Mud volcanoes can be caused by dewatering processes during sediment compaction at continental margins. Some mud volcanoes are situated above gas and petroleum reservoirs buried in the sea floor. They can form at continental slopes above sediments with abnormally high pore pressure produced as a consequence of gravity sliding, an explanation put forward for the formation of the HMMV (Hjelstuen et al., 1999). This pressure instability can be introduced either by a thermal anomaly or a density inversion. Undercompacted sediments buried under younger material, an excess of pore water due to dewatering or destabilizing of gas hydrates could be a source of less dense and incompetent material. Any conduit or other weakness would then trigger a mud volcano.

Mud volcanoes are loci of mud and fluid transport to the seafloor from source sediment layers that may lie at several km depths below the seafloor. Mud eruption is often episodic but fluid emission has been observed to remain active, even in periods of quiescence between two eruption events. The fluid ascending to the seafloor is often enriched in methane. If methane reaches over-saturation in the ascending fluid, gas hydrate (frozen methane) may be formed in conditions of high pressure and low temperature required for gas hydrate stability. These conditions are found in water depths greater than a few hundreds of meters, about 300 m in polar regions. Gas hydrate accumulations are therefore an important component of the fluid flow system operating at mud volcanoes. Large gas hydrate accumulations may form in ascending gas fluxes. Large amounts of free gas (methane) may later be released from dissociated gas hydrate, after mud warming or a decrease in pore pressure.

As major methane seeps, mud volcanoes are often densely populated by tubeworms, clams and other symbiotic organisms – just like hot vents. Hence, chemosynthetic communities, i.e. organisms, which are fuelled by the chemical energy of dissolved minerals, can indicate the presence of active gas seeps. Other indicators of gas seeps at continental margins are carbonate structures and gas plumes in the water column. Only recently the mystery of the link between gas seeps and chemosynthetic organisms has been solved: in gassy sediments a microbial symbiosis has been detected, which is able to consume methane by oxidizing it with sulfate. This symbiosis consists of archaea and bacteria, which can use the abundant sulfate in seawater instead of oxygen. Product of this reaction is sulfide, which is used as energy source by the chemosynthetic organisms (tube worms, clams, giant sulfur bacteria). Hence, in contrast to hot vents, it is not the volcanic energy but methane-consuming microbes which are sustaining large biomasses of chemosynthetic animals. The high microbial activity at cold seeps shapes the geochemistry of the sediment water interface. A variety of redox couples interact such as methane and sulfate, methane and oxygen, sulfide and oxygen, sulfide and nitrate. Sharp gradients in DIC form by the fast respiration of methane. Furthermore, the gassy fluids rising from the deep and their lateral advection leave imprints in the geochemistry of the subsurface sediments. The formation of hydrates within the stability field at cold seeps causes strong deviations from typical continental margin sedimentary properties. A variety of cold seeps are currently studied around the world, but little research has been carried out at high latitudes. This is mainly because only a few structures have been observed so far, and much more exploration is needed to identify active cold seeps in polar systems.

The Håkon Mosby Mud Volcano (Fig. A1-2) was discovered in 1990 by Vogt et al. (1991) during side scan sonar mapping. An expedition in 1995 R/V ″Håkon Mosby", recovered tubeworms, indicating active chemosynthesis, measured very high temperature gradients in the sediments, and recovered methane hydrate from 2 m subbottom depth (Vogt et al. 1997). This was the first indication of an active cold seep and of shallow hydrate recovered in the Nordic Seas. These discoveries led directly to more extensive studies carried out on the Russian vessel "Professor Logachev", and the results were published as a special volume of Geo Marine Letters (Vogt et al. 1999), with papers on hydrates, porewater chemistry, sea-floor geology, seep biota, heat flow, and other topics.

The HMMV site is located at the Norwegian–Barents–Spitsbergen continental margin, which is characterised by major submarine slides, large-scale mass wasting and smaller seafloor features (Vogt et al. 1999). The HMMV is situated in a submarine valley on the Børnøya fan, a large complex composed of glacial sediments, which covers the entire continental slope and reaches a thickness of more than 3 km beneath the mud volcano (Hjelstuen et al., 1999). The presence of free gas deeper than 3 km below the HMMV is indicated by multichannel seismic data (Hjelstuen et al., 1999). The HMMV is about 1 km in diameter and rises up to 10 m above the seafloor, to bottom depths of 1255-1265 m (Vogt et al., 1997). The HMMV is of a concentric structure with highly gas-saturated sediments. In the flat central a zone of grey fluid sediments with a high geothermal gradient (Crane et al., 1997) is surrounded by an area with bacterial mats over gas hydrates. This central region is surrounded by elevated sediment features populated by *Pogonophora* (Pimenov et al., 1999).

Research by the AWI of the HMMV started with an expedition of RV "Jan Mayen" in July 1999 to investigate the gas plume above and the hydrography of the HMMV, which was first described by Egorov et al. (1999). Damm et al. (2003) found a direct methane release into the bottom water in the central zone of the HMMV. Methane included in the subseafloor reservoir and in the plume above the vent have the same carbon isotopic ratios, indicating that the released methane is not microbially oxidized but mixes with the bottom to intermediate waters. In 2001 during an AWI/IFREMER expedition the Håkon Mosby Mud Volcano was investigated for 4 days, using the research vessel "L'Atalante" of the French research institution IFREMER. Main working tool was the unmanned submersible "Victor 6000" (Fig. A3-1). This remotely operated vehicle (ROV) can dive down to 6000 m and is equipped with modern video cameras, two manipulator arms and a variety of sampling devices. Using this tool, different chemotrophic communities were sampled at the mud volcano, to quantitatively investigate their consumption of methane and sulfide. Methane concentrations were measured in high resolution profiles in sediments of the mud volcano and in the water column above. In addition, the multimedia imaging techniques of "Victor 6000" were used for monitoring of the seafloor and the chemosynthetic communities at the mud volcano. The short sampling program showed many interesting results and led to the planning of the present extensive international and multidisciplinary research expedition with R/V "Polarstern" and the ROV "Victor 6000" to take place in 2003.

The main questions of our working program were

1) What is the small-scale morphology of the HMMV and how does it relate to the distribution of benthic communities, gas hydrates and subsurface temperature gradients?
2) What is the origin and extent of the extensive gas plume in the water column above the HMMV?
3) What is the impact of the different benthic communities on the turnover of methane and related elements?
4) Can we identify zones of different biodiversity at the HMMV from microbial communities to fish distribution? What are their causes?
5) Are there other active structures in the vicinity of HMMV?

Working with the ROV "Victor 6000" allowed us to study the geology, geophysics, geochemistry, and biology of the HMMV by *in situ* as well as ex situ targeted sampling approaches. We focused on a North-South transect across the HMMV to investigate the different zones such as the centre, the bacterial mats, and the *Pogonophora* fields. The search for methane emission causing the large plume was successful and 3 bubble sites were identified. In addition, we were able to use a variety of free falling and winch operated instruments for our geochemical and biological investigations, some of which obtained the first *in situ* measurements of methane turnover rates at this polar cold seep. A series of gravity corer deployments resulted in the recovery of 5-6 m long cores with warm gassy fluidised mud from the centre, and gas hydrates from the outer rim of the mud volcano. The first results of all these multidisciplinary measurements are presented in the following chapters.

B. 2 Microbathymetry on ROV "Victor 6000"

Edy, C., Bisquay, H. and shipboard scientific party

This report illustrates the use of the IFREMER CARAIBES software® to process microbathymetry data acquired by multibeam echosounders installed on ROV "Victor 6000" during the cruise ARK XIX/3b onboard R/V "Polarstern".

Multibeam echosounders installed on "Victor 6000"
Two different multibeam, echosounders have been used during dives #221 and #223:

Reson SeaBat 8125

Technichal features:

- frequency: 455 kHz,
- Beam width : 1 x 0,5°,
- 240 beams per ping,
- 7 pings per second,
- swath = 3.5 x depth.

Dive #221:

- survey of 44 hours,
- 980000 pings, 235 millions of soundings.
-

Simrad EM2000

Technichal features:

- frequency: 200 kHz,
- Beam width : 1,5 x 3,5°,
- 111 beams per ping,
- 4 pings per second,
- swath = 6 x depth.

Dive #223:

- survey of 15 hours,
- 170000 pings, 19 millions of soundings.

Microbathymetry data processing

The IFREMER CARAIBES software® have been used to produce bathymetric and reflectivity maps. CARAIBES is a complete line for processing data from various multibeam echosounders and sidescan sonars. It takes raw data acquired by multibeams, allows various corrections (manual editing, motion sensor, tide and navigation corrections) depending of acquisition environment and produces bathymetric digital terrain models (DTM) and reflectivity image mosaics.

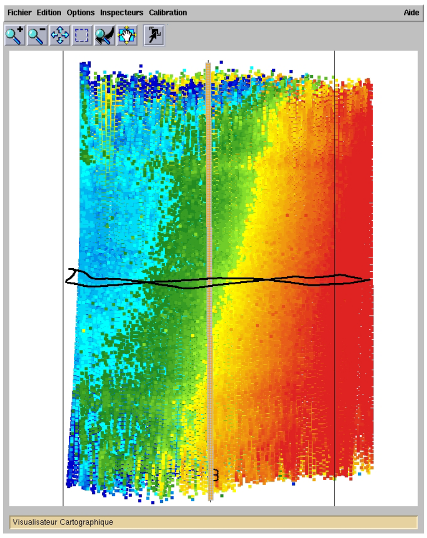
Ping editing

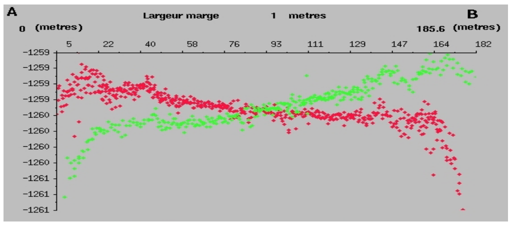
To remove very abnormal values which affect the bathymetric data, Batmul ping editor has been used all over the data sets.
About 0.2% of the soundings have been so manually removed.

Roll calibration

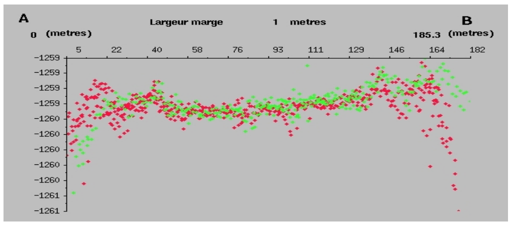
Due to assembling of vertical reference unit (VRU Octans) on "Victor 6000", a roll calibration using the two same profiles surveyed in opposite directions is needed.

For SeaBat 8125, a roll bias of 1.7° and for the EM2000 a roll bias of 0.3° has been assigned.





Raw soundings across two profiles



Calibration profiles

Soundings after roll bias correction

Pitch correction

Due to assembling of the multibeam echosounder on "Victor 6000" and its position with regard to VRU, a pitch correction is needed.

Before pitch correction

After pitch correction

Tide correction

The final goal of microbathymetry is to produce maps given absolute depths with regard a unique reference, respecting the accuracy of the soundings delivered by the multibeam sounders.

All measurements done in real time are relative to sea surface. So, it is needed to correct the bathymetric data from the tide effect which maximum amplitude was about 2.5 meters is Håkon Mosby area during the two "Victor 6000" dives.

Navigation correction

A major problem is due to navigation accuracy which involves bad positionning of geological structures.

A special module (Regina) has been developed specifically to solve this type of problem, with a methodology as followed:

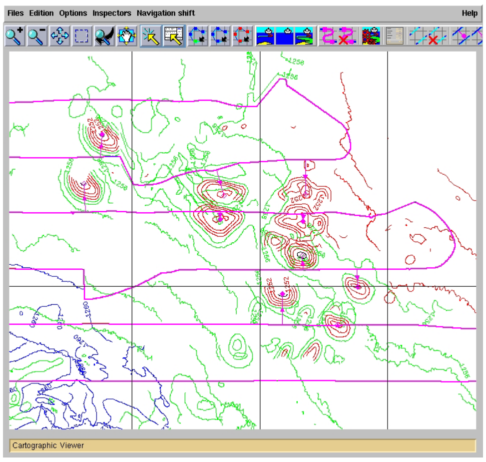
- bathymetry is displayed by contour lines along the ship's track,
- operator visually and manually detects identical geological structures surveyed on different profiles,
- an automatic adjustment of navigation is computed to position the identical structures at the same location.

During "Victor 6000" dives, two navigation modes were used:

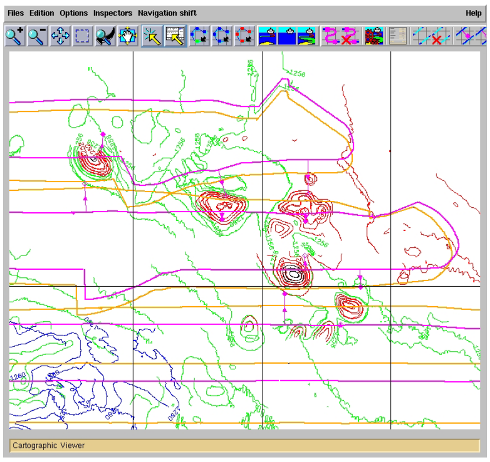
- ultra short base line (USBL POSIDONIA system), used as reference to reset the dead-reckoning in real time,
- dead-reckoning, computed by IFREMER TRIADE system, used to aid the "Victor 6000" navigation in real time and which is the raw navigation for post-processing.

From raw navigation (dead-reckoning), and to adjust dives #221 (SeaBat 8125) and #223 (EM2000) navigations, Regina has been used successively to:

- for SeaBat 8125: move globally dead-reckoning towards USBL,
- for SeaBat 8125, profiles east-west: adjust automatically identical structures surveyed on different profiles toward the same geographic location,
- for SeaBat 8125, profiles north-south: adjust manually these profiles on DTM generated with well adjusted east-west profiles,
- for EM2000: adjust manually these profiles on DTM generated with SeaBat 8125 well adjusted profiles.



Contouring with raw navigation



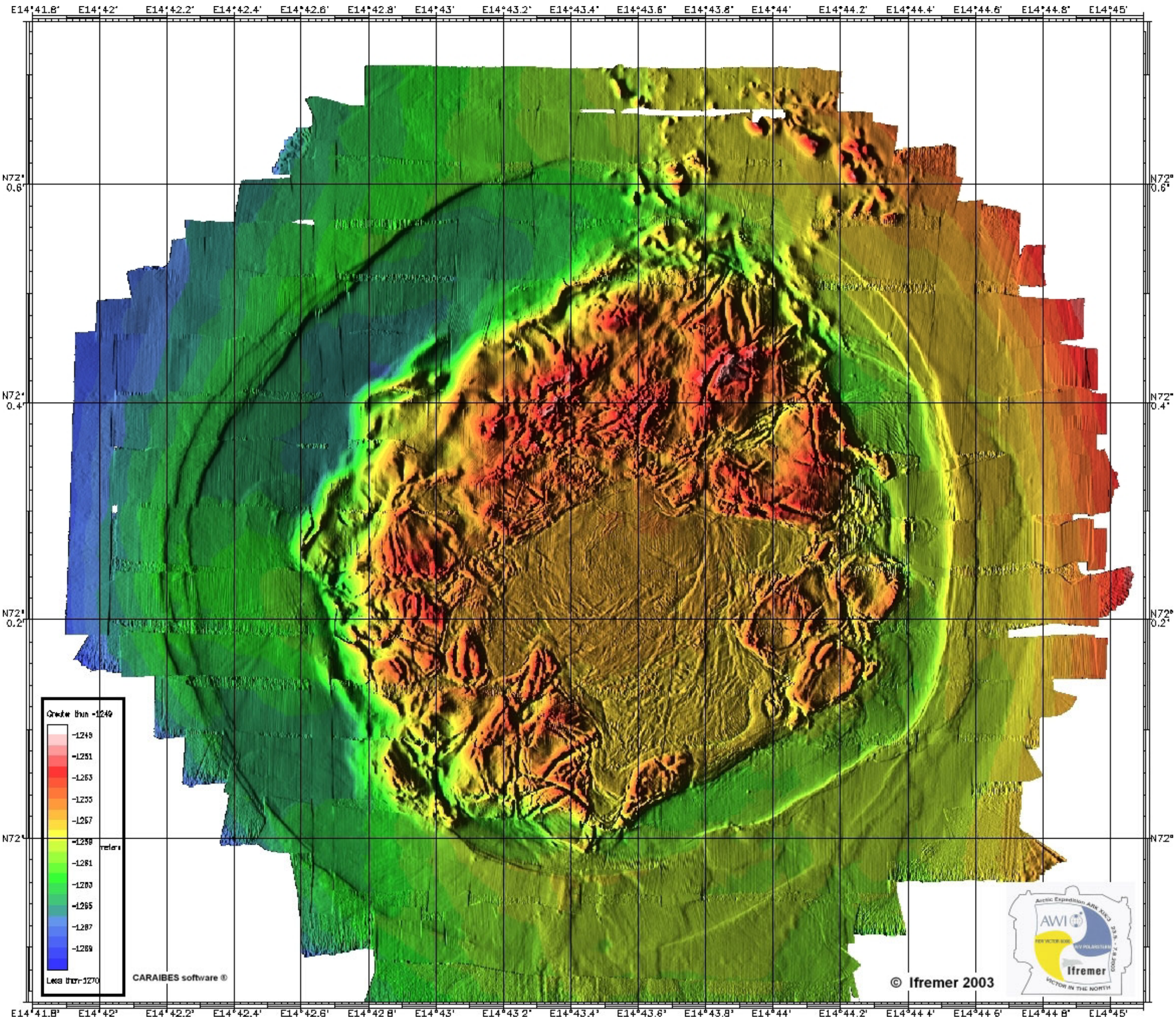
Contouring after navigation adjustment

Maps

Complete area Håkon Mosby Mud Volcano

The map below is the result obtained during ARK XIX/3b cruise, with SeaBat 8125 bathymetric DTM completed with EM2000 data.

Bathymetric DTM grid size is 0.5 meter.



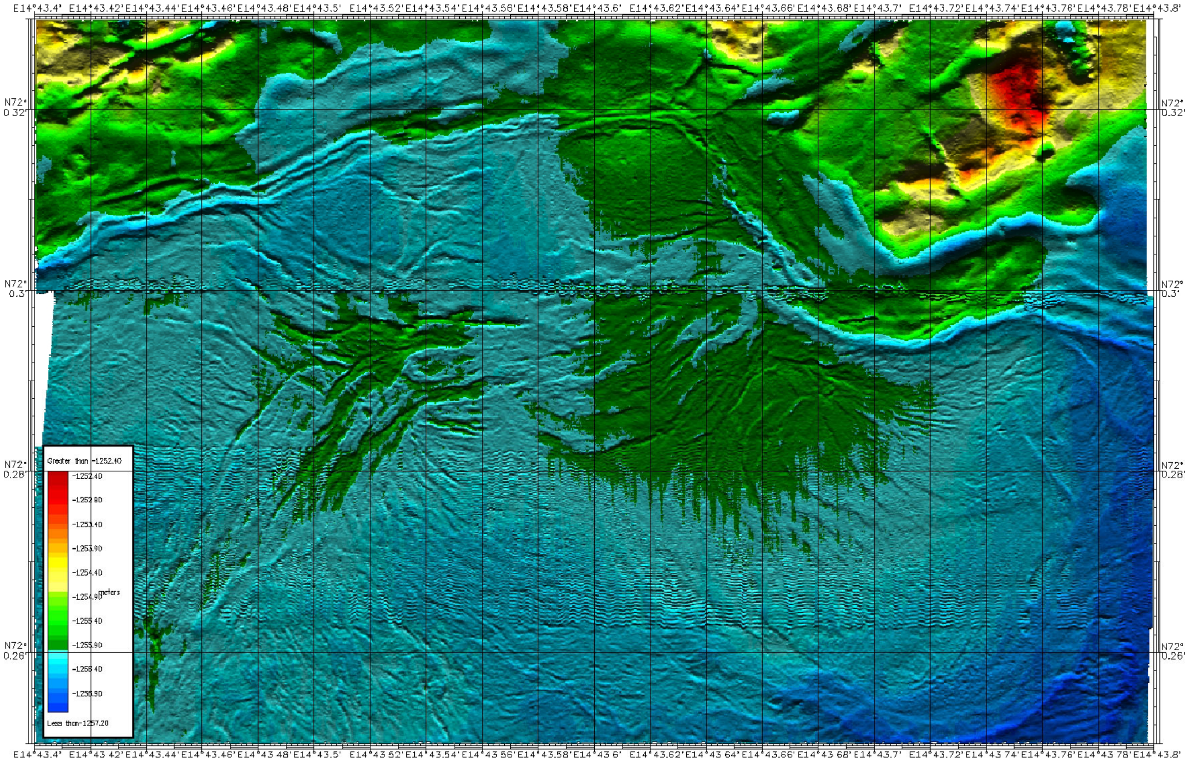
Microbathymetry map (SeaBat 8125 and EM2000) on HMMV area

Zoom on central area

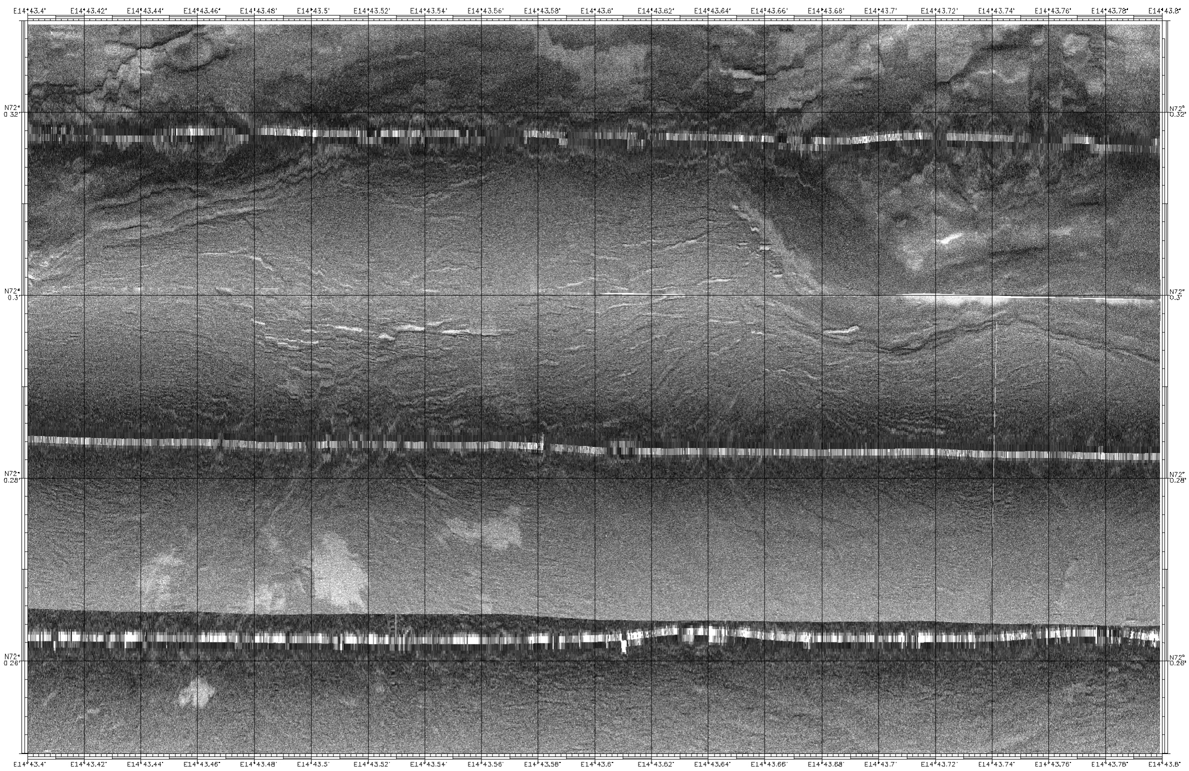
The “central area” is a zone limited in the geographic frame (N72° 0.25 - N72° 0.33 / E14 43.E14° 43.8), in the centre of the mud volcano.

Bathymetric DTM grid size is 0.2 meter.

Reflectivity mosaic pixel size is 0.05 meter.



Microbathymetry with SeaBat 8125



Reflectivity with SeaBat 8125

B. 3 Geochemistry, geophysics and sedimentology of the Håkon Mosby Mud Volcano

B. 3.1 *In-situ* temperature measurements at Håkon Mosby Mud Volcano

B. 3.1.1 Heat probe measurements down to 3 m depth

Kaul, N., Heesemann, B.

During ARK XIX/3b the 3 m long heat probe of the University of Bremen was used to gain a detailed picture of temperatures of the interior of HMMV with reference to its surroundings. The heat probe is of violin bow design and carries 11 Sensors at 30 cm distances from 0.55 to 3.55 m below the weight stand. Thus the results of these measurements are temperature profiles and thermal conductivity determinations between 0.55 and 3.55 mbsf. They are accomplished by shallow and deep penetrating measurements, see below.

A number of 81 penetrations were successful on profiles across HMMV and another 6 on a transect in search of M2. Only one site in the SE sector of HMMV failed due to poor penetration.

In summary, temperature measurements revealed bottom water temperatures of approximately – 0.8 °C at the water-seafloor interface. At a distance larger than 1 km away from the mud volcano, temperature increases with depth by 48 – 65 mK/m, representing a heat flux of 50 – 70 mW/m^2. This can be considered as a regional reference value, as found by other investigators in this area.

Several crossprofiles at HMMV indicate a thermal zonation within the apparent outcrop of the volcano. This zonation is not concentric but NW-SE in direction. In the NW part, we find high temperatures as high as app. 22°C and very high gradients up to 3°C/m. An example of station H0310P08 is given below. The position is in the geometric centre of the volcano. At one position 100 m NW of the centre, temperature gradient does not increase but decreases up- and downwards with a maximum temperature of 25.8°C at app. 2 m depth. We take this as a hint for a fresh and warm mudflow which has not yet cooled to equilibrium. From the centre toward SE surface temperatures become cooler in combination with high vertical gradients. These very high temperature gradients observed within the upper four meters of sediment can not sustain into greater depth for this would give unrealistic high temperatures in shallow depth. Thus we have to consider a warm cap on top of cooler material, which fits into the picture of a recently active mud volcano. From long gravity cores the bending of gradients becomes obvious (see below).

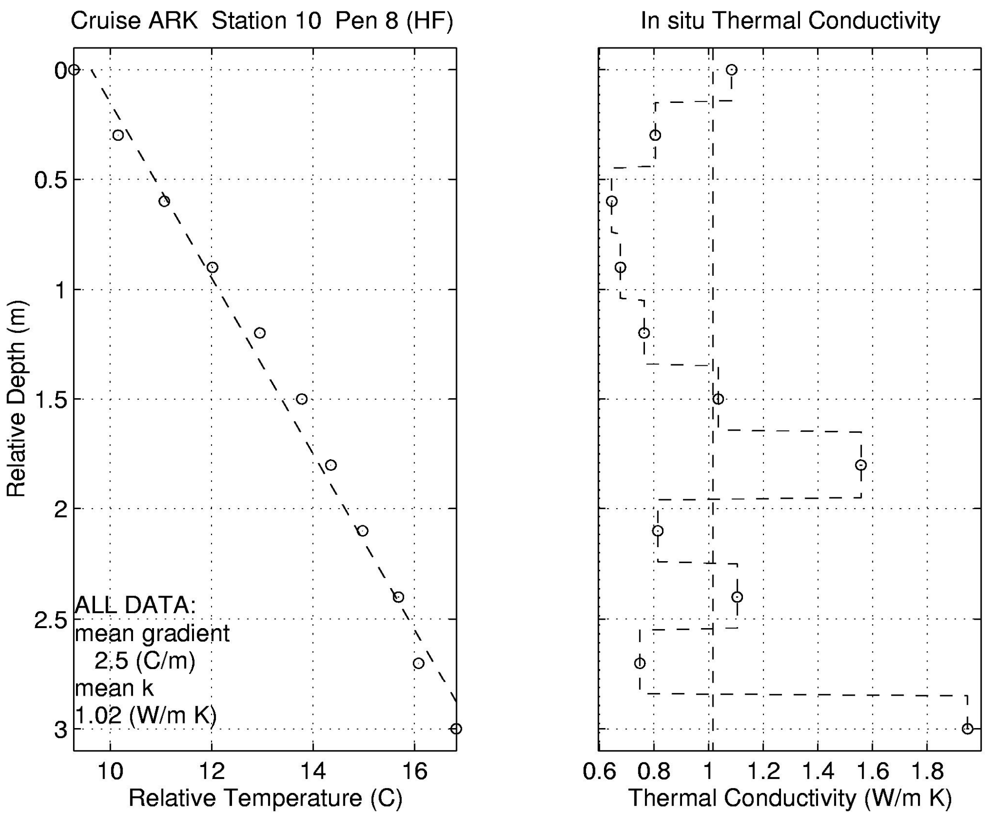


Figure B3.1.1-1: Temperature gradient of centre location is 2.5°C/m, mean thermal conductivity is 1 W/m K. Temperature at shallowest sensor is more than 9°C.

The limit of the volcano is very distinct and associated with a horizontal temperature gradient of app. 10°C per 100 m. Beyond 200 m from the rim of HMMV (i.e. 600 m from the centre) almost no thermal signal of the mud volcano can be detected.

In many cases but not all thermal gradients are not linear but curved in a convex shape. This gives reason to suggest upward convective heat flow by fluid transport of considerable amount.

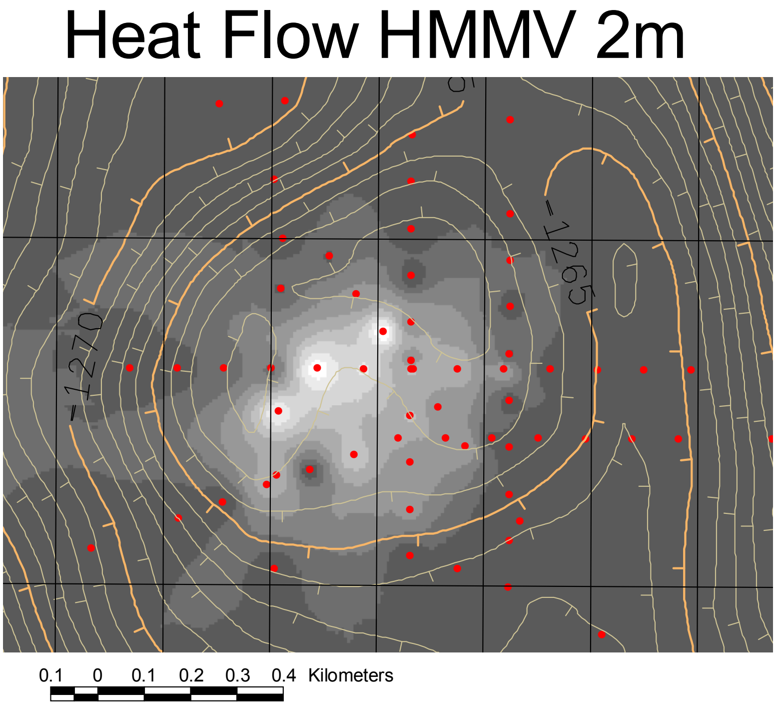


Figure B3.1.1-12: Temperature distribution at 2 m depth sensor. Solid dots indicate data points.

Table B3.1.1-1: Locations and temperatures of 3 m heat probe stations

Lat_dec.	Lon_dec	Name	k	T_0m	PS64/station
14.7064	72.0136	H0310P01	1.11	-0.76	PS64/319-1
14.7115	72.0114	H0310P02	1.11	-0.75	PS64/319-2
14.7167	72.0092	H0310P03	1.11	-0.69	PS64/319-3
14.7201	72.0078	H0310P04	1.40	-0.48	PS64/319-4
14.7235	72.0063	H0310P05	1.08	-0.5	PS64/319-5
14.7252	72.0056	H0310P06	1.08	5	PS64/319-6
14.727	72.0049	H0310P07	1.08	24.5	PS64/319-7
14.7287	72.0042	H0310P08	1.02	11.5	PS64/319-8
14.7304	72.0034	H0310P09	1.07	4.5	PS64/319-9
14.7321	72.0027	H0310P10	1.07	7	PS64/319-10
14.7355	72.0012	H0310P11	1.27	-0.68	PS64/319-11
14.7406	71.9991	H0310P12	1.19	-0.78	PS64/319-12
14.7458	71.9969	H0310P13	1.13	-0.8	PS64/319-13
14.7492	71.9954	H0310P14	1.11	-0.8	PS64/319-14
14.7528	71.9933	H0310P15	1.12	-0.8	PS64/319-15
14.7615	71.9893	H0310P16	1.12	-0.811	PS64/319-16
14.7112	72.0042	H0311P01	1.00	-0.8	PS64/333-1
14.7141	72.0042	H0311P02	1.03	-0.51	PS64/333-2
14.717	72.0042	H0311P03	1.12	0.5	PS64/333-3
14.7199	72.0042	H0311P04	1.18	1.2	PS64/333-4
14.7228	72.0042	H0311P05	1.00	23	PS64/333-5
14.7257	72.0042	H0311P06	1.00	16	PS64/333-6
14.7288	72.0042	H0311P07	1.00	13.6	PS64/333-7
14.7316	72.0042	H0311P08	0.69	10.1	PS64/333-8

Lat_dec.	Lon_dec	Name	k	T_0m	PS64/station
14.7345	72.0042	H0311P09	1.00	8.9	PS64/333-9
14.7374	72.0042	H0311P10	1.15	-0.2	PS64/333-10
14.7403	72.0042	H0311P11	1.00	-0.6	PS64/333-11
14.7432	72.0042	H0311P12	1.34	-0.72	PS64/333-12
14.7461	72.0042	H0311P13	1.16	-0.75	PS64/333-13
14.7287	72.0087	H0312P01	1.16	-0.5	PS64/333-14
14.7287	72.0078	H0312P02	1.11	-0.2	PS64/333-15
14.7287	72.0069	H0312P03	1.22	-0.8	PS64/333-16
14.7287	72.006	H0312P04	1.7	-0.8	PS64/333-17
14.7287	72.0051	H0312P05	0.73	4.5	PS64/333-18
14.7287	72.0043	H0312P06	1.19	2.5	PS64/333-19
14.7287	72.0033	H0312P07	1.10	10	PS64/333-20
14.7287	72.0024	H0312P08	0.99	4	PS64/333-21
14.7287	72.0015	H0312P09	1.13	5	PS64/333-22
14.7287	72.0006	H0312P10	1.11	-0.5	PS64/333-23
14.7217	72.0255	H0313P01	1.1	-0.79	PS64/343-1
14.7216	72.0237	H0313P02	1.1	-0.78	PS64/343-2
14.7215	72.0219	H0313P03	1.09	-0.78	PS64/343-3
14.7213	72.0201	H0313P04	1.1	-0.77	PS64/343-4
14.7212	72.0183	H0313P05	1.09	-0.78	PS64/343-5
14.7211	72.0165	H0313P06	1.1	-0.77	PS64/343-6
14.721	72.0147	H0313P07	1.13	-0.75	PS64/343-7
14.721	72.0129	H0313P08	1.15	-0.72	PS64/343-8
14.7209	72.0111	H0313P09	1.1	-0.7	PS64/343-9
14.7208	72.0093	H0313P10	1.1	-0.65	PS64/343-10
14.7206	72.0067	H0313P11	1.1	-0.3	PS64/343-11
14.7205	72.0057	H0313P12	1.06	-0.8	PS64/343-12
14.7204	72.0033	H0313P13	1.1	17	PS64/343-13
14.7203	72.0021	H0313P14	1.1	7	PS64/343-14
14.7202	72.0003	H0313P15	1.22	-0.6	PS64/343-15
14.7201	71.9985	H0313P16	1.30	-0.73	PS64/343-16
14.72	71.9967	H0313P17	1.32	-0.75	PS64/343-17
14.7199	71.9949	H0313P18	1.1	-0.76	PS64/343-18
14.7198	71.9931	H0313P19	1.1	-0.77	PS64/343-19
14.7142	72.0013	H0314P01	1.34	-0.74	PS64/361-1
14.7088	72.0007	H0314P02	1.1	-0.6	PS64/361-2
14.717	72.0016	H0314P03	1.22	-0.6	PS64/361-3
14.7197	72.0019	H0314P04	1.1	9	PS64/361-4
14.7224	72.0022	H0314P05	1.21	-0.51	PS64/361-5
14.7252	72.0025	H0314P06	0.95	13	PS64/361-6
14.7279	72.0028	H0314P07	1.17	8	PS64/361-7
14.7308	72.0028	H0314P08	1.30	7.9	PS64/361-8
14.7337	72.0028	H0314P09	1.09	-0.2	PS64/361-9
14.7366	72.0028	H0314P10	1.13	-0.7	PS64/361-10
14.7396	72.0028	H0314P11	1.23	-0.6	PS64/361-11
14.7425	72.0028	H0314P12	1.3	-0.7	PS64/361-12
14.7454	72.0028	H0314P13	1.22	-0.72	PS64/361-13
14.7512	72.0028	H0314P14	1.10	-0.76	PS64/361-14
14.7348	71.9964	H0315P01	1.16	-0.74	PS64/361-15
14.7348	71.9982	H0315P02	1.25	-0.74	PS64/361-16
14.7348	72	H0315P03	1.34	-0.71	PS64/361-17
14.7348	72.0009	H0315P04	1.15	-0.71	PS64/361-18
14.7348	72.0018	H0315P05	1.27	-0.6	PS64/361-19
14.7348	72.0027	H0315P06	1.23	-0.6	PS64/361-20
14.7348	72.0036	H0315P07	1.20	-0.3	PS64/361-21
14.7348	72.0045	H0315P08	1.14	0.2	PS64/361-22
14.7348	72.0054	H0315P09	1.1	0.0	PS64/361-23

Lat_dec.	Lon_dec	Name	k	T_0m	PS64/station
14.7359	72.0059	H0315P10	na	na	PS64/361-24
14.7348	72.0072	H0315P11	1.1	-0.2	PS64/361-25
14.7348	72.009	H0315P12	1.2	-0.76	PS64/361-26
14.7317	72.0003	H0316P01	1.32	-0.61	PS64/369-1
14.7479	71.9929	H0316P02	1.12	-0.79	PS64/369-2
14.7642	71.9854	H0316P03	1.1	-0.8	PS64/369-3
14.7804	71.978	H0316P04	1.36	-0.81	PS64/369-4
14.7966	71.9705	H0316P05	1.1	-0.8	PS64/369-5
14.8129	71.963	H0316P06	1.2	-0.79	PS64/369-6
14.8291	71.9556	H0316P07	1.1	-0.77	PS64/369-7
14.8453	71.9481	H0316P08	1.23	-0.79	PS64/369-8
13.4328	71.7018	H0317P01	1.21	-0.79	PS/64/389-1
13.4333	71.7000	H0317P02	1.21	-0.78	PS/64/389-1
13.4340	71.6982	H0317P03	1.1	-0.78	PS/64/389-1
13.4353	71.6946	H0317P04	1.1	-0.8	PS/64/389-1
13.4527	71.6589	H0317P05	1.14	-0.83	PS/64/389-2
13.4489	71.6571	H0317P06	1.15	-0.81	PS/64/389-2

B. 3.1.2 Shallow measurements with mini temperature lance
Foucher, J.-P., Kaul, N.

The ROV "Victor 6000" gave the opportunity to measure temperatures at the water-sediment boundary very accurately under controlled conditions. The manipulator arm of "Victor 6000" can place a temperature sensor at a known position. Therefore a miniature temperature lance was prepared, which consisted of two autonomous temperature loggers, fixed to a 0.8 m long rod (see Figure B3.1.2-1).

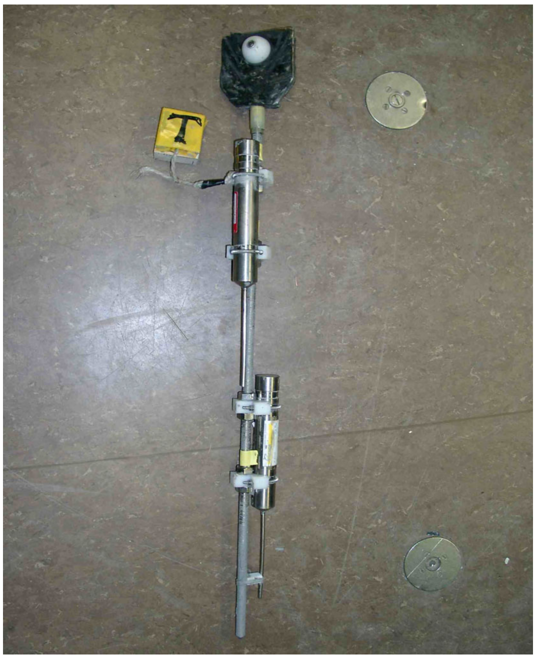


Figure B3.1.2-1: Mini temperature lance with two mounted temperature loggers. The instrument can be easily pushed into the sediment by the manipulator arm of "Victor 6000".

One N-S profile was sampled at a spacing of 50 m. The result is a set of two temperature curves at 0.25 and 0.55 mbsf. Only one site near the centre of HMMV shows significantly increased values, at 100 m distance, temperature values are almost background values (figure B3.1.2-2).

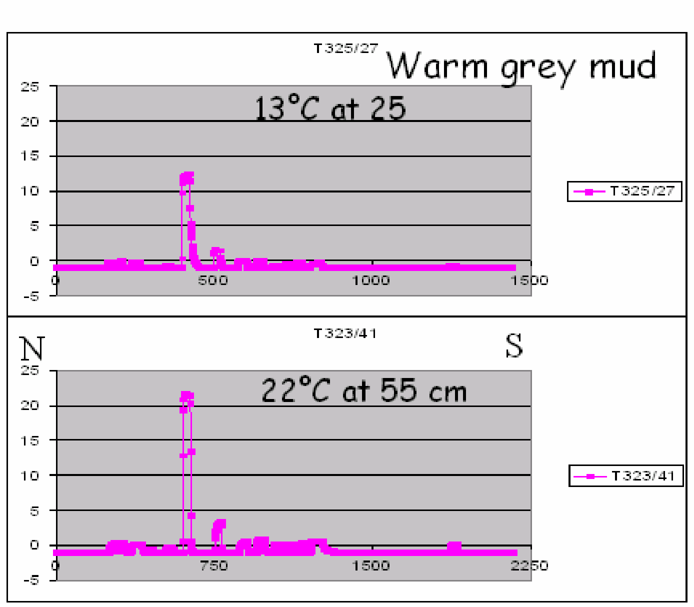


Figure B3.3-2: Temperature profile of a N-S profile across the centre of HMMV. Horizontal axis is a continuous time scale and vertical temperature excursions represent station time in the sediment.

B. 3.1.3 Temperature measurements with long gravity corers

Foucher, J.-P., Kaul, N.

On several gravity corer stations the tool is equipped with autonomous temperature loggers to gain temperature information from greater depth, i.e. down to 10 or more m below sea floor. From technical consideration, we chose a setting of a 10 m long core barrel with 9 or 10 loggers attached to it at a spacing of 0.88 or 1 m, respectively. Nine gravity corers were equipped with loggers and six of them gave successful readings (for locations, see figure B3.1.3-1, below). We think that failed penetrations are due to gas hydrates. On the other hand the centre of the mud volcano yielded “over-penetration”, i.e. the instrument penetrated completely and the overall penetration depth had to be reconstructed from mud line marks on the deep sea cable. In summary we got 6 temperature-depth profiles, covering depth intervals from almost 0 to 16 mbsf (see figure B3.1.3-2).

Temperature / Gravity Corer

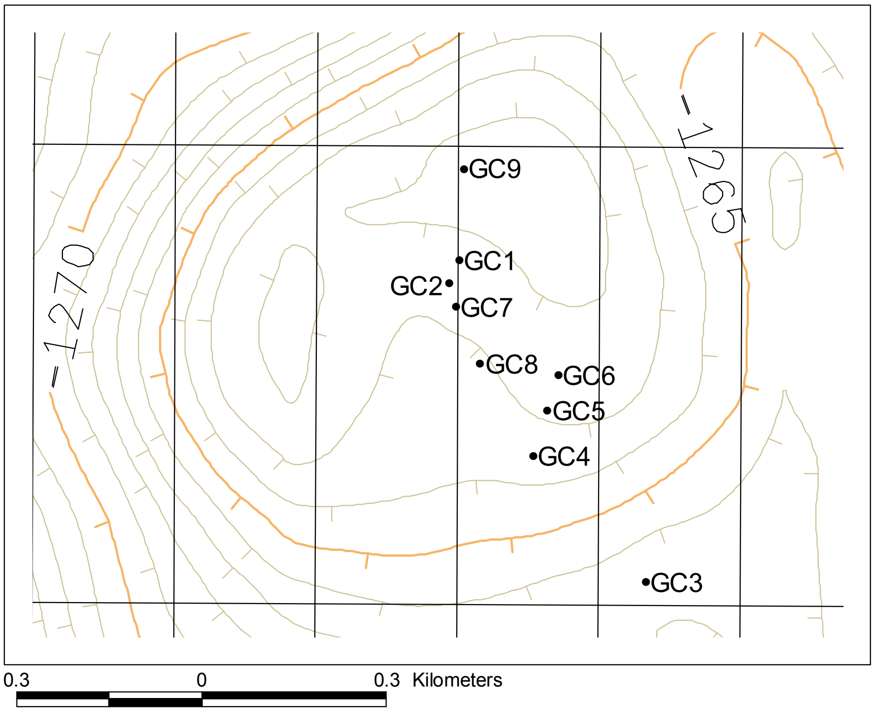


Figure B3.1.3-1: Locations of gravity corers, equipped with temperature loggers.

As a preliminary result from deep penetrating temperature measurements, we have the observation that temperatures do not increase steadily with depth but tend to level out near a temperature maximum.

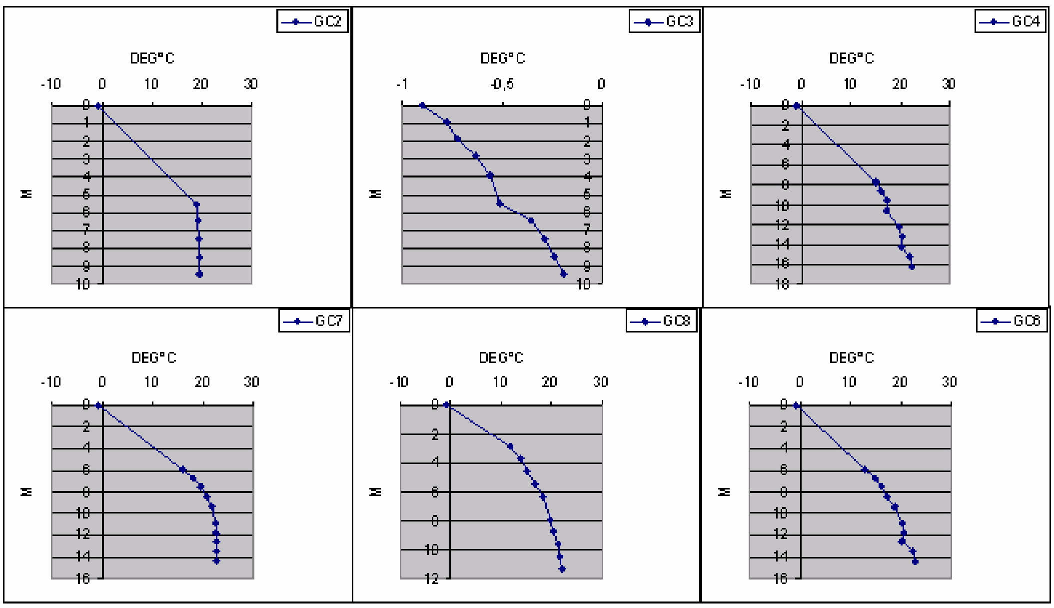


Figure B3.1.3-2: Six deep penetrating temperature depth profiles down to 16 mbsf.

This maximum differs from location to location but we never find temperatures above 25°C. This verifies the hypothesis that very high surface gradients cannot sustain into greater depth.
It is remarkable to find a horizontal temperature gradient of almost 20°C over 300 m horizontal distance at 10 mbsf between GC3 and GC4.

B. 3.2 Physical properties of gravity cores

Usbeck, R., Rogenhagen, J.

The physical properties of sediment cores (gravity cores only) were measured using a GEOTEK ‚MultiSensorCoreLogger' (MSCL). P-wave travel times, magnetic susceptibility, and γ-absorption were measured simultaneously with control measurements of core diameter and temperature. From these data, the physical properties density, magnetic susceptibility, fractional porosity, P-wave velocity, and impedance can be calculated. The technical description of the system is given in Table B3.2-1.
Because of the high gas content (and sometimes, hydrate) of the cores, the logging had to be performed right after retrieval at low temperatures. Therefore, the logging instrument was set up in a reefer at 4-6°C and the cores were logged from bottom to top. After logging, the cores were brought back to the working deck for opening and further processing. Doing so, the time used for the whole procedure from retrieval of the cores to opening could be kept shorter than one hour.

Summary of results

As the sediments of Håkon Mosby are partly very warm right beneath the surface, the measurements could not be performed at constant conditions with respect to both, sediment temperatures and instrument temperatures.

Table B3.2-1: Technical specifications of the GEOTEK MSCL14

P-wave velocity and core diameter	
Plate-transducer diameter:	4 cm
Transmitter pulse frequency:	500 kHz
Pulse repetition rate:	1 kHz
Received pulse resolution:	50 ns
Gate:	2800
Delay:	10 µs
P-wave travel time offset:	7.49 µs
(SL, 2*2.5 mm liner thickness, measured at 6°C)	
Density	
Gamma ray source:	Cs-137
Activity:	356 MBq
Energy:	0.662 MeV
Collimator diameter:	5.0 mm (SL)
Gamma detector: Gammasearch2,	
Model SD302D, Ser. Nr. 3043 , John Caunt Scientific Ltd., 10 s counting time	
Fractional porosity	
Mineral grain density =	2.75
water density =	1.026
Magnetic susceptibility	
Loop sensor: BARTINGTON MS-2C, Ser. Nr. 208	
Loop sensor diameter:	14 cm
Alternating field frequency:	565 Hz,
counting time	10 s
precision	$0.1 * 10^{-5}$ (SI)
Magnetic field intensity:	ca. 80 A/m RMS
Krel:	1.56 (SL, 12 cm core-ø), 0.69
Loop sensor correction coefficient:	6.391 (SL) for 10^{-6} (SI)

Therefore, care has to be taken when interpreting absolute numbers of all parameters measured. Altogether, 33m of sediment cores have been retrieved. Table B3.2-2 summarizes positions and retrievals for all cores and Figure B3.2-1 shows the core positions at Håkon Mosby.

Temperature:

All cores except PS64/336 (the 'cold' core outside the centre of Håkon Mosby) had low temperatures around 2-4°C in the upper approx. 1.5m. For the longer cores, temperatures were increasing to about 15°C at about 3 m subbottom depth.

Table B3.2-2: Gravity cores taken during ARKXIX/3b

Station	Position Lat	Position Lon	Depth [m]	Retrieval [cm]	Comment
PS64/330	72° 0.30' N	14° 43.60' E	1287	154	Gas hydrates, "banana"
PS64/332	72° 0.28' N	14° 43.57' E	1288	481	No hydrate, warm at depths > 1.5m, centre
PS64/336	72° 0.02' N	14° 44.13' E	1286	458	Gas hydrates, *Pogonophora*
PS64/339	72° 0.13' N	14° 43.81' E	1284	502	Archive, warm at depths > 1.5m, centre
PS64/341	72° 0.17' N	14° 43.85' E	1285	114	Gas hydrates, *Pogonophora*, "banana", not logged
PS64/371	72° 0.20' N	14° 43.88' E	1289	485	Gas hydrates, location of bacterial mats, warm at depths > 1.5m
PS64/372	72° 0.26' N	14° 43.59' E	1288	474	No hydrates, warm at depths > 1.5m, centre
PS64/373	72° 0.21' N	14° 43.66' E	1288	465	Hydrates at surface, warm at depths > 1.5m, centre
PS64/374	72° 0.38' N	14° 43.61' E	1286	166	Location of bubble site, Gas hydrates

Density:

Calculated densities of the cores varied from zero (due to cavities produced by evaporating hydrates) to about 1.8 g/cm^3 at the very surface. The longer cores except PS64/336 showed quite constant densities between 1.2 and 1.4 g/cm^3 for the upper approx. 3m. Below, cavities from dissociated gas hydrates lead to lower densities down to zero. The 'cold core' PS64/336 had densities of around 1.5 g/cm^3 indicating lower gas content. The short cores have high densities at the surface (up to 1.8 g/cm^3) rapidly decreasing with depth due to gas hydrates.

Sound velocity:

As the cores all contained gas, the signal amplitude was generally very low and often zero. Interpretation of these data with respect to travelling times (and thus, sound velocities) is critical. However, travelling times for all cores were estimated to be between 1000 and 1300 m/s for the longer cores. The Short cores (< 2m) and the 'cold core' showed the same low velocities at depth but at the very top, where good acoustic coupling was present, sound velocities reached 1700 m/s.

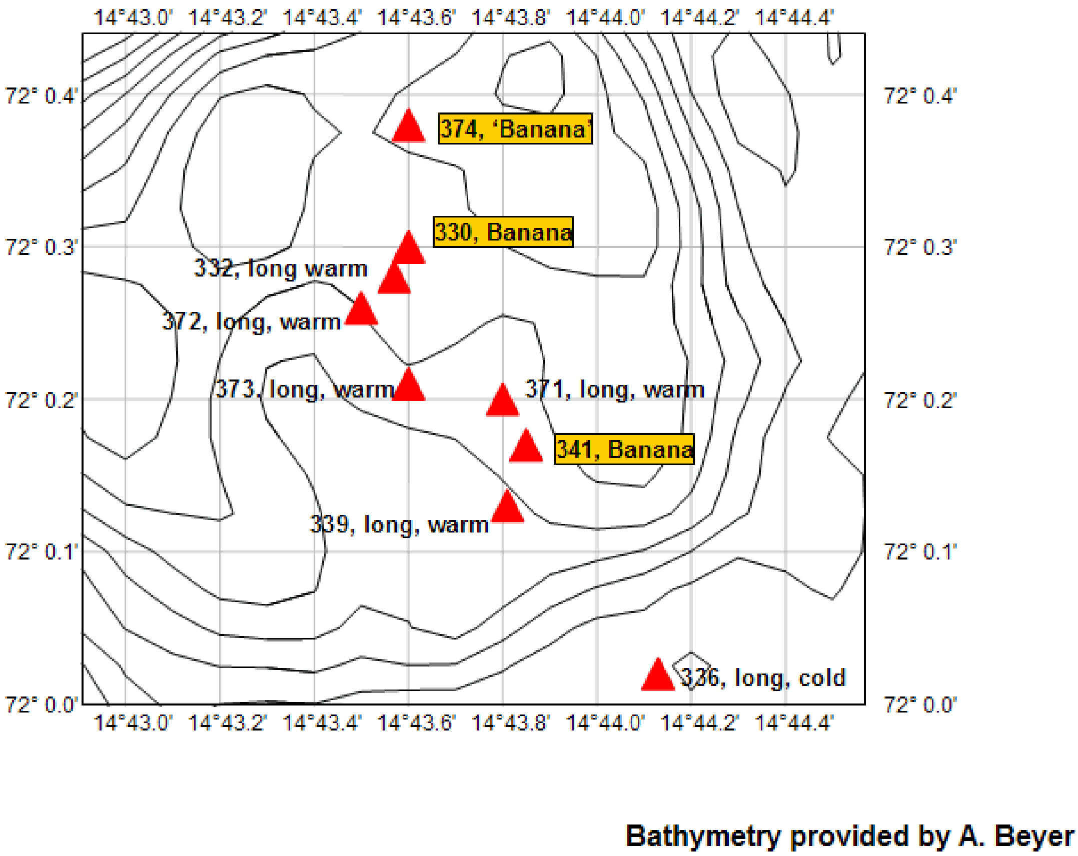


Fig. B3.2-1: Triangles indicate the positions where gravity cores were taken.

Susceptibility:

Susceptibility (10^{-6} SI) was quite homogeneous ranging between 100 and 200 in most of the cores at all depths. The 'cold core' has two layers of enhanced susceptibility of about 300 at approx. 0.7 and 4.4m depth. The core PS64/371 shows enhanced susceptibilities in the upper 30 cm reaching values of 440.

B. 3.3 PARASOUND sediment echosounding

Rogenhagen, J., Usbeck, R.

One of the fixed sensor installations onboard the “Polarstern” is the sediment echosounder PARASOUND (Krupp Atlas Electronics, Bremen). The system provides digital, high resolution information on the sediment coverage and the internal structure of the sediments.

For this purpose the echosounder uses the so-called parametric effect: PARASOUND radiates two primary frequencies in the kilohertz range that generate a secondary pulse of lower frequency, which provides the signal. The secondary frequency can be chosen between 2.5 and 5.5 kHz and is adjusted by varying the variable primary frequency from 20.5-23.5 kHz while the other is fixed to 18 kHz. Due to its low secondary frequency and a small emitting angle of 4 degrees PARASOUND achieves high resolution of the sediment structures and penetrating depths of around 100 meters.

The reflected signals of the subbottom sediments are displayed on a digital thermal printer (Atlas DESO 25). Data recording is done by a PC-based software (PARADIGMA) that digitises the signal. Finally, data is stored on hard disks for further processing. Furthermore, two printers are installed with the system, to give a tabular printout of the recording parameters and a coloured online profile.

The secondary frequency of the sediment echosounder during the cruise had been 4 kHz with a recording length of mostly 133 ms (that corresponds to a depth range of 100 m assuming sound velocity of water). Mainly good weather conditions with calm seas provided excellent measuring conditions. The echosounding system itself worked properly and without any break downs. In total, the PARASOUND system operated for about 280 hours and approx. 5 GB of data were recorded and stored on CD-ROM. The data had been edited, postprocessed and visualized. The complete dataset will be submitted and incorporated in the PANGAEA Database hosted by the AWI (see examples of the visualization in Figs. B3.3-1 and B3.3-2)

The PARASOUND system has been in use in the small scale investigations in the area of the Håkon Mosby Mud Volcano, some profiles were measured while transferring between working areas. The data will provide important preconditions for the three dimensional correlation of profiles and the sediment cores that are taken on that profiles.

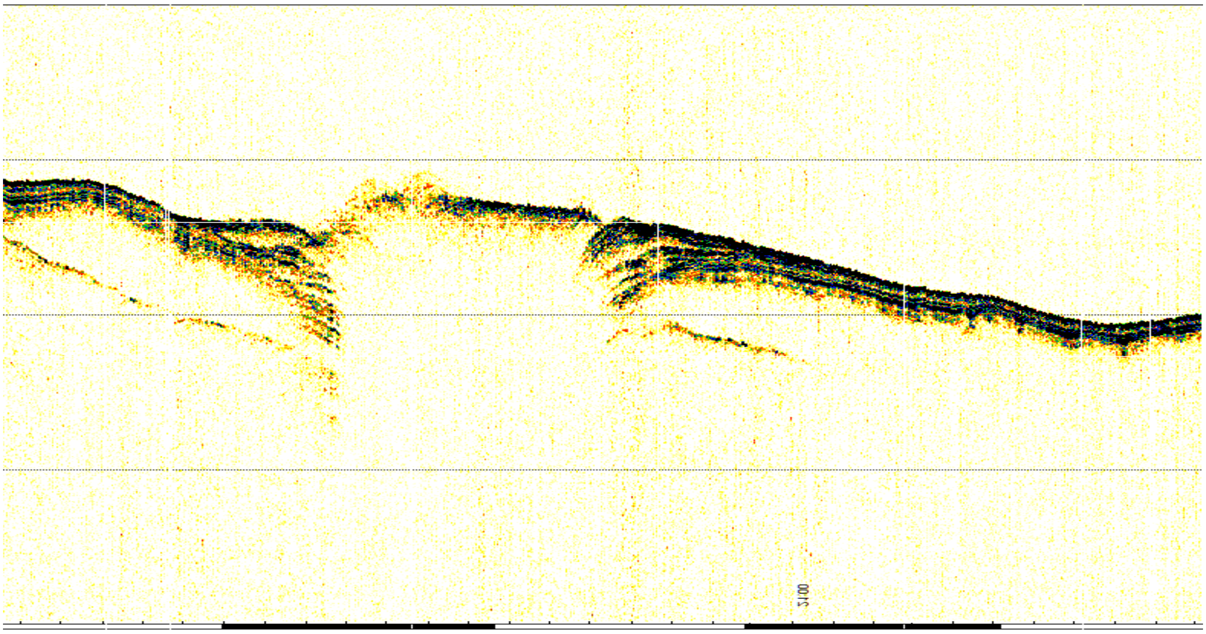


Fig. B3.3-1: Display of a 4 km long profile crossing the Mud Volcano from north to south. In the centre, almost no penetration is achieved. Here, high gas content of the sediments leads to a blanking of the signal and only the uppermost part of the Mud Volcano is visible. North and south of the central part, the signal penetration rises to around 30 m and a stack of sedimentary layers is displayed in good resolution. They build up a circular rim of the Mud Volcano and are probably formed by sediments emerging as mud flows from the volcano.

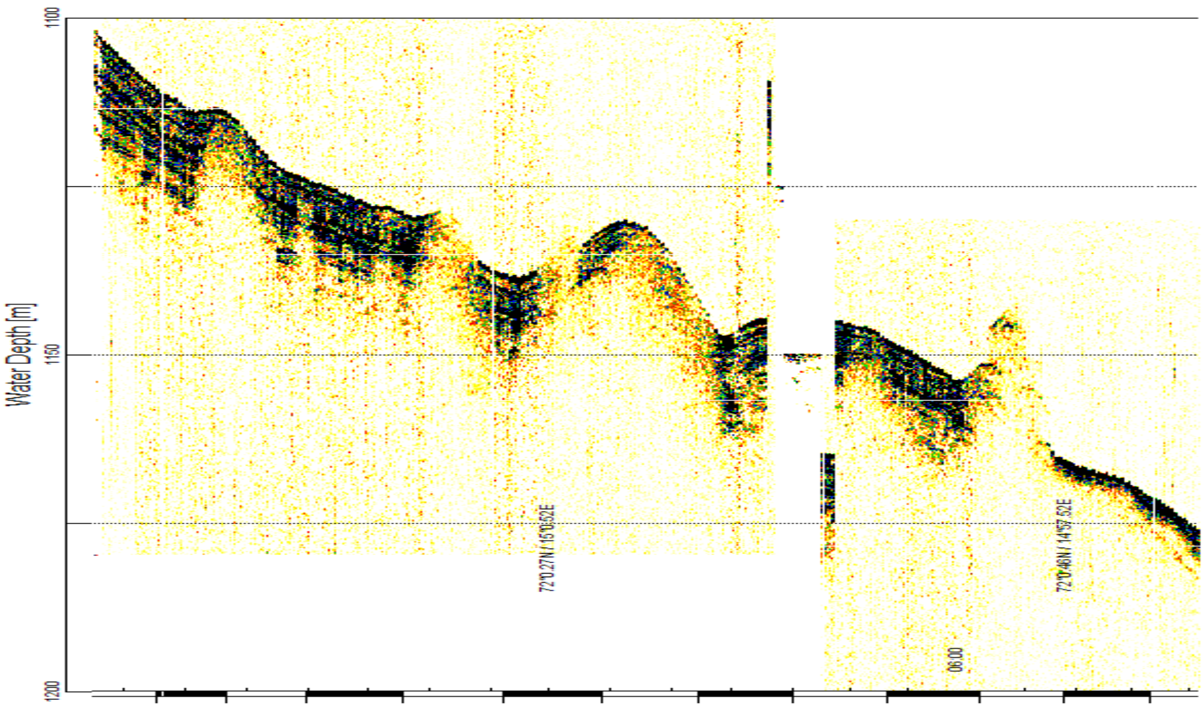


Fig. B3.3-2: Example of a profile in the vicinity of the Mud Volcano. Here, along the continental margin some small scale features were detected, that are of the same dimension as the Mud Volcano and also show partly blanking of the deeper interior. From echosounding it is known that at these locations there is no gas plume in the water column, so these structures might be sediment diapirs or former and non-active mud volcanoes and need further investigations.

Besides a general charting of sediment characteristics along the Mud Volcano, the PARASOUND data will give information on the classification and interpretation of sediment types. The sediment echo sounding of cruise ARK XIX/3b has been performed for the AWI geochemistry working group.

B. 3.4 Marine Geology

Kukina, N.

During the scientific expedition ARKXIX/3b 12 geological stations were carried out in the Håkon Mosby Mud Volcano area (Tab. B3.4-1) in the framework of the project described herein. More than 40 samples of bottom sediments were taken for future investigation at the Murmansk Marine Biological Institute (MMBI) of the Russian Academy of Science. Sedimentological investigations included granulometry, mineralogical analysis and morphology of quartz grain.

Tab. B3.4-1: Geological stations list

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Gear Ab.
PS64/314-1	28.06.03	13:17	72° 0.25' N	14° 43.50' E	1286	MUC
PS64/321-1	30.06.03	13:36	72° 0.17' N	14° 43.85' E	1287	MUC
PS64/332-1	02.07.03	16:37	72° 0.28' N	14° 43.57' E	1288.0	GC
PS64/336-1	05.07.03	08:23	72° 0.02' N	14° 44.13' E	1286.4	GC
PS64/339-1	05.07.03	13:57	72° 0.13' N	14° 43.81' E	1284.4	GC
PS64/341-1	05.07.03	16:40	72° 0.17' N	14° 43.85' E	1285.2	GC
PS64/344-1	06.07.03	06:44	72° 0.10' N	14° 44.07' E	1284.4	GKG
PS64/363-1	10.07.03	14:08	72° 0.23' N	14° 42.47' E	1289.4	MUC
PS64/371-1	11.07.03	11:12	72° 0.20' N	14° 43.88' E	1289.0	GC
PS64/372-1	11.07.03	12:52	72° 0.26' N	14° 43.59' E	1288.0	GC
PS64/373-1	11.07.03	14:17	72° 0.21' N	14° 43.66' E	1288.0	GC
PS64/374-1	11.07.03	15:41	72° 0.38' N	14° 43.61' E	1286.0	GC

Sampling of surface sediments

Surface sediments were taken on 4 geological station (Tab. B3.4-1) with Giant Box Corer (GKG; 50x50x60 cm) and Multicorer (MUC) with eight tubes of 10 cm in diameter.

Sampling of long sediment cores

The gravity corer was used to obtain long sediment cores. The length of obtained sediment cores varies between 166 to 485 cm. Six gravity cores were opened, photographed, discribed and sampled onboard RV “Polarstern” (Fig. B3.4-1a-f). Sediment colors were identified with the “Munsell Soil Color Chart”.

Preparation and examination of smear-slides from sediments have been done on board. Results of smear-slides examination are represented in Table B3.4-2. For lithological descriptions see Fig. B3.4-1a-f.

Tab. B3.4-2: List of material taken onboard from gravity corer samples for further analysis in the home laboratory.

Station	Interval [cm]	Samples	Station		Interval [cm]	Samples		Station	Interval [cm]	Samples
PS64/314-1	0-5	sediment	PS64/336-1		180-181	sediment		PS64/371-1	30-31	sediment
PS64/314-1	0-1	smearslide	PS64/336-1		220-221	sediment		PS64/371-1	80-81	sediment
			PS64/336-1		250-251	sediment		PS64/371-1	170-171	sediment
PS64/321-1	0-5	sediment	PS64/336-1		280-281	sediment		PS64/371-1	270-271	sediment
PS64/321-1	0-1	smearslide	PS64/336-1		320-321	sediment		PS64/371-1	370-371	sediment
			PS64/336-1		400-401	sediment		PS64/371-1	470-471	sediment
PS64/332-1	0-1	sediment	PS64/336-1		440-441	sediment				
PS64/332-1	0-1	smearslide						PS64/372-1	120-121	sediment
PS64/332-1	20-21	sediment	PS64/336-1		40-41	smearslide		PS64/372-1	220-221	sediment
PS64/332-1	54-55	smearslide	PS64/336-1		130-131	smearslide		PS64/372-1	320-321	sediment
PS64/332-1	64-65	sediment	PS64/336-1		220-221	smearslide		PS64/372-1	420-421	sediment
PS64/332-1	80-81	smearslide	PS64/336-1		280-281	smearslide		PS64/372-1	470-471	sediment
PS64/332-1	120-121	sediment	PS64/336-1		440-441	smearslide				
PS64/332-1	180-181	smearslide						PS64/373-1	0-1	sediment
PS64/332-1	220-221	sediment	PS64/339-1		10-11	smearslide		PS64/373-1	65-66	sediment
PS64/332-1	280-281	smearslide	PS64/339-1		110-111	smearslide		PS64/373-1	165-166	sediment
PS64/332-1	320-321	sediment	PS64/339-1		210-211	smearslide		PS64/373-1	265-266	sediment
PS64/332-1	380-381	smearslide	PS64/339-1		310-311	smearslide		PS64/373-1	365-366	sediment
PS64/332-1	420-421	sediment	PS64/339-1		410-411	smearslide				
PS64/332-1	480-481	smearslide	PS64/339-1		510-511	smearslide		PS64/374-1	0-1	sediment
								PS64/374-1	65-66	sediment
PS64/336-1	0-1	sediment	PS64/363-1		0-5	sediment		PS64/374-1	165-166	sediment
PS64/336-1	40-41	sediment	PS64/363-1		5-10	sediment				
PS64/336-1	90-91	sediment	PS64/363-1		10-15	sediment				
PS64/336-1	130-131	sediment	PS64/363-1		20-25	sediment				
			PS64/363-1		25-30	sediment				

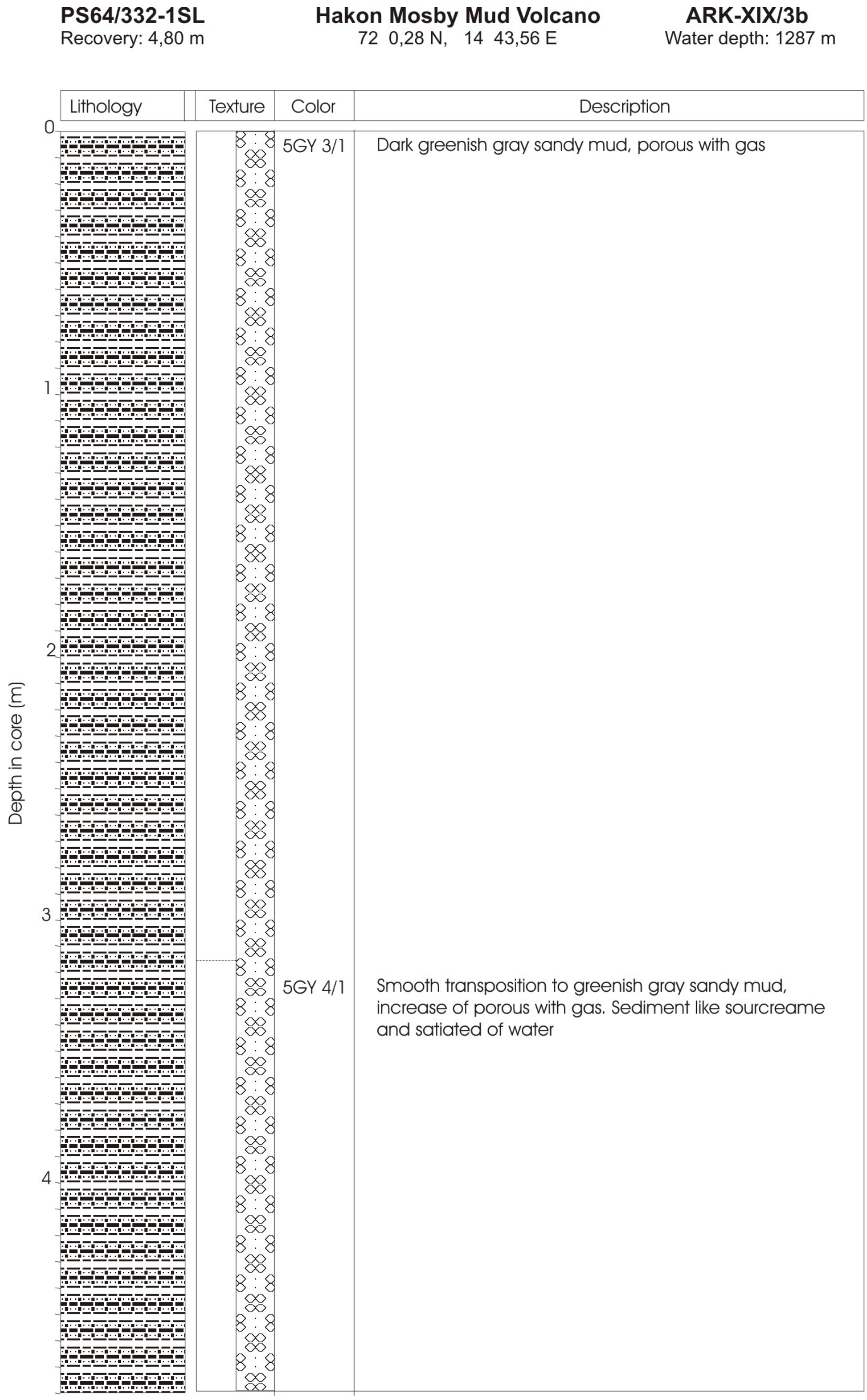


Fig. B3.4-1a: Lithological description of gravity corer sampled at station 332 (1287 m water depth)

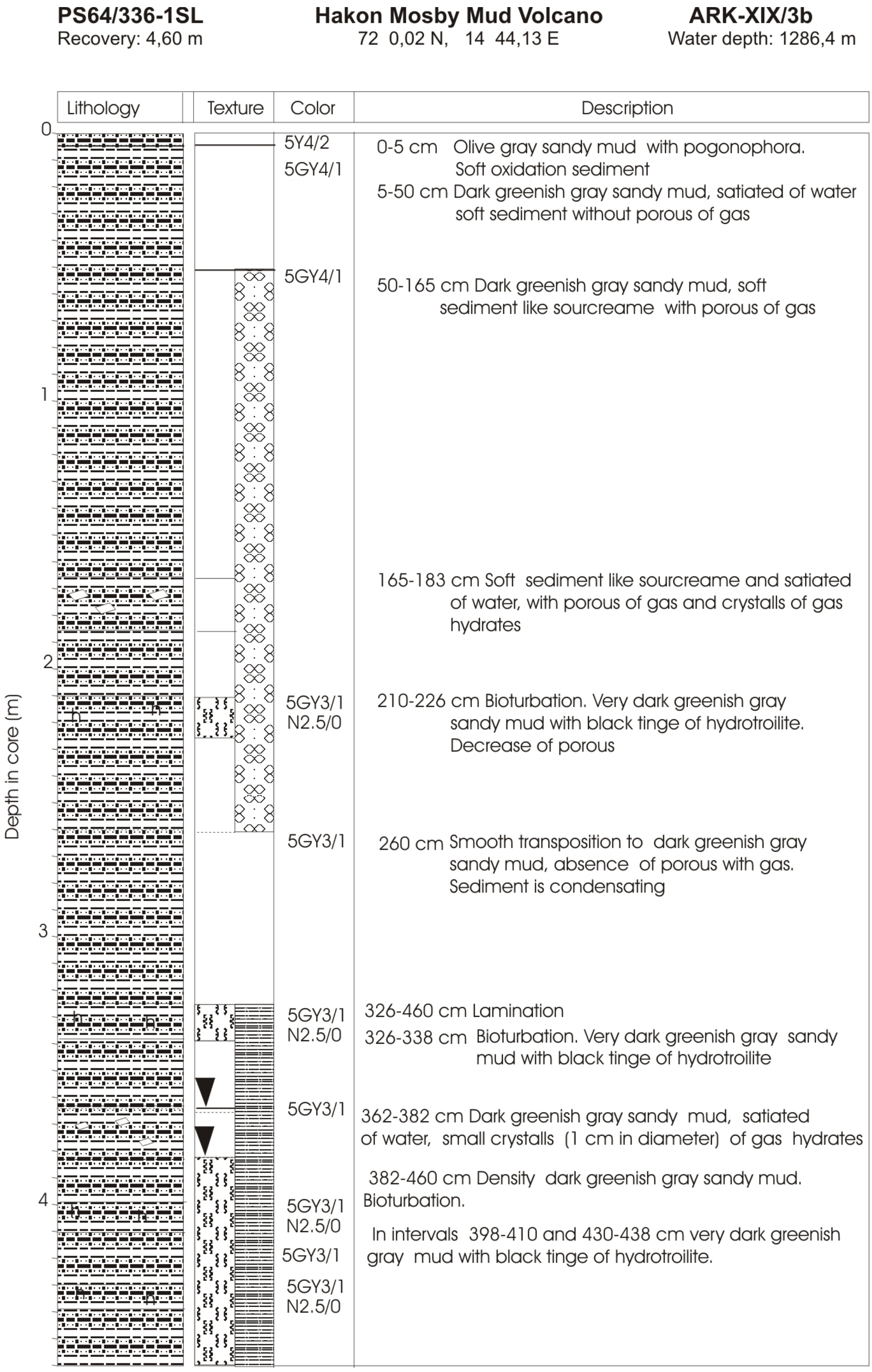


Fig. B3.4-1b: Lithological description of gravity corer sampled at station 336 (1286 m water depth)

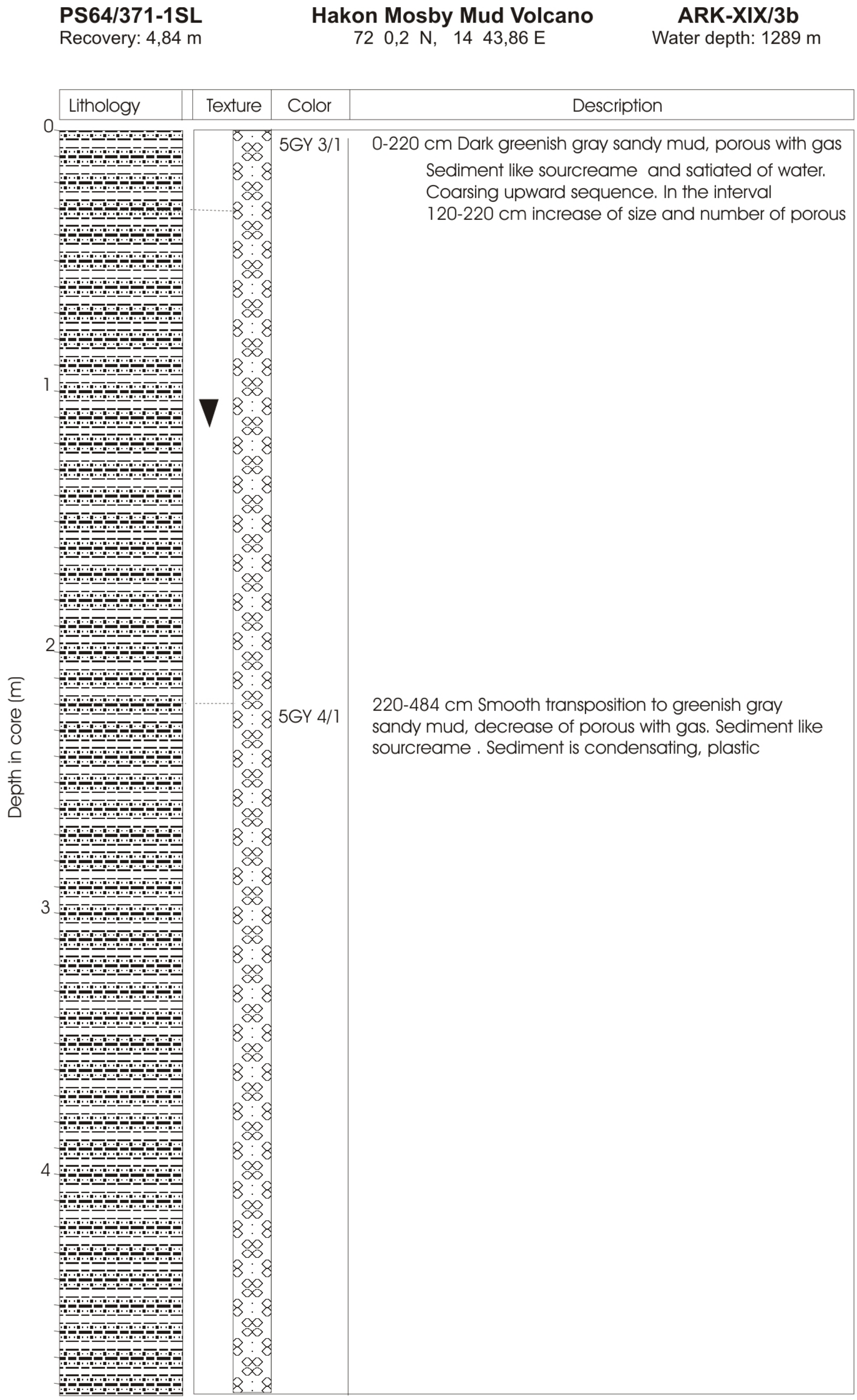


Fig. B3.4-1c: Lithological description of gravity corer sampled at station 371 (1289 m water depth)

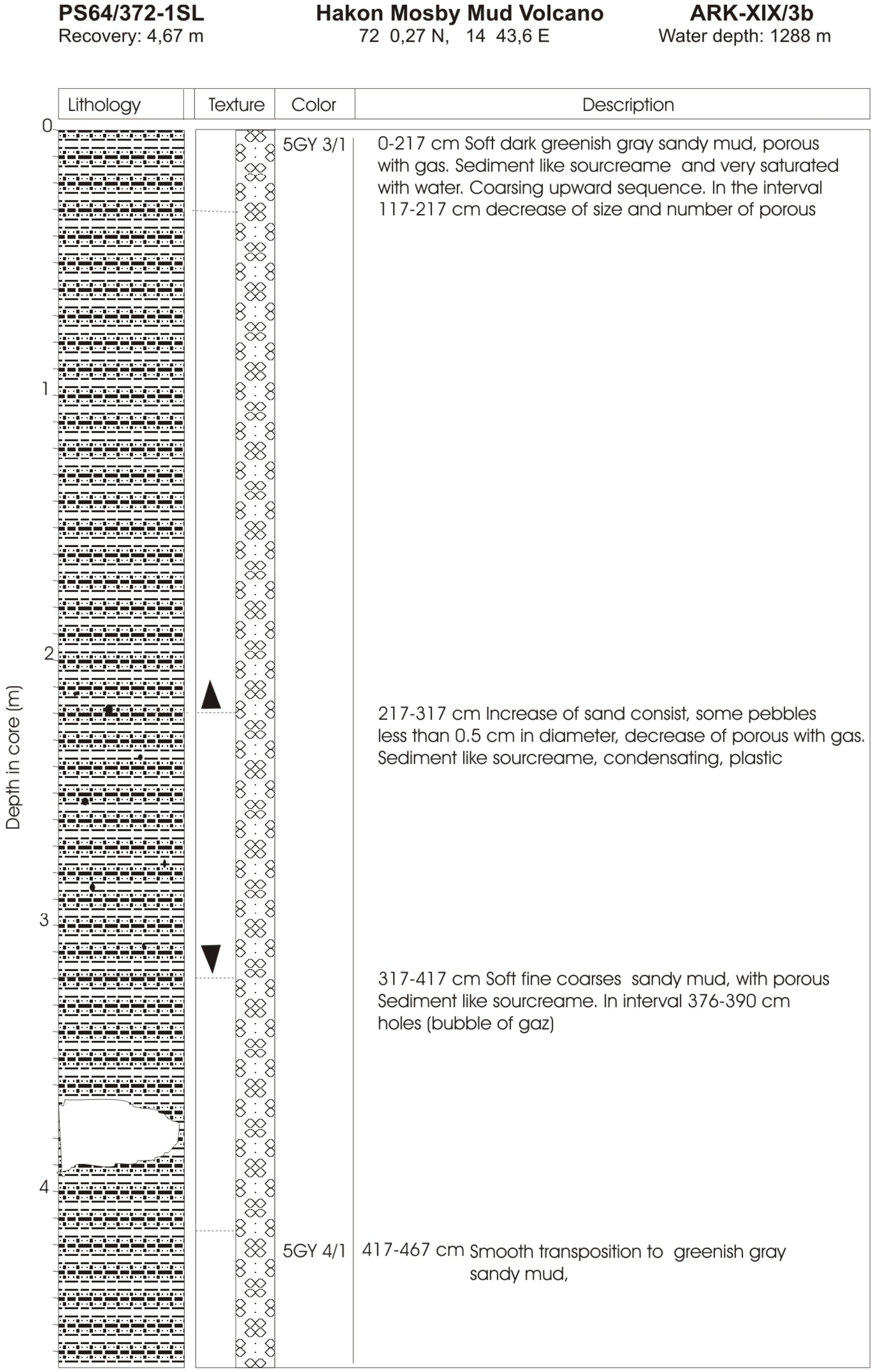


Fig. B3.4-1d: Lithological description of gravity corer sampled at station 372 (1288 m water depth)

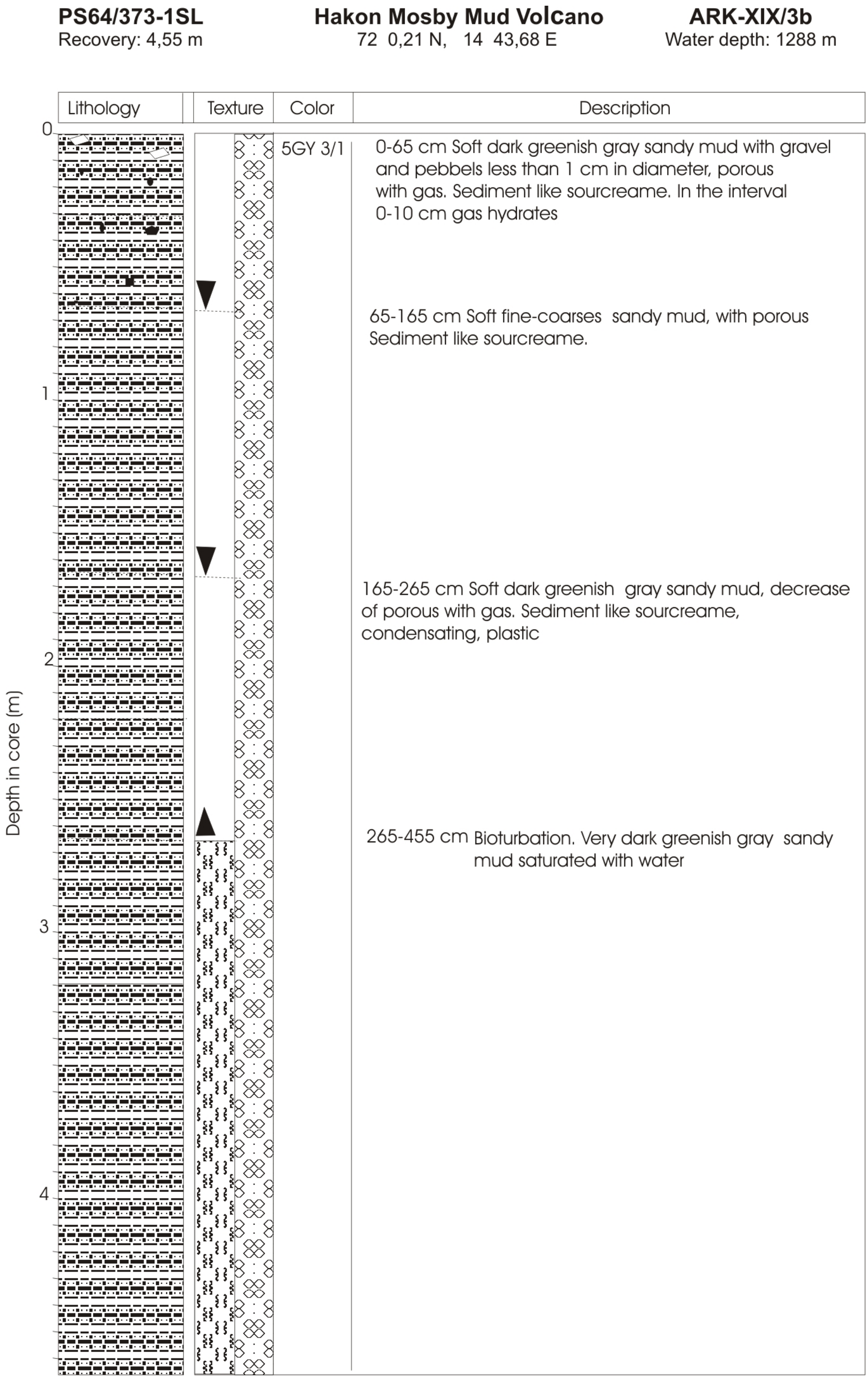


Fig. B3.4-1e: Lithological description of gravity corer sampled at station 373 (1288 m water depth)

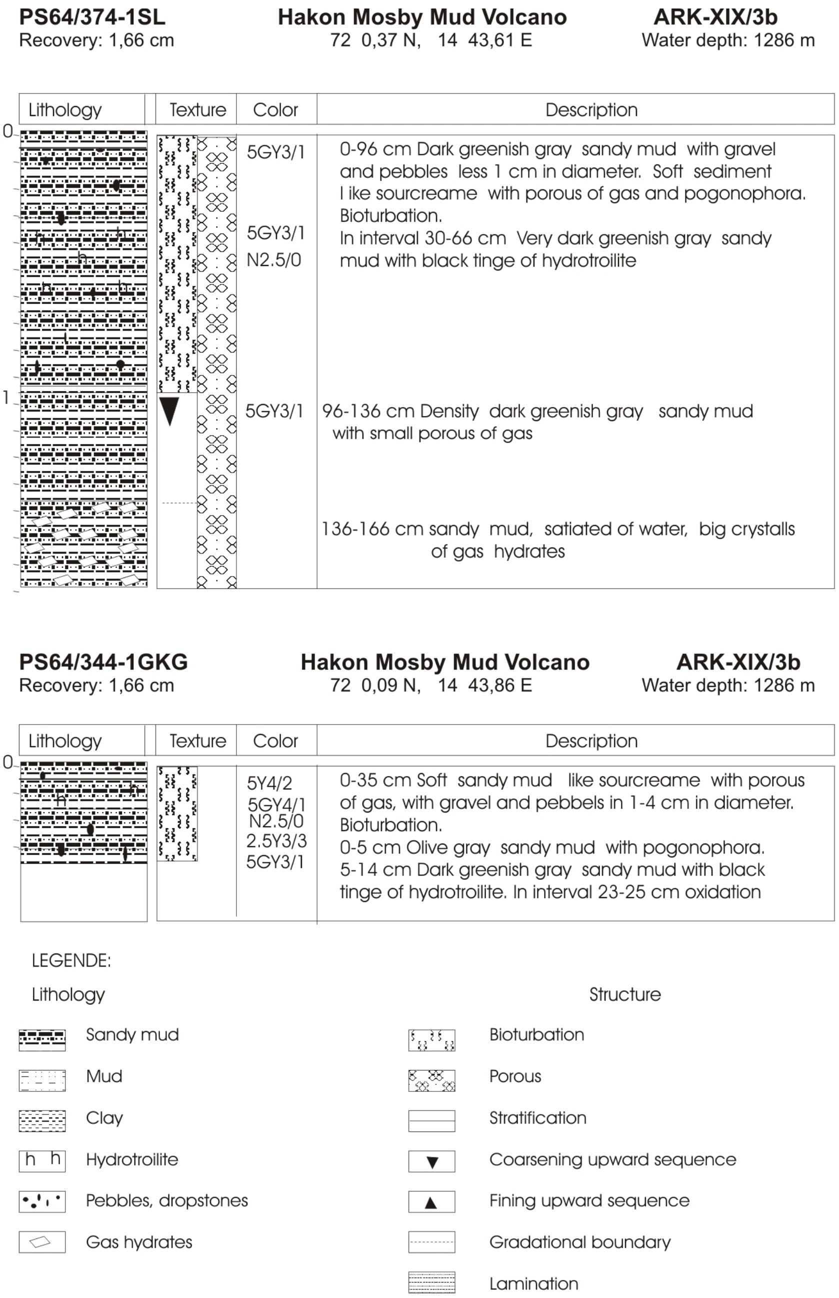


Fig. B3.4-1f: Lithological description of gravity corer sampled at station 374 (1286 m water depth) and a giant box corer sampled at station 344 (1286 m water depth).

Preliminary results

7 sediment layers were identified based on colour, consistence, texture, structure, grain size composition, and organic remains:

1) Olive gray sandy mud with *Pogonophora*;
2) Dark greenish gray sandy mud;
2a) Dark greenish gray sandy mud with gas hydrate;

2b) Dark greenish gray sandy mud with gravels and drop-stones;

3) Very dark greenish gray sandy mud (bioturbated);

3a) Very dark greenish gray sandy mud with black tinge of hydrotroilite, bioturbated;

4) Greenish gray sandy mud.

A correlation scheme of sediment layers is given in Figure B3.4-2 in which the results of some of the sampled areas of the Håkon Mosby Mud Volcano are illustrated. Included are sediment cores PS64/371, PS64/372, PS64/373 which were located in the central part. The second area was outside the centre of the volcano from where we have core PS64/332 which has only two layers of sediments.

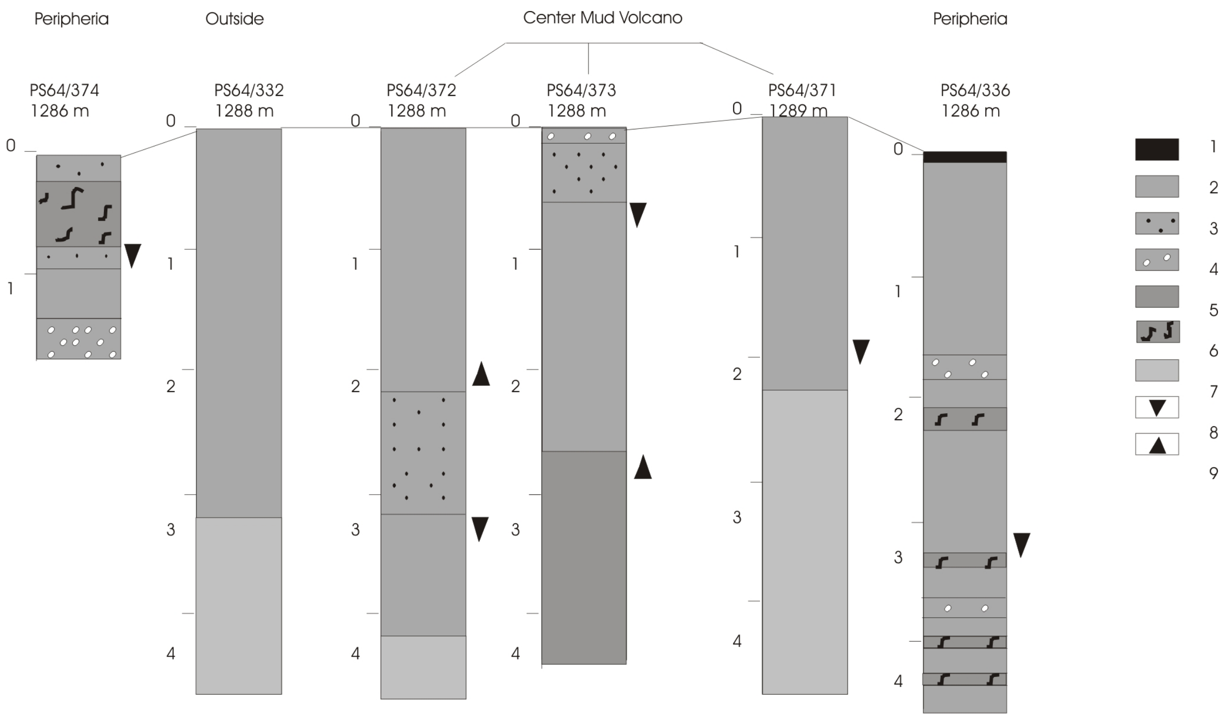


Fig. B3.4-2: Lithological description of bottom sediments from different areas of the Håkon Mosby Mud Volcano: 1- olive gray sandy mud with pogonophora; 2- dark greenish gray sandy mud; 3- dark greenish gray sandy mud with gravel; 4- dark greenish gray sandy mud with gas hydrates: ; 5- very dark greenish gray sandy mud; 6- very dark greenish gray sandy mud with black tinge of hydrotroilite; 7- greenish gray sandy mud; 8- coarsing upward sequence; 9- fining upward sequence

These layers have different color and grain size distributions: coarsening upward sequence and color smooth transposition from green gray to dark greenish gray from under layer to upper. The sediment cores, sampling from peripheral area PS64/336 and PS64/374 demonstrated coarsing upward, abundance the organic matter, hydrotroilite and gas hydrate, this sediments were mostly bioturbated. Main difference between these layers is color and consistence changes are due to diagenesis. All these layers are represented by the same lithology sandy mud.

B. 4 Water column investigations above the Håkon Mosby Mud Volcano

Sauter, E., Muyakshin, S., Rogenhagen, J., Rohr, H., Wegner, J., Baumann, L., Gensheimer, M., Schlüter, M., Boetius, A.

During the previous cruise ARK XVIII/1b of "Polarstern" to the Håkon Mosby Mud Volcano in the year 2002 a large plume image of about 600 m height and 500 m in diameter was discovered by the use of the scientific echosounder EK60. The plume was suggested to be related to mud expulsion and fluid discharge from the volcano's centre. So far, no gas bubbles had been observed at HMMV, neither by manned submersibles, TV guided devices like TV-MUC and OFOS, nor by ROV observations. Furthermore water column methane concentrations above the mud volcano have been found to be far below saturation. Accordingly, the plume has been suspected to consist of fine sediment particles rather than of gas bubbles.

Behind this background water column investigations of various kinds have been performed during this cruise. Main objectives of this were to obtain clarification of the nature and origin of the acoustically observed plume above the mud volcano's centre.

Fortunately, several locations of bubble and fluid discharge have been discovered and visually observed with "Victor 6000" (Fig. B4-1). The proofed existence of gas bubbles makes the further interpretation of acoustic plume images much easier.

Acoustic plume survey

The scientific echosounder EK60 is one of the fixed sensor installations onboard RV "Polarstern". It provides an acoustic image of the water column and is normally used to detect fish shoals. The EK 60 provides four operating frequencies, ranging from 38 to 200 kHz. The data is displayed online and recorded in digital format. Two frequencies (30 and 70 kHz) were operated regularly, while the other two channels were too noisy or off less performance in regard to depth range. The EK60 interferes very much with other sounding devices of RV "Polarstern". To achieve high quality data, the EK60 was used as a stand alone sounding device with Hydrosweep and

Parasound switched off. While surveying the Mud Volcano area the ships speed was reduced and the use of the ships thrusters was limited to its minimum.

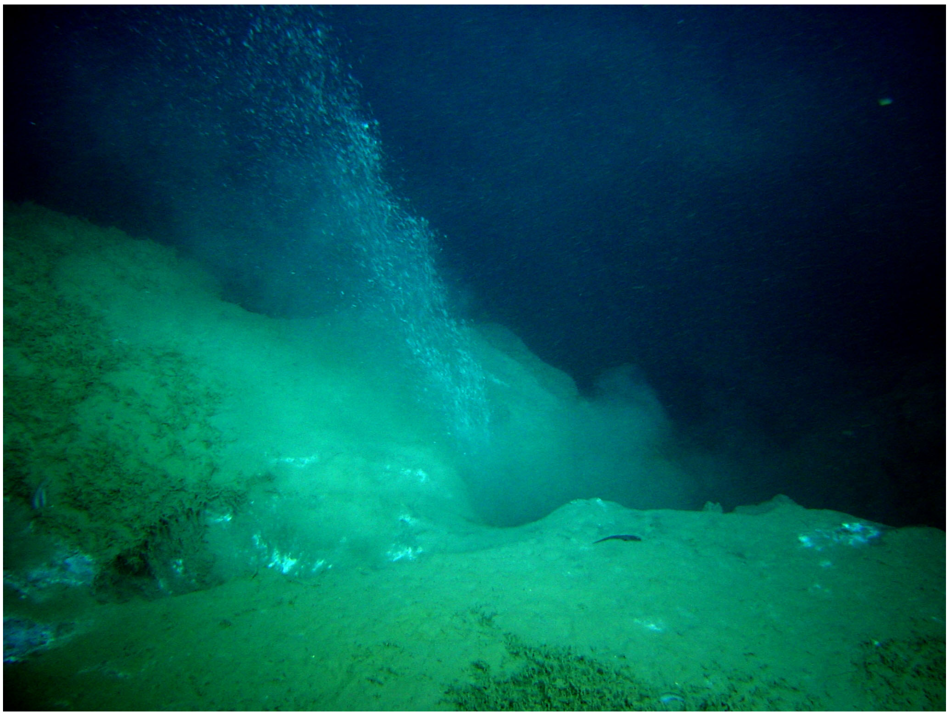


Fig. B4-1: Gas discharge location at the north western part of HMMV.

In total, the EK60 was operated for nearly 70 hours with data recording (and some times more for plain observation) with a total data volume of 37 CD-ROMS, which will be post-processed later on.

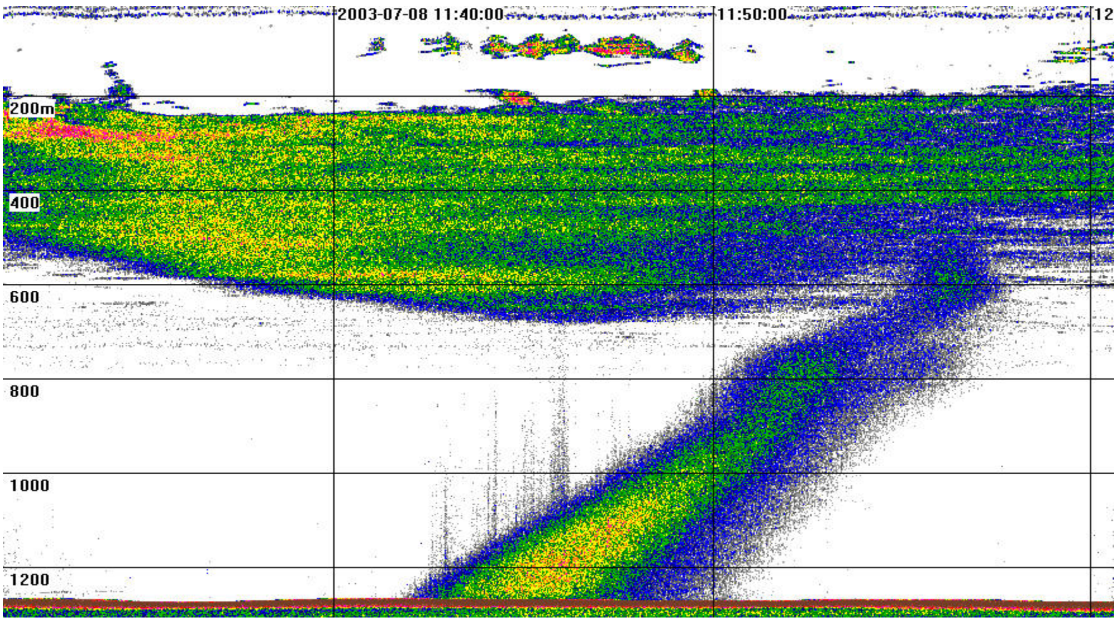


Fig. B4-2: displays an north-south transect above the centre of the Håkon Mosby Mud Volvano. The plume extends from the seafloor to a height of nearly 800 m. The plume region on the seafloor is around 250 m wide.

As an example, a echo sounder image obtained on a north-south survey line is depicted in Fig. B4-2.

The shape of the plume obviously follows the dominant current which changes within relatively short time intervals, probably in relation to tidal currents. Subsequently to the hydroacoustic survey, the water column was sampled by CTD rosette and a special high resolution bottom water sampler guided by the EK60 echo sounder. While the ship was slowly following the plume in accordance to the deep current, the vertical positioning of the device was controlled by its reflection signal (Fig. B4-3).

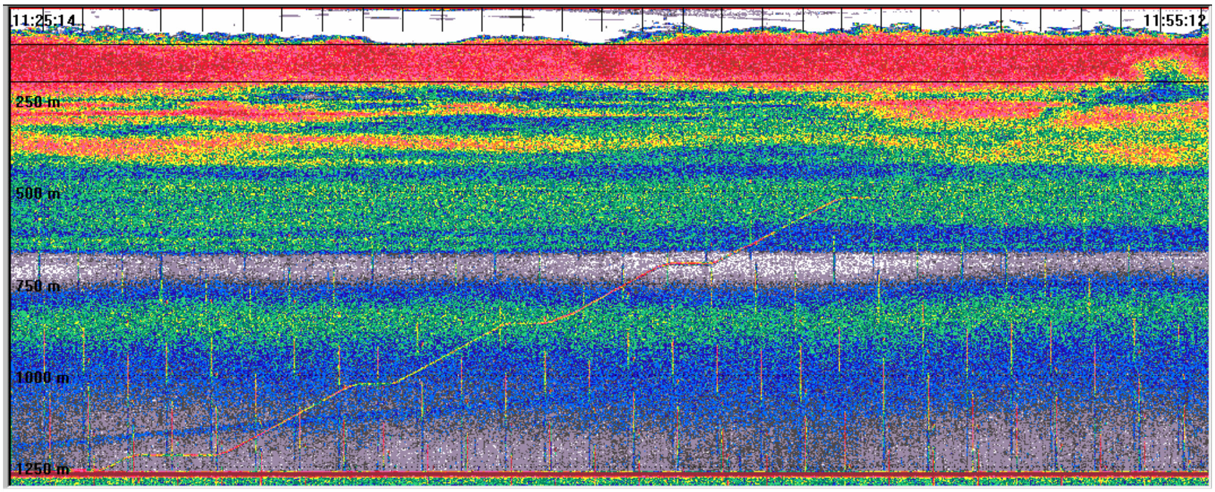


Fig. B4-3**:** The respect height of closing rosette bottles is visualized in the echo sounder image by the CTD's own reflection.

Beside the surveying of the HMMV area, several hydroacoustic transects in the surrounding of the mud volcano were performed to detect related structures. Beside an imagery of shape and dynamics of the plume the acoustic dataset will be used in conjunction with the geochemical dataset to quantify the expulsed sediment and the released gas, respectively.

CTD measurements and water sampling

For water column characterization and water sampling a SeaBird Electronics 911 plus CTD was used together with a 24 bottle rosette water sampler. Beside the standard sensors the CTD was additionally equiped with fluorometer, transmissionmeter, nephelometer and, for some of the last stations, also with an autonomous video camera and a methane sensor.

The comparison of the entity of the 14 CTD casts obtained during ARK XIX/3b, shows modest anomalies in temperature and salinity right above the plume. More distinct are anomalies in the transmission and nephelometer records.

Water samples from the CTD as well as from the bottom water sampler have been taken for immediate shipboard and subsequent laboratory analyses, respectively, for oxygen, methane, nutrients, radon-222, and different microbiological parameters.
According to preliminary results, oxygen and methane measured on the water samples correlate well with acoustic plume indications. Other parameters have to be measured in the insitute’s laboratories back home.

Bottom current measurements
With the aim to understand gas discharge and the fate of methane in the water column above HMMV bottom currents have been observed 1) by current vanes and 2) by a newly available high precisision currentmeter of the type Nobska MAVS3. Both instruments werde deployed by means of "Victor 6000" and used to characterize the near bottom current milieu in different heights above the sea floor.
In addition to the measurement of horizontal bottom current velocities, the MAVS3 currentmeter was used to determine horizontal current velocities and the outflow rates at fluid discharge locations.

B. 5 Biological investigations at the Håkon Mosby Mud Volcano (HMMV)

B. 5.1 Geomicrobiology of sediments and bottom waters of the Håkon Mosby Mud Volcano

Boetius, A., Beier, V., Niemann, H., Müller, I., Heinrich, F., Feseker, T.

Since January 2001 the BMBF-funded project MUMM (*Mikrobieller Umsatz von Methan in gashydrathaltigen Sedimenten*) investigates the microbial methane turnover above focussed sources of methane in the sea. Other key research areas are Hydrate Ridge (Cascadia Margin off Oregon, USA, projects LOTUS and OMEGA, GEOMAR), the pockmarks off Congo continental slope (University Bremen) and the methane seeps of the north-western Black Sea (project GHOSTDABS, University Hamburg). The Håkon Mosby Mud Volcano on the Barents Sea continental margin is of medium depths and coldest site investigated in this project. The investigations at HMMV in the framework of the project MUMM in cooperation between MPI, AWI, University of Bremen, and the IFREMER aim at an analysis of the main factors regulating the activity of the methanotrophic microorganisms and their contribution to biogeochemical fluxes at this mud volcano. There are three main work packages planned: 1) geomicrobiological investigations, 2) high resolution biogeochemistry with microsensores (see B. 5.3; Witte, U.), 3) *in situ* measurements with benthic landers (se B. B. 5.2; DeBeer, D. and Eickert, G.).

Microbially mediated anaerobic oxidation of methane (AOM) is the major biological sink of methane in marine sediments. Hence, this process is crucial in maintaining a sensitive balance of our atmosphere's greenhouse gas content. However, a fundamental understanding of the associated biology is still lacking, consequently preventing a thorough biogeochemical understanding of an integral process in the global carbon cycle. Studies employing stable isotopes, radiotracers, modelling, and microbiological techniques have now established that methane in marine sediments is oxidized biologically under anoxic conditions. Although no anaerobic methanotroph has ever been isolated, biogeochemical studies have shown that the overall process involves a transfer of electrons from methane to sulfate. Accordingly, the isotopic and genetic signatures of the dominant microbial populations in environments enriched with methane proved that this transfer is mediated by a microbial consortium that includes archaea and sulfate-reducing bacteria. The current hypothesis is that AOM is mediated by the two syntrophic partners, which rely on interspecies hydrogen transfer: methanogenic archaea mediating the oxidation of methane with water (reaction 1), and sulfate reducing bacteria scavenging the intermediate hydrogen (reaction 2):

$$CH_4 + 2\ H_2O \rightarrow CO_2 + 4\ H_2 \qquad (1)$$

$$SO_4^{2-} + 4\ H_2 + H^+ \rightarrow HS^- + 4\ H_2O \qquad (2)$$

The net reaction of methane oxidation can thus be formulated as:

$$CH_4 + SO_4^{2-} \rightarrow HCO_3^- + HS^- + H_2O$$

In the methane budget proposed by Reeburgh (1996), more than 80% of the methane produced annually in anoxic marine sediments is consumed before it can reach the atmosphere. The previously estimated 75 Tg/yr (not including the high AOM rates at methane seeps) indicate that methane consumption is nearly twice the annual increase in the atmospheric inventory of CH_4 (40 Tg/yr). In several sedimentary environments, AOM can be the dominant sulfate-consuming process, e.g., in sediments above gas hydrate and at methane seeps, as well as in the deep biosphere. No data are yet available from mud volcanoes which are another important geological source of methane. An updated compilation of AOM rates shows that the consumption of methane in gassy sediments is probably several times higher than previously estimated (Hinrichs and Boetius, 2002). Hence, even if the area affected by methane seepage at continental margins is below 1%, this might have a significant impact on the total methane budget. Thus, measurements of methane turnover rates in sediments and bottom water and methane emission to the hydrosphere are extremely important for realistic calculations of methane consumption in the sea.

Thus, measurements of methane and sulfate turnover rates in sediments and bottom water and methane emission to the hydrosphere are extremely important for realistic calculations of methane consumption in the sea. The main questions for this investigation are:

- Where are the hot spots of methane turnover at the Håkon Mosby Mud Volcano ?
- How much methane is oxidized anaerobically in the sediments ?

- How much methane is oxidized aerobically in the bottom water ?
- What are the dominant microbial populations mediating anaerobic methane turnover ?
- Is their isotopic signature indicative of methane consumption ?
- What is the link between microbial methane turnover and the chemosynthetic communities at the HMMV ?

Materials and Methods

The Håkon Mosby Mud Volcano (HMMV) at about 72° N 14° E was first investigated during an international cruise with RV "Professor Logachev" in 1996. It is the only mud volcano in a polar region that has been studied in greater detail by photo and video camera observation. The HMMV is situated on the continental slope north-west of Norway at a water depth of 1250 m. It has a diameter of about 2 km, with an outer rim populated by methane-depending, chemosynthetic communities and an inner centre of about 500 m diameter where fresh muds are expelled. Between the central plain and the outer rim, a complex topography of hills and depressions can be found which is derived from the transport of young sediments. All investigations focussed at the three main geobiological communities in the centre of HMMV, at the *Beggiatoa* mats and *Pogonophora* fields as well as at the surrounding reference sites. In addition small-scale gradients were sampled such as within a *Beggiatoa* mat (mat-covered and not-covered sediments), and between freshly expelled mud and aged mud.

The major aim of this study was the investigation of microbial sulfate reduction (SRR) and anaerobic methane oxidation (AOM) in methane enriched surface sediments of the HMMV, as well as sampling the sediments for microbiological and molecular analysis. Samples were obtained from the sediment cores which were retrieved by the ROV pushcores, by TV guided multiple corer hauls (Tab. B5.1-1) and gravity cores (Tab. B5.1-2). In parallel to the on board rate measurements, sub-samples were taken from cores to determine the total number of bacteria, to quantify different taxonomic groups of bacteria by fluorescence *in situ* hybridisation (FISH, 16s rDNA clone libraries, DGGE) and to investigate the metabolic activity of methane consuming micro-organisms involved in sulfate reduction as well as anaerobic and aerobic methane oxidation under controlled laboratory conditions in microcosms. Furthermore, sediment subsamples were obtained to investigate the distribution of lipid products derived from members of AOM consortia and their stable carbon isotopic composition which bears diagnostic information on the carbon source and/or metabolic carbon fixation pathway utilised by its producer.

Tab. B5.1-1: Sediment samples obtained by multiple corer (MUC) and ROV (PC – push corer). Sediment samples were split into different layers for rate measurements, biomarker analysis, for total bacterial counts, fluorescence *in situ* hybridization (FISH), as well as for microbial diversity analysis (0-10 cm in 1 cm horizons, >10 cm in 2 cm horizons).

Device	Station No	Date	Core No	Dive	Sediment conditions, community	Lat N	Long E
MUC	PS64_312	28-Jun-03	7,8 (4)		Centre, GH, slightly sulphidic, gas	72° 0,25	14° 43,49
MUC	PS64_314	28-Jun-03	3,6		Centre, GH, slightly sulphidic, gas	72° 0,25	14° 43,54
ROV	PS64_317-1	29-Jun-03	8	219	*Beggiatoa* mat, sulphidic, gas	72° 0,156	14° 43,887
ROV	PS64_317-2	29-Jun-03	14,17	219	*Beggiatoa* mat, sulphidic, gas	72° 0,163	14° 43,880
MUC	PS64_322	30-Jun-03	2,3,5,6,7		*Beggiatoa* mat, sulphidic, gas	72° 0,18	14° 43,85
ROV	PS64_326	1-Jul-03	7,8,12, 11,10,9,2 2	220	*Pogonophora*	72° 0,059	14° 42,130
ROV	PS64_347	6-Jul-03	1,2,3, 6,7,8	222	centre, grey bacterial mat	72° 0,297	14° 43,397
MUC	PS64_354	8-Jul-03	1,2,3,7		Centre north, *Pogonophora*, slightly sulphidic	72° 0,32	14° 43,62
MUC	PS64_356	8-Jul-03	4,5,6,7,8		*Pogonophora* on rim	72° 0,05	14° 44,18
MUC	PS64_362-1	10-Jul-03	2,5,7,8		Eastern flank, oxidized sed	72° 0,21	14° 42,47
MUC	PS64_366	10-Jul-03	1,2		Centre middle, small mat pieces on sediment	72° 0,17	14° 43,55
ROV	PS64_377	12-Jul-03	13,14,27, 23	224	centre, grey bacterial mat	72° 0,309	14° 43,352
ROV	PS64_377	12-Jul-03	1,2	224	naked, fresh sediment	72° 0,307	14° 43,676
ROV	PS64_377	12-Jul-03	3,4	224	Bacterial mat	72° 0,307	14° 43,676
ROV	PS64_377	12-Jul-03	17,18	224	Transition between naked sediment and mats	72° 0,307	14° 43,676
ROV	PS64_398	16-Jul-03	7,8	225	*Pogonophora* (7) embedding bacterial mat	72° 0,389	14° 43,628

All these samples will be processed in the home laboratories of MPI and AWI. We will compare oxidation rates obtained by numerical modeling of changes in pore water concentrations of methane and sulfate to the measurements with radioactive tracer, as well as to measurements obtained with *in situ* instruments (chamber lander and profiler). Bottom water samples have been obtained at various sites to investigate methane oxidation in the water column, measured by injection of tritiated methane.

Tab B5.1-2: Sediment samples obtained by gravity corer. Sediment samples were split into different layers for rate measurements, biomarker analysis, for total bacterial counts, fluorescence *in situ* hybridization (FISH), as well as for microbial diversity analysis (every 25-50 cm over the total length of the core). In most cores up to 50 cm of the surface appeared to be lost. The recovered length was measured in the opened cores.

Device	Station No	Date	length [cm]	Sediment conditions, community	Lat N	Long E
GC	PS64/332	2-Jul-03	461	Centre, warm fluids	72° 0,28	14° 43,57
GC	PS64/336	5-Jul-03	470	*Pogonophora*, small pieces of GH at -410cm	72° 0,02	14° 43,57
GC	PS64/339	5-Jul-03	465	Centre, archive	72° 0,13	14° 43,81
GC	PS64/341	5-Jul-03	114	*Pogonophora* 10cm chunk of GH at -114cm	72° 0,17	14° 43,85
GC	PS64/371	11-Jul-03	488	Bacterial mat but first 0.5 to 1m lost	72° 0,20	14° 43,88
GC	PS64/372	11-Jul-03	430	Centre NW with warm fluids	72° 0,26	14° 43,59
GC	PS64/373	11-Jul-03	453	Centre middle	72° 0,21	14° 43,66
GC	PS64/374	11-Jul-03	166	Bubble site with *Pogonophora* in core	72° 0,38	14° 43,61

Water samples are taken with three types of water samplers: the rosette for 4-1200 m above seafloor (CTD), the horizontal water sampler (BWS) as well as from the ROV bottles (PEP) to investigate the methane emission from the sediments into the water column (Tab. B5.1-3).

The major aim of this study was the investigation of microbial sulfate reduction (SRR) and anaerobic methane oxidation (AOM) in methane enriched surface sediments of the HMMV. For the measurement of methane concentrations in sediments, a sample is mixed into a sodium hydroxide solution. After equilibration with the headspace of the sample vial, a gas sample is removed with a gas tight syringe and injected into a gas chromatograph with a flame ionisation detector. Sulfate and sulfide concentrations in sediment pore-water fixed with zinc chloride will be determined photometrically. For the tracer measurements both radioactive tracers $^{35}SO_4$ and $^{14}CH_4$ were injected into replicate core sub-samples (inner diameter 1 cm) which were incubated anoxically at *in situ* temperature for 24 hrs. After incubation, the sediment sub-cores (1-5, 7-11, 13-17 cm) were mixed with zinc acetate (20% w/w) or sodium hydroxide (2.5% w/w), respectively, to stop the bacterial activity. These samples will be analysed in the home laboratory. ^{14}C-methane is injected into undisturbed sediment samples and incubated for hours to days. Subsequent mixing of the samples into a solution of sodium hydroxide terminates the microbial activity. The SRR and AOM rates are calculated from the amount of $H_2{}^{35}S$ or $^{14}CO_2$ formed and from the concentration and radioactivity of sulfate or methane in the sample, respectively (Iversen and Blackburn 1981).

Tab. B5.1-3. Water samples obtained by the horizontal bottom water sampler (BWS), by rosette (CTD), ROV (PEP bottles). Water samples were used for methane oxidation measurements and for fluorescence *in situ* hybridization.

Device	Station No	Dive	Date	Bottle No	Conditions, Community	Lat N	Long E
CTD	310		28-Jun-03	10,12,14,16,17,20,22,24	Centre	72° 0,23	14° 43,49
PEP	317-1	219	29-Jun-03	1,5,9	Bacterial mat	72° 0,164	14° 43,884
PEP	317-2	219	29-Jun-03	13,17	Bacterial mat	72° 0,156	14° 44,887
CTD	320-1		30-Jun-03	10,12,14,16,17,20,22,24	Bacterial mat	72° 0,16	14° 43,88
BWS	329		2-Jul-03	2,3,4,5,6	Bacterial mat	72° 0,15	14° 43,84
CTD	328		2-Jul-03	10,12,14,16,17,20,22,24	Bacterial mat	72° 0,15	14° 43,83
Slurp Gun	326	220	2-Jul-03	4,5	*Pogonophora*	72° 0.059	14° 43,895
BWS	338		5-Jul-03	1,2,3,4,5,6	Centre	72° 0,20	14° 43,28
CTD	337		5-Jul-03	10,12,14,16,17,20,22,24	Centre	72° 0,18	14° 43,33
PEP	347	222	6-Jul-03	1,5,7,11	Centre N, grey mats	72° 0,295	14° 43,391
BWS	351		8-Jul-03	1,2,3,4,5,6	*Pogonophora*	72° 0,03	14° 44,09
CTD	350		8-Jul-03	10,12,14,16,17,20,22,24	*Pogonophora*	72° 0,05	14° 44,16
BWS	365		10-Jul-03	1,2,3,4,5,6	Reference	72° 0,19	14° 42,39
CTD	364		10-Jul-03	10,12,14,16,17,20,22,24	Reference	72° 0,22	14° 42,47
PEP	377	224	13-Jul-03	1,5,9,13,17	*Pogonophora*	72° 0,055	14° 44,225

Water samples were taken with two types of water samplers (rosette and horizontal water sampler) as well as from the multiple corers to investigate the methane emission from the sediments into the water column. Microbial oxidation of methane in the water column was measured using tritium-labelled methane (C^3H_4). Water samples were incubated for 3 days under *in situ* temperature (-1°C) in the dark before termination of the reaction with addition of formaldehyde (method according to Valentine *et al*., 2001.

Further sub-samples were taken from cores and slurries to determine the total number of bacteria, to quantify different taxonomic groups of bacteria by fluorescence *in situ* hybridisation (FISH, method according to Pernthaler *et al*. 2001) and to investigate the metabolic activity of methane consuming micro-organisms involved in sulfate reduction and methane oxidation under controlled laboratory conditions in microcosms. Furthermore, sediment sub-samples were obtained to investigate the distribution of lipid products derived from members of AOM consortia and their stable carbon isotopic composition which bears diagnostic information on the carbon source and/or metabolic carbon fixation pathway utilised by its producer. Also, a giant box corer was retrieved to sample the *Pogonophora* for investigation of their stable isotope signature in the bulk biomass as well as in the lipids of the work and its symbionts. All these samples will be processed in the home laboratories of MPI and AWI.

Preliminary results

Molecular ecology studies based on 16S ribosomal DNA diversity and whole cell hybridisation revealed a substantial diversity among the microbial players in different methane-rich environments. One important question for understanding the process of AOM is whether this process obligatorily requires the syntrophy of sulfate reducing bacteria with methanogenic archaea in the form of symbiotic associations as observed in the sediments of the Hydrate Ridge. Orphan *et al*. (2001) found a similar consortium in sediments of the Eel River Basin and proved its capability of methane consumption under anaerobic conditions. A different archaea/bacteria consortium has been detected in surface sediments above a subsurface gas hydrate layer in the Congo basin and in microbial associations in the Black Sea (Knittel *et al*., unpubl. data). It is likely that different forms of syntrophic associations are responsible for AOM in such methane-rich environments. Evidence derived from parallel biomarker chemotaxonomy and 16S rRNA or FISH probing in several environments supports the hypothesis that several phylotypes have to be considered as producers of ^{13}C-depleted archaeol and hydroxyarchaeol. A series of studies report the predominant occurrence of phylotypes from the ANME-2 group (more closely related to *Methanosarcinales* than ANME-1) above gas hydrate (Boetius *et al*. 2000, Orphan *et al*. 2001, Teske *et al*., 2002.). At other gas seeps, we observed cases in which the ANME-1 group was predominant (Hinrichs *et al*. 1999, Michaelis et al. 2002) or even the exclusive archaeal group, but ^{13}C-depleted archaeol and hydroxyarchaeol were present as well. This indicates considerable archaeal diversity in AOM communities, and our investigation of HMMV as the first high latitude cold seep studied in detail resulted in the discovery of a new type of AOM consortium.

The investigations at the HMMV took place in the framework of studying the role of sedimentary microbes in consuming the greenhouse gas methane and in delivering energy to the chemosynthetic communities on the sea floor. Understanding the interaction between geology, chemistry and biology is necessary to analyse the fluxes of methane between the different compartments, and to find out about the magnitude of methane emission from mud volcanoes. At HMMV defined zones of different benthic communities can be identified and related to the morphology and activity of the mud volcano. Interestingly, a lot of methane is emitted from the barren centre of the mud volcano. Here, we could not detect the symbiotic association of archaea and bacteria consuming methane in the sediments, but found new types of aerobic methanotrophs (Lösekann et al. in prep; Niemann et al. in prep). At the HMMV, the zone of highest methane turnover is indicated by the presence of white mats of giant sulfur-oxidising bacteria (*Beggiatoa*) on the seafloor. These bacterial mats cover large areas around the centre of the HMMV. The thickest mats retrieved were up to several cm thick and consisted of tangled filaments, which were relatively easily resuspended from the sediment surface in large aggregates. Two other types of bacterial mat (grey patches with filaments and with laminated structure) were discovered in the northern part of the mud volcano and will be further investigated. Anaerobic oxidation of methane was limited to the surface sediments below the mats of sulfur bacteria covering the outer zone of the central plain. Here, a new consortium of archaea and sulfate reducing bacteria was detected which consists of a previously unknown type of anaerobic methanotroph with a new type of sulfate reducer (*Desulfobulbus*) as a partner (Lösekann et al., in prep; Niemann et al., in prep.). The steeper part of the HMMV outside of the centre is populated by high biomasses of tubeworms. One giant box core (0.5x0.5 m) retrieved from the outer rim of the HMMV contained as much as

1 kg of tubeworms in wet weight. The *Pogonophora* manage to aerate the sediments, hence excluding the AOM communities from the surface sediments. Our investigations will show whether there are subsurface AOM communities in this zone of the HMMV. Clearly, in the zones populated by the chemosynthetic communities only very little methane escapes to the water column compared to the barren centre. Obviously, the methane-consuming microorganisms form an effective barrier against the greenhouse gas methane.

The relatively high biomass of methanotrophic archaea is obviously capable of oxidising methane with sulfate in the anaerobic sediments at temperatures close to the freezing point (-1°C), producing a source of sulfide to the extensive mats of giant, sulfide-oxidising bacteria surrounding the central area. Despite its rapid turnover in the sediments, large amounts of methane dissolved in the rising mud-volcano fluids are seeping to the hydrosphere. It is yet unknown how much of the methane is removed in the aerobic bottom waters and how much escapes to the water column. First experiments on the aerobic oxidation of methane in the bottom waters of HMMV show that methane turnover may be limited to the bottom water and is below detection limit in the water column as predicted by Damm et al. (2003) from methane stable isotope signatures. Most interestingly, methane occurs in relatively high concentrations also in the central barren area of the HMMV but is used only by a shallow microbial community. It is possible that in these relatively young sediments, the population of slow growing methane oxidising archaea is too small to provide enough sulfide for the support of sulfide dependent chemosynthetic communities. Accordingly, the anaerobic methanotrophs were absent in the centre surface sediments and only found deep below the *Pogonophora* communities populating the outer rim of the mud volcano.

In addition to the sampling program dealing with surface sediments, we took samples from 7 gravity cores, to investigate the presence of microbial communities down to 5 m below the seafloor. Gas hydrates occur in fine layers to bulk ice of several cm thicknesses at the HMMV in the outer zone of the warm centre, at depths up to 25 cm (Tab. B5.1-3). Towards the outer rim of the HMMV populated by *Pogonophora*, the depth of the gas hydrate layer increases to about 2-5 m. A first result from the gravity coring is that the subsurface sediments of the centre show very little evidence for microbial activity. Highest activity was found in the surface sediments above the shallow hydrates (bacterial mats) and some also in the upper meter of the northern *Pogonophora* sites. The samples from the gravity cores as well as of the water column will be analysed in detail in the home laboratory regarding biomass, diversity and activity of the microbial communities to extend the understanding of the microbial ecology of the HMMV to the third dimension.

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B. 5.2 Microscale analysis of the surface sediments

De Beer, D., Eickert, G.

The aim of the study was to determine the vertical distribution of microbial activities and mass transport phenomena in the 3 main segments of the Håkon Mosby Mud Volcano. The main microbial processes are anaerobic methane oxidation (AOM) coupled to sulfate reduction and aerobic or anaerobic oxidation of sulfide (SO). The net equations for the main carbon and sulfur cycling are:

AOM $CH_4 + SO_4^{-2} \rightarrow HCO_3^- + HS^- + H_2O$ Eq.1

SO $HS^- + 2O_2 \rightarrow SO_4^{-2} + H^+$ Eq.2

Due to AOM a slight pH increase can occur, which in turn could stimulate calcification. It was hypothesized as a possible explanation of the calcite deposits often found in and near sites of AOM. This should be accompanied by a calcium flux towards the AOM zone. The second reaction is a simplification of the reality, as sulfide oxidation occurs in steps, thus all intermediates can be expected. Also, these intermediates will be used for sulfate reduction, actually are preferred the e-acceptors due to the low activation energy. Especially in the low sediment temperatures, -1°C was reported for the site, the use of less oxidised sulfur species for e-acceptance would be favorable. However, if SO is complete, with sulfate as final product, a strong pH decrease will occur in the zone where sulfide and oxygen overlap.

To investigate these processes, we measured the distribution of oxygen, sulfide, protons, carbonate and calcium. To study transport phenomena, finescale temperature distributions were measured in the top 10 cm of the seafloor (in situ). Heat is not a significant product of microbial processes, however, is produced at depths in the volcano. Thus, the finescale temperature profiles can be used to determine the occurrence of advection in the investigated sediment layer.

Methods

Both laboratory measurements on retrieved sediments and in situ measurements with a profiling unit were performed. The profiling unit was mounted on a chamber lander operated by Ursula Witte. The profiling unit has been described previously (Glud et al., 1994). The lander was deployed as free-falling unit, occasionally the position was

corrected by use of the ROV. The lander was equipped with 2 oxygen, 2 H_2S, 1 temperature sensor, and 3 potentiometric sensors (Ca^{2+}, pH or CO_3^{2-}).
Sediment samples were retrieved with a multicorer, or by an ROV, or taken from the incubation chambers (Witte). The cores were placed immediately after retrieval in a water bath of -1°C. For laboratory measurements 3 microsensors were mounted in one holder, allowing simultaneous measurements of 3 parameters.

Most microsensors used have been described previously (O_2, pH, H_2S, Ca^{2+} (Kühl and Revsbech, 1999)). The total sulfide was calculated from the local H_2S concentration and pH using a dissociation constant of 10e-7.05. New is the use of a carbonate sensor, based on a recently developed ionophore (Choi et al., 2002). The DIC was calculated from the local CO_3^{2-} concentration and pH using dissociation constants corrected for salinity, temperature and pressure (Zeebe and Wolf-Gladrow, 2001). The $pK_{1,\ 2}$ values used were 6.126734 and 9.420233 for laboratory measurements (-1°C, 3.4 % salinity, 1 bar) and 6.099953 and 9.498722 for in situ profiles (-1°C, 3.4 % salinity, 140 bar). These constants may need to be corrected.
The 3 segments of the volcano investigated were the central area, the rim where extensive *Beggiatoa* fields are found, and the other regions dominated by symbiontic methane and sulfide oxidising tubeworms (*Pogonophora*). The worm-fields with their highly heterogeneous structure and hard chitine tubes are unfavorable for analysis with fragile microsensors. The center was supposed to have little microbial activity. We focussed on the *Beggiatoa* fields, where AOM was found in a thin zone up to 5 cm below the surface.

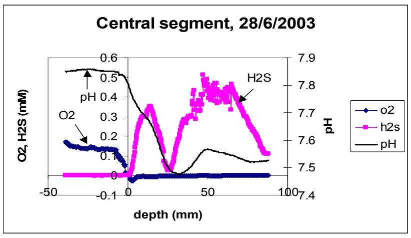
Results and discussion

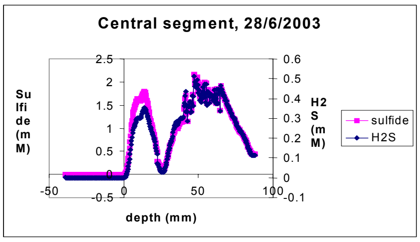
A total of 43 cores were measured with 6 different microsensors, 7 lander deployments were successfully done, each resulting in 9 profiles. The data need detailed analysis and to be organized. Here follows a summary of the results, with examples of measurements. The data are not yet absolute, calibrations are still estimates. Especially the DIC data obtained from pH and carbonate measurements are still inaccurate, as the equilibrium constants of the carbonate system at this pressure and depth are uncertain.

Laboratory measurements

<u>*Central site*</u>

The sediments in this site were very soft and probably still fluidized. During retrieval strong out-gassing occurred disturbing the structure of the sediments. The sediments were left for settling for several hours before measurements commenced.

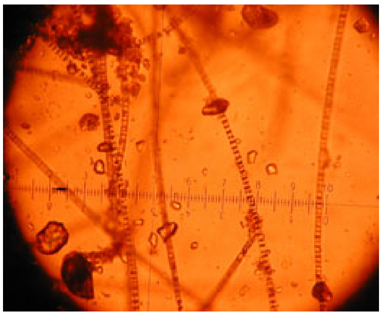




Profiles in a fresh core from the central segment.

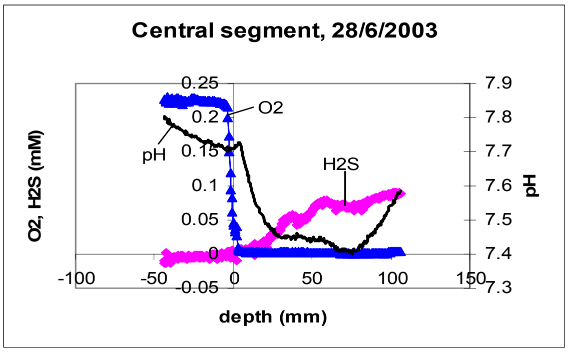
In the first day directly after sampling (location, time), the sediments showed a very high oxygen uptake and penetration of only a few mm. Sulfide was detected in an irregular pattern. The pH was always lower than in SW. No pH dip was found at the oxic-anoxic interface where sulfide was consumed. The SW pH was cross-checked with values obtained from fresh bottom-water samples (7.93). In a second core less sulfide was found and the pattern was more regular. Also here no pH dip at the oxic-anoxic interface indicated the oxidation of sulfide to sulfate. Carbonate measurements showed a strong increase with depth in the sediments. The sensors are not sensitive to sulfide, indeed the profiles show a different pattern. The carbonate increase cannot be exclusively caused by biological activity. Whereas the sulfide peaks in the top 5 cm, the pH and carbonate showed a shoulder at 2 cm, DIC continuously increases with depth. In a duplicate experiment, similar data were obtained, showing microbial activity at 4 cm contributing to the carbonate and DIC profile, but a flux from deep sediments was obvious. Other, non-biological, processes must contribute to the carbonate pool.

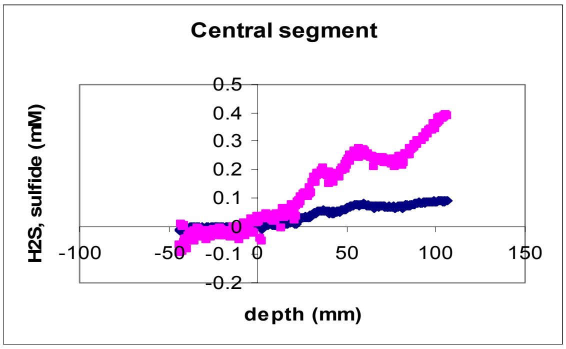
Beggiatoa site.



The sediments were less soft as those from the center. Also here some out-gassing occurred and the sediments were left for several hours to recover. The white *Beggiatoa* mats re-colonized the surface quickly. The filaments were morphologically the same, having a diameter of ca 10 µm. This may indicate that these areas are occupied by a single strain.

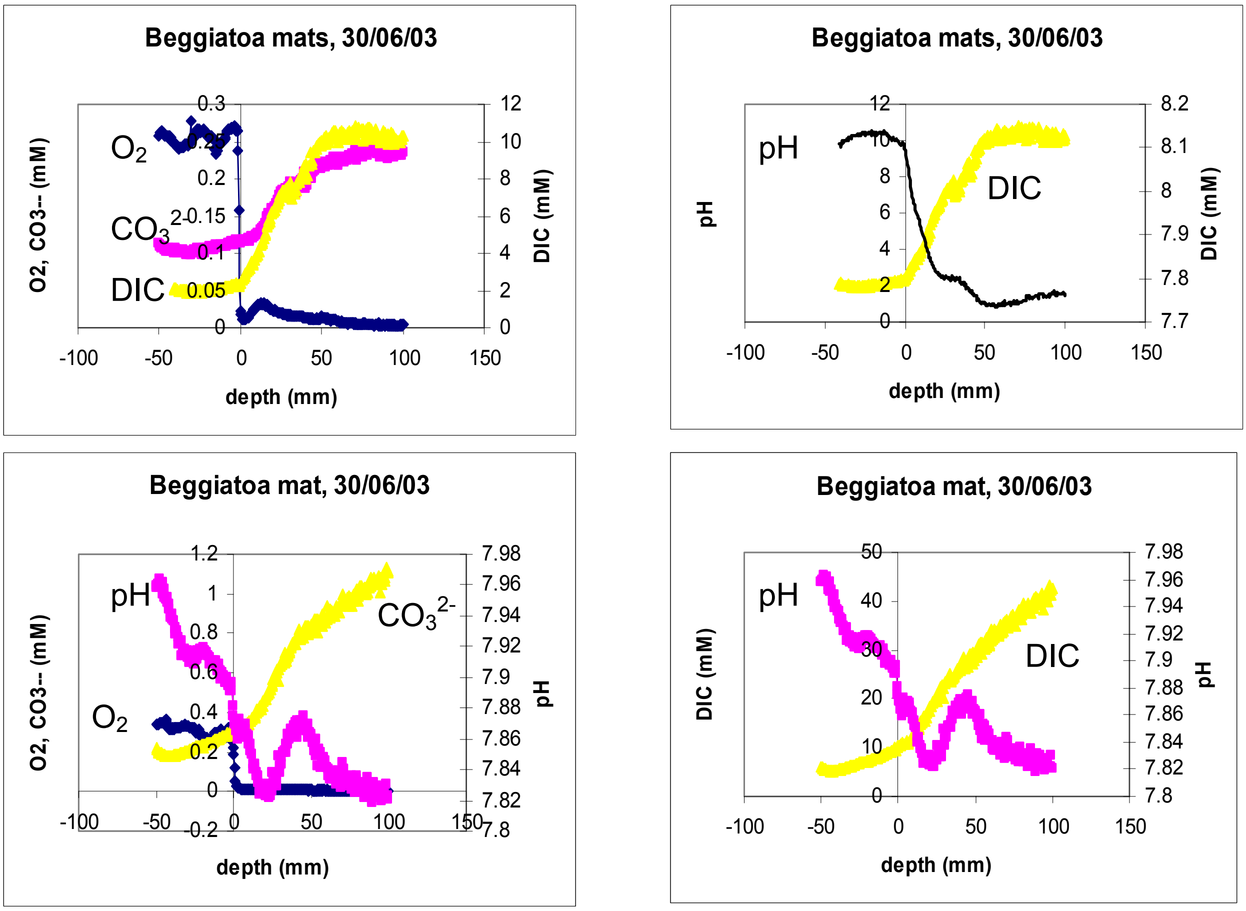
The profiles in cores from the *Beggiatoa* site differed from the Central site. The pH profiles showed a gradual decrease, contrary of what was expected from the AOM equation. Furthermore, the top is highly sulfidic. At 2 cm depth, sulfide peaks to a concentration of 12 mM.





Profiles in a core of 12 hours age. Same area and MUC deployment.

Oxygen penetrates less than 2 mm. Further measurements in these sediments confirmed that the pH only very slightly increased with less than 0.05 unit due to AOM. It is unlikely that this can explain the extensive calcification observed in other locations. The carbonate sensor is very new and the profiles must be regarded with caution. However, we have not found significant interferences from compounds abundant in this type of sediment. To calculate DIC from pH and CO_3^{2-} we need very precisely the pK values of the carbonate system at this low T and Sal. Thus the profiles presented here are preliminary. The values in the sediments are very high and need to be checked by porewater analyses. The measurements may have suffered from an artifact, the core was too narrow to stir well.



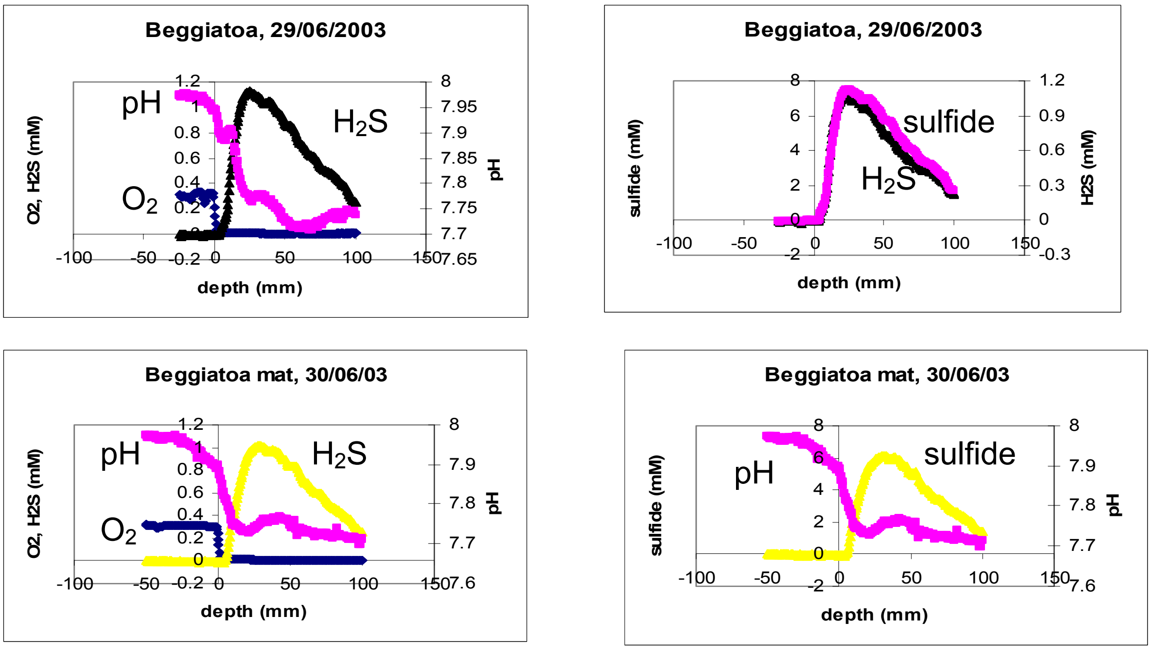
Measured carbonate and calculated DIC profiles in Beggiatoa dominated sediments.

The DIC values in the water column are higher than expected. Samples have been extracted and will be analysed soon. However, both the carbonate and DIC profile show microbial activity in the zone of AOM. The rates of Ci_{tot} will be calculated from the profiles after cross-check with the porewater profiles. The high DIC concentration may explain the relatively modest pH effects that accompany the very high microbial activities: the DIC in the porewater forms a pH buffer

Similar results were obtained in various duplicate cores. The pH gradients were the most variable in shape.

Some experiments were conducted on the mats. Addition of 200 µM nitrate caused a further penetration of oxygen, down to 1 cm. Also the sulfide front was pushed downwards, but maintained its overlap with the oxygen profile. This is an indication that the *Beggiatoa* involved do not store nitrate. The *Beggiatoa* disappeared from the surface, following the oxic-sulfidic interface.

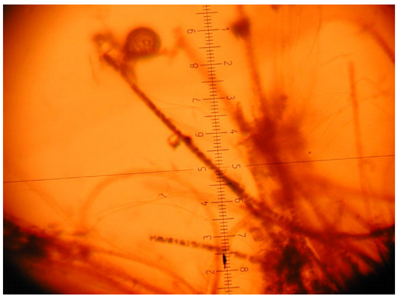
Addition of 100 µM $FeCl_3$ had no effect on the H_2S, O_2 or pH distributions within 6 hours. Flushing the core with Argon reduced the oxygen levels to 20% air-saturation. The H_2S profiles did not change shape, and sulfide did not leak out of the sediment.



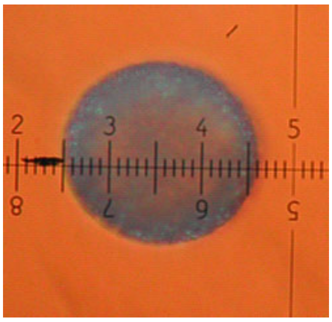
Sulfide, Oxygen and pH profiles in *Beggiatoa* sediments. The sulfide peaks coincides with AOM.

The *Beggiatoa* seems to depend on a very high sulfide supply by AOM at close distance from the surface. It might be possible that AOM favors from the *Beggiatoa* too, by using different e-acceptors than sulfate. The pH profiles show that *Beggiatoa* does not oxidise the sulfide to sulfate. An internal cycling of sulfur is very likely, where AOM may favor from the supply of partially oxidised S intermediates from *Beggiatoa*, who depend on the AOM for sulfide.

Calcification was not observed in these sediments. The calcite often associated with AOM is probably formed by calcification driven by out-gassing of methane that removes CO_2 and increases the pH.



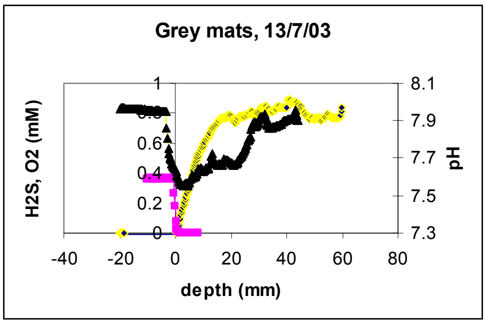
Photograph of the sulfide oxidising community. The sphere is *Thiomargarita*, the dark filaments *Beggiatoa*,the transparent cells are *Thiotrix*.

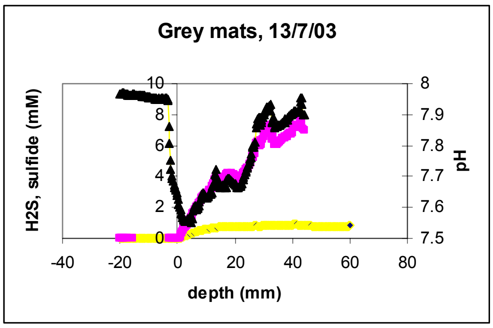


Thiomargarita. The sulfur globules are blueish fluorescent.

Grey mats

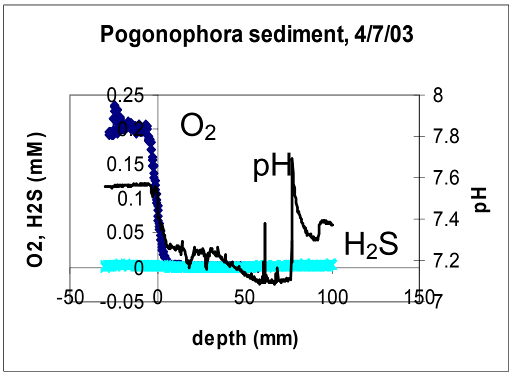
The gray mats were found near the gas seep, or more precise where gas hydrate snow was released from the sediments. The grey mats contained a complex sulfur oxidising community, consisting of *Beggiatoa* of various thickness (3-20 µm), *Thiotrix* (15 µm) and *Thiomargarita* (≤ 150 µm). The latter is a surprise, as they have been found only for the coast of Namibia. They are depending on regular resuspension into the water column, during which they fill up their vacuoles with nitrate. Thus the finding of bubbling sites agrees well with the finding of this unique organism. *Thiotrix* is aerobic, *Beggiatoa* can use both oxygen (low levels) and nitrate, *Thioploca* and *Thiomargarita* can use only nitrate. The motile nitrate using sulfide oxidisers can separate the oxic and sulfidic zone, thus outcompeting the other sulfide oxidisers.

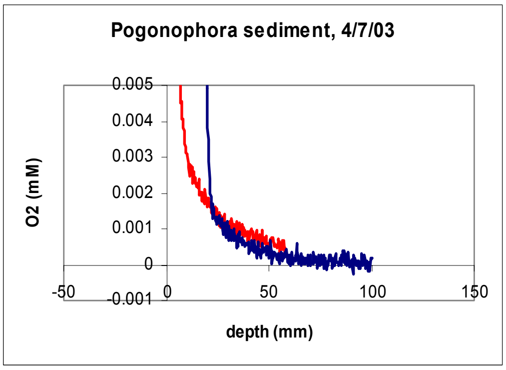




In the grey mats no such separation occurred. The pH profile showed a clear dip at the surface, showing oxidation of sulfide to sulfate.

Pogonophora field





Profiles in *Pogonophora* sediments. The pH sensor broke at 75 mm depth. The irregularities at 30-40 mm depth may be caused by collisions against hard surfaces, resulting in piezo potentials. The right panel shows two oxygen profiles scaled between 0 and 5 µM. Clearly oxygen penetrates over 50 mm. No H_2S was detected.

The sediments are made coherent by the abundant chitine tubes of the worms that extent to more than 30 cm below the sediment surface. The microsensor measurements were difficult, and all sensors eventually broke during the penetration. However, several profiles were obtained. Interesting is that no sulfide was detected and that oxygen penetrated over 50 mm deep. This was not observed in the sediments from the *Beggiatoa* fields or in the center area. This must be s result from ventilation by the worms.

Lander measurements (list of deployments)

	date	depth	Lat N	Lon E	sensors	area
1	28/6/2003	1286	72.0.22	14.43.11	pH, redox, O_2, H_2S	Some *Beggiatoa*
2	30/6/2003	1287	72.0.159	14.43.887	pH, T, O_2, H_2S, pH, Ca^{2+}, CO_3^{2-}	Worms
3	5/7/2003	1278	72.0.387	14.43.603	pH, T, O_2, H_2S, CO_3^{2-}	Worms
4	6/7/2003	1283	72.0.115	14.43.496	pH, T, O_2, H_2S, CO_3^{2-}	*Beggiatoa*
5	9/7/2003	1252	72.00.334	14.43.691	pH, T, O_2, H_2S, CO_3^{2-}	Central area, border worms
6	11/7/2003	1252	72.00.148	14.43.630	pH, T, O_2, H_2S, CO_3^{2-}	*Beggiatoa*, disturbed
7	14/7/2003	1290	71.59.03	14.45.44	pH, T, O_2, H_2S, CO_3^{2-}	reference site

Central area

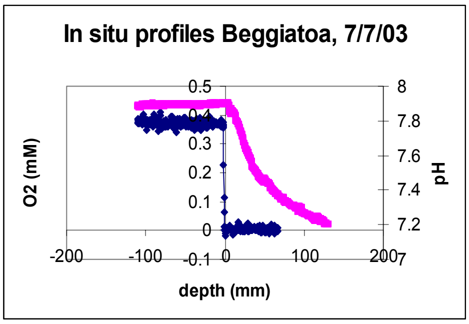
No measurements could be done, the lander did not reach the area.

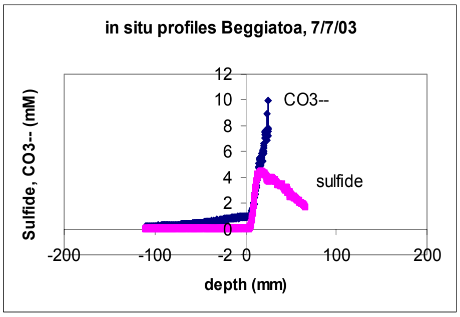
Beggiatoa field

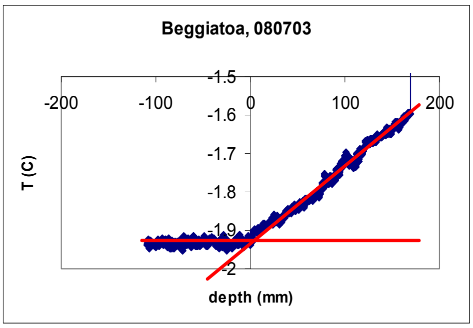
The first deployment (28/6/03) was on the border of a *Beggiatoa* field, ca 1 m from a large white patch. The ROV inspected the lander after deployment; unfortunately no high quality images were captured. A day later the feet were seen and photographed. The outskirts of the *Beggiatoa* field are visible.

O_2, H_2S and pH measurements were successful. Oxygen was depleted with in the top 3 mm. The interfacial flux was ca 3E-07 mol/m^{2}s. The sulfide and oxygen profiles overlapped, but the sulfide profiles indicate consumption of sulfide in the top 3 cm, i.e. in the anoxic zone. In the absence of electron acceptor this cannot be microbially mediated. Possibly, *Beggiatoa* can oxidise sulfide with nitrate, stored in the vacuoles. Samples are taken for nitrate analysis.

A second deployment in the *Beggiatoa* field was done by the ROV (07/07/03). The sulfide profiles were different; they showed a peak at 2 cm depth. The temperature profile shows that the transport is exclusively diffusive. The calculated fluxes are included in the report from Ursula Witte. Sediments were taken in cores from the chamber that ran parallel to the profiler. These sediments were used to assess the effect of retrieval, i.e. pressure release and temporary warming up during ascent to the surface.





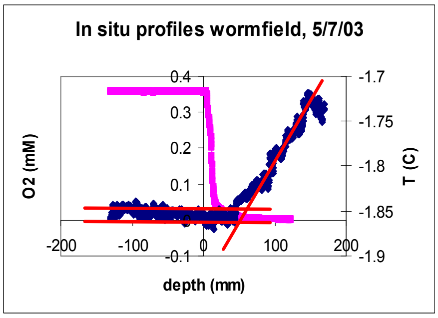


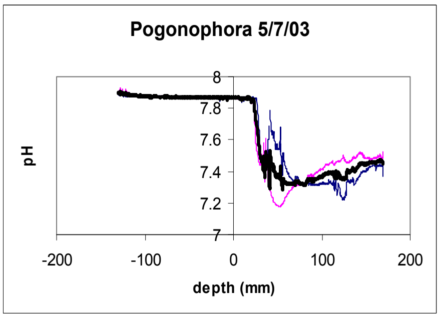
A comparison shows that the profiles are similar, but less pronounced. The oxygen influx is ca 4 times lower than the in situ rates. The sulfide peak is now present at 4 cm depth. This might be an effect of out-gassing during ascent, mixing the zones to some extent.

Pogonophora field

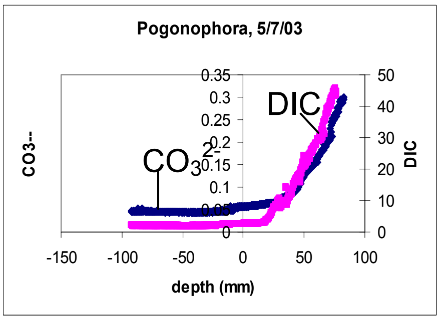
The location of the second deployment could not be found. The Posidonia transmitter did not respond, the ROV could not find it by sonar or cameras. From the sediment in the chamber, analysed after retrieval of the lander, it could be inferred that it was close to a worm field. *Pogonophora* tubes were found.

One deployment landed in *Pogonophora* fields. All sensors broke but data were obtained. The sulfide is lower than in the *Beggiatoa* site and oxygen penetrates deeper. Interesting is the temperature profile. The top 30-50 mm of the sediment has the same temperature as the seawater, below that it increases. This shows that advection determines heat transfer in the top layer of the sediment. This is also visible in the oxygen profiles that show penetration to ca 35 mm, much deeper than in the *Beggiatoa* mats.





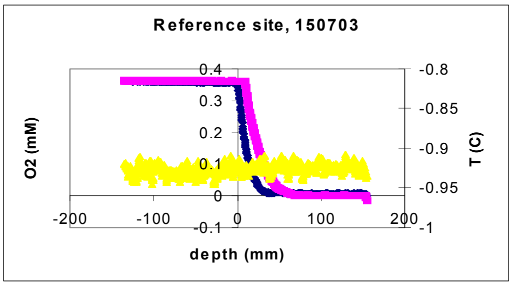
In situ profiles from *Pogonophora* field. The red lines cross at a depth where advection determines heat transfer. It coincides with the O_2 penetration. The thick black line is the average of two pH profiles.

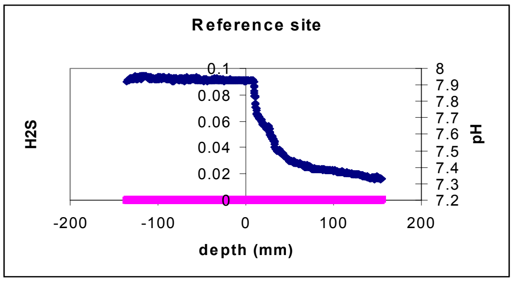


The next deployment landed in a dense *Pogonophora* field. The chambers could not be pushed in the sediments, due to the network of chitine tubes re-enforcing the sediment. Only temperature, oxygen, pH and carbonate data were obtained. Again the temperature profile showed advectional heat exchange in the top 5 cm, corresponding to a 5 cm deep oxygen penetration.

<u>*Reference site*</u>

This site consisted of fine yellowish mud, so rather oxidised. No special features to be mentioned. Oxygen penetrated 4-5 cm, the temperature profile was flat, no free sulfide was detectable. It was thus a good reference site, where nothing special happened.





Summary

The sulfide oxidising community is highly interesting. It consists of large *Beggiatoa* fields, mainly oxidising sulfide with oxygen, but with the capability of using nitrate. Near the gas seeps a complex community was observed of various *Beggiatoa* types, Thiotrix and Thiomargarita. The Thiomargarita is exciting, although similar to the Namibian strain it does not grow in strains, but as single cells. Thus is likely a new species. It was found exactly near the sites where the sediments can be suspended by gas outbursts.

The white *Beggiatoa* fields are closely associated with AOM, occurring ca 2 cm below the surface. It is worth finding out if there is a cross dependence.

The interfacial transport in the *Beggiatoa* fields is exclusively diffusional, in the worm field advection by bio-irrigation is dominant. The efficient ventilation in the worm field leads to sulfide oxidation in the deeper zones.

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B. 5.3 Methane in gas hydrate bearing sediments – turnover rates and microorganisms (MUMM)

Witte, U.

Mud volcanoes like the HMMV are present at tectonically inactive areas of continental margins and can occur independently of volcanic sulfide and heat above gas and petroleum reservoirs buried in the sea floor. Biogenic methane is formed in deep sediment strata and rises to the surface of the seafloor. The gas may accumulate in the sediments and form gas reservoirs such as gas hydrates (frozen methane). If these gas reservoirs reach a certain pressure, they can form geological structures called mud volcanoes. At mud volcanoes, sediment pore water, gas and mud is expelled from deep below forming mounds and crater at the sea floor. Active mud volcanoes are a seep for natural gas (methane) and are often densely populated by tube worms, clams and other symbiotic organisms – just like hot vents. Hence, chemotrophic communities, i.e. organisms which are fuelled by the chemical energy of dissolved minerals can indicate the presence of active gas seeps. The rising methane is often very efficiently used by a symbiosis of archaeal and bacterial microorganisms that is able to oxidise methane with sulfate - which is abundant in seawater. This reaction produces sulfide, which in turn fuels conspicious chemosynthetic communities (sulfur bacteria, clams and tube worms with bacterial symbionts).

From the HMMV, three main habitats were described from previous cruises: a central, barren area of sediment not (yet ?) colonized by sulfur-oxidising communities, areas covered by dense *Beggiatoa* mats, and *Pogonophora* fields. The investigations showed that a lot of methane is emitted from the barren centre of the mud volcano. In areas covered by chemosynthetic communities, on the other hand, only very little methane was observed to escape to the water column. Possibly, the methane-consuming microorganisms that produce the sulfide fuelling these communities form an effective barrier against the greenhouse gas methane.

In addition, an attempt was made to quantify biological turnover rates and identify key horizons for the respective processes involved, in order to:

a. quantify total benthic carbon turnover as well as sulfide production and consumption rates, and finally generate a numerical transport-reaction model coupling the processes involved,

b. describe the microhabitat structure in this „microbial world“,

c. find out how efficient the unique microbial communities are as methane barriers.

To address these questions, *in situ* measurements of oxygen, methane and sulfide fluxes were carried out with benthic chambers, and microprofiles of O_2, H_2S, pH, redox, Ca^{2+}, and CO_3^{-2} (see D. deBeer).

During ARK XIX/3b, altogether 7 deployments of the MPI modular lander system were carried out (table B5.3-1). For the first two deployments (BL 1 & 2), the frame was equipped with one benthic chamber, a profiling module and the sulfate reduction module „Orpheus“. During all following deployments, the „Orpheus“ module was replaced by a second benthic chamber. In order to obtain the exact position of the lander at the sea floor, the system was additionally equipped with a Posidonia-compatible transponder provided by RV "Polarstern". Because of the highly patchy distribution of the different benthic habitats, the lander system was additionally equipped with a still camera and flashlight in order to identify the actual habitat sampled by the profiling module (as this does not retrieve the sediment as do the benthic chambers). During 3 dives, the lander position was visited with the deep-sea ROV "Victor 6000", in one case the ROV lifted and moved the instrument in order to position it accurately on a dense bacterial mat.

Table B3.5-1: Lander deployments during ARK XIX/3 b

gear no.	date	Position		incubation time [h]	habitat type
		deployed at	at bottom		
BL 1	28.06.2003	72° 00, 22' N 014° 42,93 ' E	72° 0.22' N 14° 43,11' E	16	rim of Beggiatoa mat
BL 2	30.06.2003	72° 00,159' N 014° 43,887' E		12	Pogonophora
BL 3	05.07.2003	72° 00,386 S 014° 43,650 E	72° 00.387 N 14° 043,603 E	8	Pogonophora
BL 4	06.07.2003	72° 00,139' N 014° 43,476' E	72° 00.115' N 14° 043,496 ' E	8	thick Beggiatoa mat
BL 5	09.07.2003	72° 00,237' N 014° 43,444' E	72° 00.334' N 14° 043,691 ' E	12	Pogonophora
BL 6	11.07.2003		72° 00,148' N 14° 043,630 ' E	12	Beggiatoa mat ?
BL 7	14.07.2003	71° 59,0 N 14° 45,5' E	71° 59,03' N 14° 045,44 ' E	22	Reference

The deployments covered 3 (5) different habitats: a reference site without methane seepage, *Pogonophora* fields (low and high *Pogonophora*n abundance), and *Beggiatoa* mats (sediments both sparse and thickly covers with *Beggiatoa*). The „naked“, central area of younger sediments could not be investigated.

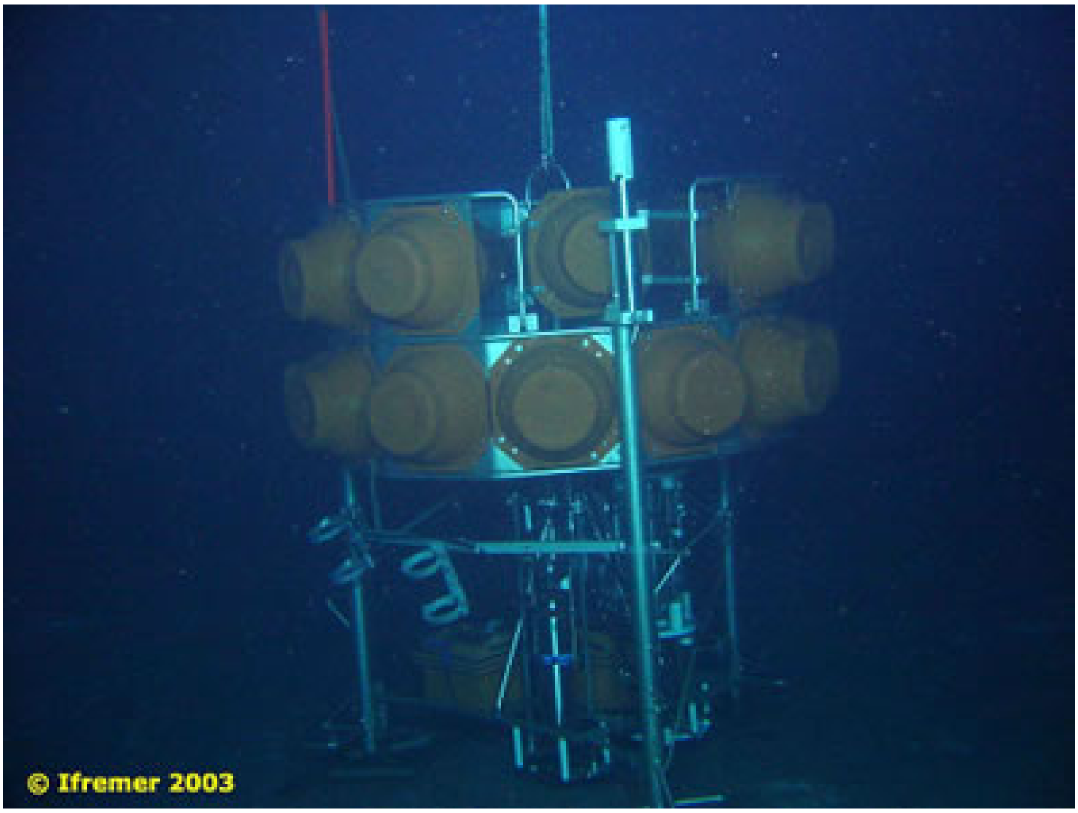
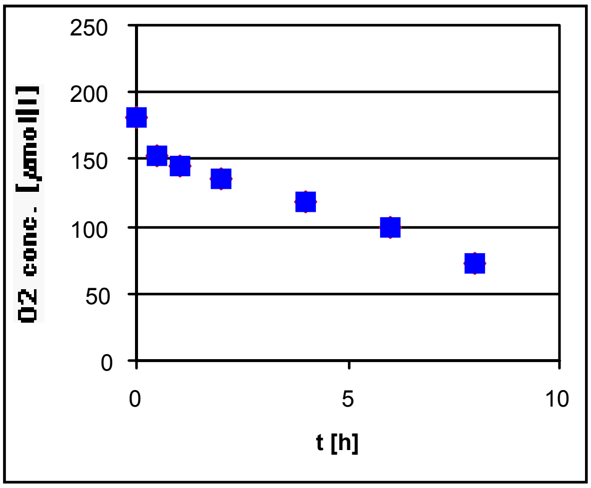


Fig. B3.5-1 The MPI lander at the sea bottom about to be moved by the ROV "Victor 6000"

First results indicate an elevated sediment community oxygen consumption at all HMMV sites as compared to the reference site, with highest oxygen consumption rates in the dense *Pogonophora*n fields. At the *Beggiatoa* sites, the decrease of oxygen concentration was accompanied by an increase of methane in the chamber water indicating a seepage of methane from these habitats (Fig. B3.5-2).

A comparison between total oxygen fluxes calculated from the chamber incubations (TOU) and diffusive oxygen fluxes (DOU) calculated from the oxygen microprofiles indicates that whereas solute transport is exclusively diffusive at the *Beggiatoa* sites, most of the oxygen flux is biologically mediated in the *Pogonophora*n fields.



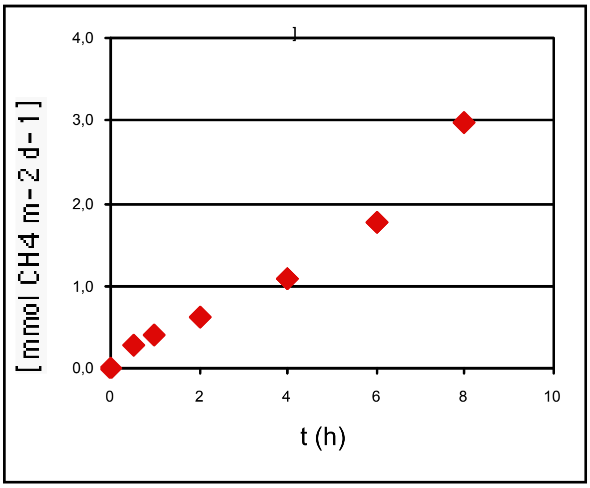


Fig. B3.5-2: Oxygen (left) and methane (right) concentrations in teh chamber water of an incubation on a *Beggiatoa* mat.

Macrofauna

In addition, the following questions were addressed:

Does the macrofauna at HMMV play an as important role for habitat structure as it does at „normal" continental slope settings ?

Does the macrofauna utilize the methane - based food chain (stable isotope analysis)?

How does the mud/ fluid flow affect the community structure of larger organisms (Macrofauna) in terms of biomass and diversity ?.

In order to address these questions, the sediments retrieved with the benthic chambers were sieved (250 µm) and the remaining organisms preserved in 4 % buffered formaldehyde. In the home laboratory, the samples will be sorted, identified to the lowest taxonomic level possible. Subsequently, the $\partial^{13}C$ signatures of each single specimen will be determined.

B. 5.4 Video Mosaicking on Håkon Mosby Mud Volcano

Jerosch, K., Vincent, A.G., Schlüter, M.

Introduction

Geo-referenced video mosaicking of the sea floor is useful to many applications. In our case, we use it to gain an understanding of the oceans' biological and sedimentological entities – especially the distribution of different habitats and mud flows at the Håkon Mosby Mud Volcano (HMMV). The ability to produce video mosaics with the help of a ROV in real time offers the advantage to control the quality of the mosaic results immediately during the dive. If necessary, steps can be taken and areas of particular interest can be determined at once and be given special attention.

Video mosaicking has been conducted for many years. At the beginning, manual mosaicking consisted in laying pictures side by side and taping them together [1]. Recently, computer-aided image processing has enabled the digital merging. The process of video mosaicking is carried out by estimating the displacement between two images of an image stream. Mosaics are then created as single large images which represent a global scene. The image stream can be a video flow coming from a camera fixed on a ROV. Moreover, navigation data of the vehicle, which the camera is fixed on, enable to provide mosaics with geo-referencing.

Materials and methods

During this cruise, geo-referenced video mosaicking was processed by the MATISSE software (Mosaicking Advanced Technologies Integrated in a Single Software Environment) [2]. This system, developed by IFREMER, operates on-line (as in our case) or off-line for post-processing of video images. The video source comes from a vertical camera fixed on the ROV "Victor 6000" and geo-referencing is provided by measured or estimated data from navigation including dead-reckoning and acoustic USBL positioning. For a matter of real-time working, even if the camera has a resolution of 795×596 pixels, we use images of an original size of 352×288 pixels to create mosaics. To improve the image quality and remove partly the halo of light due to the non-uniformity of lighting, four offsets which reduce the size of the image have to be set to get a mosaic of a better quality.

Video mosaicking surveys were carried out at a maximum altitude of 3 meters to ensure a good image quality. Since the aperture of the camera is 60°, the width of the mosaics is about the same as the altitude of survey. This means in our case that the mosaics have a width of about 3 meters. The speed of "Victor 6000" during these surveys is 0.3 m/s maximum. Indeed, video mosaicking algorithms, developed within MATISSE, are based either on feature tracking or robust optic flow methods and require a small displacement between two successive images.

All the geo-referenced mosaics are stored on-line in a hierarchical file structure: cruise/dive/session/treatment. One mosaic represents the smallest unit consisting of 500 merged images collected within each half a minute during the mosaicking process. It covers an area about 3 m x 6-7 m. And in this case one treatment consists of up to about 20 mosaics which equals an area of about 3 m x 100 m (Figure B5.4-1 and B5.4-2).

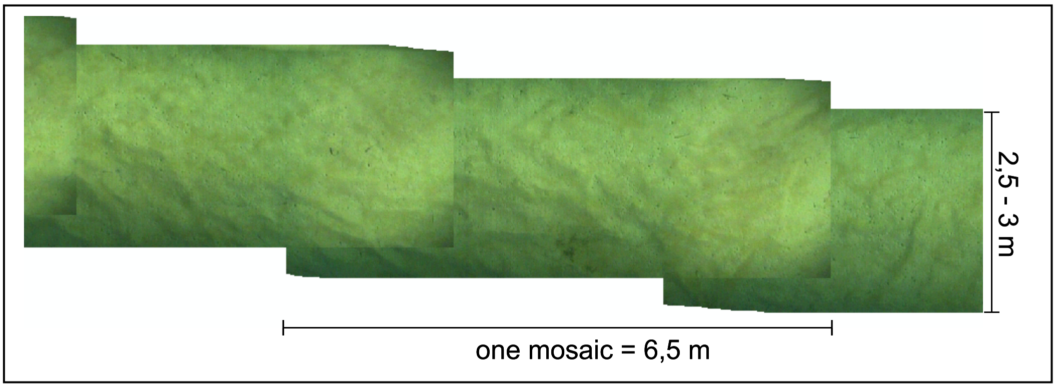


Fig. B5.4-1: This part of a treatment shows the construction of the images within the muddy region (thermal centre) of the HMMV.

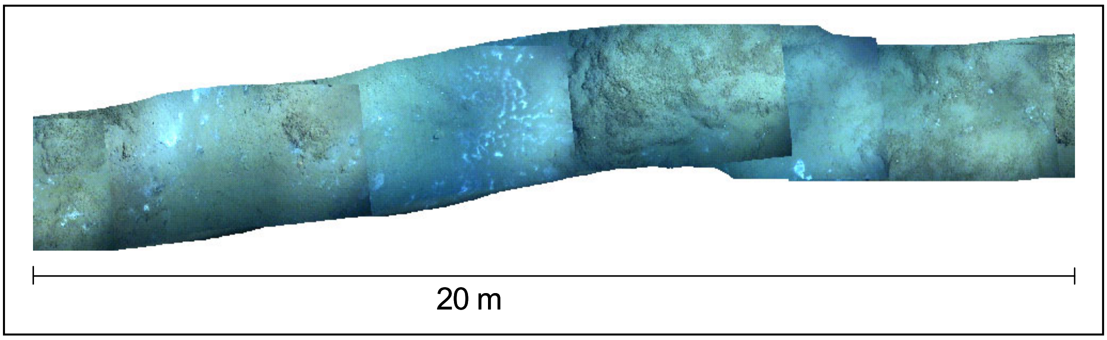


Fig. B5.4-2: Changing areas of tube worms and bacterial mats within a 20 m stripe in the north west of the thermal centre of HMMV.

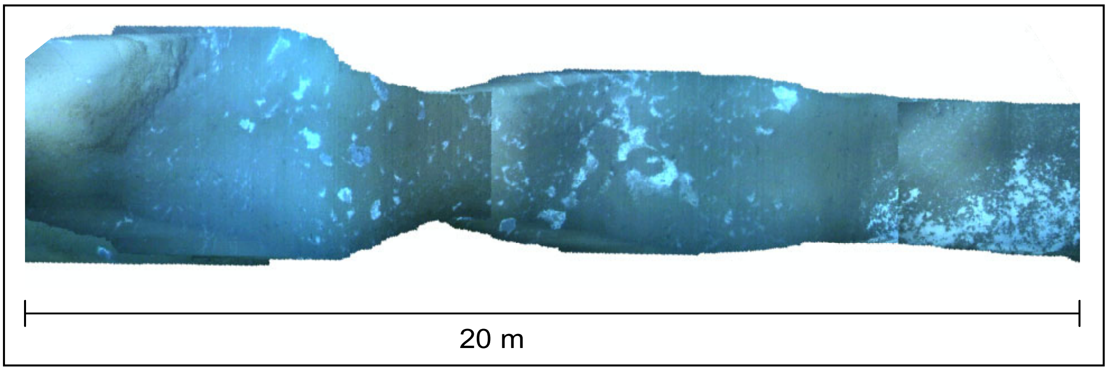


Fig. B5.4-3: Rough topography effects of pixel sizes during the real time video mosaicking.

The quality of the mosaics depends on several conditions including different lightings (differences are easily to recognize comparing figures B5.4-1 and B5.4-2) as well as the varieties of pixel sizes (when the camera had to record a rough topography) (figure B5.4-3). The geo-referenced mosaics can be visualized and queried station-temporally within a geographical information system (GIS) and together with other collected data it will be possible to receive a multidisciplinary view of HMMV.

Results

Video mosaicking was conducted during six of the seven dives of "Victor 6000". Finally data were collected for 51.5 hours – this equals about 37 km stripes 3 meter wide and covering an area of 0.111 km² (Table B5.4-1).

Tab. B5.4-1: Some features of the video mosaicking surveys of the different dives of "Victor 6000"

Station_No	ID_Dive	ID_VM	Start (Date, UTC)	End (date, UTC)	DVD No	Duration	Positioning
PS64/317-1	219	1	28/06/03, 23:08	29/06/03, 09:16	0219/101-107	10h 08min	USBL
PS64/326-1	220	2	01/07/03, 01:25	01/07/03, 11:41	0220/101-106	10h 16min	USBL
PS64/326-1	220	2b	01/07/03, 23:30	02/07/03, 03:08	0220/113-115	03h 38min	USBL
PS64/347-1	222	4	06/07/03, 23:08	07/07/03, 08:17	0222/106-110	09h 09min	Dead-reckoning
PS64/347-1	222	4b	07/07/03, 14:27	07/07/03, 19:00	0222/115-116	04h 33min	Dead-reckoning
PS64/359-1	223	5	09/07/03, 16:52	09/07/03, 17:34	0223/102-103	42min	Dead-reckoning
PS64/347-1	224	6	12/07/03, 20:01	13/07/03, 07:38	0224/113-118	11h 37min	Dead-reckoning
PS64/398-1	225	7	16/07/03, 11:00	16/07/03, 11:40	0225/101	40min	Dead-reckoning
PS64/398-1	225	7	17/07/03, 00:54	17/07/03, 01:26	0225/106	32min	Dead-reckoning

Considering the observed 5000 m² video and still photo material of Milkov et al. which covered 0.5 % of the edifice of the mud volcano [3], it should be emphasised that the new data set is 20 times more extensive and covers more than 10% of the sea-floor area. Fig. B5.4-4 represents the tracks of the mosaics and shows the full extend of the video mosaicking surveys.

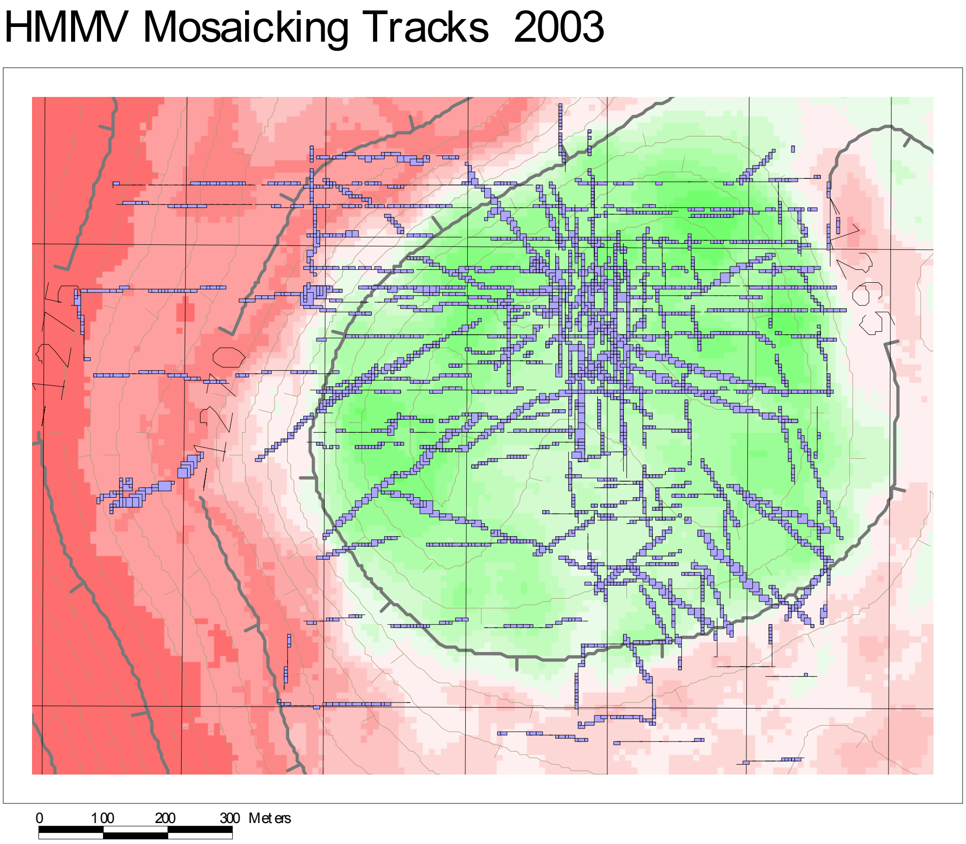


Fig. B5.4-4: Frames of the video mosaicking images during the cruise PS64.

This very successful data collection will deliver an insight into the habitats of the Håkon Mosby Mud Volcano better than before. The mosaics will be analysed for habitat types according to Milkov et al., 1999: smooth mud, mud with holes, mud with ripples, mud with relief, seafloor with bacterial mats (*Beggiatoa*), seafloor with tubeworms (*Pogonophora*) with a comparable method like in Bergmann (this issue).

References:

[1] Pollio, J. (1968): Stereo-photographic mapping from submersibles. In SPIE: Vol. 12, pp 67-71. U.S. Naval Oceanographic Office, Deep Vehicle Branch.

[2] Vincent AG, Pessel N, Borgetto M, Jouffroy J, Opderbecke J, Rigaud V: Real-Time Geo-Referenced Video Mosaicking with the MATISSE System. Oceans'03, September 2003, To appear.
[3] Milkov, A.; P. Vogt; G. Cherkashev (1999): Sea-floor terrains of Håkon Mosby Mud Volcano as surveyed by deep-tow video and still photography. Geo-Marine Letters Vol. 19, pp 38-47. Springer-Verlag.

B. 5.5 Mapping of (fish) habitats at the Håkon Mosby Mud Volcano

Bergmann, M.

In 1996, a Russian expedition of the RV "Professor Logachev" acomplished a first description of habitats at the Håkon Mosby Mud Volcano (HMMV) using deep-tow photography and video imagery (Milkov *et al.,* 1999). Apart from *Pogonophora* and *Beggiatoa*, *Lycodes* spp. constituted the most abundant fauna at HMMV. Here, we use advanced techniques of the "Victor 6000 6000" system to describe habitats along transects and estimate the abundance of demersal fish in different habitats. The aim of this study was to determine possible fish-habitat associations.

1. Habitat mapping

Victor 6000 undertook six dives in total for habitat-mosaicking purposes (for details on dives see Jerosch *et al*., this issue). Each mosaicking period had a duration of approximately 10-12 h with "Victor 6000" (at 0.3 m s^{-1}). Mini-films were created from DVDs using the software Adélie (©IFREMER). Adélie extracted one frame per minute from each DVD, which was then analysed in terms of habitat, abundance of fish and other obvious fauna. Each picture was analysed for the two predominant habitat types and the presence of isolated *Beggiatoa* spots was also recorded: >50% coverage = habitat 1, <50% coverage habitat 2.

The following categories were used for habitat classification (modified after Milkov *et al.*, 1999):

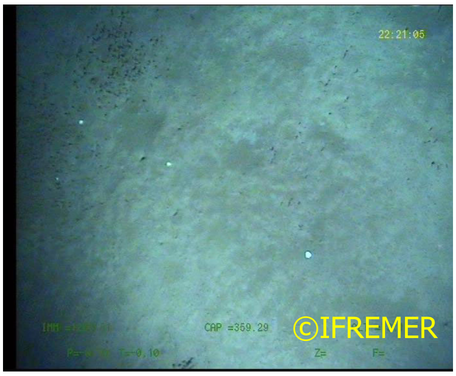


Fig. B5.5-1: smooth mud

Fig. B5.5-2: mud with holes

Fig. B5.5-3: mud with ripples

Fig. B5.5-4: *Beggiatoa* mats

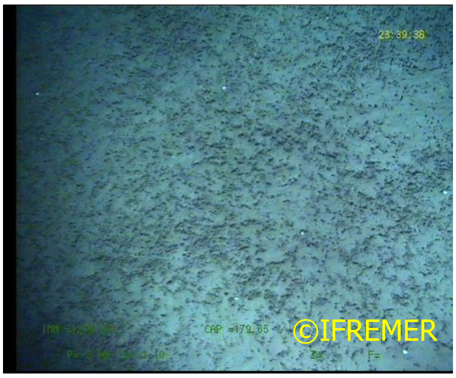


Fig. B5.5-5: *Pogonophora*

The fish observed in each picture were then counted along with rays, brittlestars, starfish and other fauna. The geo-referenced data of the first dive (PS64/347-1) was mapped (Fig. B5.5-6). The highest *Lycodes* densities were recorded at the centre of the volcano and in an area south of the centre. Further conclusions can be drawn by overlaying fish abundance with environmental data (e.g. sedimentology, habitat, and bathymetry). The area of high *Lycodes* density in the centre, for example, appeared to coincide with a site where the highest temperatures were measured by Kaul and Heesemann (B. 3.1.1) during this cruise.

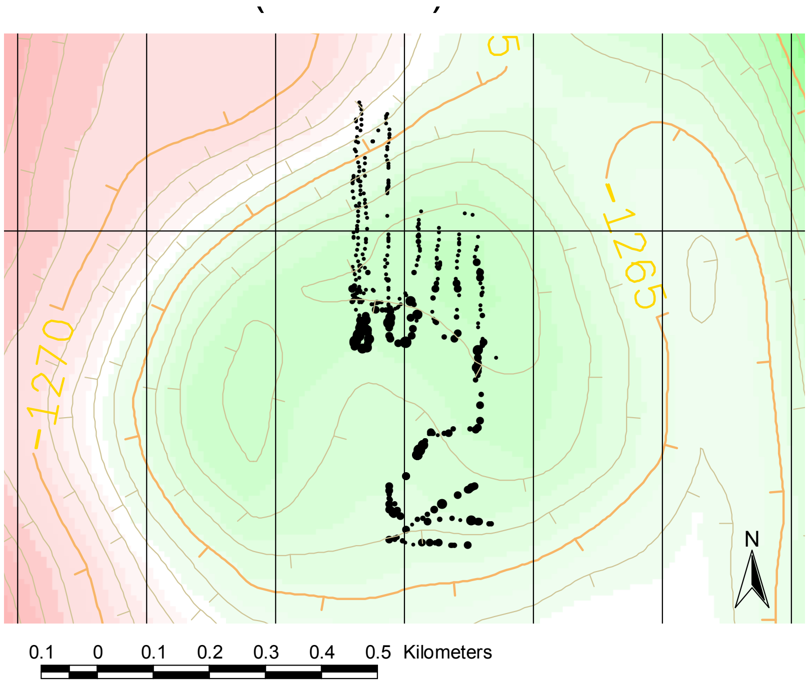


Fig. B5.5-6: Abundance of demersal fish along "Victor 6000" transect 219 (PS64/347-1).

2. Exploring possible fish-habitat associations

A total of 560 images was analysed and the mean abundance of fish in different habitats calculated (Fig. B5.5-7). A Kruskal-Wallis test indicated that there were significant differences in the abundance of fish in different habitats (H= 291.28, df = 4, p = 0.000).

Two attempts to catch fish with traps either deployed on the sea floor by "Victor 6000" (PS64/326-1) or attached to the bottom of a benthic lander 'only' yielded large numbers of scavenging amphipods. The first (14.5h) deployment of two funnel traps baited with whiting yielded 659 amphipods, two large shrimps and calanoid copepods that were kept for taxonomic work (P.Geoffrey Moore). The following Lyssianassoids were preliminarily identified (by Claude de Broyer) from a sub-sample: *Anonyx nugax*, *Boeckosimu*s spp., *Orchomenopsis* sp., *Tmetonyx* spp. In another attempt to catch fish, ten modified traps (trap entrance consisted of a net with a 4cm plastic ring instead of a funnel) were attached to a benthic lander and deployed on the sea floor for 17h at a depth of 1288m. Each trap contained whiting in bait bags made of nylon material to prevent the fish from feeding. The content of the traps was identified and counted (Table B5.5-1). Fifteen amphipods were kept for radio-stable isotope analysis and genetic work (Patrick Martin).

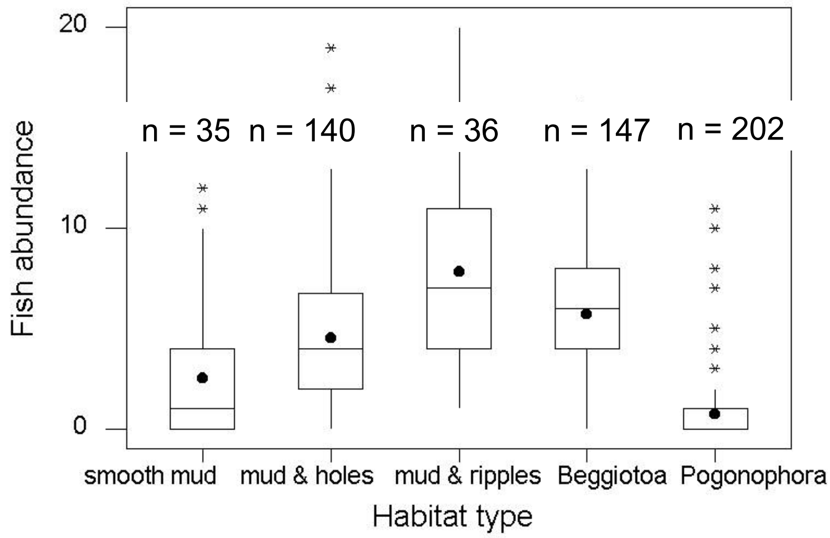


Fig. B5.5-7: Abundance of demersal fish in different habitats at HMMV (PS64/347-1)

The whole bait was consumed down to the skeleton. The camera attached to the lander recorded a large number of amphipods similar to those trapped swimming around the trap and crawling in and out of it.

Table B5.5-1: Contents of traps attached to benthic lander (PS64/349-1)

Trap no.	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	Total
No of amphipods	2	0	0	0	0	6	5	6	0	0	19

Owing to technical problems only one fish could be caught with the "Victor 6000" slurp gun to investigate possible dietary links with particular habitat types. This specimen and one individual that had been accidentally caught by a multicorer will be analysed in terms of trophic status (^{15}N radio-stable isotope analysis) and stomach contents analysis.

In addition, one sample was taken with a giant box core (PS64/344-1) on *Pogonophora* grounds for taxonomic work and analysis of bivalve shell growth increments. Together with data from fish stomach contents analysis this could provide a measure of prey selectivity. Furthermore, a sub-sample of *Pogonophora* was frozen for radio-stable-isotope analysis as a possible baseline for the fishes trophic level.

References

Milkov, A., Vogt, P., Cherkashev, G., Ginsburg, G., Chernova, N., Andriashev, A., 1999. Sea-floor terrains of Håkon Mosby Mud Volcano as surveyed by deep-tow video and still photography. Geo-Mar. Lett. 19, 38-47.

Acknowledgements

I would like to thank Laurent Mear from IFREMER and Kerstin Jerosch (AWI) for their help with Adélie and GIS. Jan Wegner kindly helped with the preparation of the lander. Claude de Broyer kindly identified amphipods caught by the traps.

B. 5.6 The macro- and microscale patchiness of meiobenthos associated with the Håkon Mosby Mud Volcano.

Vanreusel, A.

Introduction

Participation to the ARK XIX/3b cruise to the Håkon Mosby Mud Volcano fits within a larger PhD project that aims at understanding the importance of different topographical structures on the seafloor for the present diversity patterns of meiofauna, and in particular Nematoda along European continental margins (between 500 and 1500m water depth). It will be investigated to what extent the local (alpha) and regional (gamma) biodiversity increase in relation to the large topographic structures such as mounds and banks, and in relation to biogenic and biochemical gradients present along pock marks, seeps and mud volcanoes. Along these seafloor structures, estimations will be made of the species turnover (beta diversity) of the Nematoda (the frequency by which species appear of disappear along a gradient in the habitat), and to what extent nematode species do show special adaptations to these extreme environments. Also small scale patchiness will be examined, in order to estimate its importance for the present local biodiversity.

The aim of the sampling campaign was therefore threefold :

To sample the meiofauna (metazoans smaller than 1 mm) in order to investigate changes in densities, biomass, size spectra, taxonomic composition and biodiversity (morphological and molecular):

1. along a microscale gradient (meter to centimetre scale) at the *Beggiatoa* and *Pogonophora* fields at the HMMV

2. along a macroscale gradient (100 meter scale) through a transect covering the different habitats in terms of the presence of oxygen, sulphide and methane (methane rich centre, *Beggiatoa* area, *Pogonophora* area and background sediments)
3. at the HMMV as the most northern site of a latitudinal gradient covering the European Margins.

Sampling

Cores were collected either by a video guided multi-corer (MUC) or by the ROV "Victor 6000". The Multicore samples were collected in the framework of the macro-scale analysis, while the push cores deployed by the ROV "Victor 6000" allowed sampling for a micro-scale gradient at cm to m scale.

MUC

The MUC was deployed in different habitats recognized at the HMMV by means of video observations. Cores retrieved from one deployment are considered to be pseudo-replicates, therefore we aimed at retrieving cores from as much deployments as possible within one habitat, which was achieved in most cases. In total 3 deployments were aimed for at respectively the centre, the *Beggiatoa* area, the *Pogonophora* site, the mixed active northern area, the outer rim and background sediments (at 1 mile and at about 30 miles). In total 8 cores (90 mm in diameter) were collected at each deployment From these, 2 cores were assigned to UGent in most cases. In some cases 2 or even only 1 MUC deployment was achieved per habitat. In that case up to 4 or 5 cores were assigned to UGent.

All cores retrieved by the MUC were sliced in horizontal layers of 1 cm high, up to 5 cm in the sediment. For each habitat at least one core was sliced up to 10 cm in the sediment. For each core pictures were taken and visual colour profiles or particular features were described in detail. All samples collected for meiofauna were fixed in a borax neutralized formaldehyde solution of 4 %. At each habitat, also at least one core was sliced and put into the -30° freezer for further analysis of relevant environmental characteristics including granulometry, org C/N and possibly pigment analysis. At each habitat at least one core was fixed with acetone for molecular analysis.

ROV "Victor 6000"

The ROV "Victor 6000" allowed to collect in total up to 24 cores (25 cm²) of which 3 to 6 cores were assigned to Ghent during 5 dives. Also here all three different habitats from the HMMV were aimed at to sample. In the bacteria area the sampling was random within a small area (of maximum 4 m²) although completely covered *Beggiatoa* patches were selected each time. At the *Pogonophora* area, and the northern active site with mixed habitats, a micro-scale gradient was selected from inside a dense *Pogonophora* patch to a less covered area, bare mud and finally a mixed sample of *Beggiatoa* and *Pogonophora*. Cores collected by "Victor 6000" were always fixed as bulk in formaldehyde (4 %).

Results

No analysis were done on board since meiofauna in fine sediment needs extraction by centrifugation in a density gradient. Some sediment from in between the *Pogonophora* was checked for the presence of meiofauna, and these small amounts already proved the presence of several specimens belonging to different species.

By return to the laboratory, the samples will be processed, meiofauna will be counted and identified up to higher taxa level while nematodes will be identified up to species level and biodiversity estimated. The following hypotheses will be tested:

The presence of a topographic structure or chemical gradients in the deep-sea changes the meiobenthic community structure and results in an increased regional diversity. Through community analyses by means of multivariate statistics, species turnover will be established along a gradient from the summit of the volcano, along the slope, the outer rim, until the background sediments. 2. The presence of a small scaled biogenic structure in or on the sediment results in a change of the community structure by which the local diversity increases. All samples collected in the framework of the first hypothesis are summarized in Table B5.6-1. In total 5 micro-gradients were sampled as summarized in Table B5.6-2

During the last dive an additional sampling was done. When reaching the seafloor large amounts of dead Gadiidae fish were observed. Taking the opportunity of this natural experiment in order to investigate the response of the fauna to this event, samples were collected at 50, 20 and 2 cm from the 60 cm long fish.

Table B5.6-1: Co-ordinates of MUC samples collected for macro-scale patchiness of meiofauna

date	Longitude	Latitude	Station nr	habitat	# cores Formol	#cores Aceton	# cores freezer
28/06	72 0 25	14 43 49	64/312	Centre	1		
28/06	72 0 26	14 43 49	64/313	Centre	1		1
28/06	72 0 25	14 43 54	64/314	Centre	1	1	
30/06	72 0 17	14 43 85	64/321	*Beggiatoa*	1		1
30/06	72 0 18	14 43 85	64/322	*Beggiatoa*	1	1	
30/06	72 0 18	14 43 81	64/324	*Beggiatoa*	2		
8/07	72 0 37	14 43 52	64/353	Active	2	1	1
8/07	72 0 05	14 44 18	64/356	*Pogonophora*	2		
8/07	72 0 05	14 44 14	64/357	*Pogonophora*	1		1
10/07	72 0 21	14 42 47	64/362	Outer rim	2		
10/07	72 0 23	14 42 47	64/363	Outer rim	2		1
10/07	72 0 05	14 44 04	64/367	*Pogonophora*	2	1	1
15/07	71 41 96	13 26 10	64/390	Reference 2	3	1	1
15/07	71 85 97	14 45 41	64/395	Reference 1	3		1

After removal of the fish 4 cores were collected from underneath it, in order to look for the disturbance or enrichment effect on the present microbiota (Corinna Kanzog, AWI) and meiofauna (UGent). This experiment was done in collaboration with Michael Klages (AWI).

Table B5.6-2: Co-ordinates of ROV push cores collected for micro-scale patchiness of meiofauna.

date	Long. N	Lat. E	Dive nr	Habitat 1 Core nr	Habitat 2 Core nr	Habitat 3 Core nr	site
29/06	72 0.163	14 43.880	219	4-*Beggiatoa*	5- *Beggiatoa.*	1 - *Beggiatoa*.	
1/07	72 0.004	14 43.875	220	3 -# pogonophora.	5- *Beggiatoa.*	6- Few pogo	
7/07	72 0.360	14 43.558	222	12-few pogonophora	11 –Sed.	10-*Beggiatoa*	Active N
13/07	72 0.360	14 43.546	224	23-few pogonophora	28-Few pogo	22- *Beggiatoa*	Active N
16/07	72 0.169	14 42.180	225	6- at 20 cm fish	9-at 50 cm fish	11-at 2 cm fish	
				12 – below fish	23-below fish	22-below fish	

Acknowledgements

I would like to take the opportunity to thank first of all Michael Klages for his perfect organisation and coordination of the cruise. I thank Antje Boetius for all the effort she has spent in organising the coring and all her other input on board, including introducing us in the HMMV microbiology. Norbert Lensch and Tom Feseker took great care of the MUC sampling. Jan Wegner provided us with video images on the MUC deployments *in situ*, which will make blind sampling never the same again. The people of Genavir are thanked sincerely for anticipating maximally to our scientific wishes. The crew of *"Polarstern"* for their continuously help and taking care. All participants of the ARK XIX/3b for their pleasant company. And last but not the least Melanie Bergmann and also Natalia Kukina, for helping me in processing the mud.

C. Cruise leg ARK XIX/3c: Interdisciplinary research at the deep-sea long-term station AWI-"Hausgarten" – an Introduction

Soltwedel, T. and the shipboard scientific party

The deep sea represents the largest ecosystem on earth. Due to its enormous dimensions and inaccessibility, the deep-sea realm is the world's least known habitat. To understand ecological ties, the assessment of temporal variabilities is essential. Only long-term investigations at selected sites, describing seasonal and interannual variations, can help to identify changes in environmental settings determining the structure, the complexity, and the development of deep-sea communities. The opportunity to measure processes on sufficient time scales will also help to differentiate between natural variabilities and environmental changes due to anthropogenic impacts.

High latitudes are amongst the most sensitive environments in respect to climate change, a fact urgently demanding the assessment of time series especially in polar regions. AWI-"Hausgarten" represents the first and only deep-sea long-term station at high latitudes. Following a pre-site study using the French ROV "Victor 6000", "Hausgarten" was established in summer 1999 in the eastern Fram Strait west off Spitsbergen (Fig. C1). Beside a central experimental area at 2500 m water depth, we defined 9 stations along a depth transect between 1000 - 5500 m, which are revisited yearly to analyse seasonal and interannual variations in biological, geochemical and sedimentological parameters. During ARK XIX/3c the number of permanent stations was increased to a total of 15 stations by introducing additional sampling sites along a latitudinal transect following the 2500 m water depth isobath (Fig. C1).

To characterise and quantify organic matter fluxes to the seafloor, we use moorings carrying sedimentation traps, which were replaced during ARK XIX/3c (see Chapter C. 1). The exchange of solutes between the sediments and the overlaying waters as well as the bottom currents were studied to investigate major processes at the sediment-water-interface. A micro-profiler, being positioned and activated by the ROV, was used to assess the oxygen consumption by the benthic community (see Chapter C. 2). Gradients in oxygen were also measured from bottom water samples in order to quantify interfacial solute fluxes (including nutrients) and metabolic rates in the benthic boundary layer. These investigations were completed by the use of an acoustical current meter, handled by the ROV.

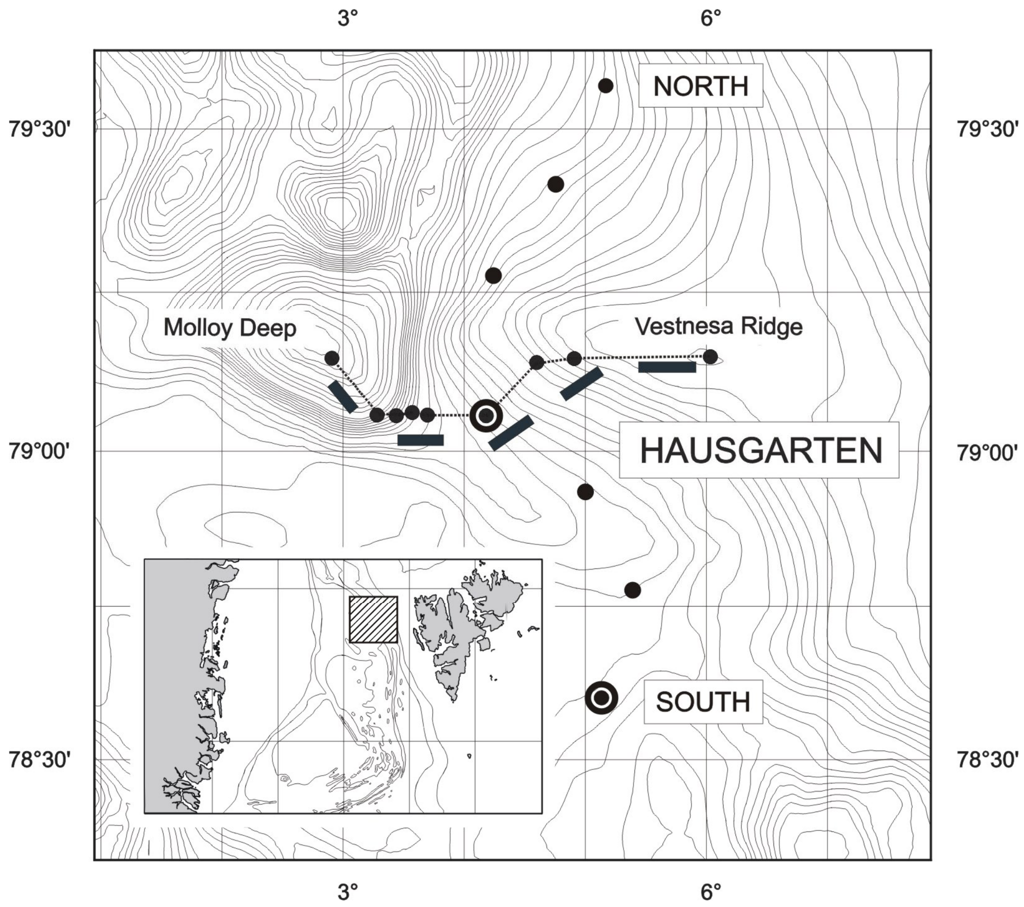


Fig. C1: Deep-sea long-term station AWI-"Hausgarten", west off Spitsbergen

(●: sampling sites; ⊙: experimental areas; ▬ : optical surveys).

A multiple corer was used to retrieve virtually undisturbed sediment samples. Vertical gradients of nutrients, C_{org} contents, C/N ratios, porosity and other geochemical parameters were determined to characterize the geochemical milieu of the upper sediment layers (see Chapter C. 2). Near-surface sediments are also sampled with the giant box corer for sedimentological, mineralogical and micropaleontological investigations, to assess source areas for the sediments (see Chapters C. 3 - 5).

A special project during RV “Polarstern” expedition ARK XIX/3c dealt with optical surveys on anthropogenic debris in the “Hausgarten” area (see Chapter C. 6).

Biogenic sediment compounds were analysed to estimate activities (e.g. bacterial exo-enzymatic activity) and total biomass of the smallest sediment-inhabiting organisms (see Chapter C. 7). Results will help to describe the eco-status of the benthic system. The quantification of benthic organisms from bacteria to megafauna was a major goal in biological investigations (see Chapters C. 8 - 13).

A number of *in situ* experiments installed in 1999 and 2001, and terminated during ARK XIX/3c will help to identify factors controlling the high biodiversity in the deep sea (see Chapter C. 14).

C. 1 Particle flux and phytoplankton

Bauerfeind, E.

The transfer of organic material produced in upper water column to the deep waters and finally the sediments of the deep sea is a crucial process, as this organic matter is the major food source for deep-sea organisms. To get insights into the amount and composition of the sedimenting material sediment traps were installed in the area of AWI-“Hausgarten” during FS “Polarstern” cruise ARK XVIII in 2002 (FEVI-3) and during ARK XIX/1b in spring 2003 (FEVI-4). These traps were successfully recovered and another mooring with 3 sediment traps was installed at 79°01.00’N / 4°19.99’E. Samples from two depths (260 m) and 2310 m (~ 150 m above the seafloor) could be obtained from the mooring FEVI-3, whereas from the mooring FEVI-4 only samples from the shallow trap in 340 m were obtained. The amount of material collected in the bottles of the long-term mooring clearly show a seasonal pattern as well as differences between the two sampling depths (Fig. C1-1). In 260 m somewhat higher fluxes can be deduced during the period August-October 2002, very low sedimentation seemingly occurred after this period till March/April 2003 when the amount of material intercepted by this trap started to increase again showing highest amounts in the period end of May/June when the sampling ended. In 2310 m much less material than in the shallow sediment trap was collected and also no increase in summer/autumn is obvious. Increasing fluxes in this depth occurred in June 2003, ~ 6 weeks after the increase occurred in the shallow trap at 260 m. In the shallow trap of the mooring FEVI-4, that sampled with a high time resolution of 4 days from end of April 2003 until the middle of July 2003 an increase in the collected material is obvious at the beginning of June, declining afterwards till the last sampling event in the middle of July when the amount of material in the collection jars started to increase again. From this visual inspection of the sampling jars only a rough impression can be obtained, more detailed information will be obtained after detailed chemical, biochemical and microscopic analysis of the samples later on.

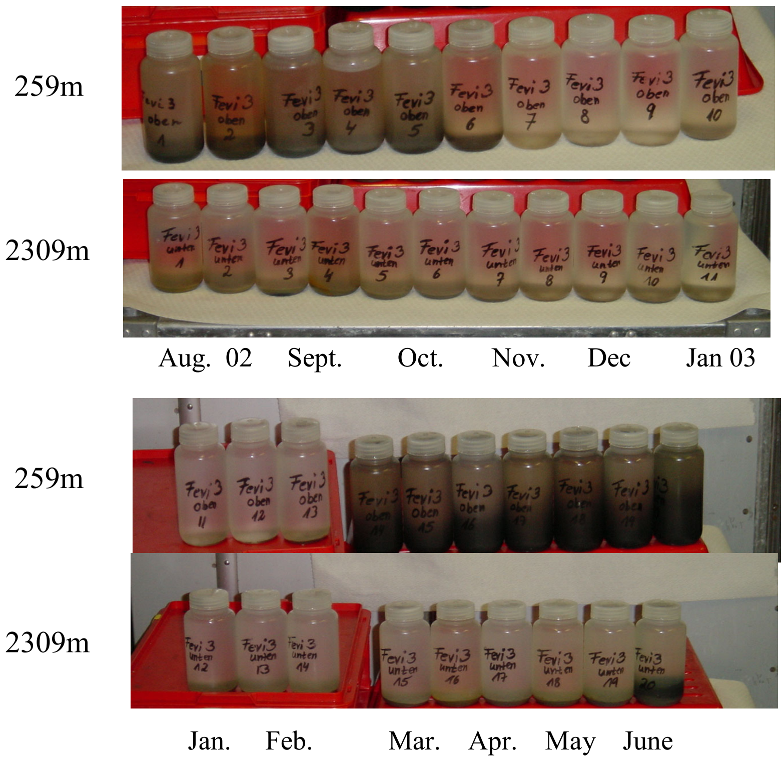


Fig. C1-1: Bottles filled with sedimented material from the two traps of mooring FEVI-3.

At the position of the moorings a CTD profile from the surface to the seafloor was carried out and water samples were taken at 16 depths and filtered for the analysis of Chl. *a*, seston, particulate organic carbon and nitrogen and the determination of biogenic Si as well as species composition of the phytoplankton. Along the “Hausgarten” depth transect samples were also taken from the bottom water sampler for measurements of the parameters mentioned above. All these analyses will be carried out after the return to the land based laboratory.

Samples with a phytoplankton net (25 μm) from the top 15 m of the water column were taken during the cruise at several stations. A first analysis of the material revealed that diatoms dominated the phytoplankton composition (Tab. C1-1). *Rhizosolenia hebetata* and *Chaetoceros decipiens* were the species that occurred in higher abundances at almost every station sampled. Details are presented in Table C1-1. Besides diatoms the silicoflagellate *Distephanus speculum* were found regularly and occasionally also colonies and single cells of *Phaeocystis* were present.

Tab. C1-1: Abundant phytoplankton species during cruise ARK XIX/3c.

Rhizosolenia hebetata	xxx
Rhizosolenia hebetata f. *semispina*	xx
Rhizosolenia borealis	x
Rhizosolenis alata	x
Chaetoceros decipiens	xxx
Chaetoceros socialis	x
Chaetoceros convolutus	xx
Chaetoceros furcellatus	x
Chaetoceros sp. (small)	x
Eucampia groenlandica	x
Thalassiosira nordenskioeldii	xx
Thalassiosira antarctica	x
Fragillariopsis cylindrus	xx
Phaeocystis	x
Distephanus speculum	xx

C. 2 Geochemical and hydrodynamic investigations at the sediment-water interface

Sauter, E., Baumann, L., Wegner, J., Delius, J.

In close interdisciplinary co-operation with the benthos biology and geology group the geochemical investigations of the sedimentary and near-bottom environments at the “Hausgarten” area west of Svålbard were performed. Scientific aim is the description of gradients in geochemical parameters close above and below the sediment/water interface. Those gradients are planed to be interpreted in close comparison to benthic habitat properties (e.g. species distribution and abundances) and the geological setting (e.g. sediment stratification).

For this purpose the central “Hausgarten” station at 2500 m water depth amongst the stations along the east-west depth transect from 1200 to 5500 m depth as well as of the north-south transect at about 2500 m depth have been sampled by multi corer and bottom water sampler. In addition, having the opportunity for targeted sampling and *in situ* measurements by means of “Victor 6000”, the focus was laid on micro profile measurements and high precision acoustic current measurements.

Vertical gradients of nutrients, C_{org} content, C/N ratio, porosity and other geochemical parameters will be determined from sediment samples taken at the stations indicated in Tab. C2-1 in order to characterize the geochemical milieu in which the organisms, analysed by the biology group, live. The oxygen concentration was determined by Winkler titration, immediately after sampling of the supernatant bottom water and the bottom water sampler, respectively (Tab. C2-1). Nutrient gradients will also be analysed from the bottom water samples in order to quantify interfacial solute fluxes and rates metabolism.

Special emphasis was laid on the exact measurement of oxygen micro gradients below the sediment/water interface. For this purpose a deep-sea micro profiler (MIC) has been modified to fit into the shuttle lander and to be operated by the ROV at the seafloor (Fig. C2-1). A switch operated by the ROV allows keeping the system down at the sea floor for several individual measurements. Due to its small dimensions MIC can be placed precisely by the ROV. Thus, the system was deployed at one of the disclusion experiment sites, where the sediment was covered by a cage for 4 years.

Micro profiles of O_2 but also of pH, H_2S, and electrical resistivity have been successfully measured on a covered as well as on an uncovered field in close vicinity. Unfortunately, MIC had to stay at the seafloor for 6 days due to ice coverage of the central “Hausgarten” station that prohibited the recovery by shuttle. Consequently, the instrument could not be deployed further on at other experimental sites.

Tab. C2-1: Sediment and pore water sampling for further geochemical investigation.

Station	Date	Gear	Comment	Sed.samples	Pore water	Bottom water
PS64/401-1	21.07.03	BWS				6
PS64/402-1	21.07.03	MUC		12	12	2
PS64/406-1	21.07.03	BWS				6
PS64/407-1	21.07.03	MUC	Kern # 4	12	12	2
PS64/413-1	23.07.03	BWS				6
PS64/414-1	23.07.03	MUC		12	12	2
PS64/419-1	24.07.03	MUC		12	12	2
PS64/426-1	25.07.03	BWS				6
PS64/429-1	26.07.03	MUC	Kern # 1	12	12	2
PS64/433-1	26.07.03	BWS				6
PS64/434-1	26.07.03	MUC		12	12	2
PS64/435-1	27.07.03	ROV	PC # 11	10	10	2
PS64/444-1	28.07.03	BWS				6
PS64/445-1	28.07.03	MUC		12	12	2
PS64/449-1	29.07.03	BWS				6
PS64/453-1	31.07.03	MUC		12	12	2
PS64/458-1	01.07.03	ROV	PC # 20	9	9	2
PS64/459-1	01.07.03	BWS				6
PS64/464-1	02.07.03	MUC	Kern # 3	9	9	2

Since the interfacial exchange of solutes strongly depends on the current milieu, the geochemical investigations were complemented by current measurements within the near-bottom water column. This was performed by means of an acoustic current meter of the type MAVS3 from Nobska Instruments, able to resolve currents down to 0.3 cm/s (Fig. C2-2). The high precision device consisting of a current meter, sensors for tilt, salinity and temperature as well as a compass was deployed by “Victor 6000” taking it for several minutes in different distances above the sea bottom and natural current obstacles, respectively.

Fig. C2-1: The *in situ* O_2 micro profiler (MIC) being taken out of the shuttle lander by the ROV.

These measurements have been performed in close co-operation with benthos biological investigations as well.

Fig. C2-2: Acoustic current meter being deployed close above the seafloor by means of the ROV.

The current regime luff and lee side of a large drop stone has been measured before sediments were taken at these locations around the drop stone. By doing so it is expected to get further information about the influence of bottom currents on the benthic fauna

C. 3 Sedimentation at the western Svålbard margin

Matthiessen, J., Kunz-Pirrung, M., Pirrung, M.

The "Hausgarten" area is located at the western Svålbard continental margin from 78°- 80° N which is characterized by a complex morphology. Plate tectonic activity and glacial erosion and deposition led to pronounced topographic gradients with prograding deep-sea fans, ridges and troughs, of which the Molloy Hole is the deepest depression in the Arctic realm. Pelagic sedimentation at continental margins, in general, is principally overprinted by a lateral influx of material from the shelves. In the "Hausgarten" area, cross-shelf troughs off Kongsfjorden and Isfjorden are important conduits for transport of water and sediment from the coastal area to the slope. Slope instability may subsequently trigger gravity flows, in particular during times of low sea level stand. The depositional conditions in the eastern Fram Strait are further complicated by specific local conditions, related to sea-ice cover, water mass exchange between the Arctic Ocean and the Nordic Seas, and deep-water formation resulting in a spatial and temporal heterogeneity of sediment composition and distribution. The northward flowing West Spitsbergen Current (WSC) may meridionally advect lithogenic and biogenic matter from the Norwegian Sea. Sediment may be supplied from Storfjorden south of Spitsbergen, when dense sediment-loaded cold water cascades descend downslope and are entrained in the WSC. Bottom water exchange may particularly occur via the "Hausgarten" area east of Hovgaard Ridge. The Transpolardrift may transport sea ice and sediments from the Siberian Arctic to the Fram Strait. These processes are documented in a number of geological records from the past 10.000 to 15.000 years (Hebbeln et al., 1994; Andersen et al., 1996) but their importance in the modern environment has not been evaluated. Sedimentological investigations during expedition ARK XIX/3c therefore concentrated on sampling of surface and near-surface, to study the large-scale depositional environment in the "Hausgarten" area.

During ARK XIX/3c, bottom sediment sampling was conducted by means of multicorer (MUC) and large box corer (GKG) along the standard "Hausgarten" transect, and along a N-S transect in approximately 2500 m water depth (Fig. C3-1). In total, 19 MUC and 28 GKG were deployed at 17 locations of which 15 MUC and 12 GKG were sampled at 14 locations for sedimentological and related studies (Tab. C3-1). Ice-rafted debris (IRD) was analysed from 28 stations of 14 locations and 2 samples from "Victor 6000" dive # 229 (see chapter C. 5, Pirrung et al.). Additionally, photos were taken of the sediment surface and the profile of most box cores. The lithology of selected box cores was described visually by Kukina (chapter C. 4).

Various methods will be applied to describe the modern sedimentation in the "Hausgarten" area. Granulometric and x-radiograph analyses may reveal information on processes such as gravity flow, bottom current activity and sedimentation from sea ice and/or icebergs. X-radiograph analyses will further provide supplementary information on internal sedimentary structures indicative for e.g. benthic activity. Sedimentation rates will be calculated from radionuclide analyses including radiocarbon dating (^{210}Pb, ^{137}Cs, ^{14}C). Sources and transport pathways of sediments will be characterized by magnetic suceptibility, bulk mineralogy and clay mineralogy as well as gravel analysis. The composition and source of organic matter will be derived from analyses of bulk organic matter, and of selected biomarkers such as fatty acids, sterols and alkanes. These data will be compared with sediment trap data to evaluate the significance of selective degradation on organic matter while settling through the water column. Micropaleontological analyses on e.g. diatoms and dinoflagellate cysts together with carbonate and opal contents will finally give information about environmental conditions such as sea-ice cover, advection of water masses and sediments and sediment source areas on centennial to millennial time scales.

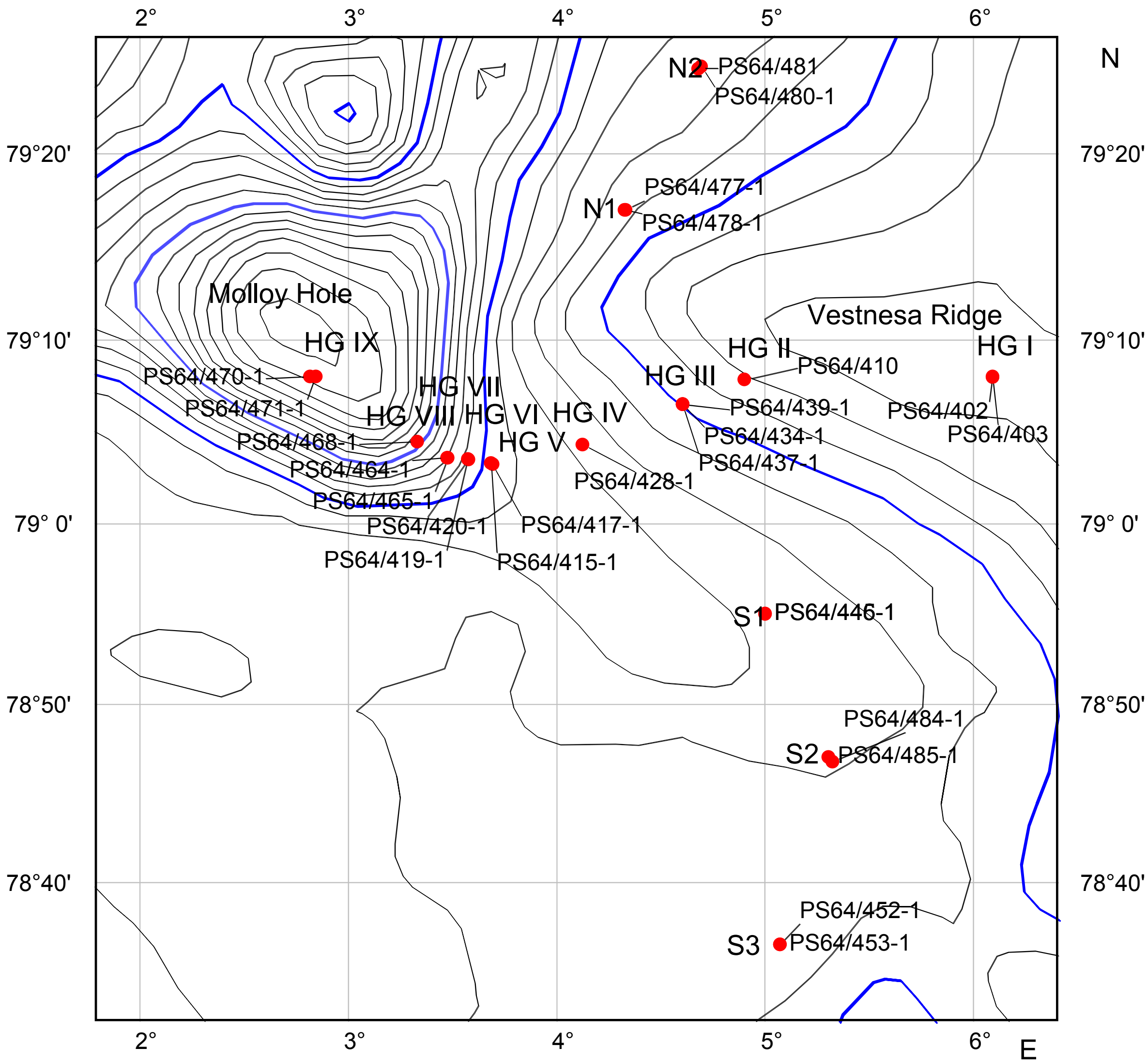


Fig. C3-1: Geological sampling at the western Svålbard margin.

The surface sediments consist primarily of brownish bioturbated hemipelagic muds with variable sand and gravel contents. Grain-size distribution is obviously not related to water depth. The shallow water locations HG-I to HG-III (1000 - 2000 m) contained relatively fine-grained sediments, while the central station, HG-IV (2500 m) and the deep water locations HG-VII (4500 m) contained coarse-grained sediments compared to most other stations. This trend might be related to an advection of fines in the subsurface WSC in shallower water and a winnowing in deeper waters due to bottom current activity. This may suggest a rather patchy distribution of certain lithologies in the area, which certainly cannot be resolved with the widely spaced sampling locations of ARK XIX/3c. Shallow seismic and bathymetric surveys between sampling locations may give important insights into the large-scale sedimentation processes and sediment distribution in the area but could not be conducted due to time constraints.

Tab. C3-1: Stations taken at the standard sampling locations of the project group and sampling scheme.

station	IRD	archive liner	bulk samples	x-rays	sedi-mentology	magnetic suscepti-bility	TOC $CaCO_3$ Opal	biomarker	radio-nuclides	planktic micro-fossils	benthic micro-fossils
PS64/402-1	x										x
PS64/403-1					x	x		x	x	x	x
PS64/407-1	x										
PS64/409-1	x										
PS64/410-1	x	x		x		x					
PS64/414-1											
PS64/415-1					x	x	x	x	x	x	x
PS64/416-1	x										
PS64/417-1	x	x	x	x		x					
PS64/419-1					x						
PS64/420-1	x	x	x	x		x					
PS64/427-1	x										
PS64/428-1	x	x	x	x		x					
PS64/429-1	x				x						
PS64/430-1	x					x	x	x	x	x	x
PS64/434-1					x	x	x				
PS64/437-1	x	x	x	x		x					
PS64/439-1								x	x	x	x
PS64/440-1	x										
PS64/441-1	x										
PS64/442-1	x										
PS64/445-1					x	x	x	x		x	
PS64/446-1	x	x	x	x		x					
PS64/452-1	x	x	x	x		x					
PS64/453-1	x				x	x	x	x		x	
PS64/454-1	x										
PS64/455-1	x										
PS64/456-1	x										
PS64/461-1	x										

station	IRD	archive liner	bulk samples	x-rays	sedi-mentology	magnetic suscepti-bility	TOC $CaCO_3$ Opal	biomarker	radio-nuclides	planktic micro-fossils	benthic micro-fossils
PS64/462-1	x										
PS64/463-1	x										
PS64/464-1					x	x	x				
PS64/465-1		x	x	x		x					
PS64/467-1											
PS64/468-1		x	x	x		x					
PS64/470-1		x	x	x		x					
PS64/471-1					x	x					
PS64/477-1					x	x	x	x		x	
PS64/478-1	x	x	x	x		x					
PS64/480-1					x	x	x	x	x	x	
PS64/481-1	x	x	x	x		x					
PS64/484-1	x				x	x	x	x	x		
PS64/485-1	x					x					

Only one box core (PS64/480-1) comprised diamictic sediments indicating that most sections are completely of Holocene age (cf. Andersen et al., 1996). Surprisingly, gravel make up a considerable amount in the cores from the upper continental slope (C. 5, Pirrung et al.). The majority of gravel (>2 mm) is supplied from West Spitsbergen but a considerable amount of gravel is derived from southern sources. This is attributed either to reworking of glacial sediments on the shelf and subsequent downslope transport during the Holocene or absence of Holocene sediments at the core tops (C. 5, Pirrung et al.). A pre-Holocene age, at least of the base of cores, is supported by relatively low sedimentation rates on the order of a few centimetres per ka in the past 8.000 to 12.000 years (Jones & Keigwin, 1988; Andersen et al., 1996). These low rates for a continental margin may be explained by a constant winnowing of fines due to bottom current activity associated with an intensified exchange of deep and bottom waters between the Nordic Seas and the Arctic Ocean in the late glacial and Holocene. On the other side, sediment supply from Svålbard may be reduced during the interglacial because the major fjords act as sinks for continental sediments. Further investigations on sediment texture and structure, supplemented by dating, are required to solve this issue.

Sediment profiles of the Molloy Hole locations (PS64/468, PS64/470) indicate that gravity transport processes may play an important role in deeper waters. Bioturbated hemipelagic sediments are confined to the upper few centimetres and are underlain by sediments consisting visually of variable grain size. At the deepest location, massive creamy muds that are characteristic for mass flow deposits in deep basins of the Nordic Seas and East Greenland fjords may be deposited from distal turbidity currents.

Sediments in the "Hausgarten" area are obviously derived from various sources as indicated by gravel analyses (C. 5, Pirrung et al.). This is also valid for the clay fraction of sediments because previous studies on core tops from the area revealed a pronounced increase of the clay mineral smectite from the West Spitsbergen shelf to the Molloy Hole (Matthiessen, Vogt, Knies, unpublished data). A local smectite maximum in water depths greater than 2000 m may be attributed either to a local source or to long distance advection of sea ice rafted debris from the Siberian Arctic or within deep waters from the Greenland-Scotland Ridge.

These preliminary interpretations must be verified by shore-based sedimentological studies. These will focus on a detailed description of lithofacies based on granulometric and x-radiograph data to describe sedimentation and transport processes in the area.

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C. 4 Marine Geology

Kukina, N.

Major objectives of the marine geological program described herein were high-resolution studies of changes in paleoclimate, paleoceanic circulation and former sea-ice distribution by investigations in the adjacent Arctic Ocean basins. The Late Pleistocene and Holocene records are of main interest, as the Arctic Ocean is regarded to be of great significance for the global climate system. The terrigenous sediment supply is controlled by oceanic currents, sea-ice and iceberg transport, and down-slope processes. Most of these mechanisms also influence biological processes in the water column as well as at sea floor.

Research objectives will concentrate on studies of terrigenous sediment supply. For these purpose detailed sedimentological and mineralogical analyses of surface sediment samples taken by giant box corer are conducted. The close cooperation of the geological work with biological, geochemical and other disciplines on board will allow a better understanding of modern sedimentation, identification of major transport processes and reconstruction of oceanic currents, which are necessary for the interpretation of the geological records.

During expedition ARK XIX/3c from 19.07. to 7.08.2003 to the AWI-“Hausgarten” area off West Spitsbergen, 13 geological stations were sampled (Tab. C4-1; Fig. C4-1) at which this project was involved. More than 50 samples of bottom sediments were taken for future investigation at the Murmansk Marine Biological Institute of the Russian Academy of Science (MMBI, RAS) (Appendix 1). Sedimentological investigations will include grain size, light and heavy minerals composition and morphology of quartz grains.

Tab. C4-1: List of MMBI RAS geological stations

Station	Date	PositionLat	PositionLon	Depth [m]	Gear Abbr.
PS64/409-1	21.07.03	79° 07.81' N	4° 54.04' E	1549.6	GKG
PS64/417-1	23.07.03	79° 03.24' N	3° 41.68' E	3011	GKG
PS64/420-1	24.07.03	79° 03.49' N	3° 34.71' E	3544	GKG
PS64/428-1	25.07.03	79° 04.32' N	4° 07.59' E	2500.8	GKG
PS64/437-1	27.07.03	79° 06.49' N	4° 36.44' E	1914.8	GKG
PS64/446-1	28.07.03	78° 55.01' N	5° 00.10' E	2587	GKG
PS64/452-1	30.07.03	78° 36.49' N	5° 04.41' E	2342.8	GKG
PS64/465-1	02.08.03	79° 03.58' N	3° 28.79' E	4003	GKG
PS64/468-1	02.08.03	79° 04.47' N	3° 20.01' E	5219	GKG
PS64/470-1	03.08.03	79° 08.01' N	2° 49.19' E	5576	GKG
PS64/478-1	04.08.03	79° 16.99' N	4° 19.71' E	2403	GKG
PS64/481-1	04.08.03	79° 24.48' N	4° 40.85' E	2542.4	GKG

Surface sediments were taken at all geological stations with the giant box corer (50 x 50 x 60 cm). The sediments were photographed and described (Appendix 2). Sediment colors were identified according to the "Munsell Soil Color Chart"; we recovered 12 sediment layers based on colour, consistence, texture, structure, grain size composition (a correlation scheme of sediment layers is presented in Fig. C4-2):

1) Dark olive sandy mud with gravel and dropstones;
1a) Dark olive gray sandy mud;
1b) Olive gray sandy mud;
1c) Olive brown sandy mud;
2) Dark olive gray sand (oxidation);
3) Olive sandy silt (bioturbation);
4) Olive silty clay;
4a) Olive silty clay with black points of hydrotroilite (bioturbated);
4b) Dark olive gray silty clay;
4c) Olive brown silty clay laminated (oxidation);
5) Dark olive clay.

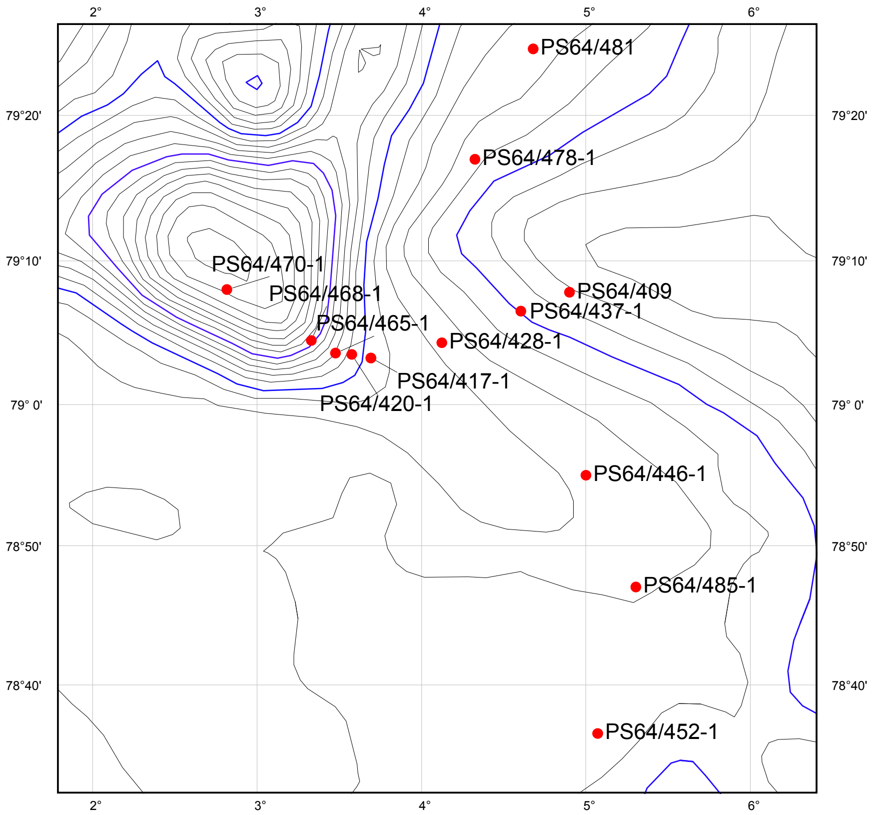


Fig. C4-1: Geological stations.

Deep-sea sediments were often described as ranging from clay to silty clay. They are homogenous and very soft. The colors have often a dark olive to olive brown touch. The sediments are mostly rare of ice-rafted material, also turbidite like deposits of well sorted, coarse grained sand are interbedded.

A remarkable amount of ice-rafted material and rock fragments up to 3-10 cm in diameter (mostly metamorphic rock and sandstones) were found in upper 20 cm on the West off Spitsbergen continental margin. The dropstones are mostly rounded. The sediment have sandy silt and sandy mud composition with gravel and dropstones, which indicate the nearly glaciogenic transport by sea-ice and iceberg. The sediment mostly has a olive brown color, indicating oxygenated bottom waters. In the upper 2 cm abundant benthic and planktic foraminifers were observed indicating seasonally open-water conditions and moderate surface water productivity.

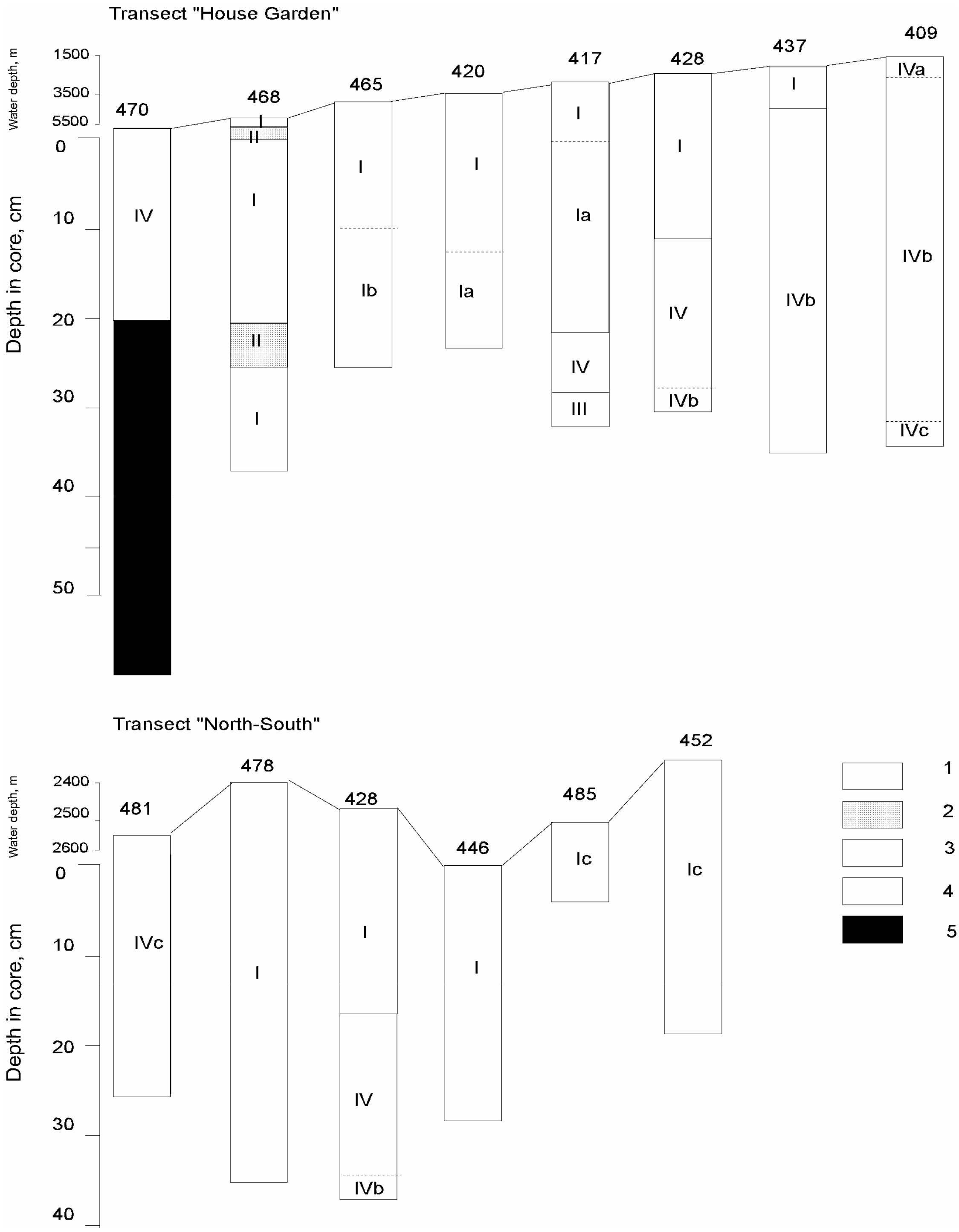


Fig. C4-2: Lithological description of surface sediments: 1 - olive sandy mud with gravel and dropstones; 1a - dark olive gray sandy mud: 1b - olive gray sandy mud; 1c - olive brown sandy mud; 2 - dark olive gray sand; 3 - olive sandy silt; 4 - olive silty clay; 4a - olive silty clay with black points of hydrotroilite; 4b - dark olive gray silty clay; 4c - olive brown laminated silty clay.

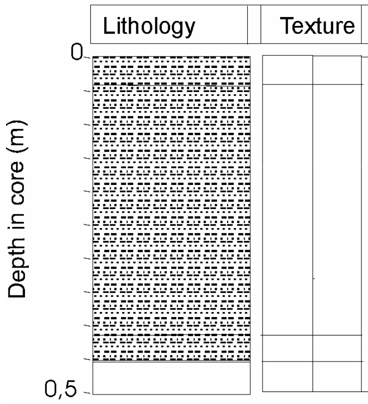
Appendix 1: List of samples for future sedimentological analyses at MMBI RAS.

Station	Interval (cm)	Station	Interval (cm)
PS64/409-1	0-1	PS64/452-1	20-21
	15-16		32-33
	44-45	PS64/465-1	0-1
PS64/417-1	0-1		10-11
	10-11		20-21
	20-21		30-31
	30-31	PS64/468-1	0-1
	40-41		10-11
PS64/420-1	0-1		20-21
	10-11		30-31
	20-21		38-39
	30-31	PS64/470-1	0-1
PS64/428-1	0-1		59-60
	10-11	PS64/478-1	0-1
	20-21		15-16
	30-31		24-25
	38-39		34-35
PS64/437-1	0-1	PS64/481-1	0-1
	44-45		10-11
PS64/446-1	0-1		20-21
PS64/452-1	0-1		30-31
	10-11	PS64/485-1	0-1

Appendix 2: Description of sediments.

PS64/409 GKG | **West off Spitsbergen** | **ARK-XIX/3c**

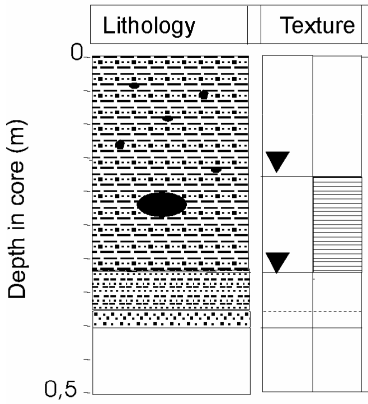
Recovery: 0,45 cm | 79°7,81 N, 4°54,04 E | Water depth: 1549,6 m



Color	Description
5Y4/4	0-3 cm Olive silty clay with black points of hydrotroilite. Oxidation.
5Y4/1	3-42 cm Dark gray silty clay. In interval 15-16 cm reddish ferous concretion.
5Y3/2	42-45 cm Dark olive gray silty clay. Density

PS64/417 GKG | **West off Spitsbergen** | **ARK-XIX/3c**

Recovery: 0,40 cm | 79°3,24 N, 3°41,68 E | Water depth: 3006,8 m



Color	Description
5Y4/4	0-17 cm Olive sandy silty clay with pebbles and gravel 0.3-1.8 cm in diameter.
5Y4/4 5Y3/2	17-32 cm olive and dark olive gray sandy silty clay. Lamination, thickness of dark olive layers 0.3-0.8 cm. In interval 20-25 cm metamorphic rock fragment 9x10x4 cm
5Y4/4	32-40 cm Olive silty clay. Below 38 cm sandy silt layer satiated of water.

LEGEND:

Lithology

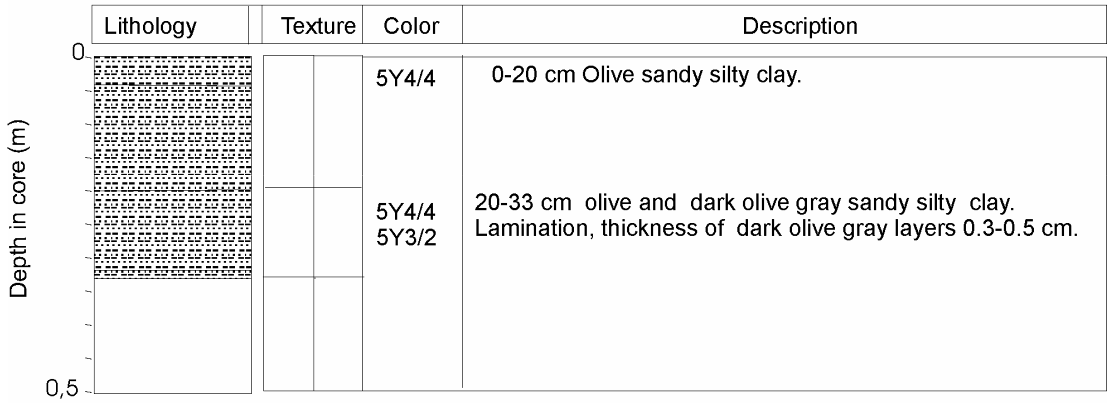
- Sand
- Silty clay
- Clay
- Silt
- Pebbles, dropstones
- Rock fragment

Structure

- Bioturbation
- Spotty
- Stratification
- Coarsening upward sequence
- Fining upward sequence
- Gradational boundary
- Lamination

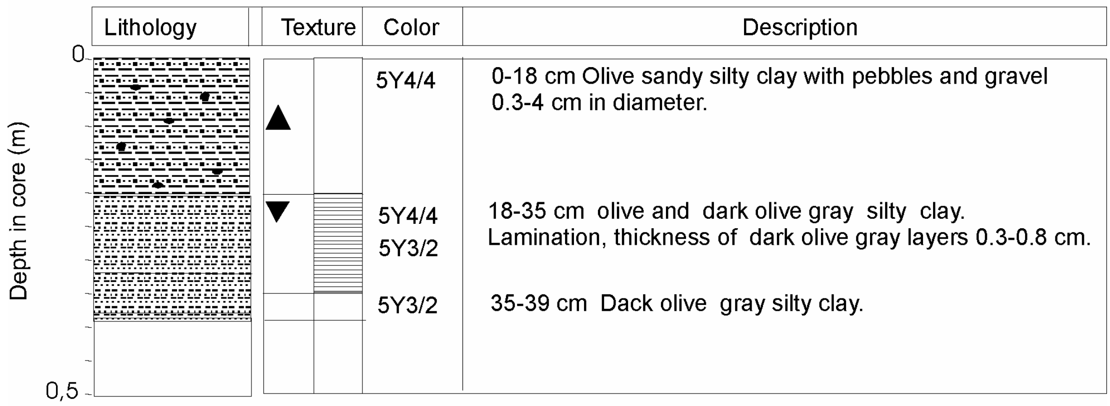
PS64/420 GKG **West off Spitsbergen** **ARK-XIX/3c**

Recovery: 0,33 cm 79°3,49 N, 3°34,71 E Water depth: 3508 m



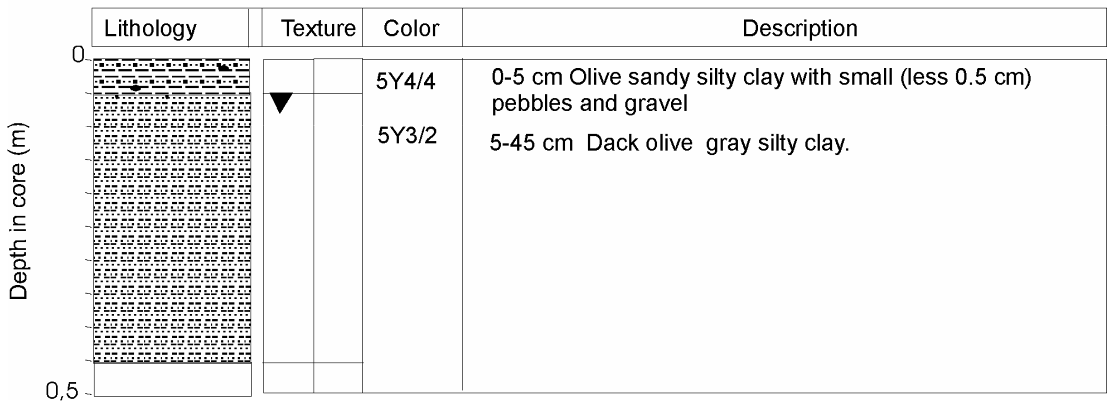
PS64/428 GKG **West off Spitsbergen** **ARK-XIX/3c**

Recovery: 0,39 cm 79°4,32 N, 4°7,59 E Water depth: 2500,8 m



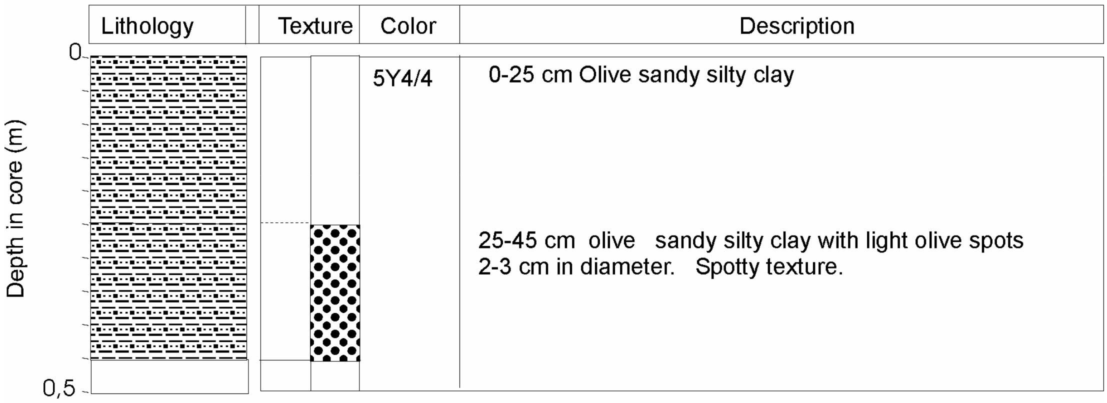
PS64/437 GKG **West off Spitsbergen** **ARK-XIX/3c**

Recovery: 0,45 cm 79°6,49 N, 4°36,44 E Water depth: 1914,8 m



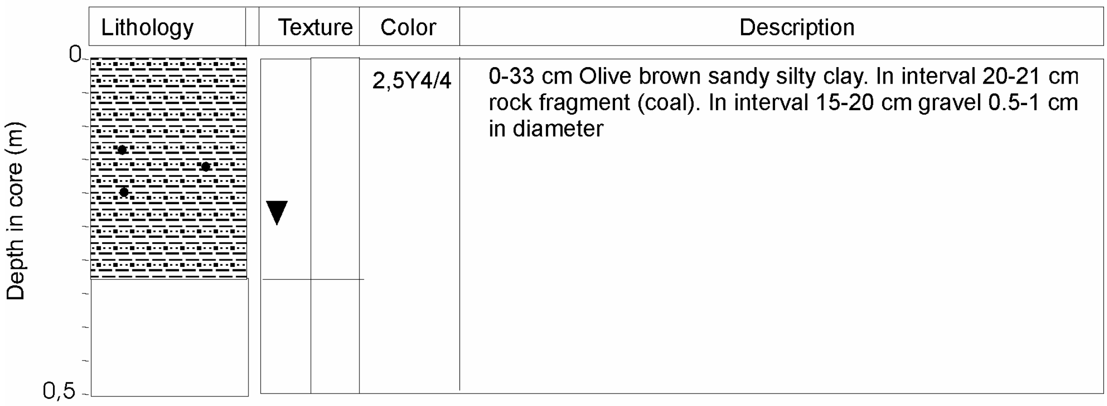
PS64/446 GKG West off Spitsbergen **ARK-XIX/3c**

Recovery: 0,45 cm 78°55,01 N, 5°0,10 E Water depth: 2635,6 m



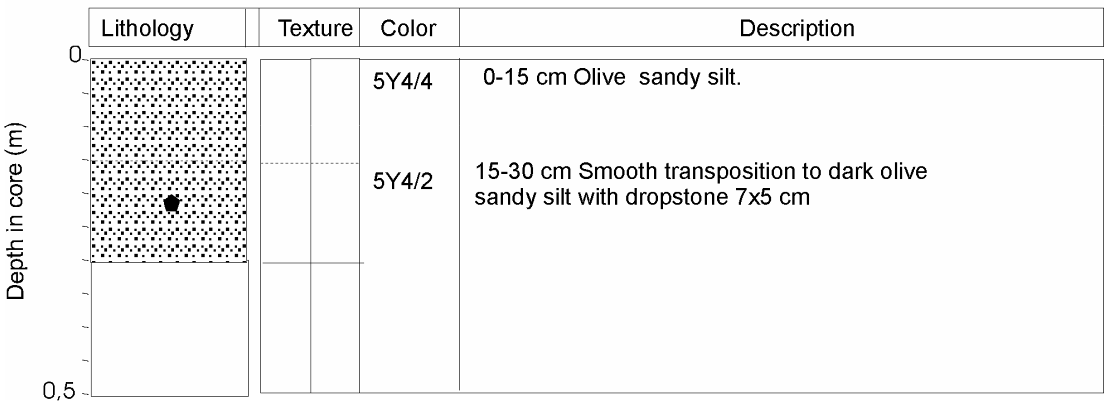
PS64/452 GKG West off Spitsbergen **ARK-XIX/3c**

Recovery: 0,33 cm 78°36,49 N, 5° 4,41 E Water depth: 2342,8 m



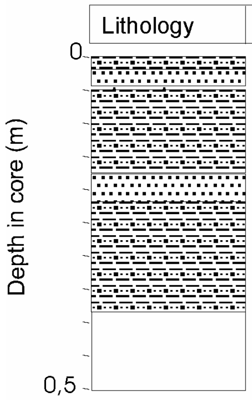
PS64/465 GKG West off Spitsbergen **ARK-XIX/3c**

Recovery: 0,30 cm 79°3,58 N, 3°28,79 E Water depth: 4003,2 m



PS64/468 GKG | **West off Spitsbergen** | **ARK-XIX/3c**

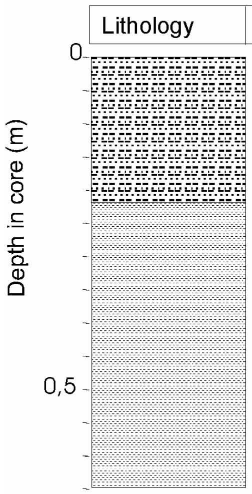
Recovery: 0,38 cm | 79°4,47 N, 3°20,01 E | Water depth: 5219,2 m



Texture	Color	Description
	5Y4/4	0-2 cm Olive sandy mud.
	5Y3/2	2-4 cm Dark olive gray sand. Oxidation.
	5Y4/2	4-17 cm Olive gray sandy mud.
	5Y3/2	17-22 cm Dark olive sand. Oxidation.
	5Y4/2	22-38 cm Olive gray sandy mud.

PS64/470 GKG | **West off Spitsbergen** | **ARK-XIX/3c**

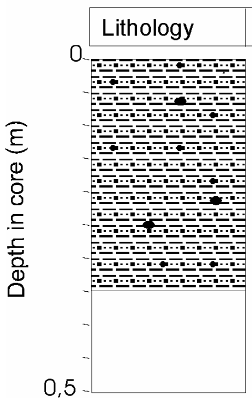
Recovery: 0,65 cm | 79°8,01 N, 2°49,19 E | Water depth: 5580,8 m



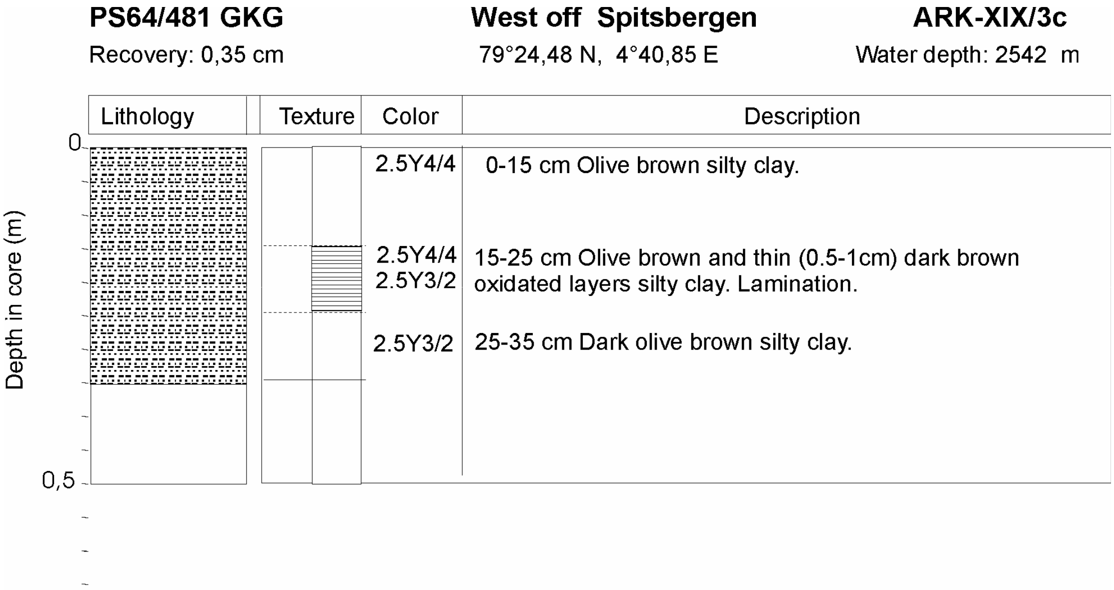
Texture	Color	Description
	5Y4/4	0-22 cm Olive silty clay.
	5Y3/2	22-65 cm Dark olive clay, soft like sourcream.

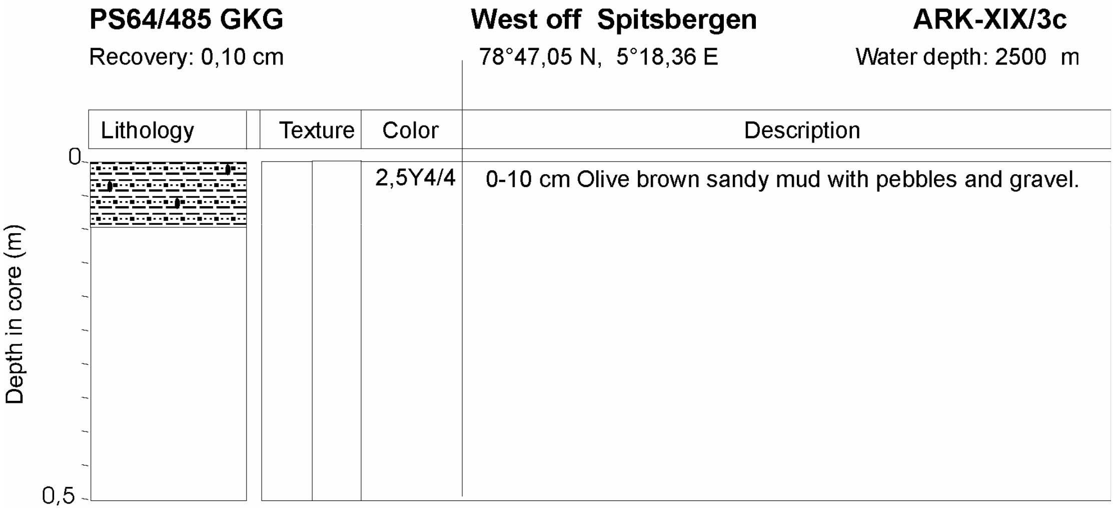
PS64/478 GKG | **West off Spitsbergen** | **ARK-XIX/3c**

Recovery: 0,45 cm | 79°16,99 N, 4° 19,71 E | Water depth: 2403 m



Texture	Color	Description
	2,5Y4/4	0-35 cm Dark olive sandy mud with pebbles and gravel. In interval 15-25 cm brown oxidated layers thickness 0.5 cm





C. 5 Ice-rafted material in box cores from the eastern Fram Strait

Pirrung, M., Kunz-Pirrung, M., Matthiessen, J.

Introduction

Ice-rafted material is a frequent component in sediments of the Nordic Seas. Fine- to coarse-grained melt-out from icebergs and sea ice of clay to bloc size rains to the seafloor episodically. Actually low amounts of icebergs drifting in the Nordic Seas calve from glaciers at Svålbard, Greenland and the Siberian islands. But during the last glacial maximum, armadas of icebergs released debris to the Nordic Seas. Today sea ice originating from the Siberian shelves transports incorporated sediment material via the Transpolar Drift through the Fram Strait into the Nordic Seas. The goal during this cruise leg was to reconstruct the origin of the icebergs that released ice-rafted debris (IRD) from the study of gravel-sized clasts in sediments of the "Hausgarten" area during the Holocene and late Pleistocene.

Materials and Methods

Sediment samples taken during expedition ARK XIX/3c from which IRD was analysed are listed in the contribution of Matthiessen et al. (chapter C. 3). The content of gravel grains (>2 mm) in surface sediments was estimated from photos of sediments recovered with a Giant Box Corer (GKG). The uppermost 20 to 40 cm of sediments recovered with a GKG were sieved through a 2 mm mesh for epi- and endobenthos studies (see Budaeva (C. 9), and Urban-Malinga & Jankowska (C. 10)). Gravel collected from these sediments could be analysed for petrography and grain size. Also gravel from the upper 33 cm of sediment from several tubes of a multicorer (MUC) was studied. A total number of 1061 gravel- (and bloc-) sized clasts from 29 stations recovered at 15 locations was analysed.

Clasts of the gravel (and bloc) fraction were studied under 10-fold magnification with a lense. The material was classified into plutonic, volcanic, sedimentary and metamorphic rocks. A further subclassification into 28 different rock types was performed and rock colors were noted. When incrustation or scratching was observable this was also registered. With a micrometer scale the longest, shortest and intermediate diameter of the clasts was measured, values were rounded to 0.5 mm length. The sphericity was calculated by dividing the shortest through the longest diameter. For determination of the roundness of the material three groups were classified: well-rounded, marginally-rounded and unrounded (with sharp edges). When gravel grains are only partly well-rounded and partly sharp as they were broken they are classified as well-rounded.

The detailed grain size and petrographic data can be retrieved online under
http://www2.uni-jena.de/chemie/geowiss/angeol/start.html;
the gravel content in surface sediments under http://www.pangaea.de.

Results

The grain size distribution of the bulk sediments is generally silty to clayey terrigenous mud with varying sand, gravel and bloc content (C. 3, Matthiessen et al.). For hydrodynamic reasons the gravel (2 - 63 mm) and bloc fraction (>63 mm) cannot be transported by bottom currents together with the silt and clay fractions. The gravel material is therefore interpreted as IRD from dropstones melted out at the base of ice floats or icebergs that may have been resedimented by debris flows.

The uppermost sediments of the GKGs consist of brownish bioturbated hemipelagic mud (see Matthiessen et al., C. 3) and hence the content of gravel grains in the surface sediments is generally low. In most GKGs it is absent and only 1 % of the area is covered by gravel at the stations PS64/438, 441 and 442. Epibenthic organisms like holothurians document that no surface sediments have been lost during lift up of the gear.

The size of the studied gravel- (N = 1058) and bloc-sized clasts (N = 3) ranges between 2 and 330 mm with a mean of 12 mm (averaged from the intermediate diameters). Marginally-rounded clasts are more frequent with 40 % than well-rounded (32 %) and unrounded clasts (28 %). 11 % of the clasts were broken after the rounding, probably by sub- or englacial deformation processes. 7 % of the clasts, mainly well- or marginally-rounded fine sandstones and siltstones (10 % of the well- or marginally-rounded clasts) were scratched during collisions with rock debris at the base of the glacier.

The sphericity is on average 0.42 for all analysed clasts and 0.46 for well-rounded clasts, with a range of 0.1 to 0.9. Well-rounded clasts are not a typical appearance for glacial debris and demand for an explanation. The well rounding requires a fluvial or coastal environment with frequent resedimentation. One possibility is that the rounding of these components already existed before the glacial transport of the material. Then there should be at least some clasts embedded into the “mother rock” that disintegrated by physical weathering or during deformation below the glacial ice. However, only one well-rounded vein-quartz clast of 4 cm diameter could be found that was part of a sericite shist. Due to the shistosity and the lack of siliceous cement small clasts of these shists can be broken easily by hand. But there must be other rounding processes as well. One possibility is that coastal wave activity rounded the clasts, as it can be actually observed e.g. at the Isfjorden coast near Longyearbyen. Another possibility is that glaciers advanced over extensive sander plains and this sandy and gravelly material was entrained in moraines during later glacier readvances. Today this is not observable on Spitsbergen. During the lowstand of the last glacial maximum (ca. 18 kyr BP) this may have occurred on the shelf around Svålbard. In southern Scandinavia this was a widely active landscape forming process.

17 % of the clasts are incrusted by bryozoa, serpulid tubes, calcareous sponges or rare foraminifers. Most of these clasts are siliciclastic sediments (90 %), less frequent are metamorphics (7 %, mainly fine quartzites), volcanics (1 %) and bituminous siltstones, limestones and chalk (2 %), but none are plutonic rocks. Some clasts show incrustation on all sides of the clasts, indicating low sedimentation rates and occasional rotation of the clasts by bioturbation or sediment reworking. Most bryozoa shells are damaged and only the part in contact with the clast is preserved, except when the bryozoa were protected from abrasion in small cavities.

The surface of many clasts, most of them incrusted, is often entirely or partly darker than the interior due to Mn-oxide and Fe-hydroxide precipitation. On these Mn-oxide covered clasts the skeletons of bryozoa and the tubes of serpulids have orange colours (siderite?) whereas on other clasts they are white (calcite). Probably the Mn-oxides and Fe-hydroxides were formed in the upper part of the sediments under suboxic or changing oxic and reducing conditions.

On average the material consists of 4 % plutonic %, 1 % volcanic, 73 % sedimentary and 22 % metamorphic rocks and this distribution does not vary much between sampling sites (Fig. C5-1). Description of various rock types:

Plutonic rocks: unrounded quartz, unrounded feldspar, granite / granodiorite, diorite / gabbro.

Volcanic rocks: basalt with or without bubbles, pumice.

Sedimentary rocks: rounded quartz, rounded feldspar, coarse grained sandstone, middle grained sandstone, fine grained sandstone, siltstone, limestone, flint, chalk, weakly-consolidated bituminous siltstone, black shale, till.
Metamorphic rocks: quartz with fragments of shists or mica shists, sand- to clay-rich shist / sericite shist / phyllite, quartzite with observable grain contours, quartzite without observable grains, muscovite mica shist, biotite mica shist, gneiss, serpentinite / meta-gabbro.

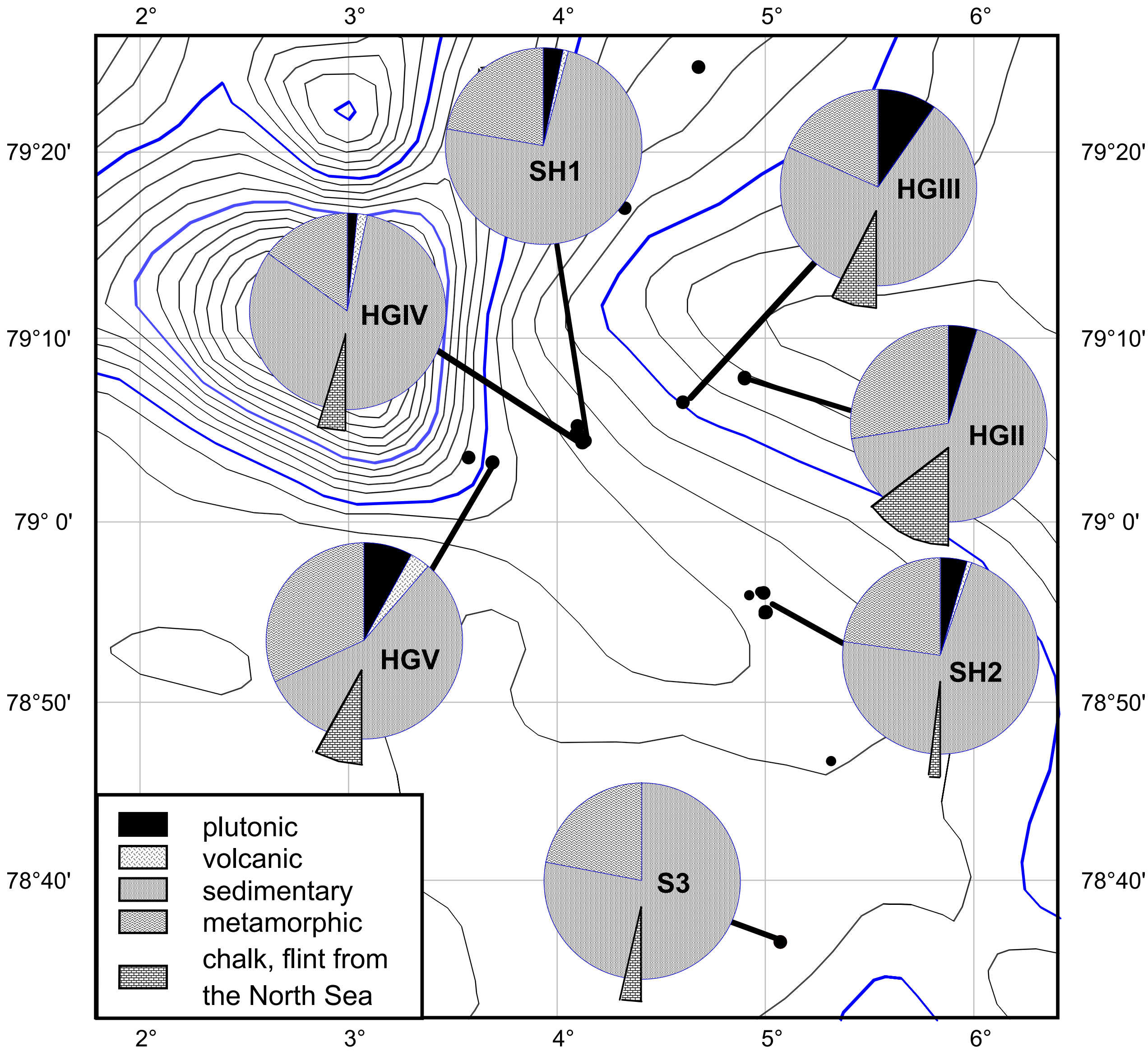


Fig. C5-1: Distribution of rock types in the uppermost 20 cm of the sediments for locations from which more than 80 gravel grains were counted.

The most frequent rock type is sandstone (44 %; Fig. C5-2d), of which fine sandstone (26 %) is more frequent then the middle sandstone (15 %) and the coarse sandstone (3 %). Together with siltstones (19 %, Fig. C5-2a) and quartzites (11 %; Figs C5-2c, C5-2f) siliciclastic sediments and meta-sediments build up 74 % of the ice-rafted material. They probably originate from Svålbard for the major part.

Some clasts give more detailed information about their source areas (Fig. C5-2c). Red fine- to middle-grained sandstones (0.9 % of the clasts; Fig. C5-2e) occur in Devonian redbeds on northern Spitsbergen and Eastern Greenland. Weakly consolidated black organic-rich siltstones (1.6 %) occur in Tertiary sediments on West Spitsbergen near Longyearbyen and Ny Ålesund, where they have been mined for brown coals. Black shales (6.9 %) occur in Jurassic deposits on Spitsbergen. In three clasts imprints of Lias ammonites were discovered. Granites and granodiorites (2.5 %; Fig. C5-2f) are frequent in the Scandinavian shield. Gabbros (0.3 %) occur on Franz Josef Land and in Norway. Basalts (0.6 %) originate from Tertiary or Quaternary volcanism in Eastern Greenland (e.g. Geikie Plateau), on Jan Mayen Island and on the Iceland-Faeroe-Shetland Ridge. A single 5 mm large, angular, white, non-floating pumice fragment in PS64/417 GKG (HG-V, 0 - 20 cm depth) has certainly been erupted from an Iceland volcano and was transported with sea ice to the core location. Volcanic clasts are more frequent in the westernmost locations (HG-IV, HG-V; see Fig. C5-1). Chalk (2.4 %; Fig. C5-2b) and flint (0.9 %, Fig. C5-2e) are present in almost all locations (Fig. C5-1). These are indications for Cretaceous source rocks in the southern North Sea area. The origin of one serpentinite clast (PS64/437, HG-III, 10 - 20 cm) is uncertain, it might originate from submarine outcrops of meta-basalts on the Vesteris Ridge east of the Molloy Hole.

Rocks for which an origin on Spitsbergen is certain (Tertiary, Jurassic and Devonian sediments) comprise 2.5 % of the sediments, but many of the siliciclastic sediments will originate from Svålbard as well. Medium- to high-grade metamorphic rocks and plutonites from southern source areas (Eastern Greenland around Scoresby Sund, Iceland, Norway) or from a small metamorphic belt along the western coast of Spitsbergen make up 7.2 % of the IRD.

Conclusions

From the shape and composition of ice-rafted debris two scenarios can be reconstructed:

The occurence of well-rounded, incrusted, scratched gravel consisting mainly of siliciclastic rocks in sediments of the continental slope west of Spitsbergen requires a combination of several sedimentary processes. During a lowstand of the last glaciation glaciers advanced onto the shelf around Svålbard (Andersen et al., 1996) where they deposited moraines with unrounded debris. After a warming and subsequent flooding of the shelf this debris was exposed to resedimentation and rounding by wave activity along the shoreline. During a readvance of the glaciers onto the shelf these deposits were again incorporated into the glaciers and were bulldozed to the grounding line of the glaciers at the shelf break, where they were subject to bioerosion (incrustation by shallow water fauna like e.g. bryozoa and serpulids) and Mn-oxide and Fe-hydroxide precipitation. The deposits become unstable and debris flows transported the material down the continental slope where it was covered by only several centimetres thick Holocene muds (see chapter C.3, Matthiessen et al.; Andersen et al., 1996).

The presence of Cretaceous chalk and flint at most of the locations of the "Hausgarten" area requires for a northward transport of icebergs calved from glaciers covering the North Sea shelf during the last glacial maximum. In addition, some of the intermedium- to high-grade metamorphic (mica shist, gneiss) and plutonic (granite) clasts may originate from Norwegian or eastern Greenland glaciers. Tertiary and Quaternary basalts were eroded from Iceland, Jan Mayen Island or Eastern Greenland and the pumice clast certainly originates from Iceland. This debris rained to the seafloor during basal melting of the icebergs, where it was mixed with debris originating from Spitsbergen during debris flows. Sea ice can almost be excluded as transport medium as it drifts southwards within the Eastern Greenland Current. In the Fram Strait sea ice originating from the Siberian shelves contains almost no sand or gravel. A large scale counter clockwise circulation of icebergs following the course of the recent surface currents in the Nordic Seas (East Greenland Current, Irminger Current, Norwegian Current, West Spitsbergen Current) may transport material from

Eastern Greenland, Iceland and Scandinavia towards Spitsbergen. Under recent conditions this is not observed in the Nordic Seas, but for the last glacial maximum such a circulation pattern has been reconstructed from analysis of IRD. In surface sediments of the Nordic Seas the distribution pattern of magnetic susceptibility also implies such a circulation (Pirrung et al., 2002).

The occurence of IRD from southern source areas in the uppermost 2 - 10 cm of the "Hausgarten" sediments deposited during the Weichselian glaciation implies very low Holocene sedimentation rates (less than 5 - 10 mm/kyr) in the "Hausgarten" area. A more detailed discussion of sedimentation patterns requires more information from radiographs of giant box corers and age models e.g. on the basis of radioactive decay, stable oxygen isotopes or ^{14}C-dates from foraminifers. Additional information is to be expected from measurements of magnetisation.

Acknowledgement

We thank Melanie Bergmann, Natalia Budaeva, Katarzyna Jankowska, Natalia Kukina, and Barbara Urban-Malinga for kindly providing the sieved gravel clasts from the GKG stations. The staff onboard the polar research icebreaker "Polarstern" is thanked for their excellent assistance during the cruise ARK XIX/3c.

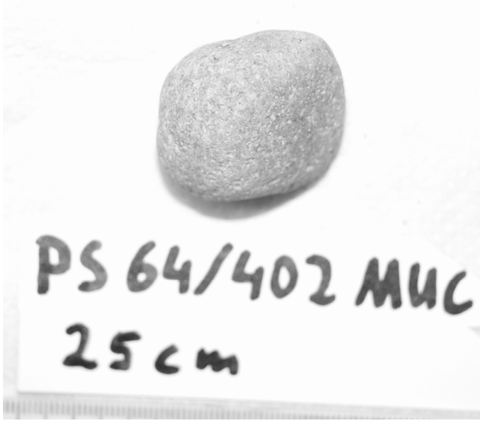
References

Anderson, E.S., Dokken, T.M., Everhoi, A., Solheim, A., Fossen, I. (1996): Late Quaternary sedimentation and glacial history of the western Svålbard continental margin. Marine Geology, 133: 123-156.

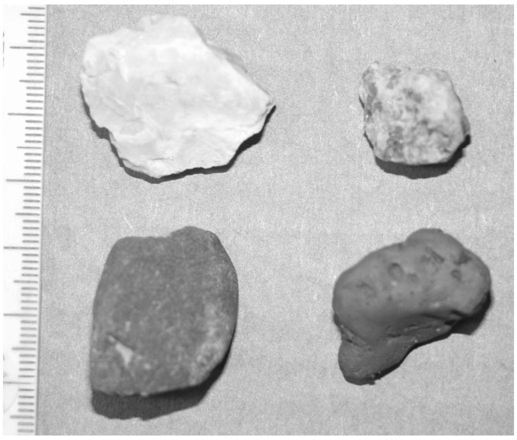
a: PS64/427, GKG, 5-15 cm;
Siltstone clast, probably from Svålbard

b: PS64/409, GKG, 0-20 cm;
Cretaceous chalk clasts from the southern North Sea area

c: PS64/442, GKG, 0-20 cm;
Scratched clasts, light quartzite and dark siltstones, probably from Svålbard



d: PS64/402, MUC, 25 cm;
Coarse sandstone probably from Svålbard, well-rounded by coastal wave activity



e: PS64/437, GKG, 0-15 cm;
Flint (upper left), granite (upper right), red Devonian sandstone (lower left), till (lower right)

f: PS64/409, GKG, 0-20 cm;
Unrounded sericite shist, mica shist and quartzites

Fig. C5-2a-f: Photos of ice-rafted debris in the uppermost 20 cm of the sediments.

C. 6 Debris on the seafloor at “Hausgarten”

Galgani, F, Lecornu, F.

Introduction

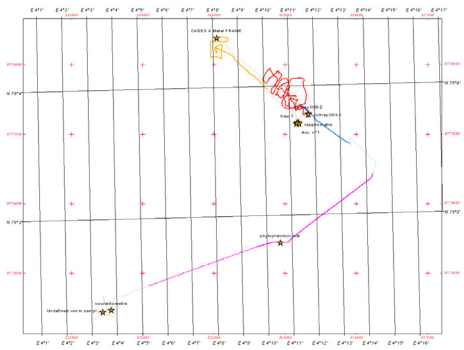
The presence of litter has been evaluated since 1992 along the European coasts at different locations (Baltic Sea, North Sea, Celtic Sea, French coasts and Adriatic Sea). Some high densities were found in different areas especially where the currents are eddying and in coastal canyons where they can accumulate. Fram Strait is of special interest because of the currents enabling the transportation of debris through the different water masses such as the Norwegian and the north Atlantic currents (deep and intermediate) coming from the North Sea and along the Norwegian coast. Beside, the presence of geomorphological factors in Fram Strait that could lead to an accumulation of debris is of special interest. The Molloy Deep is about 5500 m deep and could retain debris.

In this context, debris were observed and counted during dives of the ROV "Victor 6000" to demonstrate the presence of debris in “Hausgarten”. In addition, dives from the 1999 "Polarstern" expedition with the ROV onboard were also analysed in order to compare data and demonstrate the expected accumulation of debris in the Molloy deep.

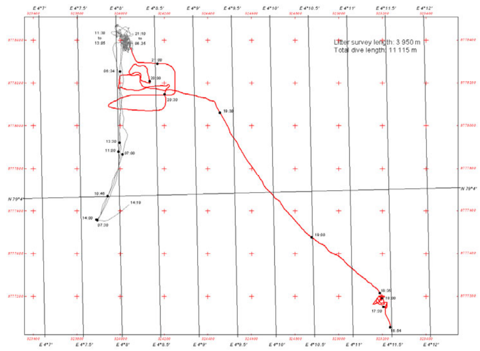
Methods

Litters were counted by observers during 5 dives (No.s 227, 228,229, 230 and 232) performed during the ARK XIX/3c cruise (Fig. C6-1). Most of the dives were in central “Hausgarten”, except dive 230 located at “Hausgarten”-South. Dives data were computed using the ADELIE software (F. Lecornu, IFREMER). Counts were performed only during survey (routes) from the "Victor 6000" ROV with distance on the bottom varying from 1.150 to 12.670 meters. Densities of litters were calculated per km route. Additional data were obtained from the 1999 ARK XIV cruise.

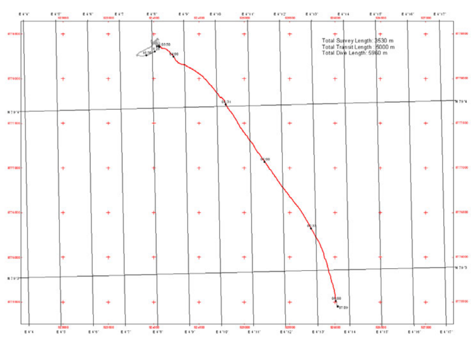
227



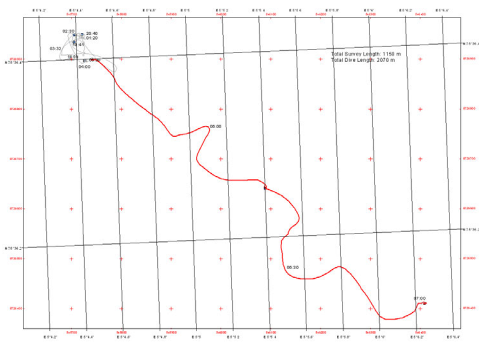
228



229



230



232

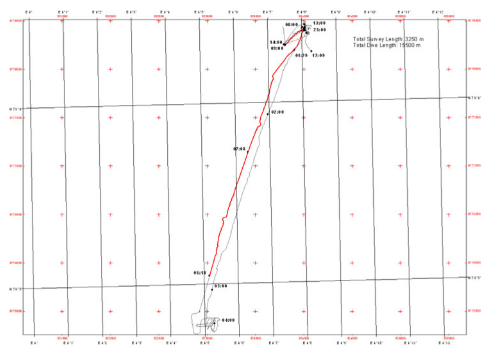


Fig. C6-1: Routes of the ROV dives 227, 228, 229, 230 and 232 during ARK XIX/3c; surveys for litters were performed only along ROV transits.

Results

A summary of the results is given in Tab. C6-1. Total amount of debris found during the 5 dive was 17 for a total distance of 25.020 m. Density per km was ranging from 0.20 to 0.92 with a total percentage of plastic of 76 %.

Tab. C6-1: Litter on transits of the ROV "Victor 6000" during dives at AWI-“Hausgarten”.

Dive	Date	Position (lat N / lon E)	Depth (m)	Transits (km)	Debris (no. of items)	plastics	debris/ km
102	30/06/1999	79 04.0 / 04 10.0	2365-2517	15.42	1	0	0.06
103	01/07/1999	79 03.8 / 04 11.1	2392-2458	1.89	1	1	0.52
104	03/07/1999	79 07.0 / 02 50.0	5339-5552	6.77	15	13	2.21
105	08/07/1999	79 28.1 / 03 00.1	2813-3410	13.95	7	2	0.50
106	10/07/1999	74 19.7 / 10 37.8	3154-3167	14.10	5	1	0.35
227	22/07/2003	79 03.8 / 04 11.6	2395-2453	12.67	9	7	0.71
228	24/07/2003	79 04.0 / 04 05.0	2415-2445	3.95	3	2	0.75
229	26/07/2003	79 04.0 / 04 10.0	2336-2485	5.00	1	1	0.20
230	29/07/2003	78 36.4 / 04 05.0	2284-2294	1.15	1	1	0.86
232	31/07/2003	79 04.0 / 04 07.0	2334-2344	3.25	3	2	0.92

Discussion and Conclusions

The density of litters at “Hausgarten” is low when compared to some European basins (Baltic Sea, North Sea, NW Mediterranean and Adriatic Sea) but significant since such densities remains in the same range than some European deep sea and costal areas (Celtic Sea, Bay of Seine, Bay of Biscay). Plastic account for the larger part of debris as commonly observed in other European areas. Analysis of dive 104 (1999) demonstrate a higher density of debris in the Molloy Deep. From these results, we can conclude that debris is present at “Hausgarten” and could accumulate on deeper part of the area. Extrapolation to the entire Fram Strait (76.40 N/ 80.50 N; between Svålbard and Greenland) is not possible with insufficient data but could lead to total amount of debris of more than 10 millions.

C. 7 Activity and biomass of the small biota

Schewe, I., Hasemann, C., Kanzog, C., Kolar, I., Soltwedel, T.

Benthic deep-sea ecosystems are fuelled by the input of organic matter sinking vertically through the water column or being advectively transported. Sediment-bound chloroplastic pigment equivalents, CPE (i.e. chlorophyll *a* plus degradation products) have been determined to quantify such an organic matter input from primary production. Differences in activities and biomass within the sediment samples were assessed by a series of biochemical assays commonly used in ecological investigations of the deep sea. To evaluate bacterial exo-enzymatic activities, esterase turnover rates were determined with the fluorogenic substrates fluorescein-di-acetate (FDA). Rather labile macro-molecules like phospholipids were analyzed as indicators for 'living biomass', i.e. small sediment-inhabiting organisms. More stable compounds like particulate proteins were determined to estimate the bulk of 'living' plus 'dead biomass', i.e. organisms and the proportion of detrital organic matter in the sediments.

Investigations as described above were performed with sediments sampled by means of a multicorer (MUC) or ROV. Other sediment samples came from colonisation experiments with soft sediments performed with moored trays (see Chapter C. 14). Biochemical analyses estimating heterotrophic activity in the uppermost centimeters of the sediments were done immediately on board to avoid losses in activity during storage. Determinations of chloroplastic pigments were carried out on board, whereas sediments for all the other biochemical analyses and investigations on bacterial communities were preserved and stored for later analyses at the home institute.

C. 8 Notes on benthic mega-/epifauna and small-scale habitat diversity in the long-term observation area

Juterzenka, K. v.

The sediment-water interface in the central “Hausgarten” area, which is visited for the third time by means of the ROV “Victor 6000”, is shaped by a variety of biogenic structures. These structures enhance the three-dimensional small-scale heterogeneity at the deep seafloor. Therefore their abundance and effects on different elements of benthic community are of crucial importance when addressing relevant questions of deep-sea community ecology and biology, such as turnover capabilities of infaunal organisms and various aspects of deep-sea biodiversity. ROV imaging and post-processing tools will help to evaluate the relative position and ecological significance of experimental sites and sampling locations in the overall "Hausgarten" environment (see A. 3, Christophe et al.; C. 6, Galgani & Lecornu).

The seafloor at approx. 2400 m water depth is characterised by a high abundance of holes, which represent burrows with a predominantly non-symmetric opening. ROV video observations during dives 227/229 (HG-IV) and 230 (S-3) revealed that at least a part of these burrows is inhabited by crustaceans with two pairs of long antennae (Isopoda, cf *Arcturidae*). One specimen could be sampled by means of the slurp gun for species identification (compare C. 11, Piepenburg & Schmid). Several of the burrows were enclosed in box cores at St. 427, 428 and 478, although no inhabitant was caught "red-handed". Analysis of material taken for macrofauna studies may reveal further specimens of the originator (compare C. 10, Urban-Malinga et al.; and C. 9, Budaeva). The burrows resemble hole structures found at 2000 - 2300 m water depth along the slope foot north and northwest of Svålbard in the course of cruise ARK XVIII/2 in 1997, which had been allocated to, but so far not confirmed as burrowing activities of isopods. Since they seem to be widespread and abundant in the depth zone of 2000 - 2500 m, they are bound to play a significant role regarding bioturbation and bioirrigation.

Another structuring element protruding into the boundary flow is given by large-growing sponges of several species (cf *Caulophacus* sp., branched sponges), which had been noted and partly sampled in 1999 and 2002. They represent elevated sites which often serve as colonisation, feeding or resting spots for anemones, shrimp species, amphipods, and comatulid crinoids. Comatulid - unstalked - crinoids had also been observed on lander frames (e.g. St. 421) and one of the sponge mimics (Dive 231), whereas stalked crinoids (cf *Bathycrinus* sp.) are abundant at the sediment surface throughout the central "Hausgarten" area. Dropstones often appear as well-colonised "habitat islands" in the soft-bottom environment of the study area. Their role in shaping the habitat for the associated benthic community has been investigated during the cruise by characterisation of the surrounding current patterns (E. Sauter, AWI) and push core sampling in the vicinity of a stone during dive 227 (T. Soltwedel, AWI) to analyse biogenic sediment compounds.

The demersal fish fauna comprises predominantly *Lycodes* sp. The frequent occurrence of the Arctic eelpout *Lycodes frigidus* had been already reported in 1999, but the genus is probably represented by more than one species. Other common elements are anthozoans, gastropods, and large-growing isopods (*Saduria* sp.). Amphipods were regularly observed by ROV cameras, but are more effectively studied by baited traps (compare C. 13, De Broyer & Martin). The subsurface-feeding irregular echinoid *Pourtalesia jeffreysi* was found in box cores of St. 428, 478, 452 in a water depth of approx. 2400 m. An elasipodid holothurian (*Irpa abyssicola?)* was observed during dives at the central station and present in box cores at St. 462 and 463 in a water depth of 2600 m (compare C. 9, Budaeva). Multicorer and box core samples in the Molloy Hole confirmed the dominant role of the smaller elasipodid species *Elpidia glacialis* for the epifaunal community in a water depth of > 5000 m (St. 468, 470, 471).

A so far unidentified epifaunal species, which had been known from image material, but were not found in trawl and grab samples during preceding cruises was obtained by push coring due to the masterly operation of the ROV tools by the "Victor 6000"-Team (Dive 227, HG-IV).

The suprabenthic environment revealed occasional appearances of a cirriped octopus, probably *Cirroteuthis muelleri*. The regular occurrence of compact, red-coloured medusas was noted.
During the last ROV deployment (Dive 232), the high density of calanoid copepods in the near-bottom water layer was striking, accompanied by a high abundance of ctenophores.

Colonisation of artificial hard substrates – partial recovery
During the expedition ARKXV/1 in 1999, an metal frame carrying 40 artificial substrates was deployed to study the colonisation by sessile species (see M. Klages, Ber. Polarforsch. 339, 1999). Five plates (Perspex and bricks) could be recovered in the course of Dive 232, three of which were sampled from the upper part of the frame and two from the lower part. A first visual observation of the recovered plates from the lower

frame showed no obvious colonisation by macrofauna, although several benthic foraminifera were found. Two of the upper plates, both Perspex and bricks, are partly covered by filamentous colonies (hydroids?). The microbial colonisation of the substrates will be analysed in the home lab (scrap samples taken by C. Kanzog).

C. 9 Small- and large-scale distribution of macrobenthic invertebrates

Budaeva, N.

FS "Polarstern" expedition ARKXIX/3c provided the opportunity to study small- and large-scale distribution patterns of macrofaunal communities at the deep-sea long-term station "Hausgarten". Six sampling sites were established along a transect from "Hausgarten" central station HG-IV in south-westerly direction at water depths around 2500 m. Three giant box corers (0.25 m²) were obtained at each station (Tab. C9-1). Five square subsamples (12.5 x 12.5 cm) were taken from each of the box corers. Subsamples were taken from four different layers (0 - 2 cm, 2 - 7 cm, 7 - 12 cm, 12 - 17 cm). All sediment samples were sieved onboard over 500 µm mesh size. Remaining sediments from box corers were separated in two layers (0 – 2 cm, 2 – 17 cm). The upper layer of the remaining sediments and all subsamples from giant box corers were sieved by hands. The rest was sieved using the "benthos washing machine". All the material was preserved in 4 % buffered formalin. Samples of the overlaying waters were taken from each giant box corer and preserved separately.

Further laboratory analyses will include:

- the definition of all macrofaunal species,
- the assessment of macrofaunal abundance and biomass,
- investigations on the vertical distribution of macrobenthic invertebrates in the sediment columns,
- investigations on the biodiversity of macrofaunal invertebrates between box corers from the same station and between different stations (on higher taxonomic level and on the species level).

Tab. C9-1: Sampling sites for investigations on small- and large-scale distribution patterns of macrofaunal organisms at AWI-“Hausgarten”

	Station	Gear	Latitude	Longitude	Depth (m)
1	PS64/440	GKG 1	79° 4,79' N	4° 6,05' E	2500,0
	PS64/441	GKG 2	79° 4,89' N	4° 5,77' E	2499,6
	PS64/442	GKG 3	79° 5,22' N	4° 6,13' E	2482,0
2	PS64/454	GKG 4	78° 55,01' N	5° 0,27' E	2636,8
	PS64/455	GKG 5	78° 54,97' N	5° 0,24' E	2637,2
	PS64/456	GKG 6	78° 54,97' N	5° 0,25' E	2637,6
3	PS64/461	GKG 7	78° 56,02' N	4° 59,60' E	2610,4
	PS64/462	GKG 8	78° 56,04' N	4° 59,62' E	2610,0
	PS64/463	GKG 9	78° 56,21' N	4° 59,18' E	2606,0

C. 10 Vertical distribution of benthic fauna in sediments along the water depth gradient

Urban-Malinga, B., Jankowska, K., Juterzenka, K.v.

The main objective of this project was to study the vertical distribution of benthic fauna in sediments along the water depth gradient and to relate this distribution to the changing physical environment. Until now only few efforts were made to quantify the vertical distribution of macrofauna in the Arctic.

The major questions addressed are:

a) Does a pattern in the vertical distribution of benthic fauna inhabiting sediments along the water depth gradient exist?
b) If so, how can this pattern be related to the changing biotic/abiotic environment (sediment texture, food quality and availability etc. changing both with water depth and sediment depth gradient) and if so, to what extend?

What has already been done?

Sediment samples were taken at 9 stations along the water depth transect between 1000 m and 5500 m (every 500 m depth; stations in “Hausgarten” area: HG-I to HG-IX). Macrofauna was sampled with a giant box-corer (0.25 m^2 in area). Two or three replicate subsamples (area of 400 - 800 cm^2) were taken from the box-corer and sliced vertically in layers of 0 - 1, 1 - 5, 5 - 10 and 10 - 15 cm. The sediment was washed onboard on a 0.5 mm sieve and stored in 4 % buffered formaldehyde solution.

Triplicate sediment samples for meiofauna were taken from the multicorer with cores 10 cm^2 in area and sliced vertically in the same way as for macrofauna. Samples were preserved with 4% buffered formaldehyde solution.

Additionally, at the same stations and in the same sediment layers sediment samples were also taken for:

- bacterial counts (2-3 replicates taken with a core 2 cm in diameter, samples were frozen at –25 °C);
- granulometric analyses (2 replicates taken with a core 3.6 cm in diameter, samples were frozen at –25 °C);
- organic carbon and nitrogen content (2-3 replicate samples taken with a core 2 cm in diameter, samples were frozen at –25 °C);
- pigment concentrations (3 replicate samples taken with a core 2 cm in diameter, samples were frozen at –80 °C).

What is planned?

The core of the study will be an estimate of densities and biomass of macrofauna in particular sediment layers. Macrofauna will be identified to the species/genus level. Attention will be paid to the contribution of different macrofaunal trophic groups (for example suspension vs. deposit feeders) to the total macrofaunal density.

On the other hand total densities and biomass of meiofauna in vertical sediment profiles will be also studied. Major meiofaunal taxa will be recognized and the contribution of different trophic groups to the total meiofaunal density is planned to be estimated. The results on meiofauna will be compared with the data provided by the group from Gent University, Belgium.

All the results on macro- and also meiofaunal communities characteristics will be, if possible, related to the results on biotic and abiotic factors characterising each site, like total bacterial numbers and biomass, medium grain size and contribution of different sediment fractions in particular sediment layers, organic carbon and nitrogen content, C/N ratio and concentration of Chl. *a*. Results on bacteria and chemical parameters will be compared with the data provided by AWI.

On this basis we are expecting to get a view on the relation between faunal distribution and parameters explaining food conditions at each water depth. This would allow then to conclude about the potential role of benthic fauna in processing of organic matter reaching the bottom surface at different water depths.

Acknowledgements
We wish to express our thanks to Martina Kunz-Pirrung, Jens Matthiessen and Michael Pirrung for their help with the box-corer. Eveline Hoste, Natalia Budaeva and Natalia Kukina are acknowledged for their help with sampling and washing the sediment. Our thanks are also to Karen von Juterzenka for her help and advice. The crew and all the scientific staff onboard the polar research icebreaker "Polarstern" is thanked for the fantastic working environment during the cruise ARK-XIX/3c.

C. 11 Distribution patterns and carbon demand of epibenthic megafauna

Piepenburg, D., Schmid, M.

Introduction
Analysing still photographs and video footage taken during the ROV dives will assess species composition, abundance and distribution patterns of megabenthic organisms occurring in the "Hausgarten". This material will complement imaging data taken during "Polarstern" cruise ARK XVIII in 2002 and, thus, enhance the spatial coverage in the inventory of habitats in the study area. In the long run, this work will contribute to an ecological mapping ("marine habitat classification") of the entire "Hausgarten" environment.

The carbon demand of benthic communities has been estimated in numerous studies by assessing the sediment oxygen uptake, i.e. by incubating sediment cores and following the decrease of dissolved oxygen in the ambient overlying water with time. These measurements – regardless of whether they are performed *in situ* with benthic lander or using shipboard techniques – provide a bulk parameter, i.e. the “sediment community oxygen consumption” (SCOC) or “sediment oxygen demand” (SOD), which integrates chemical oxygen uptake plus total aerobic respiration of all benthic organisms contained in the core. The cores used for sediment-water incubations are usually rather small and cover only modest sample areas (< 500 cm^2). Therefore, they only contain organisms ranging in body size from micro-, meio- to small macrobenthos but no megafauna. For these animals, total population or assemblage respiration – and, by implication, carbon demand – cannot be measured directly with an integrating determination but has to be approximated by other approaches, such as combining abundance or biomass figures with individual respiration rates. We will use this method to estimate the oxygen and carbon demand of the epibenthic megafauna in the “Hausgarten” area.

Besides precise information on abundance and distribution, a sound knowledge about the individual oxygen consumption rates is critical for assessing the carbon demand of megabenthos assemblages. However, only few data on individual oxygen uptake are available for deep-sea Arctic species, mainly because many technical problems are involved in performing unbiased measurements of routine respiration rates of unstressed animals at low ambient temperatures. Therefore, live megafaunal specimens will be collected – either by means of the ROV or from box cores and trawl catches – and kept in aquaria. Respiration measurements of these specimens are difficult, but new sensitive techniques (with optodes as oxygen sensors) will be used to determine rates with sufficient precision in lab measurements conducted on board the research vessel. Furthermore, it is planned to use the capabilities of the ROV to measure the respiration of selected megabenthic specimens *in situ*.

Our basic rationale has been to complement studies on other portions of the benthic community (micro- to macrobenthos) being conducted by other working groups. A synopsis of the various results will allow for achieving a more comprehensive understanding of the ecosystem under study.

The main goals of our various megabenthos investigations were:

1. Assessment of small-scale distribution patterns of megafaunal associations in the “Hausgarten” area using imaging methods.

2. Determination of individual oxygen uptake rates of megafaunal organisms (both in situ and in the lab) and estimation of their carbon demand
3. Estimation of megabenthic carbon demand at population level by combining information on abundance and individual oxygen uptake.

Methods

For the assessment of small-scale distribution extensive video footage and photographs have been taken. These images will be evaluated at home using various image analysis tools.

Oxygen uptake rates have been determined *in situ* with a fibre-optical oxygen sensitive sensor (optode). The actual respirometer consisted of three parts: the optode (1) which is mounted to a logging device (Aanderaa, RCM11) (2), which finally is build into a frame with an attached corer tube (3). The oxygen sensor is reaching into the core and measures when pushed into the sediment with “Victor 6000s” manipulating arm continuously the oxygen consumption in the overlying water of the core.

Individual respiration rates of macrobenthic animals have been measured using Winkler-titration. Animals have been taken from box corers and traps. Prior to the measurements the animals have been kept in aquaria at in situ temperatures (-0.8 °C).

Results and discussion

Overall nine *in situ* measurements have been carried out, lasting from 4 to 105 hours according to availability of “Victor 6000”. Sediment community oxygen consumption (SCOC) has been measured with and without megabenthic epifauna (Tab. C11-1). Figure C11-1 shows the summary of the first deployment of the respirometer. A rough estimate of consumption rates is listed in Tab. C11-2. The numbers are preliminary and have to be recalibrated at a later time.

The calculated carbon demand (Tab. C11-2) ranges from 1 to 22 mg C m^{-2} h^{-1}. Cores without visible megabenthic epifauna sometimes had higher consumption rates than cores with animals (see experiment M7 and M8). This may be due to high activity in the sediment. Pictures made by “Victor 6000” indicate a high abundance of burying animals, e.g. isopods and polychaetes.

Tab C11-1: Stationlist of *in situ* measurements

Station	Dive	Measurement	Latitude (N)	Longitude (E)	Depth (m)	Date and Time	Duration (h)	Remarks
64-412	227	**M1**	79°03,8'	4°11,4'	?	21/07/03 22:10		Porifera + Anthozoa
64-412	227					22/07/03 10:45	12,58	approx. 1 nm SE of Metal Frame
64-412	227	**M2**	79°03,8'	4°11,4'	?	22/07/03 10:52		Blind M1
64-424	228					24/07/03 18:23	55,52	2 m to the right of M1
64-424	228	**M3**	79°04,416'	4°08,064'	2450	24/07/03 21:28		Bathycrinus
64-424	228					25/07/03 05:58	8,50	close to Metal Frame and cages
64-424	228	**M4**	79°04,416'	4°08,064'	2450	25/07/03 06:02		Blind M3
64-424	228					25/07/03 12:20	6,30	1 m to the right of M3
64-435	229	**M5**	79°04,403'	4°08,118'	2437	26/07/03 17:34		Porifera+Garnele

64-435	229					27/07/03 03:27	9,88	approx. 100 m NW of Metal Frame
64-435	229	**M6**	79°04,403'	4°08,118'	2437	27/07/03 03:31		Blind M5
64-458	232					31/07/03 12:33	105,03	approx. 1 m apart of M5
64-458	232	**M7**	79°04,403'	4°08,118'	2437	31/07/03 12:41		Bathycrinus + "hole" (Arcturus?)
64-458	232					31/07/03 20:45	8,07	very close to M5
64-458	232	**M8**	79°04,403'	4°08,118'	2437	31/07/03 20:55		Blind M7
64-458	232					01/08/03 00:39	3,73	very close to M7
64-458	232	**M9**	79°04,409'	4°08,071'	?	01/08/03 00:58		Bathycrinus
64-458	232					01/08/03 08:10	7,20	approx. 10 m NW of M8

Tab. C11-2: In-situ measurements of oxygen consumption.

						Respiration chamber		C-Remineralisation		
						Volume (l)	area (m^2)	RQ = **0,85**		
						2,6	**0,028**			
							per hour		per day	
measurement	time	duration (h)	C (µM O_2)	%	∂C (µM O_2 h^{-1})	∂C (µmol O_2 h^{-1})	mmol O_2 m^{-2} h^{-1}	mg C m^{-2} h^{-1}	mmol O_2 m^{-2} d^{-1}	mg C m^{-2} d^{-1}
M1	21.07.03 22:10		301	82%						
Porifera + Anthozoa	22.07.03 07:40	9,50	102	28%	19	50	1,8	18	42	432
M2a	22.07.03 11:00		277	76%						
Blind M1	22.07.03 17:45	6,75	105	29%	15	38	1,3	14	32	328
M2b	23.07.03 06:30		214	58%						
	24.07.03 18:20	35,83	163	44%	1	4	0,1	1	3	30
M3	24.07.03 21:30		285	78%						

Tab. C11-2: In-situ measurements of oxygen consumption.

							Respiration chamber	C-Reminerali-sation		
							per hour		per day	
measurement	time	duration (h)	C (µM O_2)	%	∂C (µM O_2 h^{-1})	∂C (µmol O_2 h^{-1})	mmol O_2 m^{-2} h^{-1}	mg C m^{-2} h^{-1}	mmol O_2 m^{-2} d^{-1}	mg C m^{-2} d^{-1}
Bathycrinus	25.07.03 05:55	8,42	123	34%	23	60	2,1	22	51	518
M4	25.07.03 06:15		245	67%						
Blind M3	25.07.03 10:40	4,42	145	40%	23	59	2,1	21	50	507
M5	26.07.03 17:40		301	82%						
Porifera + shrimp	27.07.03 03:25	9,75	242	66%	4	11	0,4	4	9	92
M6a	27.07.03 03:35		280	76%						
Blind M5	27.07.03 17:20	13,75	89	24%	9	24	0,9	9	21	210
M6b	27.07.03 22:15		146	40%						

Tab. C11-2: In-situ measurements of oxygen consumption.

							Respiration chamber	C-Remineralisation		
							per hour		per day	
measurement	time	duration (h)	C (µM O_2)	%	∂C (µM O_2 h^{-1})	∂C (µmol O_2 h^{-1})	mmol O_2 m^{-2} h^{-1}	mg C m^{-2} h^{-1}	mmol O_2 m^{-2} d^{-1}	mg C m^{-2} d^{-1}
Blind M5	31.07.03 12:30	86,25	95	26%	1	2	0,1	1	1	14
M7	31.07.03 12:45		268	73%						
Bathycrinus + "hole"	31.07.03 20:45	8,00	180	49%	10	26	0,9	9	22	222
M8	31.07.03 20:55		288	79%						
Blind M7	01.08.03 00:35	3,67	218	59%	23	60	2,1	21	50	514
M9	01.08.03 01:00		296	81%						
Bathycrinus	01.08.03 08:00	7,00	208	57%	11	28	1,0	10	23	240

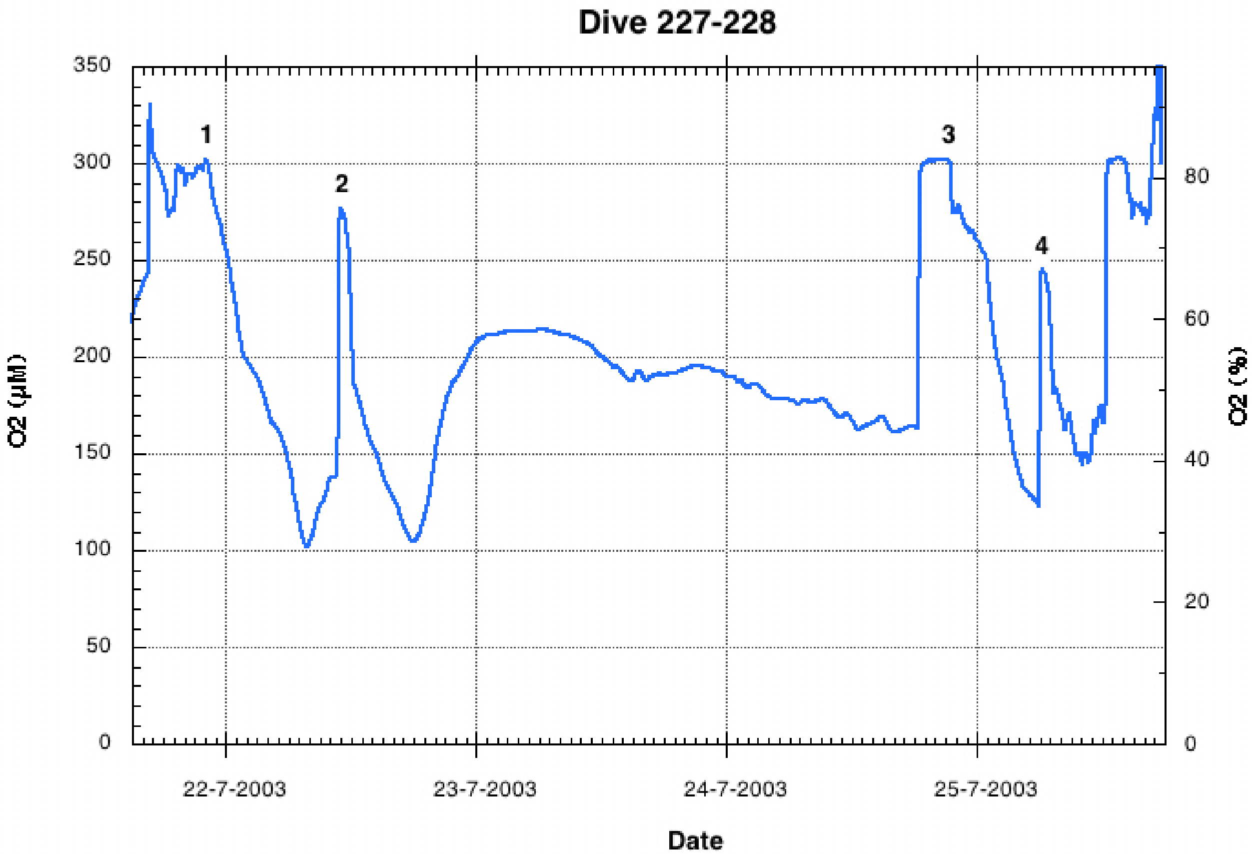


Fig. C11-1: Graphical display of oxygen consumption rates during first deployment of the respirometer (numbers indicating starting points of discrete incubations).

C. 12 Temporal variations in the meiobenthos along a bathymetrical gradient ("Hausgarten", Arctic): impact of climate oscillations

Hoste, E., Soltwedel, T., Vanhove, S., Vanreusel, A.

Introduction

The Arctic is one of the most extreme environments on this planet, with limited sunlight, extremely low temperatures and a short growing season. These characteristics make this environment very sensitive for small changes in climate. Former studies indicate a change in benthic fauna community structure with varying biological and physical environmental factors, due to climatic oscillations (AO, NAO, PDO and ENSO). These oscillations induce cyclic changes in temperature, wind and precipitation, resulting in a complex effect on the marine ecosystem. Effects on benthos were already studied in the Barents Sea and Labrador Sea.

Climate models predict that global warming will have the highest impact on the Polar Regions. Temperature rises of 2 °C per decennium during winter were already reported. Expectations are that there will be another temperature rise of 1.5 - 3 °C till the year 2030. This has severe an impact on the ice extension which has been diminished by 2.9 % since 1980. Global warming has a great impact on the salinity, stratification of the water column, food supply and chemical composition of the sea water.

Objectives

Sampling for meiobenthic investigations took place along the “Hausgarten” bathymetrical transect (between 1200 - 4000 m). Three replicates of the upper 5 cm were taken from the MUC with a syringe of 2 cm diameter (3.14 cm^2) and divided in 1 cm-slices. The samples were put on a 4 % formaldehyde solution. Further analysis will be done in the lab of the Marine Biology Section, University Gent.

These data will be analyzed together with another four years of samples in order to make a conceptual model that allows predictions of changes in the meiobenthos ecosystem in relation to variation in environmental parameters linked to climate oscillations (e.g. AO, ENSO) and global warming. The model will be adjusted according to the answers to following questions:

1. Are there annual differences in meiobenthos composition in the Arctic region and can these differences be linked to changes in physical and biological environmental parameters, such as oxygen concentration, temperature and food supply?
2. Is there a relation between changes in meiofauna community structure and environmental parameters along the bathymetrical gradient?

Emphasis will be on nematodes and copepods, the most abundant meiofauna groups, which will be identified up to species level. Density, biomass (length and width measurements), productivity and diversity (α-, β-, and γ-diversity) will be assessed. These data will be analysed using variance analysis, correlation and regression analysis and multivariate techniques.

From 1200, 2500 and 4000 m water depth an extra replicate was taken with a core of 3.6 cm diameter (10 cm^2) in order to analyse the influence of sample size on biodiversity measurements.

Results

Preliminary results show significant interannual variation in the meiobenthos composition. Kinorhyncha, Tardigrada and Gastrotricha are absent in the year 2000, while present in 2002. In 2001 only Kinorhyncha were found. Highest mean nematode densities were found in 2002 (2804 nematodes/10 cm^2), at 2000 m water depth (Fig. C12-1). This is also the case for copepods which reach a mean density of 69 copepods/10 cm^2 at this station (Fig. C12-2). Nematodes and copepods show the same trend in densities along the bathymetrical transect (Fig. C12-3).

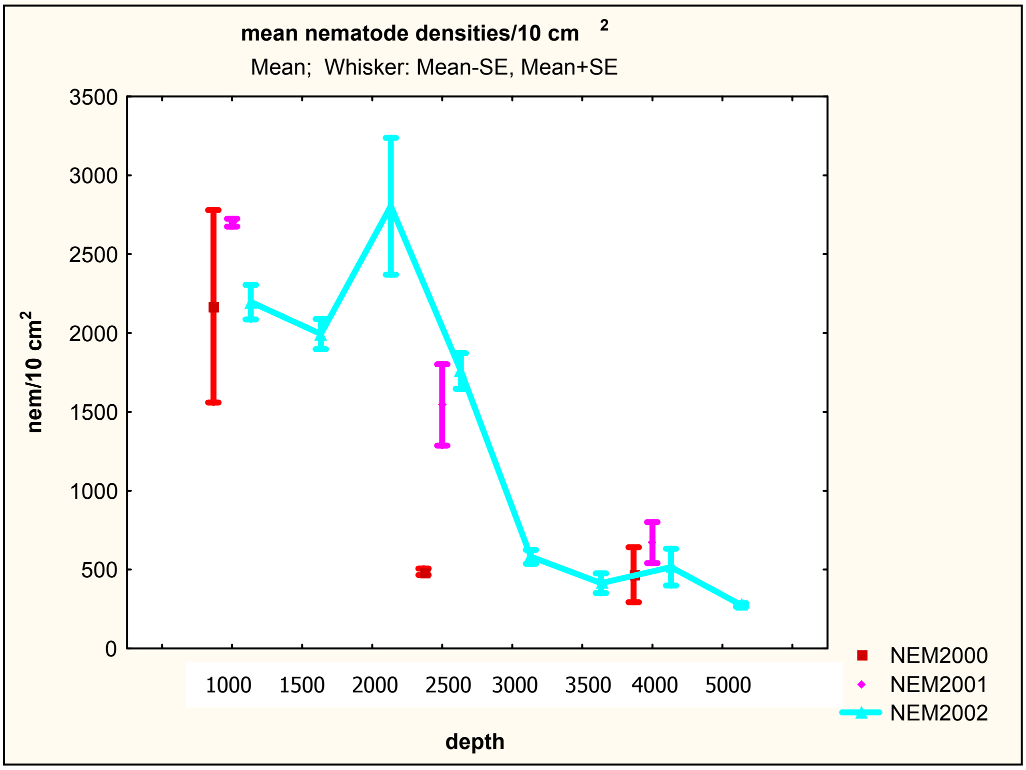


Fig. C12-1: mean nematode densities/10 cm^2 for the years 2000-2002.

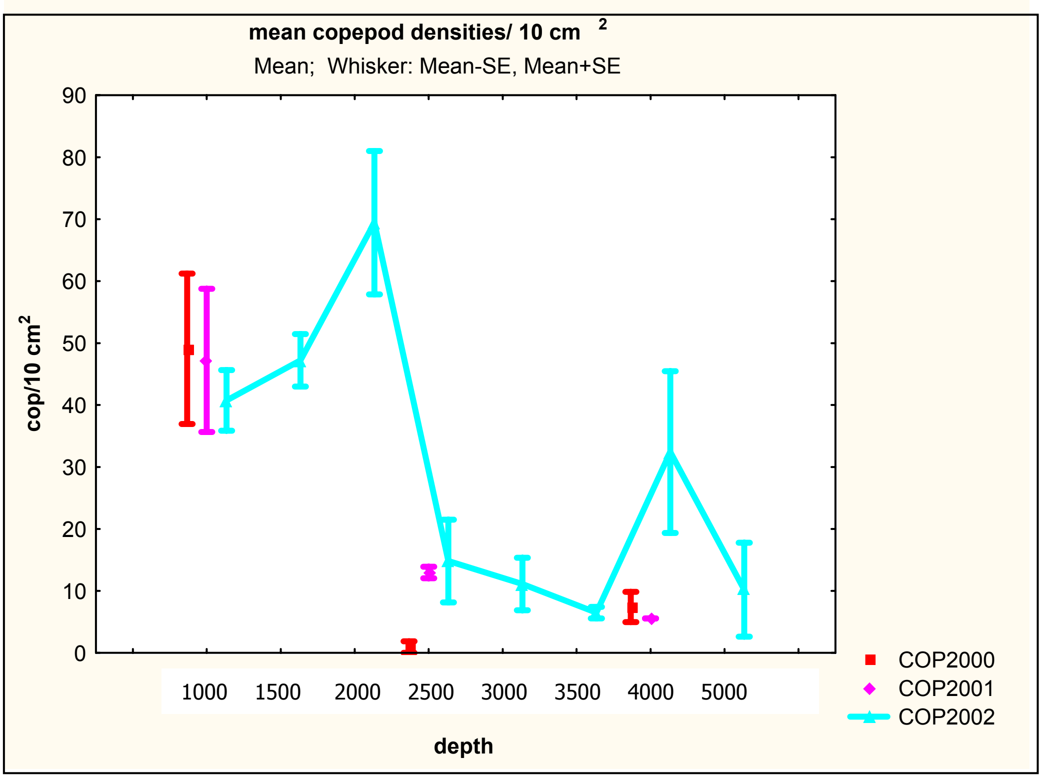


Fig. C12-2: Mean nematode densities/10 cm^2 for the years 2000-2002.

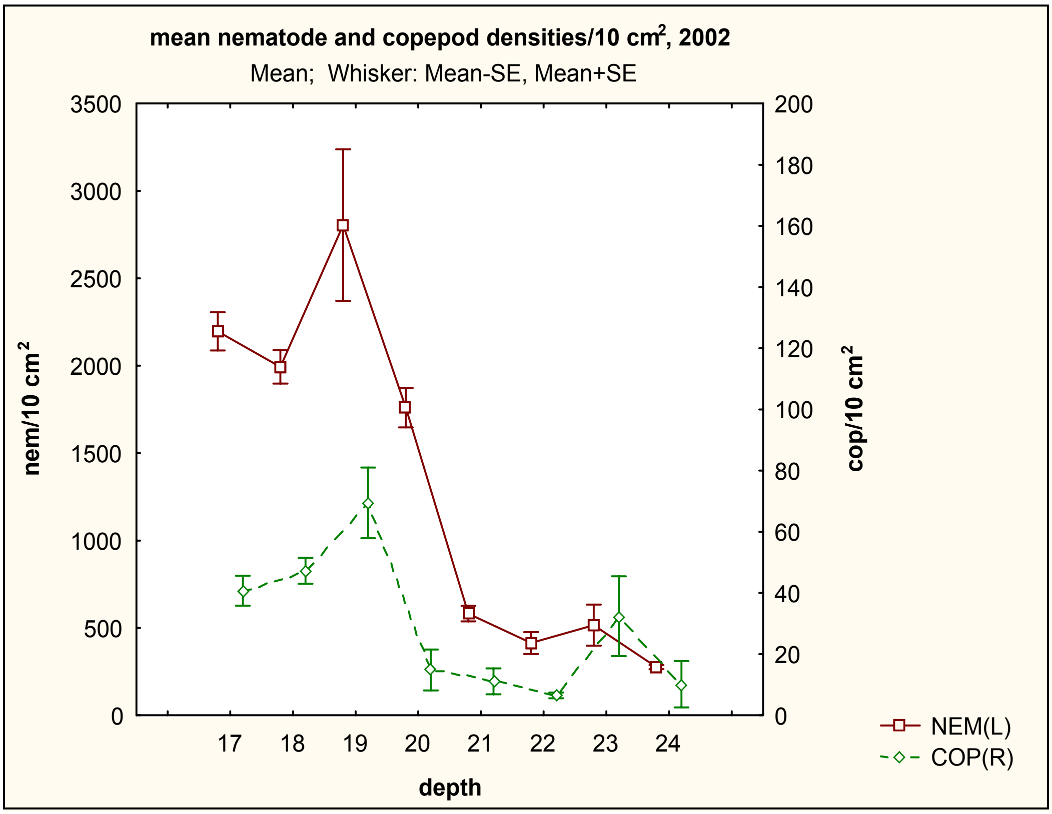


Fig. C12-3: mean nematode and copepod densities/10 cm^2 for the year 2002.

C. 13 Biodiversity, molecular phylogeny and trophic ecology of amphipod crustaceans in the polar deep sea: a bipolar comparison

De Broyer, C., Martin, P.

Peracarid crustaceans, and amphipods in particular, constitute one of the most diverse macrobenthic groups in terms of species richness, life styles, trophic types, habitats and size spectra in both polar sublittoral communities. The East Arctic seas for instance, count more than 500 species of Amphipoda, the Barents Sea harbors 302 species and 262 species of Gammaroidea are listed only from the Svålbard area.

Investigations of the Arctic deep sea revealed a much lower diversity with few tens of benthic, suprabenthic or benthopelagic amphipod species representing only a small fraction of the 260 species found below 2000 m deep in the World Ocean. Most of these deep-sea species belong to relatively primitive families, characterized by free-swimming males, and exhibit deposit-, predatory- or scavenging-feeding habits.

The origin and determinants of the species richness of the deep-sea macrobenthos in both Polar Regions are still a matter of debate. The diversity, abundance, ubiquity and low dispersal capabilities of the amphipod crustaceans make them a good model group for studying patterns and processes of biodiversity and biogeography. A bipolar analysis of the biodiversity patterns observed in this taxon can contribute to better understand some driving forces shaping the vagile macrobenthos communities in polar ecosystems.

The project focuses on peracarid crustaceans, in particular amphipods, of the Arctic deep sea and includes several complementary approaches:

- Patterns and processes of polar macrobenthic biodiversity

The project aims at contributing to characterize Arctic deep-sea amphipod biodiversity (alpha and gamma diversity, taxonomic diversity, life styles, habitats, distribution) and at comparing it with Antarctic deep sea amphipods currently investigated under the ANDEEP project (De Broyer et al., 2003). A particular attention is given to the scavenger species that form a significant guild within the deep-sea benthic trophic system and may show different degrees of adaptation to necrophagy.

- Molecular phylogeny and phylogeography of selected deep sea taxa

In parallel to a morphological approach, a molecular study is carried out in order to obtain a robust molecular phylogeny of selected amphipod taxa (with special reference to lysianassoids), on the basis of different nuclear and mitochondrial gene fragments. Such a phylogeny will be subsequently used as a tool for studying different issues related to biogeography, origin, colonisation and evolutionary biology of benthic taxa from the two polar regions.

Moreover, due to the temporal dimension included in models commonly used for phylogenetic reconstructions, data about tempo and mode of evolution in lysianassoids taxa are expected. They should enable us to contribute to reconstruct the evolutionary scenario of this group, to study radiations within the group and to identify possible species flocks, cryptic species, as well as convergent adaptive radiations (in particular adaptations related to trophic niches).

- Trophodiversity and trophodynamics

In the framework of a general approach to understand the ecofunctional role of the amphipod taxocoenoses in the Polar and deep-sea benthic ecosystems, the project aims at contributing to characterize the trophodiversity and the trophodynamic role of selected Arctic deep sea amphipods and at comparing it in different benthic communities on bipolar and bathymetric scales.

The trophic approach will rely on the use of stable isotope ratios (carbon, nitrogen) as amphipod diet tracers combined with digestive tract analyses to delineate the trophic relationships involving amphipods in the Arctic deep sea food webs. The results will be compared to a similar trophic study undertaken in the Antarctic.

Work at sea

Baited trap sets were deployed three times, twice from the ROV and once from a Lander (see Tab. C13-1). In addition, large box corers samples provided additional amphipod and tanaid material. Whenever possible, the freshly collected material was identified to the species level. Parts of the living animals from trap samples were maintained in aquariums for behaviour and feeding biology observations. DNA extractions were performed from selected specimens of all possible sampled species.

Preliminary results

<u>*Biodiversity survey*</u>

Trap operations (Tab. C13-1) allowed collecting scavenger crustaceans from Hausgarten area (7 amphipod species, 1 isopod species) and, during the previous leg ARK/XIX3b, from HMMV (6 amphipod species) (Tab. C13-2). In addition, preliminary sorting of several GKG samples (from stations 409, 417, 465, 468, taken from depths of 1549 to 5219 m) provided some species of Eusiridae, Lysianassidae and Phoxocephalidae as well as some Tanaidacea. One *Eusirid* species was not identifiable from current keys and may be new to science.

Tab. C13-1: Results of trap operations.

Station	**Location**	**Gear**	**Depth**	**Duration**	**Amphipoda**	**Isopoda**	**Gastropoda**
			m	h	spp (ind)	spp (ind)	spp (ind)
326-1	HMMV	Victor	1290	14.5	6 (?)		
412-1	HG	Victor	2464	68+14	2 (32)	1 (21)	1 (2)
423-1	HG	Lander	2461	29	7 (436)		
448-1	HG	Victor	2342	43	5 (244)	1 (162)	
Total					13 (712+)	1 (183)	1 (2)

Tab. C13-2: List of crustacean species collected in traps at “Hausgarten” and HMMV.

Species	Stations
Amphipoda	
Lysianassoidea	
Anonyx nugax	326-1
Boeckosimus sp.1	326-1
Boeckosimus sp.2	326-1, 423
Eurythenes gryllus	412, 423, 448
Orchomenopsis sp.1	326-1
Paracallisoma sp.1	423, 448
Paracallisoma sp.2	448
Tmetonyx norbiensis	423

Species	Stations
Tmetonyx sp.1	326-1, 423
Tmetonyx sp.2	326-1
Tryphosella abyssalis	423
Tryphosella sp.3	412, 423, 448
Stegocephalidae	
Gen. sp.1	448
Isopoda	
Idoteidae	
Saduria cf. *sabini*	412, 448

Molecular phylogeny and phylogeography of selected deep sea amphipod taxa

Specimens devoted to molecular analyses were put in absolute ethanol the soonest as possible after sampling, preferably live when possible, in order to avoid possible DNA degradation by enzymatic activity. As a rule, a very little part of each specimen selected for molecular analyses was taken (usually the pereopod 6, as a whole or a part of it, depending of the size of the animal). The amputated animals were preserved in absolute ethanol as voucher specimens and for future morphological studies. DNA extractions and purifications were carried out by means of QIAamp DNA Mini Kit (Qiagen), from selected specimens of a total of at least 3 families, 7 genera and possibly 10 different species, of which one could be a species new for science. In addition, DNA was extracted from the isopod *Saduria* cf. *sabini*, abundantly caught in some baited traps.

The biological material consisted mostly of representatives of the superfamily Lysianassoidea, of which at least 5 genera (*Eurythenes*, *Boeckosimus*, *Paracallisoma*, *Tmetonyx*, and *Tryphosella*) and 8 species were obtained during ARK XIX/3c cruise. The remaining material consisted of a few specimens of related amphipod families (Stegocephalidae, Eusiridae), and was processed for the sake of outgroup use in future molecular phylogenetic reconstructions. All this material will be processed in the laboratory, in order to obtain DNA fragment sequences of at least 18S, COI and possibly

ITS2 genes. These genes have proven to be useful for different phylogenetic levels and to give complementary information.

Feeding eco-ethology

Traps results (Tab. C13-1) indicated 12 lysianassoid amphipod species being regular scavengers. Checking of the mouthparts morphology and of the degree of extension of the "storing" gut showed typical adaptations to necrophagy: mandibles with strong incisor, bowl-shaped mandibular body, and molar process with different degrees of reduction, long extended foregut or midgut (*Eurythenes*) for storing food.

About 200 specimens of *Eurythenes gryllus* (mostly juvenile, of a size of 12 to 65 mm) were kept in aquarium for a maximum of 10 days. After having been taken on the bottom at about 2500 m deep, at a temperature of -0.8 °C, they transited through the 6 °C surface waters for about 30 minutes and were out of the water for about 10 minutes before being put in aquarium at 0 °C (± 1 °C). Most of them (90 %) recovered from the decompression and the thermal shocks, and after maximum 24 h could be seen moving and swimming around. No *Saduria* cf. *sabini* put in aquaria survived the capture.

Most of *Eurythenes* had their mid-gut dilated and entirely filled with easily distinguishable pieces of bait (herring). After 8 days in aquarium, the gut content did not show any apparent transformation or reduction (15 specimens checked).

Several tens of amphipod specimens of selected species were deep-frozen alive at -30 °C for further stomach content analyses and for the stable isotopes (carbon and nitrogen) analyses.

C. 14 Experimental approaches to study causes and effects of environmental gradients at the deep seafloor

Soltwedel, T., Schewe, I., Sauter, E., Hasemann, C., Klages, M.

To identify factors controlling the high biodiversity in the deep sea, we carried out a number of biological long-term experiments at stations "Hausgarten"-Central and "Hausgarten"-South (Fig. C1). During the expedition ARK XIX/3c, the ROV "Victor 6000" was used to terminate and sample the experiments started in 1999 and 2001, to carry out short-term experiments throughout the cruise, and to start new long-term experiments.

Cages placed on the sediment to study the development of infaunal communities not effected by disturbances introduced by larger benthic organisms (e.g. the disruption of the sediment structure, predation) were sampled by push coring undisturbed sediments underneath the cages (Fig. C14-1a). Sediment samples taken in the immediate vicinity of the cages serve as controls. Fish baits were deployed at the seafloor to simulate large food-falls and to study the impact of such events on small sediment-inhabiting organisms in the size range from bacteria to meiofauna (Fig. C14-1b).

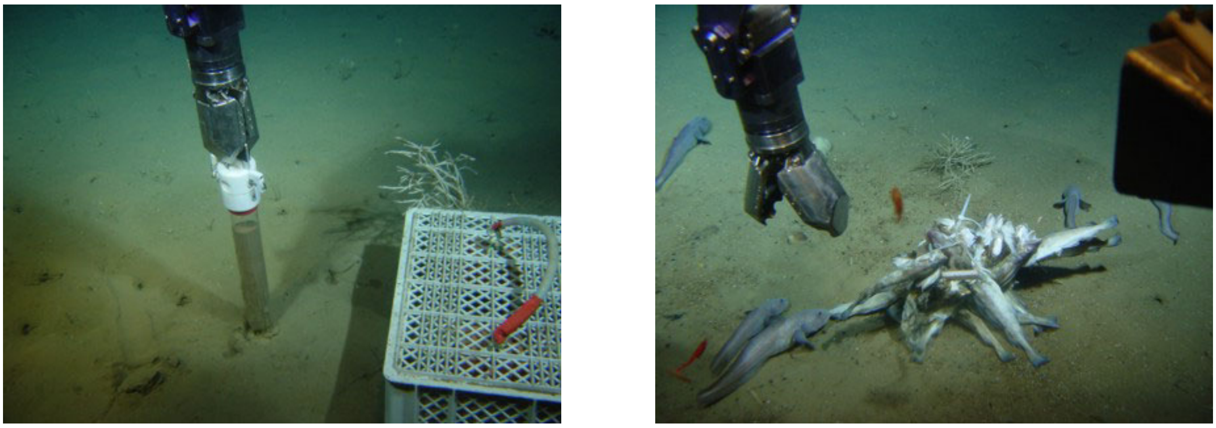


Fig. C14.1:
a) Sampling of control sediments next to a cage for the exclusion experiment (left);
b) Deployment of fish baits to simulate large food-falls at the deep seafloor (right).

Various artificial substrates (plates of stone and Perspex™) exposed since 1999 were retrieved to study the colonisation of empty spaces in an environment short in hard-substrates to settle on (Fig. C14-2a). Free-falling devices carrying colonisation trays, containing different types of artificial sediments with different concentrations of organic matter, already deployed during ARK XIX/1b in spring 2003 were recovered and sampled to investigate how the smallest benthic organisms react to an episodic and significant food supply (Fig. C14-2b).

Fig. C14-2:
a) Metal frame carrying various hard substrates for a colonization experiment (left);
b) Subsampling of colonization trays after recovery of the free-falling device (right).

The deployment of plastic rings on the sediment surface, which were subsequently filled up with an algae suspension followed the same approach (Fig. C14.-3a). Sponge mimics anchored at the sediment surface to study effects of small biogenic structures (in this case sessile epibenthic organisms) on sediment-inhabiting micro-organisms were sampled by push coring with the ROV (Fig. C14-3b).

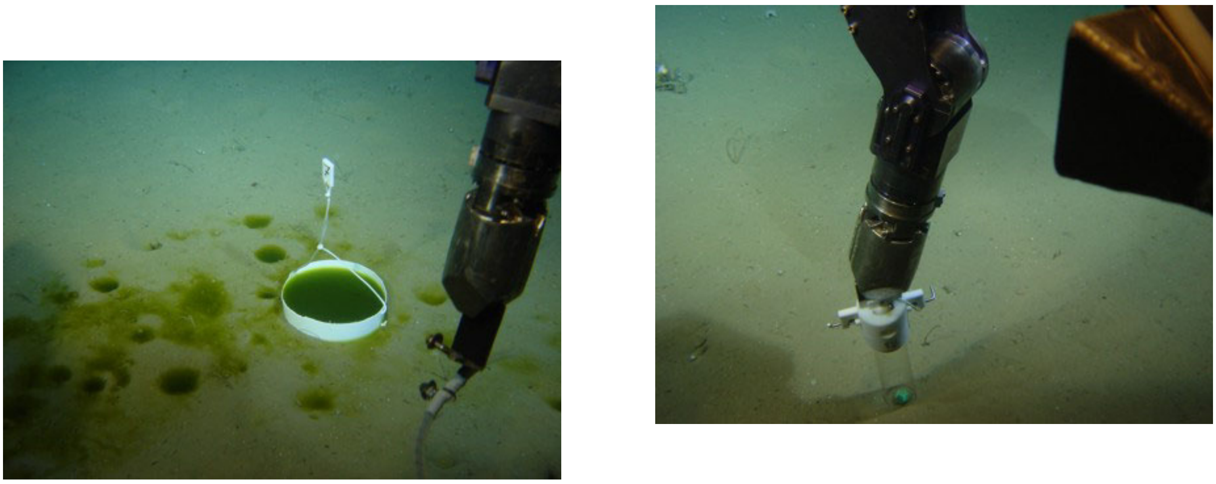


Fig. C14-3:
a) Plastic ring anchored at the seafloor and filled with algae suspension (left);
b) Sampling of sponge mimics with a push corer handled by the ROV (right).

An *in situ* flume, approx. 6 m in length, was installed at the seafloor to investigate benthic respiration and interfacial solute exchange under changing bottom current regimes (Fig. C14-4a). According to near-bottom current data, the flume was orientated in a SW to NE direction. With a funnel-like entrance at both ends with openings of 45° at both sides the channel captures bottom currents of S to W and E to N direction. The channel was designed to several times increase the current velocity of the water flowing through it. Windows in the flume walls as well as transparent lids allow observing the interior of the flume. Experimental manipulations inside the flume can be performed trough the removable lids. Current measurements with the acoustic current meter have been carried out directly after installation (Fig. C14-4b). The flume will be re-visit it in 2005 to carry out oxygen measurements in the upper sediment layers using a micro profiling unit, and to sample sediments inside the flume to investigate environmental conditions (e.g. food availability), and to study the community of small sediment-inhabiting organisms adapted to increased near-bottom currents inside the flume. Sediment samples taken outside the flume will serve as controls.

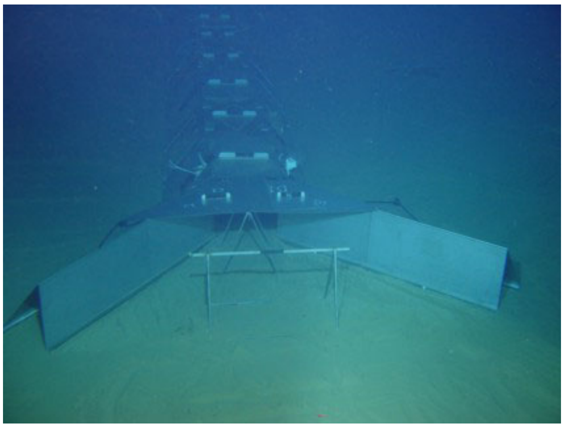


Fig. C14-4:
a) Flume installed at the seafloor to increase near-bottom currents (left);
b) Current measurements inside the flume using an acoustic current meter (right).

Appendix D: Station list of ARK XIX/3

The station list contains all information generated by the officer on watch during station work of the cruise ARK XIX/3. To reduce the number of pages the last "comment" column was deleted in the printed version. However, this information is given in the station list file stored on the CD-ROM attached to this report.

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/234-1	02.06.03	11:53	48° 41.61' N	6° 20.64' W	123.0	S 6	300.6	7.2	Calibration	CAL	start
PS64/234-1	02.06.03	13:45	48° 42.00' N	6° 21.39' W	122.0	S 7	338.9	7.2	Calibration	CAL	End
PS64/235-1	03.06.03	08:52	50° 34.89' N	11° 25.77' W	1678.0	WNW 4	286.9	0.7	CTD	CTD	surface
PS64/235-1	03.06.03	09:23	50° 34.97' N	11° 26.01' W	1683.0	W 4	314.4	0.3	CTD	CTD	at depth
PS64/235-1	03.06.03	09:45	50° 35.05' N	11° 26.21' W	1692.0	W 4	327.5	0.6	CTD	CTD	on deck
PS64/235-2	03.06.03	10:01	50° 35.12' N	11° 26.31' W	1697.0	W 6	312.9	0.3	Posidonia	POS	Transponder in the water
PS64/235-2	03.06.03	10:05	50° 35.13' N	11° 26.34' W	1698.0	W 6	343.0	0.3	Posidonia	POS	Transponder slipped
PS64/235-2	03.06.03	10:19	50° 35.20' N	11° 26.46' W	1704.0	W 5	315.9	0.4	Posidonia	POS	Information
PS64/235-2	03.06.03	11:39	50° 35.23' N	11° 26.39' W	1702.0	WSW 6	277.5	4.1	Posidonia	POS	Begin
PS64/235-2	03.06.03	14:09	50° 35.05' N	11° 26.43' W	1696.0	WSW 8	177.5	2.1	Posidonia	POS	release
PS64/235-2	03.06.03	14:41	50° 35.33' N	11° 26.39' W	1705.0	SW 10	61.5	0.8	Posidonia	POS	End
PS64/235-3	03.06.03	15:11	50° 34.93' N	11° 25.81' W	1676.0	SW 9	293.8	0.6	Multi corer	MUC	surface
PS64/235-3	03.06.03	15:13	50° 34.93' N	11° 25.83' W	1680.0	SW 10	298.2	0.4	Multi corer	MUC	information
PS64/235-3	03.06.03	15:23	50° 34.97' N	11° 25.88' W	1680.0	SW 8	324.4	0.3	Multi corer	MUC	surface
PS64/235-3	03.06.03	15:59	50° 35.09' N	11° 25.92' W	1686.0	SW 8	15.4	0.3	Multi corer	MUC	at sea bottom
PS64/235-3	03.06.03	16:35	50° 35.26' N	11° 25.95' W	1686.0	SW 8	221.3	0.0	Multi corer	MUC	on deck
PS64/236-1	03.06.03	18:00	50° 46.12' N	11° 24.28' W	1034.0	SW 9	140.5	0.6	Multi corer	MUC	surface
PS64/236-1	03.06.03	18:25	50° 46.08' N	11° 24.02' W	1021.0	SW 8	122.3	0.6	Multi corer	MUC	at sea bottom
PS64/236-1	03.06.03	18:49	50° 45.95' N	11° 23.87' W	1021.0	SW 9	172.7	0.4	Multi corer	MUC	on deck
PS64/237-1	03.06.03	19:46	50° 44.94' N	11° 12.26' W	465.2	SSW 8	280.4	6.8	HydroSweep/ParaSound profile	HS_PS	start track
PS64/237-1	03.06.03	21:14	50° 43.05' N	11° 31.81' W	1667.0	SSW 7	264.4	8.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/237-1	03.06.03	22:44	50° 44.00' N	11° 11.86' W	866.7	SSW 7	83.8	9.0	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/237-1	04.06.03	00:14	50° 40.78' N	11° 29.24' W	1600.0	S 7	196.1	7.0	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/237-1	04.06.03	01:20	50° 31.94' N	11° 26.36' W	1418.0	SSW 8	172.5	8.1	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/237-1	04.06.03	01:30	50° 31.97' N	11° 28.24' W	1471.0	S 6	284.1	9.3	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/237-1	04.06.03	03:07	50° 46.79' N	11° 32.92' W	1529.0	SSW 7	351.4	9.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/237-1	04.06.03	03:21	50° 47.47' N	11° 30.82' W	1418.0	SSW 8	158.8	7.7	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/237-1	04.06.03	03:56	50° 42.43' N	11° 29.07' W	1747.0	SSW 8	161.2	9.1	HydroSweep/ParaSound profile	HS_PS	profile end
PS64/238-1	04.06.03	04:31	50° 42.14' N	11° 29.04' W	1751.0	SSW 8	115.7	0.4	Remote operated vehicle	ROV	surface
PS64/238-1	04.06.03	04:47	50° 42.12' N	11° 29.06' W	1752.0	SSW 6	210.9	0.0	Remote operated vehicle	ROV	Depressor into water
PS64/238-1	04.06.03	07:10	50° 42.23' N	11° 28.74' W	1736.8	SSW 8	2.4	1.4	Remote operated vehicle	ROV	at depth
PS64/238-1	04.06.03	11:06	50° 42.28' N	11° 26.26' W	1654.0	SW 7	102.9	0.2	Remote operated vehicle	ROV	coming back to the surface

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/238-1	04.06.03	12:14	50° 41.76' N	11° 25.93' W	1583.0	WSW 8	176.2	0.5	Remote operated vehicle	ROV	coming back to the surface
PS64/238-1	04.06.03	12:27	50° 41.62' N	11° 25.96' W	1479.6	SW 7	180.6	0.9	Remote operated vehicle	ROV	coming back to the surface
PS64/238-1	04.06.03	12:33	50° 41.55' N	11° 25.98' W	1434.8	SW 7	189.9	0.8	Remote operated vehicle	ROV	Depressor on deck
PS64/238-1	04.06.03	13:07	50° 41.25' N	11° 25.99' W	1412.5	WSW 8	98.4	0.3	Remote operated vehicle	ROV	on deck
PS64/239-1	04.06.03	14:38	50° 53.37' N	11° 24.56' W	1192.0	WSW 8	99.9	0.3	Multi corer	MUC	surface
PS64/239-1	04.06.03	15:08	50° 53.28' N	11° 24.64' W	1160.0	SW 7	245.1	0.3	Multi corer	MUC	at sea bottom
PS64/239-1	04.06.03	15:36	50° 53.29' N	11° 24.78' W	1180.0	SW 8	240.8	0.4	Multi corer	MUC	on deck
PS64/240-1	04.06.03	16:10	50° 53.32' N	11° 28.99' W	1349.0	WSW 8	221.9	0.5	Multi corer	MUC	surface
PS64/240-1	04.06.03	16:41	50° 53.30' N	11° 28.95' W	1350.0	SW 7	289.6	0.4	Multi corer	MUC	at sea bottom
PS64/240-1	04.06.03	17:15	50° 53.31' N	11° 29.03' W	1351.0	SW 8	352.6	0.3	Multi corer	MUC	on deck
PS64/241-1	04.06.03	18:52	50° 42.46' N	11° 27.02' W	1704.0	SW 8	244.8	0.2	Remote operated vehicle	ROV	surface
PS64/241-1	04.06.03	19:02	50° 42.45' N	11° 27.05' W	1703.0	SW 8	256.3	0.1	Remote operated vehicle	ROV	Depressor into water
PS64/241-1	04.06.03	20:51	50° 42.48' N	11° 27.06' W	1703.0	SW 7	289.1	0.3	Remote operated vehicle	ROV	at depth
PS64/241-1	04.06.03	21:40	50° 42.30' N	11° 26.54' W	1688.0	SW 10	75.4	0.6	Remote operated vehicle	ROV	Information
PS64/241-1	05.06.03	04:00	50° 42.54' N	11° 22.72' W	1531.0	SSW 11	345.2	0.1	Remote operated vehicle	ROV	Information
PS64/241-1	05.06.03	05:15	50° 42.45' N	11° 22.72' W	1533.0	SSW 12	139.7	0.5	Remote operated vehicle	ROV	Information
PS64/241-1	05.06.03	07:20	50° 42.52' N	11° 19.44' W	1355.0	S 13	213.6	0.2	Remote operated vehicle	ROV	Information
PS64/241-1	05.06.03	10:16	50° 42.74' N	11° 18.39' W	1313.0	S 15	35.7	0.8	Remote operated vehicle	ROV	coming back to the surface
PS64/241-1	05.06.03	11:01	50° 42.62' N	11° 17.96' W	1300.0	S 16	158.6	0.6	Remote operated vehicle	ROV	coming back to the surface
PS64/241-1	05.06.03	11:05	50° 42.59' N	11° 17.93' W	1294.0	S 16	237.6	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/241-1	05.06.03	11:09	50° 42.57' N	11° 17.90' W	1289.0	S 15	111.1	0.5	Remote operated vehicle	ROV	Depressor on deck
PS64/241-1	05.06.03	11:45	50° 42.96' N	11° 17.14' W	1186.0	S 16	63.2	2.5	Remote operated vehicle	ROV	on deck
PS64/242-1	05.06.03	13:09	50° 43.96' N	11° 15.68' W	1090.0	S 16	322.3	0.4	Multi corer	MUC	surface
PS64/242-1	05.06.03	13:34	50° 43.99' N	11° 15.69' W	1092.0	S 16	181.8	0.2	Multi corer	MUC	at sea bottom
PS64/242-1	05.06.03	14:07	50° 43.84' N	11° 15.66' W	1078.0	S 16	221.7	0.9	Multi corer	MUC	on deck
PS64/243-1	05.06.03	14:43	50° 42.64' N	11° 19.33' W	1351.0	S 16	101.1	0.4	Multi corer	MUC	surface
PS64/243-1	05.06.03	15:09	50° 42.62' N	11° 19.24' W	1341.0	S 16	266.9	0.7	Multi corer	MUC	at sea bottom
PS64/243-1	05.06.03	15:43	50° 42.54' N	11° 19.21' W	1342.0	SSW 14	172.1	0.5	Multi corer	MUC	on deck
PS64/244-1	05.06.03	16:14	50° 42.58' N	11° 22.53' W	1530.0	SSW 14	63.9	1.0	Multi corer	MUC	surface
PS64/244-1	05.06.03	16:44	50° 42.45' N	11° 22.32' W	1522.0	SW 14	155.8	0.4	Multi corer	MUC	at sea bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/244-1	05.06.03	17:16	50° 42.22' N	11° 22.11' W	1480.0	SW 12	158.6	0.2	Multi corer	MUC	on deck
PS64/245-1	05.06.03	17:50	50° 42.20' N	11° 26.15' W	1677.0	WSW 11	24.9	0.3	Multi corer	MUC	surface
PS64/245-1	05.06.03	18:26	50° 42.17' N	11° 26.07' W	1674.0	WSW 10	98.5	0.2	Multi corer	MUC	at sea bottom
PS64/245-1	05.06.03	19:02	50° 42.03' N	11° 26.08' W	1669.0	SW 9	114.7	0.5	Multi corer	MUC	on deck
PS64/246-1	05.06.03	19:23	50° 42.35' N	11° 28.16' W	1728.0	SW 11	356.6	0.4	Multi corer	MUC	surface
PS64/246-1	05.06.03	19:27	50° 42.37' N	11° 28.13' W	1729.0	SW 10	52.6	0.7	Multi corer	MUC	information
PS64/246-1	05.06.03	19:32	50° 42.37' N	11° 28.10' W	1728.0	SW 10	110.7	0.3	Multi corer	MUC	surface
PS64/246-1	05.06.03	20:07	50° 42.32' N	11° 28.13' W	1730.0	SW 9	49.9	0.6	Multi corer	MUC	at sea bottom
PS64/246-1	05.06.03	20:48	50° 42.21' N	11° 27.93' W	1727.0	SW 9	168.9	0.5	Multi corer	MUC	on deck
PS64/247-1	05.06.03	21:15	50° 42.32' N	11° 24.01' W	1598.0	SSW 9	93.3	0.3	Multi corer	MUC	surface
PS64/247-1	05.06.03	21:49	50° 42.15' N	11° 24.10' W	1603.0	SSW 8	225.7	0.4	Multi corer	MUC	at sea bottom
PS64/247-1	05.06.03	22:25	50° 41.99' N	11° 24.24' W	1593.0	SSW 8	214.0	0.5	Multi corer	MUC	on deck
PS64/248-1	05.06.03	22:54	50° 42.60' N	11° 21.11' W	1479.0	SSW 8	186.7	0.9	Multi corer	MUC	surface
PS64/248-1	05.06.03	23:33	50° 42.46' N	11° 21.07' W	1479.0	SSW 9	95.0	0.3	Multi corer	MUC	at sea bottom
PS64/248-1	06.06.03	00:06	50° 42.44' N	11° 21.20' W	1486.0	S 9	237.6	0.3	Multi corer	MUC	on deck
PS64/249-1	06.06.03	00:38	50° 43.82' N	11° 17.43' W	1182.0	S 9	54.1	0.1	Multi corer	MUC	surface
PS64/249-1	06.06.03	01:05	50° 43.78' N	11° 17.54' W	1191.0	S 9	224.8	0.6	Multi corer	MUC	at sea bottom
PS64/249-1	06.06.03	01:33	50° 43.65' N	11° 17.74' W	1212.0	SSW 9	205.9	0.3	Multi corer	MUC	on deck
PS64/250-1	06.06.03	04:57	51° 10.27' N	11° 47.09' W	1589.0	WSW 10	321.6	0.2	Multi corer	MUC	surface
PS64/250-1	06.06.03	05:29	51° 10.40' N	11° 47.09' W	1536.0	WSW 10	178.1	0.2	Multi corer	MUC	at sea bottom
PS64/250-1	06.06.03	06:04	51° 10.35' N	11° 47.15' W	1577.0	SW 9	326.8	0.5	Multi corer	MUC	on deck
PS64/251-1	06.06.03	06:45	51° 12.16' N	11° 40.75' W	1016.0	SW 10	202.8	0.3	Multi corer	MUC	surface
PS64/251-1	06.06.03	07:08	51° 12.11' N	11° 40.78' W	1017.0	SW 9	3.2	0.4	Multi corer	MUC	at sea bottom
PS64/251-1	06.06.03	07:33	51° 12.14' N	11° 40.77' W	1016.0	SW 10	56.9	0.4	Multi corer	MUC	on deck
PS64/252-1	06.06.03	08:09	51° 11.20' N	11° 34.85' W	724.0	SW 9	11.7	0.2	Multi corer	MUC	surface
PS64/252-1	06.06.03	08:28	51° 11.16' N	11° 34.88' W	723.3	SW 8	129.4	0.4	Multi corer	MUC	at sea bottom
PS64/252-1	06.06.03	08:44	51° 11.15' N	11° 34.78' W	716.3	WSW 10	69.9	0.8	Multi corer	MUC	on deck
PS64/253-1	06.06.03	11:00	51° 26.24' N	11° 45.32' W	934.2	SW 8	320.4	0.3	Remote operated vehicle	ROV	surface
PS64/253-1	06.06.03	11:12	51° 26.28' N	11° 45.36' W	934.8	SSW 8	281.8	0.5	Remote operated vehicle	ROV	Depressor into water
PS64/253-1	06.06.03	13:05	51° 26.24' N	11° 45.50' W	950.5	SSW 10	79.8	0.3	Remote operated vehicle	ROV	Information
PS64/253-1	06.06.03	14:06	51° 25.71' N	11° 45.86' W	961.1	SSW 12	236.7	1.1	Remote operated vehicle	ROV	Information
PS64/253-1	06.06.03	15:30	51° 26.34' N	11° 45.39' W	926.9	S 14	168.4	1.0	Remote operated vehicle	ROV	Information
PS64/253-1	06.06.03	17:10	51° 26.04' N	11° 45.40' W	941.5	S 16	279.8	1.0	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	01:00	51° 26.15' N	11° 45.34' W	942.9	SW 11	210.8	0.1	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	03:00	51° 25.56' N	11° 45.56' W	973.5	SW 9	64.0	0.3	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/253-1	07.06.03	04:01	51° 26.13' N	11° 45.09' W	939.7	WSW 9	291.1	0.6	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	04:51	51° 25.61' N	11° 45.63' W	965.4	SW 9	179.7	0.9	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	05:43	51° 26.11' N	11° 45.23' W	940.5	SW 8	50.5	1.1	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	06:56	51° 25.67' N	11° 45.46' W	963.7	SW 7	337.1	0.5	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	07:50	51° 26.15' N	11° 45.06' W	939.4	SW 9	306.2	0.4	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	09:14	51° 25.53' N	11° 45.38' W	977.7	SW 8	83.9	0.5	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	10:39	51° 25.77' N	11° 45.26' W	959.1	SW 7	88.7	0.3	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	11:19	51° 25.45' N	11° 45.31' W	984.5	SSW 8	159.4	0.7	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	13:14	51° 26.16' N	11° 44.92' W	937.7	SSW 8	236.4	0.9	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	15:11	51° 26.11' N	11° 44.83' W	939.4	SW 10	86.3	1.3	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	16:34	51° 25.70' N	11° 45.56' W	955.1	WSW 9	12.8	0.5	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	17:25	51° 26.21' N	11° 45.25' W	936.8	SW 10	6.4	0.7	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	18:25	51° 27.05' N	11° 45.15' W	802.1	SW 7	329.8	1.0	Remote operated vehicle	ROV	Information
PS64/253-1	07.06.03	19:03	51° 27.03' N	11° 45.09' W	818.8	SSW 7	203.9	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/253-1	07.06.03	19:34	51° 26.89' N	11° 45.36' W	911.0	SSW 7	233.0	0.5	Remote operated vehicle	ROV	Depressor on deck
PS64/253-1	07.06.03	20:12	51° 27.06' N	11° 45.29' W	851.2	SSW 7	15.7	1.0	Remote operated vehicle	ROV	on deck
PS64/254-1	07.06.03	20:48	51° 27.00' N	11° 45.03' W	848.0	SSW 6	88.8	0.3	Box corer	BC	surface
PS64/254-1	07.06.03	21:05	51° 26.97' N	11° 45.00' W	856.1	SSW 7	65.4	0.3	Box corer	BC	at sea bottom
PS64/254-1	07.06.03	21:24	51° 26.97' N	11° 45.05' W	848.2	S 6	240.8	0.7	Box corer	BC	on deck
PS64/254-2	07.06.03	22:50	51° 27.15' N	11° 45.10' W	815.5	SSW 7	339.4	0.2	Box corer	BC	surface
PS64/254-2	07.06.03	23:06	51° 27.14' N	11° 45.08' W	818.4	SSW 6	321.6	0.3	Box corer	BC	at sea bottom
PS64/254-2	07.06.03	23:25	51° 27.15' N	11° 45.08' W	827.0	SSW 6	267.9	0.5	Box corer	BC	on deck
PS64/254-3	07.06.03	23:51	51° 27.19' N	11° 45.11' W	839.4	S 6	88.4	0.5	Box corer	BC	surface
PS64/254-3	08.06.03	00:08	51° 27.29' N	11° 45.04' W	873.0	S 5	118.0	0.4	Box corer	BC	at sea bottom
PS64/254-3	08.06.03	00:28	51° 27.14' N	11° 44.98' W	848.5	S 6	143.9	0.4	Box corer	BC	on deck
PS64/255-1	08.06.03	00:46	51° 26.82' N	11° 44.96' W	886.0	SSW 6	29.3	0.2	CTD - Seabird	CTD-R	surface
PS64/255-1	08.06.03	01:06	51° 26.79' N	11° 44.93' W	889.5	SSW 8	237.3	0.6	CTD - Seabird	CTD-R	at depth
PS64/255-1	08.06.03	01:23	51° 26.73' N	11° 44.98' W	889.1	SSW 9	106.4	0.8	CTD - Seabird	CTD-R	on deck
PS64/256-1	08.06.03	01:42	51° 27.51' N	11° 45.20' W	913.1	WSW 9	268.8	0.4	CTD - Seabird	CTD-R	surface
PS64/256-1	08.06.03	02:02	51° 27.48' N	11° 45.29' W	890.2	WSW 10	248.6	0.8	CTD - Seabird	CTD-R	at depth
PS64/256-1	08.06.03	02:19	51° 27.45' N	11° 45.36' W	885.1	SW 8	118.7	0.5	CTD - Seabird	CTD-R	on deck
PS64/257-1	08.06.03	02:30	51° 27.09' N	11° 45.10' W	799.5	SW 6	90.0	0.5	CTD - Seabird	CTD-R	surface
PS64/257-1	08.06.03	02:47	51° 27.08' N	11° 45.20' W	811.4	SW 4	219.3	0.0	CTD - Seabird	CTD-R	at depth
PS64/257-1	08.06.03	03:02	51° 27.09' N	11° 45.16' W	800.0	SSW 5	259.7	0.7	CTD - Seabird	CTD-R	on deck

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/257-2	08.06.03	03:18	51° 27.05' N	11° 45.16' W	797.8	SW 7	94.3	0.3	Box corer	BC	surface
PS64/257-2	08.06.03	03:37	51° 27.08' N	11° 45.17' W	796.7	SW 6	329.2	0.4	Box corer	BC	at sea bottom
PS64/257-2	08.06.03	03:54	51° 27.11' N	11° 45.14' W	800.8	SW 6	259.9	0.3	Box corer	BC	on deck
PS64/258-1	08.06.03	04:14	51° 26.53' N	11° 44.65' W	909.5	SW 5	285.2	0.5	Box corer	BC	surface
PS64/258-1	08.06.03	04:36	51° 26.53' N	11° 44.74' W	908.1	WSW 6	38.7	0.5	Box corer	BC	at sea bottom
PS64/258-1	08.06.03	04:56	51° 26.54' N	11° 44.82' W	906.1	WSW 6	243.2	0.0	Box corer	BC	on deck
PS64/259-1	08.06.03	05:24	51° 25.92' N	11° 45.33' W	941.9	WSW 6	143.9	0.1	Box corer	BC	surface
PS64/259-1	08.06.03	05:42	51° 25.90' N	11° 45.39' W	942.9	WSW 6	86.9	0.3	Box corer	BC	at sea bottom
PS64/259-1	08.06.03	06:03	51° 25.89' N	11° 45.31' W	945.7	WSW 5	95.2	0.3	Box corer	BC	on deck
PS64/260-1	08.06.03	06:45	51° 27.04' N	11° 44.53' W	919.1	W 7	254.8	0.5	Mooring (year)	MOORY	surface
PS64/260-1	08.06.03	07:04	51° 27.07' N	11° 44.51' W	922.2	WSW 4	26.8	0.2	Mooring (year)	MOORY	action
PS64/260-1	08.06.03	07:25	51° 27.08' N	11° 44.59' W	916.4	WSW 4	160.7	0.2	Mooring (year)	MOORY	action
PS64/260-1	08.06.03	07:47	51° 27.07' N	11° 44.58' W	919.0	WSW 4	258.3	0.3	Mooring (year)	MOORY	action
PS64/260-1	08.06.03	08:06	51° 27.07' N	11° 44.58' W	916.7	W 6	213.2	0.4	Mooring (year)	MOORY	action
PS64/260-1	08.06.03	08:24	51° 26.97' N	11° 44.62' W	909.5	W 7	218.9	0.8	Mooring (year)	MOORY	on deck
PS64/261-1	08.06.03	08:51	51° 27.09' N	11° 45.20' W	804.0	W 7	268.1	0.5	Bottom lander	LANDER	surface
PS64/261-1	08.06.03	08:54	51° 27.09' N	11° 45.21' W	808.7	WSW 6	181.2	0.3	Bottom lander	LANDER	surface
PS64/261-1	08.06.03	09:18	51° 27.06' N	11° 45.21' W	801.4	WSW 7	55.6	0.2	Bottom lander	LANDER	surface
PS64/261-1	08.06.03	10:19	51° 27.09' N	11° 45.12' W	750.1	W 6	274.7	0.2	Bottom lander	LANDER	Information
PS64/261-1	08.06.03	10:22	51° 27.10' N	11° 45.12' W	787.3	W 6	338.5	0.2	Bottom lander	LANDER	released
PS64/261-1	08.06.03	10:27	51° 27.08' N	11° 45.09' W	765.5	W 6	252.4	0.4	Bottom lander	LANDER	Information
PS64/261-1	08.06.03	10:31	51° 27.08' N	11° 45.10' W	792.1	W 6	82.6	0.5	Bottom lander	LANDER	Information
PS64/261-1	08.06.03	10:37	51° 27.08' N	11° 45.09' W	762.9	W 6	108.6	0.4	Bottom lander	LANDER	Information
PS64/262-1	08.06.03	11:32	51° 26.84' N	11° 46.01' W	986.2	WSW 6	340.8	0.5	Remote operated vehicle	ROV	surface
PS64/262-1	08.06.03	11:41	51° 26.86' N	11° 46.02' W	986.9	WSW 5	168.0	0.3	Remote operated vehicle	ROV	surface
PS64/262-1	08.06.03	13:00	51° 26.83' N	11° 46.26' W	994.4	WSW 5	92.0	0.6	Remote operated vehicle	ROV	Information
PS64/262-1	08.06.03	14:26	51° 27.11' N	11° 45.10' W	799.0	SW 6	92.4	0.9	Remote operated vehicle	ROV	Information
PS64/262-1	08.06.03	15:25	51° 27.09' N	11° 45.23' W	821.8	WSW 8	87.4	0.2	Remote operated vehicle	ROV	Information
PS64/262-1	08.06.03	15:30	51° 27.09' N	11° 45.17' W	792.7	WSW 6	60.9	0.6	Remote operated vehicle	ROV	Information
PS64/262-1	08.06.03	18:16	51° 26.71' N	11° 45.08' W	890.4	SW 6	77.4	0.6	Remote operated vehicle	ROV	Information
PS64/262-1	08.06.03	20:22	51° 26.89' N	11° 45.17' W	848.1	S 8	253.1	0.4	Remote operated vehicle	ROV	Information
PS64/262-1	08.06.03	21:55	51° 27.03' N	11° 44.55' W	917.0	SSE 11	78.8	0.4	Remote operated vehicle	ROV	Information
PS64/262-1	08.06.03	22:00	51° 27.03' N	11° 44.54' W	917.4	S 10	77.6	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/262-1	08.06.03	22:30	51° 27.00' N	11° 44.53' W	918.5	SSE 9	143.2	0.7	Remote operated vehicle	ROV	surface

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/262-1	08.06.03	22:39	51° 26.96' N	11° 44.26' W	914.5	SSE 10	113.0	0.3	Remote operated vehicle	ROV	Depressor on deck
PS64/262-1	08.06.03	22:42	0° 0.00' N	0° 0.00' E	0.0	N 0	0.0	0.0	Remote operated vehicle	ROV	on deck
PS64/263-1	08.06.03	23:56	51° 26.12' N	11° 44.23' W	930.1	SSE 12	109.0	1.1	Box corer	BC	surface
PS64/263-1	09.06.03	00:14	51° 26.13' N	11° 43.97' W	921.8	SSE 13	127.6	1.0	Box corer	BC	at sea bottom
PS64/263-1	09.06.03	00:40	51° 26.03' N	11° 43.96' W	922.8	SSE 12	314.7	0.6	Box corer	BC	on deck
PS64/263-1	09.06.03	00:56	51° 26.10' N	11° 44.22' W	927.8	SSE 12	237.1	0.1	Box corer	BC	surface
PS64/263-1	09.06.03	01:14	51° 26.00' N	11° 44.33' W	933.9	SE 13	238.0	0.7	Box corer	BC	at sea bottom
PS64/263-1	09.06.03	01:34	51° 25.90' N	11° 44.43' W	939.1	SSE 15	277.4	0.9	Box corer	BC	on deck
PS64/263-2	09.06.03	01:56	51° 25.99' N	11° 44.56' W	942.1	SSE 14	106.6	0.6	Box corer	BC	surface
PS64/263-2	09.06.03	02:14	51° 25.90' N	11° 44.62' W	944.2	SSE 15	253.0	0.2	Box corer	BC	at sea bottom
PS64/263-2	09.06.03	02:36	51° 25.83' N	11° 44.76' W	949.5	SSE 16	36.5	0.5	Box corer	BC	on deck
PS64/264-1	09.06.03	03:15	51° 27.54' N	11° 45.01' W	933.2	SSE 15	340.2	0.5	CTD - Seabird	CTD-R	surface
PS64/264-1	09.06.03	03:35	51° 27.54' N	11° 45.05' W	929.1	SSE 18	187.6	0.3	CTD - Seabird	CTD-R	at depth
PS64/264-1	09.06.03	03:53	51° 27.52' N	11° 44.99' W	926.7	SSE 16	48.8	0.6	CTD - Seabird	CTD-R	on deck
PS64/265-1	09.06.03	04:08	51° 27.26' N	11° 45.21' W	819.1	SSE 15	65.4	0.3	CTD - Seabird	CTD-R	surface
PS64/265-1	09.06.03	04:27	51° 27.22' N	11° 45.32' W	874.7	SSE 14	321.7	0.5	CTD - Seabird	CTD-R	at depth
PS64/265-1	09.06.03	04:43	51° 27.28' N	11° 45.27' W	841.5	SSE 14	259.8	0.2	CTD - Seabird	CTD-R	on deck
PS64/266-1	09.06.03	05:02	51° 27.35' N	11° 45.18' W	847.8	SSE 15	358.1	0.4	CTD - Seabird	CTD-R	surface
PS64/266-1	09.06.03	05:19	51° 27.38' N	11° 45.22' W	862.0	SSE 15	33.8	0.3	CTD - Seabird	CTD-R	at depth
PS64/266-1	09.06.03	05:34	51° 27.39' N	11° 45.20' W	871.5	SSE 14	235.7	1.0	CTD - Seabird	CTD-R	on deck
PS64/267-1	09.06.03	05:55	51° 27.43' N	11° 45.15' W	896.7	SSE 16	282.9	0.7	CTD - Seabird	CTD-R	surface
PS64/267-1	09.06.03	06:14	51° 27.46' N	11° 45.19' W	897.7	S 15	214.6	0.4	CTD - Seabird	CTD-R	at depth
PS64/267-1	09.06.03	06:30	51° 27.47' N	11° 45.23' W	896.1	S 14	17.6	0.9	CTD - Seabird	CTD-R	on deck
PS64/268-1	09.06.03	06:48	51° 26.55' N	11° 45.51' W	896.5	S 15	330.7	0.6	CTD - Seabird	CTD-R	surface
PS64/268-1	09.06.03	07:09	51° 26.56' N	11° 45.47' W	881.8	S 15	48.4	0.6	CTD - Seabird	CTD-R	at depth
PS64/268-1	09.06.03	07:25	51° 26.54' N	11° 45.50' W	885.2	S 15	76.1	0.4	CTD - Seabird	CTD-R	on deck
PS64/269-1	09.06.03	07:50	51° 26.08' N	11° 45.86' W	931.1	S 14	49.3	0.7	CTD - Seabird	CTD-R	surface
PS64/269-1	09.06.03	08:11	51° 26.12' N	11° 45.96' W	973.7	S 14	192.6	0.7	CTD - Seabird	CTD-R	at depth
PS64/269-1	09.06.03	08:28	51° 26.14' N	11° 45.87' W	972.5	S 15	185.3	0.9	CTD - Seabird	CTD-R	on deck
PS64/270-1	09.06.03	08:44	51° 26.00' N	11° 45.43' W	938.5	SSE 14	34.1	1.0	Box corer	BC	surface
PS64/270-1	09.06.03	09:01	51° 25.96' N	11° 45.28' W	942.5	SSE 14	203.0	0.7	Box corer	BC	at sea bottom
PS64/270-1	09.06.03	09:28	51° 26.04' N	11° 45.21' W	939.5	S 13	97.5	0.9	Box corer	BC	on deck
PS64/271-1	09.06.03	10:10	51° 25.72' N	11° 46.26' W	879.8	SSE 14	60.7	0.9	Box corer	BC	surface
PS64/271-1	09.06.03	10:29	51° 25.75' N	11° 46.18' W	899.7	S 13	116.9	0.4	Box corer	BC	at sea bottom
PS64/271-1	09.06.03	10:55	51° 25.75' N	11° 46.12' W	924.8	S 11	189.3	0.9	Box corer	BC	on deck

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/271-2	09.06.03	11:22	51° 25.77' N	11° 46.29' W	891.4	S 11	259.7	0.6	Box corer	BC	surface
PS64/271-2	09.06.03	11:40	51° 25.76' N	11° 46.25' W	884.5	S 11	190.6	0.0	Box corer	BC	at sea bottom
PS64/271-2	09.06.03	12:00	51° 25.72' N	11° 46.37' W	919.2	S 10	357.9	0.4	Box corer	BC	on deck
PS64/271-3	09.06.03	12:27	51° 25.81' N	11° 46.17' W	915.1	S 11	16.1	0.7	Box corer	BC	surface
PS64/271-3	09.06.03	12:51	51° 25.76' N	11° 46.16' W	909.7	S 10	352.4	0.2	Box corer	BC	at sea bottom
PS64/271-3	09.06.03	13:03	51° 25.70' N	11° 46.18' W	914.4	S 10	249.6	0.1	Box corer	BC	on deck
PS64/272-1	09.06.03	13:50	51° 25.68' N	11° 46.37' W	900.7	S 9	164.8	0.2	CTD - Seabird	CTD-R	surface
PS64/272-1	09.06.03	14:11	51° 25.72' N	11° 46.33' W	891.7	S 10	145.8	0.5	CTD - Seabird	CTD-R	at depth
PS64/272-1	09.06.03	14:29	51° 25.80' N	11° 46.38' W	935.4	S 9	273.4	0.4	CTD - Seabird	CTD-R	on deck
PS64/273-1	09.06.03	15:05	51° 26.35' N	11° 47.36' W	1034.0	S 9	195.2	1.4	Calibration	CAL	start
PS64/273-1	09.06.03	15:21	51° 25.54' N	11° 46.94' W	1029.0	S 9	162.5	5.2	Calibration	CAL	Information
PS64/273-1	09.06.03	15:34	51° 25.86' N	11° 46.30' W	921.5	S 9	20.5	3.8	Calibration	CAL	Information
PS64/273-1	09.06.03	15:43	51° 26.04' N	11° 45.65' W	944.4	S 9	90.7	2.5	Calibration	CAL	End
PS64/274-1	09.06.03	16:23	51° 26.11' N	11° 45.76' W	956.2	S 9	238.1	0.6	Box corer	BC	surface
PS64/274-1	09.06.03	16:45	51° 25.93' N	11° 45.79' W	928.9	S 10	244.3	0.3	Box corer	BC	at sea bottom
PS64/274-1	09.06.03	17:04	51° 25.79' N	11° 45.77' W	946.7	S 10	189.5	0.4	Box corer	BC	on deck
PS64/275-1	09.06.03	17:23	51° 26.12' N	11° 45.64' W	957.1	S 8	355.0	4.0	Calibration	CAL	start
PS64/275-1	09.06.03	19:40	51° 27.70' N	11° 41.91' W	734.0	S 8	138.1	3.2	Calibration	CAL	End
PS64/276-1	09.06.03	19:53	51° 27.62' N	11° 41.94' W	718.3	S 7	337.1	0.3	Box corer	BC	surface
PS64/276-1	09.06.03	20:14	51° 27.69' N	11° 41.98' W	742.5	S 8	115.3	0.6	Box corer	BC	at sea bottom
PS64/276-1	09.06.03	20:31	51° 27.68' N	11° 41.81' W	702.7	S 8	352.7	1.2	Box corer	BC	on deck
PS64/276-2	09.06.03	20:46	51° 27.71' N	11° 42.08' W	792.5	S 10	338.3	1.2	Box corer	BC	surface
PS64/276-2	09.06.03	21:07	51° 27.69' N	11° 41.98' W	751.8	S 10	184.8	0.7	Box corer	BC	at sea bottom
PS64/276-2	09.06.03	21:23	51° 27.68' N	11° 41.89' W	713.8	S 8	100.9	0.7	Box corer	BC	on deck
PS64/276-3	09.06.03	21:40	51° 27.67' N	11° 41.97' W	737.8	S 9	3.3	0.6	Box corer	BC	surface
PS64/276-3	09.06.03	21:59	51° 27.63' N	11° 41.91' W	704.3	S 9	147.9	0.5	Box corer	BC	at sea bottom
PS64/276-3	09.06.03	22:16	51° 27.70' N	11° 41.80' W	715.5	S 10	48.9	0.8	Box corer	BC	on deck
PS64/277-1	09.06.03	22:34	51° 27.68' N	11° 41.82' W	708.1	S 9	254.4	4.9	Calibration	CAL	start
PS64/277-1	09.06.03	23:33	51° 23.74' N	11° 41.71' W	785.0	SSW 10	174.7	4.8	Calibration	CAL	End
PS64/278-1	10.06.03	00:24	51° 22.53' N	11° 43.59' W	934.2	SSW 10	84.9	0.6	Remote operated vehicle	ROV	surface
PS64/278-1	10.06.03	00:34	51° 22.52' N	11° 43.47' W	923.7	SSW 9	43.4	0.6	Remote operated vehicle	ROV	Depressor into water
PS64/278-1	10.06.03	01:40	51° 22.39' N	11° 44.13' W	992.2	SSW 10	332.8	0.8	Remote operated vehicle	ROV	at depth
PS64/278-1	10.06.03	02:00	51° 22.47' N	11° 44.10' W	988.2	SSW 10	272.7	0.6	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	05:05	51° 22.54' N	11° 41.04' W	716.0	SW 12	12.0	0.7	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	06:48	51° 24.14' N	11° 41.97' W	818.2	WSW 10	255.8	0.5	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/278-1	10.06.03	07:41	51° 24.02' N	11° 41.89' W	770.0	SW 10	282.9	0.9	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	08:00	51° 24.30' N	11° 41.92' W	816.7	SW 9	99.5	0.7	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	08:38	51° 24.36' N	11° 41.36' W	664.0	SW 9	79.5	0.5	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	08:47	51° 24.38' N	11° 41.39' W	674.4	SW 9	140.9	1.1	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	08:57	51° 24.39' N	11° 41.21' W	632.7	SW 10	69.6	0.8	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	09:19	51° 24.36' N	11° 41.14' W	641.3	SW 9	279.4	0.6	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	09:44	51° 24.51' N	11° 40.79' W	656.1	SW 9	55.6	0.3	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	10:08	51° 24.70' N	11° 41.12' W	753.5	SW 9	314.8	0.9	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	10:27	51° 24.75' N	11° 41.14' W	755.3	SW 8	184.6	0.0	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	11:43	51° 25.26' N	11° 42.04' W	776.4	SW 8	301.2	0.5	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	11:50	51° 25.28' N	11° 42.08' W	774.4	SW 8	80.8	0.2	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	12:02	51° 25.33' N	11° 42.13' W	763.0	SW 8	149.9	0.2	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	12:09	51° 25.33' N	11° 42.15' W	764.8	SW 8	108.6	0.3	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	12:27	51° 25.44' N	11° 42.41' W	744.1	SW 9	330.6	0.6	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	12:58	51° 25.46' N	11° 42.47' W	776.4	SW 10	311.9	0.2	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	13:17	51° 25.57' N	11° 42.65' W	816.1	W 8	242.5	0.0	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	13:43	51° 25.58' N	11° 42.69' W	817.2	W 9	21.3	0.8	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	13:53	51° 25.68' N	11° 42.70' W	818.7	W 8	295.3	0.1	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	14:11	51° 25.70' N	11° 42.74' W	818.8	W 9	9.6	0.7	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	14:31	51° 25.87' N	11° 42.50' W	814.5	WSW 9	69.2	0.5	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	15:22	51° 25.94' N	11° 42.28' W	752.7	WSW 11	284.5	0.3	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	15:38	51° 26.05' N	11° 42.06' W	673.8	WSW 10	11.6	0.8	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	16:10	51° 26.08' N	11° 41.99' W	667.1	WSW 11	102.9	0.6	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	16:55	51° 26.71' N	11° 42.24' W	774.7	WSW 11	24.8	0.9	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	17:38	51° 27.33' N	11° 41.42' W	744.1	WSW 11	282.7	1.0	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	18:40	51° 27.71' N	11° 42.62' W	866.1	WSW 11	195.9	0.9	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	19:34	51° 27.23' N	11° 43.32' W	899.7	WSW 11	196.8	1.0	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	20:18	51° 27.21' N	11° 44.13' W	896.7	WSW 10	50.9	0.1	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	20:22	51° 27.21' N	11° 44.03' W	872.1	WSW 10	61.9	1.6	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	20:59	51° 27.20' N	11° 44.38' W	923.7	WSW 10	263.6	1.4	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	21:05	51° 27.14' N	11° 44.44' W	923.1	WSW 12	248.9	1.5	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	21:31	51° 27.10' N	11° 44.46' W	924.1	WSW 10	281.3	0.8	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	21:45	51° 27.10' N	11° 44.58' W	918.0	WSW 9	22.0	0.2	Remote operated vehicle	ROV	Information
PS64/278-1	10.06.03	22:38	51° 27.03' N	11° 44.63' W	912.0	WSW 10	249.7	0.4	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	02:35	51° 27.04' N	11° 44.60' W	912.2	SW 8	28.4	0.6	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	03:18	51° 27.08' N	11° 44.65' W	912.8	SW 9	5.0	0.4	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/278-1	11.06.03	04:03	51° 26.96' N	11° 45.21' W	842.2	WSW 11	77.4	0.9	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	04:16	51° 27.07' N	11° 45.28' W	851.0	SW 11	103.2	0.2	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	05:37	51° 27.11' N	11° 45.01' W	830.1	SW 8	228.6	0.0	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	07:03	51° 27.42' N	11° 45.40' W	887.7	SW 9	281.0	0.7	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	08:12	51° 27.08' N	11° 44.65' W	910.1	SSW 7	31.8	0.5	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	09:09	51° 27.00' N	11° 45.35' W	905.4	SW 9	46.7	0.4	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	09:21	51° 27.02' N	11° 45.36' W	911.7	SW 8	281.6	0.8	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	09:50	51° 26.99' N	11° 45.34' W	906.5	SW 9	71.5	0.3	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	10:42	51° 27.01' N	11° 44.66' W	907.0	SSW 8	171.1	1.6	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	11:16	51° 27.30' N	11° 45.17' W	825.5	SSW 9	346.3	0.3	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	11:31	51° 27.30' N	11° 45.27' W	835.0	SSW 9	249.7	0.5	Remote operated vehicle	ROV	Information
PS64/278-1	11.06.03	11:36	51° 27.29' N	11° 45.28' W	838.5	SSW 9	275.4	0.9	Remote operated vehicle	ROV	coming back to the surface
PS64/278-1	11.06.03	12:23	51° 27.08' N	11° 45.41' W	926.7	SSW 8	110.1	0.9	Remote operated vehicle	ROV	coming back to the surface
PS64/278-1	11.06.03	12:27	51° 27.07' N	11° 45.36' W	904.2	SSW 9	187.3	0.4	Remote operated vehicle	ROV	Depressor on deck
PS64/278-1	11.06.03	12:58	51° 26.94' N	11° 44.90' W	883.5	SSW 9	143.9	1.6	Remote operated vehicle	ROV	on deck
PS64/279-1	11.06.03	23:32	52° 3.80' N	14° 18.03' W	294.5	SW 12	170.5	0.3	Box corer	BC	surface
PS64/279-1	11.06.03	23:44	52° 3.70' N	14° 17.96' W	311.2	WSW 12	209.0	0.5	Box corer	BC	at sea bottom
PS64/279-1	11.06.03	23:54	52° 3.67' N	14° 17.87' W	324.0	WSW 10	196.0	0.4	Box corer	BC	on deck
PS64/280-1	12.06.03	03:21	52° 36.69' N	14° 15.29' W	283.9	SW 14	348.4	0.6	Box corer	BC	surface
PS64/280-1	12.06.03	03:30	52° 36.71' N	14° 15.31' W	280.9	SW 14	291.2	0.7	Box corer	BC	at sea bottom
PS64/280-1	12.06.03	03:40	52° 36.73' N	14° 15.34' W	280.9	SW 15	356.2	0.2	Box corer	BC	on deck
PS64/281-1	12.06.03	07:52	53° 4.67' N	14° 45.78' W	707.3	WSW 13	291.7	3.3	Fischereilotsurvey	FLS	Start Track
PS64/281-1	12.06.03	08:40	53° 5.49' N	14° 49.97' W	817.8	WSW 14	280.8	3.1	Fischereilotsurvey	FLS	Course Change
PS64/281-1	12.06.03	09:11	53° 5.31' N	14° 52.74' W	1027.0	WSW 14	312.9	2.7	Fischereilotsurvey	FLS	Information
PS64/281-1	12.06.03	09:33	53° 5.31' N	14° 51.82' W	982.4	WSW 15	202.8	2.6	Fischereilotsurvey	FLS	Information
PS64/281-1	12.06.03	10:08	53° 4.92' N	14° 54.50' W	1115.4	WSW 14	280.6	1.9	Fischereilotsurvey	FLS	Course Change
PS64/281-1	12.06.03	10:32	53° 6.23' N	14° 55.11' W	1083.0	WSW 13	43.2	2.4	Fischereilotsurvey	FLS	Information
PS64/281-1	12.06.03	11:02	53° 6.22' N	14° 55.32' W	1119.0	WSW 15	136.0	5.2	Fischereilotsurvey	FLS	Information
PS64/281-1	12.06.03	11:06	53° 6.25' N	14° 54.76' W	987.4	WSW 13	40.2	4.4	Fischereilotsurvey	FLS	Course Change
PS64/281-1	12.06.03	11:23	53° 5.45' N	14° 54.05' W	1083.0	WSW 16	157.8	3.1	Fischereilotsurvey	FLS	Course Change

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/281-1	12.06.03	11:28	53° 5.33' N	14° 54.27' W	1093.0	SW 14	346.4	4.0	Fischereilotsurvey	FLS	Information
PS64/281-1	12.06.03	11:55	53° 7.02' N	14° 55.19' W	1228.0	WSW 13	347.6	3.8	Fischereilotsurvey	FLS	Course Change
PS64/281-1	12.06.03	13:09	53° 12.11' N	14° 51.73' W	1171.0	WSW 13	15.3	4.9	Fischereilotsurvey	FLS	End of Track
PS64/282-1	12.06.03	15:06	53° 5.16' N	14° 48.43' W	801.2	SW 12	39.8	0.6	Remote operated vehicle	ROV	surface
PS64/282-1	12.06.03	15:14	53° 5.25' N	14° 48.34' W	796.8	SW 12	357.2	0.6	Remote operated vehicle	ROV	Depressor into water
PS64/282-1	12.06.03	16:10	53° 5.29' N	14° 48.35' W	794.4	WSW 11	246.8	1.3	Remote operated vehicle	ROV	Information
PS64/282-1	12.06.03	20:58	53° 5.35' N	14° 51.66' W	972.5	W 9	354.9	0.2	Remote operated vehicle	ROV	Information
PS64/282-1	12.06.03	21:12	53° 5.35' N	14° 51.67' W	971.1	WSW 10	277.8	0.9	Remote operated vehicle	ROV	Information
PS64/282-1	12.06.03	23:20	53° 5.34' N	14° 54.37' W	1093.0	WSW 8	276.3	0.9	Remote operated vehicle	ROV	Information
PS64/282-1	12.06.03	23:25	53° 5.37' N	14° 54.46' W	1091.0	WSW 7	291.0	0.4	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	00:17	53° 5.81' N	14° 54.73' W	1009.0	SW 7	22.7	0.5	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	01:04	53° 5.80' N	14° 54.82' W	1068.0	SW 6	56.1	0.3	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	01:24	53° 5.99' N	14° 54.85' W	1029.0	SW 6	350.5	0.5	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	02:22	53° 5.96' N	14° 54.96' W	1066.0	SSW 5	56.2	0.4	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	02:42	53° 6.10' N	14° 54.86' W	962.2	SSW 6	161.0	0.4	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	02:48	53° 6.11' N	14° 54.86' W	959.2	SSW 7	352.8	0.2	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	04:00	53° 6.21' N	14° 54.65' W	935.9	SSW 6	192.7	0.0	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	04:20	53° 6.19' N	14° 54.60' W	940.2	S 6	91.8	0.3	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	06:45	53° 5.54' N	14° 54.35' W	1064.0	S 7	176.3	0.7	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	07:41	53° 5.46' N	14° 54.84' W	1098.0	SSE 8	312.4	1.0	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	09:10	53° 6.10' N	14° 55.18' W	1122.0	S 10	9.9	0.8	Remote operated vehicle	ROV	Information
PS64/282-1	13.06.03	09:42	53° 6.13' N	14° 55.19' W	1120.0	S 10	339.5	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/282-1	13.06.03	10:30	53° 5.85' N	14° 55.17' W	1158.0	S 10	195.7	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/282-1	13.06.03	10:32	53° 5.84' N	14° 55.17' W	1158.0	S 11	192.8	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/282-1	13.06.03	10:33	53° 5.84' N	14° 55.17' W	1158.0	S 11	127.1	0.3	Remote operated vehicle	ROV	Depressor on deck
PS64/282-1	13.06.03	11:06	53° 5.79' N	14° 55.14' W	1153.0	S 10	114.6	0.3	Remote operated vehicle	ROV	on deck
PS64/282-2	13.06.03	11:32	53° 5.93' N	14° 54.72' W	1017.0	S 10	187.8	0.0	Box corer	BC	surface
PS64/282-2	13.06.03	11:52	53° 5.91' N	14° 54.71' W	1011.0	S 10	125.8	0.3	Box corer	BC	at sea bottom
PS64/282-2	13.06.03	12:15	53° 5.91' N	14° 54.73' W	1018.0	S 10	198.6	0.0	Box corer	BC	on deck
PS64/282-3	13.06.03	12:29	53° 5.91' N	14° 54.74' W	1021.0	S 11	0.2	0.2	Box corer	BC	surface
PS64/282-3	13.06.03	12:49	53° 5.96' N	14° 54.72' W	1018.0	S 11	327.7	0.4	Box corer	BC	at sea bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/282-3	13.06.03	13:10	53° 6.05' N	14° 54.68' W	984.2	S 10	335.0	0.2	Box corer	BC	on deck
PS64/282-4	13.06.03	13:17	53° 5.87' N	14° 54.68' W	998.7	S 11	173.8	1.2	Box corer	BC	surface
PS64/282-4	13.06.03	13:38	53° 5.88' N	14° 54.66' W	1001.0	S 11	287.6	0.4	Box corer	BC	at sea bottom
PS64/282-4	13.06.03	13:58	53° 5.90' N	14° 54.62' W	1000.0	S 11	200.6	0.0	Box corer	BC	on deck
PS64/282-5	13.06.03	14:12	53° 5.91' N	14° 54.73' W	1024.0	S 12	230.9	0.1	Box corer	BC	surface
PS64/282-5	13.06.03	14:32	53° 5.93' N	14° 54.68' W	1006.0	S 11	218.6	0.1	Box corer	BC	at sea bottom
PS64/282-5	13.06.03	14:52	53° 5.89' N	14° 54.71' W	1011.0	S 11	211.3	0.3	Box corer	BC	on deck
PS64/283-1	13.06.03	15:08	53° 6.07' N	14° 54.62' W	961.8	S 11	182.4	0.6	CTD - Seabird	CTD-R	surface
PS64/283-1	13.06.03	15:27	53° 6.10' N	14° 54.68' W	912.4	S 11	211.6	0.2	CTD - Seabird	CTD-R	at depth
PS64/283-1	13.06.03	15:43	53° 6.12' N	14° 54.73' W	903.8	S 11	41.6	0.3	CTD - Seabird	CTD-R	on deck
PS64/283-2	13.06.03	15:49	53° 6.14' N	14° 54.71' W	886.1	S 11	317.6	0.1	In situ pump	ISP	into water
PS64/283-2	13.06.03	16:27	53° 6.14' N	14° 54.68' W	902.8	S 11	0.1	0.7	In situ pump	ISP	pump at depth
PS64/283-2	13.06.03	17:27	53° 6.16' N	14° 54.64' W	904.1	S 10	300.5	0.2	In situ pump	ISP	pump at depth
PS64/283-2	13.06.03	17:51	53° 6.15' N	14° 54.59' W	929.9	SSE 11	87.0	0.1	In situ pump	ISP	on deck
PS64/283-3	13.06.03	18:12	53° 5.75' N	14° 54.40' W	966.1	SSE 11	236.0	0.8	Box corer	BC	surface
PS64/283-3	13.06.03	18:31	53° 5.79' N	14° 54.39' W	972.8	SSE 11	219.4	0.2	Box corer	BC	at sea bottom
PS64/283-3	13.06.03	18:53	53° 5.70' N	14° 54.52' W	944.1	SSE 12	205.5	0.5	Box corer	BC	on deck
PS64/283-4	13.06.03	19:20	53° 5.73' N	14° 54.38' W	978.7	SSE 12	152.6	0.3	Box corer	BC	surface
PS64/283-4	13.06.03	19:40	53° 5.72' N	14° 54.40' W	969.2	SSE 12	106.7	0.4	Box corer	BC	at sea bottom
PS64/283-4	13.06.03	20:00	53° 5.65' N	14° 54.33' W	1042.0	SSE 13	292.4	0.3	Box corer	BC	on deck
PS64/284-1	13.06.03	21:00	53° 12.50' N	14° 49.96' W	1072.0	S 13	89.5	4.8	Fischereilotsurvey	FLS	Start Track
PS64/284-1	13.06.03	21:29	53° 11.44' N	14° 46.61' W	714.0	S 13	118.7	4.9	Fischereilotsurvey	FLS	Course Change
PS64/284-1	13.06.03	21:38	53° 10.99' N	14° 45.87' W	721.5	S 13	140.7	4.0	Fischereilotsurvey	FLS	Course Change
PS64/284-1	13.06.03	22:00	53° 9.37' N	14° 45.83' W	777.8	S 13	181.9	4.8	Fischereilotsurvey	FLS	Course Change
PS64/284-1	13.06.03	22:20	53° 9.70' N	14° 43.99' W	700.1	S 14	85.4	5.0	Fischereilotsurvey	FLS	Course Change
PS64/284-1	13.06.03	22:27	53° 10.06' N	14° 43.34' W	684.3	S 14	34.0	3.8	Fischereilotsurvey	FLS	End of Track
PS64/285-1	13.06.03	23:27	53° 11.44' N	14° 45.58' W	811.4	S 14	49.3	0.6	CTD - Seabird	CTD-R	surface
PS64/285-1	13.06.03	23:39	53° 11.44' N	14° 45.51' W	817.5	S 16	7.2	0.3	CTD - Seabird	CTD-R	on deck
PS64/285-1	13.06.03	23:40	53° 11.44' N	14° 45.52' W	815.4	S 15	286.0	0.4	CTD - Seabird	CTD-R	surface
PS64/285-1	14.06.03	00:08	53° 11.44' N	14° 45.53' W	814.1	SSE 14	25.4	0.9	CTD - Seabird	CTD-R	at depth
PS64/285-1	14.06.03	00:23	53° 11.56' N	14° 45.52' W	828.2	SSE 14	169.1	0.1	CTD - Seabird	CTD-R	on deck
PS64/286-1	14.06.03	00:45	53° 11.51' N	14° 46.55' W	635.8	S 14	70.3	0.8	CTD - Seabird	CTD-R	surface
PS64/286-1	14.06.03	00:57	53° 11.48' N	14° 46.48' W	639.4	S 14	277.5	0.5	CTD - Seabird	CTD-R	at depth

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/286-1	14.06.03	01:09	53° 11.51' N	14° 46.38' W	593.1	S 15	91.2	0.4	CTD - Seabird	CTD-R	on deck
PS64/287-1	14.06.03	01:22	53° 11.36' N	14° 47.12' W	806.5	S 14	301.7	0.4	CTD - Seabird	CTD-R	surface
PS64/287-1	14.06.03	01:39	53° 11.40' N	14° 47.00' W	793.9	S 15	58.8	0.8	CTD - Seabird	CTD-R	at depth
PS64/287-1	14.06.03	01:54	53° 11.40' N	14° 46.94' W	785.7	S 14	345.4	0.9	CTD - Seabird	CTD-R	on deck
PS64/288-1	14.06.03	02:11	53° 11.65' N	14° 47.00' W	620.6	S 14	296.9	0.2	CTD - Seabird	CTD-R	surface
PS64/288-1	14.06.03	02:25	53° 11.70' N	14° 47.02' W	621.3	S 15	183.0	0.9	CTD - Seabird	CTD-R	at depth
PS64/288-1	14.06.03	02:40	53° 11.68' N	14° 46.91' W	636.3	S 14	208.9	1.3	CTD - Seabird	CTD-R	on deck
PS64/288-2	14.06.03	02:46	53° 11.63' N	14° 47.02' W	635.5	S 14	20.4	0.5	CTD - Seabird	CTD-R	surface
PS64/288-2	14.06.03	03:01	53° 11.65' N	14° 47.09' W	631.1	S 14	346.9	0.9	CTD - Seabird	CTD-R	at depth
PS64/288-2	14.06.03	03:16	53° 11.67' N	14° 46.98' W	605.2	S 13	113.9	0.4	CTD - Seabird	CTD-R	on deck
PS64/289-1	14.06.03	03:20	53° 11.66' N	14° 46.92' W	624.7	S 14	77.9	1.2	CTD - Seabird	CTD-R	surface
PS64/289-1	14.06.03	03:38	53° 11.71' N	14° 46.81' W	668.9	S 13	7.5	0.2	CTD - Seabird	CTD-R	at depth
PS64/289-1	14.06.03	03:51	53° 11.73' N	14° 46.78' W	673.5	S 14	310.0	0.7	CTD - Seabird	CTD-R	on deck
PS64/290-1	14.06.03	04:14	53° 11.62' N	14° 47.27' W	697.3	S 13	38.7	0.4	CTD - Seabird	CTD-R	surface
PS64/290-1	14.06.03	04:27	53° 11.64' N	14° 47.30' W	702.4	S 13	200.8	0.0	CTD - Seabird	CTD-R	at depth
PS64/290-1	14.06.03	04:39	53° 11.64' N	14° 47.24' W	658.7	S 13	126.6	0.5	CTD - Seabird	CTD-R	on deck
PS64/291-1	14.06.03	05:01	53° 11.83' N	14° 47.54' W	656.5	SSW 12	112.4	0.1	CTD - Seabird	CTD-R	surface
PS64/291-1	14.06.03	05:17	53° 11.88' N	14° 47.50' W	648.3	SSW 10	23.3	0.4	CTD - Seabird	CTD-R	at depth
PS64/291-1	14.06.03	05:28	53° 11.87' N	14° 47.49' W	645.5	SSW 10	229.0	0.4	CTD - Seabird	CTD-R	on deck
PS64/292-1	14.06.03	05:44	53° 11.79' N	14° 48.37' W	876.5	SSW 10	2.7	0.4	CTD - Seabird	CTD-R	surface
PS64/292-1	14.06.03	06:02	53° 11.74' N	14° 48.35' W	877.7	SSW 10	74.8	0.1	CTD - Seabird	CTD-R	at depth
PS64/292-1	14.06.03	06:18	53° 11.73' N	14° 48.28' W	854.5	SSW 10	126.3	0.3	CTD - Seabird	CTD-R	on deck
PS64/293-1	14.06.03	07:20	53° 10.38' N	14° 43.17' W	724.3	SSW 8	359.5	0.7	Remote operated vehicle	ROV	surface
PS64/293-1	14.06.03	07:30	53° 10.39' N	14° 43.26' W	735.0	SSW 8	216.8	0.7	Remote operated vehicle	ROV	Depressor into water
PS64/293-1	14.06.03	08:16	53° 10.16' N	14° 43.37' W	668.8	SSW 8	181.5	0.5	Remote operated vehicle	ROV	at depth
PS64/293-1	14.06.03	08:24	53° 10.11' N	14° 43.37' W	659.8	SSW 8	206.5	0.9	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	09:02	53° 9.74' N	14° 43.88' W	700.0	SSW 8	345.8	0.3	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	09:28	53° 9.86' N	14° 44.23' W	678.8	SW 7	235.3	0.4	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	10:12	53° 9.49' N	14° 44.45' W	705.3	SW 6	187.0	0.2	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	11:17	53° 9.20' N	14° 46.06' W	785.4	SSW 6	249.4	1.2	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	11:30	53° 9.34' N	14° 46.08' W	765.4	SW 6	67.5	1.8	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	14:21	53° 9.42' N	14° 45.83' W	778.4	SW 6	26.7	0.9	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	17:40	53° 10.97' N	14° 45.91' W	745.3	WSW 4	32.6	0.1	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	21:20	53° 11.55' N	14° 46.50' W	573.3	S 5	321.0	0.4	Remote operated vehicle	ROV	Information
PS64/293-1	14.06.03	22:00	53° 11.69' N	14° 46.57' W	655.0	S 5	23.6	0.8	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/293-1	14.06.03	22:37	53° 11.79' N	14° 46.63' W	707.8	SSW 6	2.2	0.3	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	02:03	53° 11.42' N	14° 47.08' W	795.4	SSE 6	295.8	0.4	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	02:20	53° 11.55' N	14° 47.13' W	737.5	S 7	263.0	0.3	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	03:17	53° 11.57' N	14° 47.07' W	708.5	SSE 7	146.5	0.2	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	03:33	53° 11.69' N	14° 47.18' W	617.9	SSE 9	114.3	0.2	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	05:11	53° 12.00' N	14° 48.63' W	849.8	S 10	271.5	0.2	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	05:45	53° 12.06' N	14° 49.21' W	850.4	S 7	4.8	1.1	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	06:30	53° 12.38' N	14° 48.69' W	878.8	S 8	257.5	0.4	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	07:29	53° 12.21' N	14° 49.31' W	914.2	S 10	299.9	1.6	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	08:10	53° 12.45' N	14° 49.85' W	1069.0	S 10	319.1	0.3	Remote operated vehicle	ROV	Information
PS64/293-1	15.06.03	08:27	53° 12.45' N	14° 49.87' W	1070.0	S 10	67.6	0.5	Remote operated vehicle	ROV	coming back to the surface
PS64/293-1	15.06.03	09:17	53° 12.28' N	14° 49.76' W	1046.0	S 10	180.7	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/293-1	15.06.03	09:22	53° 12.26' N	14° 49.74' W	1043.0	S 10	136.5	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/293-1	15.06.03	09:23	53° 12.26' N	14° 49.73' W	1040.0	S 9	124.7	0.5	Remote operated vehicle	ROV	Depressor on deck
PS64/293-1	15.06.03	09:53	53° 12.36' N	14° 49.74' W	1055.0	S 11	343.5	0.3	Remote operated vehicle	ROV	on deck
PS64/294-1	15.06.03	10:19	53° 11.52' N	14° 48.69' W	941.5	S 10	95.1	0.5	Box corer	BC	surface
PS64/294-1	15.06.03	10:37	53° 11.54' N	14° 48.62' W	937.7	S 10	44.6	0.6	Box corer	BC	at sea bottom
PS64/294-1	15.06.03	10:56	53° 11.60' N	14° 48.63' W	931.9	S 11	339.6	0.5	Box corer	BC	on deck
PS64/295-1	15.06.03	11:10	53° 11.95' N	14° 48.32' W	854.5	SSE 10	248.4	0.9	Box corer	BC	surface
PS64/295-1	15.06.03	11:26	53° 11.98' N	14° 48.33' W	849.1	S 11	254.5	0.3	Box corer	BC	at sea bottom
PS64/295-1	15.06.03	11:43	53° 11.88' N	14° 48.50' W	867.0	SSE 11	243.5	0.8	Box corer	BC	on deck
PS64/296-1	15.06.03	12:01	53° 12.58' N	14° 50.06' W	1080.0	S 12	96.4	6.0	Fischereilotsurvey	FLS	Start Track
PS64/296-1	15.06.03	12:25	53° 11.60' N	14° 46.91' W	648.4	S 12	121.7	4.7	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	12:32	53° 11.26' N	14° 46.18' W	679.1	S 13	133.9	4.9	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	12:48	53° 10.88' N	14° 45.64' W	796.5	S 11	346.6	5.3	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	13:01	53° 12.02' N	14° 45.63' W	832.4	S 12	3.0	5.0	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	13:11	53° 12.68' N	14° 44.65' W	871.1	S 13	40.8	5.9	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	13:15	53° 12.99' N	14° 44.34' W	838.8	S 12	2.7	5.2	Fischereilotsurvey	FLS	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/296-1	15.06.03	14:16	53° 12.84' N	14° 44.21' W	844.8	S 12	344.4	5.3	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	14:31	53° 14.13' N	14° 44.55' W	897.4	S 12	354.2	5.0	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	15:59	53° 20.97' N	14° 38.41' W	885.4	S 12	31.9	5.5	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	16:50	53° 23.30' N	14° 31.79' W	729.4	S 13	61.7	6.2	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	17:14	53° 25.06' N	14° 29.83' W	690.3	S 13	29.4	5.3	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	17:29	53° 25.81' N	14° 28.01' W	766.0	S 12	57.4	5.2	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	18:27	53° 30.63' N	14° 26.35' W	926.1	S 12	13.6	5.2	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	18:48	53° 31.76' N	14° 24.19' W	829.2	S 13	62.1	4.5	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	19:06	53° 30.90' N	14° 21.93' W	870.0	S 13	126.6	5.5	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	19:17	53° 30.87' N	14° 20.27' W	727.5	S 13	66.8	5.7	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	19:48	53° 32.67' N	14° 22.92' W	808.8	SSE 12	321.8	4.9	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	19:57	53° 33.00' N	14° 22.06' W	769.0	S 12	71.4	5.4	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	20:25	53° 34.67' N	14° 19.67' W	722.8	S 13	42.6	4.2	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	20:47	53° 35.69' N	14° 17.31' W	712.0	S 13	56.2	4.4	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	21:10	53° 37.33' N	14° 17.23' W	820.8	S 13	359.6	4.5	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	21:35	53° 38.60' N	14° 14.94' W	794.8	S 12	50.7	4.3	Fischereilotsurvey	FLS	Course Change
PS64/296-1	15.06.03	21:41	53° 38.80' N	14° 14.32' W	768.4	S 14	67.7	4.6	Fischereilotsurvey	FLS	End of Track
PS64/297-1	15.06.03	23:15	53° 45.98' N	13° 59.36' W	829.7	S 13	45.9	1.6	Remote operated vehicle	ROV	surface
PS64/297-1	15.06.03	23:25	53° 46.06' N	13° 59.17' W	853.1	S 14	43.5	1.0	Remote operated vehicle	ROV	Depressor into water
PS64/297-1	16.06.03	00:25	53° 45.90' N	13° 59.49' W	760.8	S 14	231.3	1.1	Remote operated vehicle	ROV	at depth
PS64/297-1	16.06.03	01:13	53° 45.76' N	13° 59.63' W	734.7	S 12	137.2	0.2	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	03:20	53° 44.66' N	13° 59.12' W	687.4	S 12	79.9	0.9	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	03:42	53° 44.68' N	13° 59.06' W	669.3	S 10	89.0	0.7	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/297-1	16.06.03	05:05	53° 44.26' N	13° 59.13' W	657.9	S 9	207.7	0.4	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	08:15	53° 44.08' N	13° 59.25' W	672.7	SSW 8	183.4	0.3	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	09:28	53° 44.15' N	13° 59.19' W	659.0	SSW 6	215.7	0.0	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	10:45	53° 43.73' N	14° 0.02' W	646.0	SSW 6	207.6	0.4	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	14:58	53° 43.65' N	14° 0.19' W	653.2	SW 8	205.2	0.9	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	15:24	53° 43.62' N	14° 0.75' W	681.7	SW 9	268.4	0.6	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	16:20	53° 43.71' N	14° 0.80' W	708.6	SW 8	229.8	0.9	Remote operated vehicle	ROV	Information
PS64/297-1	16.06.03	18:10	53° 43.27' N	14° 1.56' W	656.2	SW 9	97.4	0.6	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	00:39	53° 43.23' N	14° 1.57' W	651.0	SW 9	269.9	0.4	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	06:30	53° 41.80' N	14° 4.13' W	634.3	SW 10	2.3	0.4	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	08:22	53° 41.84' N	14° 4.26' W	663.0	SW 10	272.6	0.6	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	08:42	53° 41.78' N	14° 4.30' W	648.9	SW 10	80.7	0.8	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	09:44	53° 41.79' N	14° 4.29' W	649.8	SW 10	18.2	0.3	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	10:48	53° 41.69' N	14° 4.63' W	660.2	SW 8	145.1	0.2	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	11:00	53° 41.66' N	14° 4.66' W	656.9	SW 9	225.6	1.0	Remote operated vehicle	ROV	Information
PS64/297-2	17.06.03	11:18	53° 41.64' N	14° 4.84' W	664.5	SSW 9	250.1	0.5	Water Sample Bucket	WSB	into the water
PS64/297-1	17.06.03	11:25	53° 41.60' N	14° 5.01' W	675.7	SSW 9	255.7	1.0	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	11:38	53° 41.55' N	14° 4.96' W	663.4	SSW 10	219.8	0.2	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	11:46	53° 41.55' N	14° 5.10' W	673.1	SW 11	245.2	0.1	Remote operated vehicle	ROV	Information
PS64/297-1	17.06.03	17:40	53° 41.55' N	14° 5.20' W	681.9	S 12	11.1	0.5	Remote operated vehicle	ROV	coming back to the surface
PS64/297-1	17.06.03	18:13	53° 41.65' N	14° 5.38' W	707.0	SSE 13	225.8	0.2	Remote operated vehicle	ROV	Depressor on deck
PS64/297-1	17.06.03	18:45	53° 42.03' N	14° 5.62' W	702.5	SSE 14	357.1	0.8	Remote operated vehicle	ROV	on deck
PS64/298-1	17.06.03	19:37	53° 44.26' N	13° 59.05' W	632.5	SSE 16	30.1	0.6	Box corer	BC	surface
PS64/298-1	17.06.03	19:49	53° 44.24' N	13° 59.02' W	627.0	SSE 15	235.6	0.6	Box corer	BC	at sea bottom
PS64/298-1	17.06.03	20:03	53° 44.25' N	13° 59.14' W	657.8	SSE 15	294.8	1.2	Box corer	BC	on deck
PS64/298-2	17.06.03	20:20	53° 44.27' N	13° 59.20' W	682.4	SSE 16	174.2	0.1	Box corer	BC	surface
PS64/298-2	17.06.03	20:32	53° 44.29' N	13° 59.20' W	685.2	SSE 17	218.3	0.5	Box corer	BC	at sea bottom
PS64/298-2	17.06.03	20:46	53° 44.28' N	13° 59.09' W	656.4	S 16	126.9	0.7	Box corer	BC	on deck
PS64/298-3	17.06.03	21:02	53° 44.27' N	13° 59.14' W	666.9	S 16	138.5	0.6	Box corer	BC	surface
PS64/298-3	17.06.03	21:14	53° 44.28' N	13° 59.18' W	680.8	S 15	266.9	0.3	Box corer	BC	at sea bottom
PS64/298-3	17.06.03	21:29	53° 44.21' N	13° 59.02' W	621.2	S 16	108.5	0.9	Box corer	BC	on deck
PS64/298-4	17.06.03	21:38	53° 44.17' N	13° 58.84' W	639.5	S 15	65.4	0.4	CTD - Seabird	CTD-R	surface
PS64/298-4	17.06.03	21:53	53° 44.17' N	13° 58.82' W	639.9	SSW 15	247.9	0.2	CTD - Seabird	CTD-R	at depth
PS64/298-4	17.06.03	22:05	53° 44.19' N	13° 58.82' W	643.3	SSW 16	1.5	0.7	CTD - Seabird	CTD-R	on deck

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/298-5	17.06.03	22:16	53° 44.26' N	13° 59.03' W	631.1	SSW 15	301.6	0.5	CTD - Seabird	CTD-R	surface
PS64/298-5	17.06.03	22:32	53° 44.25' N	13° 59.11' W	644.1	SSW 15	325.0	0.2	CTD - Seabird	CTD-R	at depth
PS64/298-5	17.06.03	22:46	53° 44.29' N	13° 59.08' W	658.0	SSW 15	21.0	0.5	CTD - Seabird	CTD-R	on deck
PS64/298-6	17.06.03	22:59	53° 44.35' N	13° 59.41' W	696.7	SSW 15	262.7	0.8	CTD - Seabird	CTD-R	surface
PS64/298-6	17.06.03	23:15	53° 44.35' N	13° 59.44' W	697.0	SSW 16	81.8	0.3	CTD - Seabird	CTD-R	at depth
PS64/298-6	17.06.03	23:29	53° 44.38' N	13° 59.31' W	693.6	SSW 16	60.5	0.5	CTD - Seabird	CTD-R	on deck
PS64/299-1	18.06.03	00:15	53° 41.97' N	14° 4.20' W	693.7	SSW 15	117.9	0.6	Box corer	BC	surface
PS64/299-1	18.06.03	00:28	53° 41.94' N	14° 4.05' W	658.3	SSW 15	60.4	0.6	Box corer	BC	at sea bottom
PS64/299-1	18.06.03	00:42	53° 41.89' N	14° 3.93' W	635.3	SSW 16	113.2	1.0	Box corer	BC	on deck
PS64/300-1	18.06.03	01:30	53° 40.88' N	14° 7.21' W	670.3	SW 17	70.5	3.8	Fischereilotsurvey	FLS	Start Track
PS64/300-1	18.06.03	01:42	53° 41.18' N	14° 5.82' W	671.8	SSW 15	51.4	5.3	Fischereilotsurvey	FLS	Course Change
PS64/300-1	18.06.03	01:55	53° 41.75' N	14° 4.53' W	665.5	SSW 16	57.3	4.2	Fischereilotsurvey	FLS	Course Change
PS64/300-1	18.06.03	02:20	53° 42.92' N	14° 2.63' W	704.7	SW 16	40.5	4.9	Fischereilotsurvey	FLS	Course Change
PS64/300-1	18.06.03	02:49	53° 44.12' N	13° 59.18' W	660.7	SW 16	59.7	4.9	Fischereilotsurvey	FLS	End of Track
PS64/301-1	18.06.03	05:25	53° 35.44' N	14° 17.75' W	738.7	WSW 17	235.8	0.8	CTD - Seabird	CTD-R	surface
PS64/301-1	18.06.03	05:43	53° 35.42' N	14° 17.79' W	736.3	W 18	117.5	0.3	CTD - Seabird	CTD-R	at depth
PS64/301-1	18.06.03	05:57	53° 35.39' N	14° 17.74' W	731.2	W 17	61.4	1.2	CTD - Seabird	CTD-R	on deck
PS64/302-1	18.06.03	06:47	53° 35.50' N	14° 16.93' W	711.2	W 13	42.7	1.1	Box corer	BC	surface
PS64/302-1	18.06.03	07:02	53° 35.53' N	14° 16.89' W	717.8	W 13	135.0	0.3	Box corer	BC	at sea bottom
PS64/302-1	18.06.03	07:17	53° 35.57' N	14° 16.87' W	710.4	W 16	294.5	0.2	Box corer	BC	on deck
PS64/302-2	18.06.03	07:32	53° 35.65' N	14° 17.27' W	716.0	W 14	247.8	0.7	Box corer	BC	surface
PS64/302-2	18.06.03	07:47	53° 35.67' N	14° 17.34' W	710.0	W 12	74.0	0.4	Box corer	BC	at sea bottom
PS64/302-2	18.06.03	08:00	53° 35.69' N	14° 17.40' W	710.3	W 13	273.8	0.7	Box corer	BC	on deck
PS64/303-1	18.06.03	09:24	53° 30.82' N	14° 20.46' W	734.3	WSW 12	334.9	0.5	Box corer	BC	surface
PS64/303-1	18.06.03	09:38	53° 30.80' N	14° 20.42' W	746.3	WSW 11	230.4	0.5	Box corer	BC	at sea bottom
PS64/303-1	18.06.03	09:54	53° 30.81' N	14° 20.47' W	738.4	WSW 10	202.2	0.3	Box corer	BC	on deck
PS64/304-1	18.06.03	10:24	53° 32.35' N	14° 23.48' W	829.4	WSW 10	260.6	0.7	Box corer	BC	surface
PS64/304-1	18.06.03	10:39	53° 32.39' N	14° 23.55' W	829.4	WSW 14	272.4	0.8	Box corer	BC	at sea bottom
PS64/304-1	18.06.03	10:56	53° 32.45' N	14° 23.57' W	829.8	WSW 10	30.3	0.8	Box corer	BC	on deck
PS64/305-1	18.06.03	11:18	53° 31.07' N	14° 25.35' W	850.4	WSW 10	231.2	0.6	Box corer	BC	surface
PS64/305-1	18.06.03	11:33	53° 31.11' N	14° 25.54' W	812.0	WSW 12	264.4	0.6	Box corer	BC	at sea bottom
PS64/305-1	18.06.03	11:50	53° 31.17' N	14° 25.63' W	776.1	WSW 11	284.5	0.6	Box corer	BC	on deck
PS64/306-1	18.06.03	12:35	53° 34.15' N	14° 21.90' W	820.0	WSW 11	213.5	7.4	HydroSweep/ParaSound profile	HS_PS	start track

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/306-1	18.06.03	14:05	53° 27.04' N	14° 35.18' W	1167.0	SW 11	305.0	7.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/306-1	18.06.03	15:32	53° 35.38' N	14° 22.78' W	917.7	SW 11	353.9	3.5	HydroSweep/ParaSound profile	HS_PS	profile end
PS64/307-1	18.06.03	16:21	53° 36.43' N	14° 16.34' W	747.0	WSW 12	21.4	0.7	Remote operated vehicle	ROV	surface
PS64/307-1	18.06.03	16:36	53° 36.63' N	14° 16.11' W	743.3	WSW 11	54.8	0.9	Remote operated vehicle	ROV	Depressor into water
PS64/307-1	18.06.03	18:16	53° 35.93' N	14° 16.79' W	691.5	WSW 11	232.5	1.7	Remote operated vehicle	ROV	Information
PS64/307-1	18.06.03	20:10	53° 35.76' N	14° 17.43' W	699.3	WSW 11	14.2	0.3	Remote operated vehicle	ROV	Information
PS64/307-1	18.06.03	20:41	53° 35.76' N	14° 17.40' W	694.1	WSW 9	354.0	0.2	Remote operated vehicle	ROV	Information
PS64/307-1	18.06.03	21:08	53° 35.62' N	14° 17.71' W	749.1	WSW 9	16.0	0.2	Remote operated vehicle	ROV	Information
PS64/307-1	18.06.03	21:26	53° 35.59' N	14° 17.70' W	744.1	WSW 9	222.4	0.3	Remote operated vehicle	ROV	Information
PS64/307-1	18.06.03	22:22	53° 35.31' N	14° 18.32' W	684.3	WSW 11	228.0	0.7	Remote operated vehicle	ROV	Information
PS64/307-1	19.06.03	02:42	53° 34.95' N	14° 19.13' W	698.3	WSW 9	273.3	0.4	Remote operated vehicle	ROV	Information
PS64/307-1	19.06.03	04:20	53° 34.87' N	14° 19.17' W	718.3	WSW 8	95.3	0.9	Remote operated vehicle	ROV	Information
PS64/307-1	19.06.03	08:02	53° 33.84' N	14° 21.02' W	734.1	W 13	236.2	0.8	Remote operated vehicle	ROV	Information
PS64/307-1	19.06.03	08:27	53° 33.84' N	14° 20.91' W	747.3	WSW 13	71.8	0.9	Remote operated vehicle	ROV	Information
PS64/307-1	19.06.03	09:26	53° 33.55' N	14° 21.27' W	737.4	W 14	206.2	0.3	Remote operated vehicle	ROV	Information
PS64/307-1	19.06.03	11:15	53° 33.49' N	14° 21.43' W	726.1	W 14	67.7	0.6	Remote operated vehicle	ROV	Information
PS64/307-1	19.06.03	11:18	53° 33.50' N	14° 21.44' W	727.0	W 16	287.0	1.2	Remote operated vehicle	ROV	coming back to the surface
PS64/307-1	19.06.03	11:49	53° 33.49' N	14° 21.51' W	738.7	W 14	327.7	0.5	Remote operated vehicle	ROV	coming back to the surface
PS64/307-1	19.06.03	11:53	53° 33.49' N	14° 21.54' W	742.1	W 14	272.5	0.7	Remote operated vehicle	ROV	coming back to the surface
PS64/307-1	19.06.03	11:55	53° 33.49' N	14° 21.55' W	741.3	W 12	81.4	0.2	Remote operated vehicle	ROV	Depressor on deck
PS64/307-1	19.06.03	12:30	53° 33.58' N	14° 20.57' W	733.7	W 13	61.6	1.7	Remote operated vehicle	ROV	on deck
PS64/308-1	27.06.03	15:38	71° 58.98' N	14° 40.81' E	1325.0	NW 6	320.1	0.7	CTD/rosette water sampler	CTD/RO	surface
PS64/308-1	27.06.03	16:08	71° 59.11' N	14° 40.96' E	1323.0	NNW 6	50.0	0.3	CTD/rosette water sampler	CTD/RO	at depth
PS64/308-1	27.06.03	16:32	71° 59.17' N	14° 41.02' E	1323.0	NNW 6	72.0	0.9	CTD/rosette water sampler	CTD/RO	on deck
PS64/309-1	27.06.03	18:16	71° 58.95' N	14° 41.06' E	1324.0	N 4	29.4	6.1	HydroSweep/ParaSound profile	HS_PS	start track
PS64/309-1	27.06.03	18:39	72° 0.94' N	14° 41.02' E	1309.0	N 5	355.1	4.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	18:53	72° 1.00' N	14° 41.91' E	1301.0	N 4	183.6	5.1	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	19:18	71° 59.06' N	14° 41.64' E	1321.0	N 4	172.5	4.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	19:36	71° 58.98' N	14° 42.37' E	1316.0	N 4	5.1	4.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	20:00	72° 1.03' N	14° 42.26' E	1297.0	NNW 3	356.7	5.8	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	20:13	72° 1.05' N	14° 43.02' E	1291.0	NNW 4	193.8	4.8	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	20:39	71° 59.05' N	14° 42.92' E	1314.0	NNW 3	179.8	4.7	HydroSweep/ParaSound profile	HS_PS	alter course

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/309-1	27.06.03	20:52	71° 58.96' N	14° 43.62' E	1307.0	NNW 4	336.9	4.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	21:15	72° 0.81' N	14° 43.59' E	1291.0	NNW 4	351.8	4.7	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	21:31	72° 1.01' N	14° 44.19' E	1280.0	NNW 5	195.1	5.0	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	21:57	71° 59.04' N	14° 44.21' E	1303.0	NNW 4	183.1	4.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	22:12	71° 58.98' N	14° 44.94' E	1298.0	NNW 4	353.3	5.0	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	22:38	72° 0.97' N	14° 44.86' E	1272.0	NNW 4	1.3	4.7	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	22:51	72° 1.04' N	14° 45.57' E	1267.0	N 4	194.1	4.0	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	23:21	71° 59.03' N	14° 45.50' E	1295.0	N 5	178.5	4.3	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	27.06.03	23:36	71° 58.98' N	14° 46.30' E	1287.0	NNW 4	356.5	4.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	00:02	72° 0.98' N	14° 46.07' E	1261.0	N 3	356.2	5.9	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	00:17	72° 0.98' N	14° 45.94' E	1263.0	NNE 3	175.9	5.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	00:40	71° 59.04' N	14° 45.85' E	1292.0	N 3	182.3	5.3	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	00:50	71° 58.96' N	14° 45.21' E	1295.0	N 2	0.5	5.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	01:14	72° 1.01' N	14° 45.12' E	1271.0	N 2	2.0	5.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	01:25	72° 1.05' N	14° 44.52' E	1278.0	NNW 2	173.7	5.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	01:57	71° 59.01' N	14° 44.58' E	1301.0	NNW 2	181.4	5.0	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	02:07	71° 58.92' N	14° 44.04' E	1305.0	WNW 1	359.7	5.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	02:41	72° 1.01' N	14° 43.77' E	1283.0	NNW 2	359.8	5.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	02:52	72° 1.08' N	14° 43.40' E	1288.0	NNW 3	181.2	5.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	03:27	71° 59.05' N	14° 43.32' E	1310.0	NNW 3	179.5	4.8	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	03:37	71° 58.96' N	14° 42.60' E	1316.0	NNW 2	6.1	5.1	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	04:00	72° 0.99' N	14° 42.57' E	1294.0	NNW 3	359.0	5.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	04:16	72° 0.96' N	14° 42.10' E	1298.0	NNW 4	185.1	4.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	04:41	71° 59.05' N	14° 42.01' E	1318.0	N 4	175.1	4.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	04:54	71° 58.98' N	14° 41.31' E	1324.0	N 4	5.4	5.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	05:17	72° 0.95' N	14° 41.34' E	1305.0	NNE 3	356.0	4.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/309-1	28.06.03	05:45	72° 0.23' N	14° 43.74' E	1286.0	NNE 2	189.4	1.8	HydroSweep/ParaSound profile	HS_PS	profile end
PS64/310-1	28.06.03	06:06	72° 0.23' N	14° 43.58' E	1287.0	NE 3	326.9	0.0	CTD/rosette water sampler	CTD/RO	surface
PS64/310-1	28.06.03	06:36	72° 0.23' N	14° 43.49' E	1287.0	NE 2	50.8	0.2	CTD/rosette water sampler	CTD/RO	at depth
PS64/310-1	28.06.03	07:06	72° 0.24' N	14° 43.43' E	1286.0	ESE 3	327.7	0.0	CTD/rosette water sampler	CTD/RO	on deck
PS64/311-1	28.06.03	07:25	72° 0.26' N	14° 43.47' E	1287.0	ESE 2	274.7	0.6	Multi corer	MUC	surface
PS64/311-1	28.06.03	07:30	72° 0.26' N	14° 43.46' E	1286.0	SE 2	160.2	0.3	Multi corer	MUC	information
PS64/311-1	28.06.03	07:37	72° 0.25' N	14° 43.51' E	1287.0	ESE 2	279.6	0.2	Multi corer	MUC	surface
PS64/311-1	28.06.03	08:12	72° 0.25' N	14° 43.50' E	1287.0	SE 2	59.0	0.6	Multi corer	MUC	at sea bottom
PS64/311-1	28.06.03	08:40	72° 0.25' N	14° 43.56' E	1287.0	SSE 2	84.7	0.1	Multi corer	MUC	on deck
PS64/312-1	28.06.03	09:33	72° 0.27' N	14° 43.51' E	1287.0	SW 0	69.7	0.5	Multi corer	MUC	surface

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/312-1	28.06.03	10:02	72° 0.25' N	14° 43.49' E	1287.0	SSW 1	275.3	0.2	Multi corer	MUC	at sea bottom
PS64/312-1	28.06.03	10:31	72° 0.27' N	14° 43.45' E	1284.5	SSW 0	246.6	0.3	Multi corer	MUC	on deck
PS64/313-1	28.06.03	11:14	72° 0.27' N	14° 43.43' E	1284.2	SW 0	189.2	0.3	Multi corer	MUC	surface
PS64/313-1	28.06.03	11:43	72° 0.26' N	14° 43.49' E	1283.7	ESE 1	6.1	0.3	Multi corer	MUC	at sea bottom
PS64/313-1	28.06.03	12:08	72° 0.30' N	14° 43.54' E	1284.0	SSW 0	8.6	0.7	Multi corer	MUC	on deck
PS64/314-1	28.06.03	12:40	72° 0.24' N	14° 43.58' E	1284.5	SSE 1	165.5	0.1	Multi corer	MUC	surface
PS64/314-1	28.06.03	13:11	72° 0.25' N	14° 43.54' E	1286.0	SSE 1	269.7	0.0	Multi corer	MUC	at sea bottom
PS64/314-1	28.06.03	13:41	72° 0.24' N	14° 43.43' E	1286.0	SE 2	237.3	0.2	Multi corer	MUC	on deck
PS64/315-1	28.06.03	13:53	72° 0.25' N	14° 43.58' E	1288.0	SE 1	113.0	0.5	CTD/rosette water sampler	CTD/RO	surface
PS64/315-1	28.06.03	14:24	72° 0.24' N	14° 43.65' E	1287.0	SSE 1	264.8	0.0	CTD/rosette water sampler	CTD/RO	at depth
PS64/315-1	28.06.03	14:51	72° 0.24' N	14° 43.49' E	1287.0	SE 2	254.9	0.0	CTD/rosette water sampler	CTD/RO	on deck
PS64/316-1	28.06.03	15:20	72° 0.23' N	14° 43.12' E	1285.0	ESE 2	259.9	0.0	Bottom lander	LANDER	surface
PS64/316-1	28.06.03	16:44	72° 0.24' N	14° 42.95' E	1286.0	SSE 3	131.2	0.1	Bottom lander	LANDER	released
PS64/316-1	28.06.03	17:14	72° 0.29' N	14° 43.36' E	1287.0	ESE 3	193.4	0.2	Bottom lander	LANDER	Information
PS64/317-1	28.06.03	17:58	72° 0.29' N	14° 43.45' E	1285.0	SE 3	308.7	0.6	Remote operated vehicle	ROV	Shuttle
PS64/317-1	28.06.03	19:00	72° 0.32' N	14° 44.40' E	1290.0	S 3	293.0	0.4	Remote operated vehicle	ROV	surface
PS64/317-1	28.06.03	19:10	72° 0.33' N	14° 44.54' E	1290.0	SE 2	149.3	0.4	Remote operated vehicle	ROV	Depressor into water
PS64/317-1	28.06.03	20:22	72° 0.27' N	14° 43.75' E	1287.0	SSE 3	338.3	0.1	Remote operated vehicle	ROV	at depth
PS64/317-1	28.06.03	20:42	72° 0.27' N	14° 43.69' E	1287.0	SSE 4	245.9	0.2	Remote operated vehicle	ROV	Information
PS64/317-1	28.06.03	21:08	72° 0.37' N	14° 43.39' E	1285.0	S 3	336.0	0.4	Remote operated vehicle	ROV	Information
PS64/317-1	28.06.03	22:04	72° 0.39' N	14° 43.45' E	1287.0	SSE 4	328.8	0.1	Remote operated vehicle	ROV	Information
PS64/317-1	28.06.03	22:13	72° 0.43' N	14° 43.44' E	1287.0	SSE 4	24.7	0.3	Remote operated vehicle	ROV	Information
PS64/317-1	29.06.03	20:26	72° 0.17' N	14° 43.88' E	1287.0	NNW 1	302.2	0.2	Remote operated vehicle	ROV	Information
PS64/317-1	29.06.03	20:48	72° 0.24' N	14° 43.04' E	1287.0	NNW 1	302.0	0.4	Remote operated vehicle	ROV	Information
PS64/317-1	29.06.03	20:56	72° 0.24' N	14° 43.03' E	1286.0	NNE 1	207.7	0.1	Remote operated vehicle	ROV	coming back to the surface
PS64/317-1	29.06.03	21:42	72° 0.27' N	14° 42.85' E	1290.0	ESE 1	264.3	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/317-1	29.06.03	21:43	72° 0.27' N	14° 42.83' E	1289.0	SE 1	266.0	0.2	Remote operated vehicle	ROV	Depressor on deck
PS64/317-1	29.06.03	21:47	72° 0.27' N	14° 42.81' E	1290.0	E 1	267.0	0.0	Remote operated vehicle	ROV	coming back to the surface
PS64/317-1	29.06.03	22:13	72° 0.28' N	14° 43.35' E	1287.0	ENE 1	83.2	0.3	Remote operated vehicle	ROV	on deck
PS64/317-1	29.06.03	22:41	72° 0.31' N	14° 45.49' E	1280.0	S 1	89.0	2.3	Remote operated vehicle	ROV	Shuttle
PS64/317-1	29.06.03	22:43	72° 0.31' N	14° 45.63' E	1278.0	SE 1	86.2	0.2	Remote operated vehicle	ROV	Shuttle
PS64/317-1	29.06.03	23:00	72° 0.31' N	14° 45.31' E	1281.0	ESE 2	268.6	1.3	Remote operated vehicle	ROV	Shuttle

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/317-1	29.06.03	23:09	72° 0.30' N	14° 44.61' E	1290.0	ESE 1	76.7	0.3	Remote operated vehicle	ROV	Shuttle
PS64/317-1	29.06.03	23:12	72° 0.30' N	14° 44.69' E	1289.0	ESE 1	81.3	0.6	Remote operated vehicle	ROV	Shuttle
PS64/317-1	29.06.03	23:21	72° 0.31' N	14° 45.02' E	1287.0	SSE 2	76.1	1.1	Remote operated vehicle	ROV	Shuttle
PS64/318-1	29.06.03	23:28	72° 0.25' N	14° 44.60' E	1290.0	ESE 1	263.0	1.9	Bottom lander	LANDER	Information
PS64/318-1	29.06.03	23:38	72° 0.25' N	14° 44.49' E	1292.0	S 1	102.9	0.3	Bottom lander	LANDER	released
PS64/318-1	29.06.03	23:45	72° 0.25' N	14° 44.68' E	1290.0	SSW 1	91.4	0.7	Bottom lander	LANDER	Information
PS64/318-1	30.06.03	00:06	72° 0.20' N	14° 43.90' E	1289.0	WSW 1	50.1	0.4	Bottom lander	LANDER	Information
PS64/318-1	30.06.03	00:19	72° 0.26' N	14° 43.97' E	1288.0	SSE 1	59.0	0.9	Bottom lander	LANDER	on Deck
PS64/319-1	30.06.03	01:34	72° 0.84' N	14° 42.26' E	1300.0	WSW 1	206.1	0.2	Heat Flow	HF	in the water
PS64/319-1	30.06.03	02:01	72° 0.83' N	14° 42.27' E	1298.0	S 1	274.1	0.3	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	02:15	72° 0.84' N	14° 42.27' E	1300.0	SE 1	36.5	0.2	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	02:39	72° 0.71' N	14° 42.62' E	1297.0	E 1	322.9	0.2	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	02:54	72° 0.72' N	14° 42.64' E	1297.0	NE 2	66.8	0.3	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	03:18	72° 0.58' N	14° 42.89' E	1296.0	N 0	235.2	0.3	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	03:34	72° 0.59' N	14° 42.92' E	1296.0	ENE 1	112.6	0.2	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	03:51	72° 0.49' N	14° 43.14' E	1296.0	E 1	334.9	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	04:05	72° 0.49' N	14° 43.13' E	1295.0	NE 1	76.7	0.2	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	04:22	72° 0.40' N	14° 43.32' E	1286.0	ESE 2	38.9	0.2	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	04:36	72° 0.41' N	14° 43.31' E	1284.0	ESE 2	79.8	0.2	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	04:50	72° 0.36' N	14° 43.44' E	1285.0	ESE 2	334.7	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	05:05	72° 0.36' N	14° 43.42' E	1285.0	NE 1	93.8	0.2	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	05:20	72° 0.31' N	14° 43.57' E	1285.0	ESE 2	334.6	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	05:27	72° 0.31' N	14° 43.58' E	1286.0	ESE 2	334.5	0.0	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	05:43	72° 0.26' N	14° 43.66' E	1288.0	E 1	83.4	0.2	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	05:57	72° 0.26' N	14° 43.67' E	1289.0	ESE 1	38.0	0.3	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	06:11	72° 0.21' N	14° 43.76' E	1288.0	E 2	334.5	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	06:27	72° 0.22' N	14° 43.77' E	1287.0	E 2	114.7	0.1	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	06:41	72° 0.18' N	14° 43.87' E	1287.0	ESE 2	333.8	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	06:56	72° 0.17' N	14° 43.88' E	1289.0	E 2	117.8	0.1	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	07:13	72° 0.09' N	14° 44.09' E	1290.0	ESE 2	334.6	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	07:29	72° 0.08' N	14° 44.09' E	1292.0	E 2	207.8	0.5	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	07:51	71° 59.95' N	14° 44.38' E	1293.0	ESE 2	334.0	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	08:08	71° 59.95' N	14° 44.38' E	1290.0	E 2	334.1	0.0	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	08:28	71° 59.82' N	14° 44.70' E	1289.0	ESE 3	334.3	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	08:45	71° 59.82' N	14° 44.70' E	1292.0	ESE 3	210.7	0.2	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	09:01	71° 59.74' N	14° 44.90' E	1290.0	SE 3	294.4	0.2	Heat Flow	HF	at the bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/319-1	30.06.03	09:19	71° 59.73' N	14° 44.94' E	1288.0	SE 3	333.9	0.0	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	09:39	71° 59.62' N	14° 45.10' E	1290.0	SE 2	355.0	0.1	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	09:57	71° 59.61' N	14° 45.08' E	1289.0	SE 3	335.9	0.3	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	10:33	71° 59.37' N	14° 45.63' E	1287.0	SSE 3	334.5	0.0	Heat Flow	HF	at the bottom
PS64/319-1	30.06.03	10:53	71° 59.37' N	14° 45.64' E	1287.0	SE 3	125.6	0.1	Heat Flow	HF	off bottom
PS64/319-1	30.06.03	11:21	71° 59.40' N	14° 45.74' E	1286.0	S 3	334.2	0.0	Heat Flow	HF	on deck
PS64/320-1	30.06.03	12:02	72° 0.20' N	14° 43.87' E	1288.0	SSE 3	318.0	0.2	CTD/rosette water sampler	CTD/RO	surface
PS64/320-1	30.06.03	12:30	72° 0.16' N	14° 43.88' E	1289.0	SSE 2	156.0	0.3	CTD/rosette water sampler	CTD/RO	at depth
PS64/320-1	30.06.03	13:02	72° 0.16' N	14° 43.93' E	1289.0	SE 2	10.1	0.1	CTD/rosette water sampler	CTD/RO	on deck
PS64/321-1	30.06.03	13:06	72° 0.17' N	14° 43.88' E	1287.0	SE 1	277.7	0.4	Multi corer	MUC	surface
PS64/321-1	30.06.03	13:36	72° 0.17' N	14° 43.85' E	1287.0	SSE 2	330.0	0.0	Multi corer	MUC	at sea bottom
PS64/321-1	30.06.03	14:01	72° 0.17' N	14° 43.90' E	1289.0	SSW 1	330.4	0.0	Multi corer	MUC	on deck
PS64/322-1	30.06.03	14:29	72° 0.17' N	14° 43.85' E	1289.0	SW 1	330.1	0.0	Multi corer	MUC	surface
PS64/322-1	30.06.03	15:02	72° 0.18' N	14° 43.85' E	1289.0	SSW 2	235.6	0.2	Multi corer	MUC	at sea bottom
PS64/322-1	30.06.03	15:29	72° 0.17' N	14° 43.84' E	1288.0	SSW 2	6.2	0.2	Multi corer	MUC	on deck
PS64/323-1	30.06.03	15:55	72° 0.17' N	14° 43.82' E	1290.0	W 2	235.9	0.3	Multi corer	MUC	surface
PS64/323-1	30.06.03	16:30	72° 0.19' N	14° 43.81' E	1288.0	SW 0	277.4	0.3	Multi corer	MUC	at sea bottom
PS64/323-1	30.06.03	17:00	72° 0.19' N	14° 43.78' E	1288.0	SW 3	310.4	0.1	Multi corer	MUC	on deck
PS64/324-1	30.06.03	17:19	72° 0.18' N	14° 43.79' E	1286.0	WSW 2	132.5	0.3	Multi corer	MUC	surface
PS64/324-1	30.06.03	17:46	72° 0.18' N	14° 43.81' E	1286.0	WSW 2	301.9	0.1	Multi corer	MUC	at sea bottom
PS64/324-1	30.06.03	18:13	72° 0.29' N	14° 43.60' E	1286.0	WSW 2	151.6	0.2	Multi corer	MUC	on deck
PS64/325-1	30.06.03	18:48	72° 0.18' N	14° 43.80' E	1287.0	WNW 2	123.5	0.1	Bottom lander	LANDER	surface
PS64/325-1	30.06.03	18:49	72° 0.18' N	14° 43.80' E	1286.0	WNW 2	162.3	0.2	Bottom lander	LANDER	Information
PS64/326-1	30.06.03	19:36	71° 59.99' N	14° 43.84' E	1291.0	WSW 2	101.6	0.2	Remote operated vehicle	ROV	Shuttle
PS64/326-1	30.06.03	23:35	72° 0.54' N	14° 43.30' E	1297.0	SW 3	94.7	0.5	Remote operated vehicle	ROV	surface
PS64/326-1	30.06.03	23:45	72° 0.55' N	14° 43.55' E	1293.0	SW 3	86.1	0.6	Remote operated vehicle	ROV	Depressor into water
PS64/326-1	01.07.03	01:30	72° 0.45' N	14° 42.71' E	1299.0	WSW 3	134.3	0.5	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	01:55	72° 0.33' N	14° 43.40' E	1289.0	SW 3	214.3	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	02:30	72° 0.30' N	14° 43.46' E	1287.0	W 3	267.3	0.0	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	03:22	72° 0.08' N	14° 44.23' E	1291.0	WSW 3	122.9	0.1	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	03:34	72° 0.11' N	14° 44.19' E	1290.0	W 3	34.1	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	04:20	72° 0.39' N	14° 44.36' E	1292.0	WSW 2	305.2	0.4	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	05:45	72° 0.16' N	14° 42.75' E	1293.0	WSW 3	202.4	1.0	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	06:35	72° 0.15' N	14° 44.06' E	1287.0	W 3	245.1	0.7	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	06:45	72° 0.09' N	14° 43.80' E	1288.0	W 3	254.8	0.4	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/326-1	01.07.03	07:25	72° 0.04' N	14° 42.81' E	1294.0	W 3	148.7	0.9	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	07:31	72° 0.01' N	14° 43.00' E	1292.0	WNW 4	197.2	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	08:12	71° 59.95' N	14° 43.99' E	1293.0	WNW 4	78.1	0.6	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	08:52	72° 0.24' N	14° 44.03' E	1287.0	W 3	354.9	0.4	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	09:05	72° 0.24' N	14° 44.07' E	1288.0	WNW 2	17.2	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	09:35	72° 0.49' N	14° 44.06' E	1289.0	W 2	354.4	0.7	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	09:55	72° 0.37' N	14° 43.55' E	1285.0	W 3	217.2	0.6	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	10:25	72° 0.34' N	14° 43.58' E	1288.0	WNW 2	98.4	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	10:38	72° 0.21' N	14° 43.60' E	1289.0	W 3	179.6	0.7	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	10:42	72° 0.19' N	14° 43.56' E	1287.0	W 2	265.6	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	10:55	72° 0.11' N	14° 43.96' E	1288.0	WNW 2	115.1	0.8	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	11:29	72° 0.08' N	14° 43.96' E	1289.0	WNW 2	270.2	0.0	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	11:37	72° 0.08' N	14° 44.21' E	1291.0	WNW 3	86.4	0.4	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	11:56	72° 0.05' N	14° 44.20' E	1291.0	WNW 2	260.6	0.4	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	12:54	71° 59.97' N	14° 43.86' E	1296.0	WNW 3	323.6	0.3	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	13:05	71° 59.96' N	14° 43.64' E	1293.0	NW 3	224.8	0.4	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	13:08	71° 59.96' N	14° 43.64' E	1292.0	NW 2	138.6	0.3	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	13:34	72° 0.12' N	14° 43.84' E	1290.0	W 3	67.9	0.3	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	23:05	72° 0.06' N	14° 43.64' E	1286.0	NNW 3	285.5	0.0	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	23:22	72° 0.26' N	14° 43.69' E	1288.0	WSW 1	333.4	0.6	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	23:31	72° 0.29' N	14° 43.61' E	1289.0	WNW 2	16.4	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	01.07.03	23:46	72° 0.29' N	14° 43.28' E	1286.0	NW 2	50.0	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	02.07.03	01:00	72° 0.23' N	14° 43.05' E	1286.0	WSW 1	94.2	0.8	Remote operated vehicle	ROV	Information
PS64/326-1	02.07.03	01:27	72° 0.24' N	14° 43.27' E	1288.0	NW 1	278.0	0.0	Remote operated vehicle	ROV	Information
PS64/326-1	02.07.03	01:41	72° 0.22' N	14° 43.27' E	1288.0	NNW 1	261.2	0.2	Remote operated vehicle	ROV	Information
PS64/326-1	02.07.03	01:56	72° 0.22' N	14° 42.97' E	1286.0	NNW 1	316.5	0.1	Remote operated vehicle	ROV	Information
PS64/326-1	02.07.03	02:24	72° 0.24' N	14° 42.94' E	1288.0	NNW 1	265.5	0.3	Remote operated vehicle	ROV	Information
PS64/326-1	02.07.03	03:05	72° 0.36' N	14° 43.34' E	1286.0	NNW 1	258.3	0.0	Remote operated vehicle	ROV	Information
PS64/326-1	02.07.03	07:31	72° 0.20' N	14° 43.86' E	1288.0	SSE 1	223.3	0.0	Remote operated vehicle	ROV	coming back to the surface
PS64/326-1	02.07.03	08:13	72° 0.05' N	14° 43.06' E	1289.0	SSE 2	225.5	0.4	Remote operated vehicle	ROV	coming back to the surface
PS64/326-1	02.07.03	08:15	72° 0.05' N	14° 43.02' E	1290.0	SSE 2	239.8	0.4	Remote operated vehicle	ROV	Depressor on deck
PS64/326-1	02.07.03	08:17	72° 0.04' N	14° 43.00' E	1290.0	SE 2	250.7	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/326-1	02.07.03	08:41	72° 0.06' N	14° 42.98' E	1291.0	ESE 2	213.7	0.3	Remote operated vehicle	ROV	on deck

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/326-1	02.07.03	08:49	72° 0.08' N	14° 43.02' E	1291.0	SE 2	315.1	0.8	Remote operated vehicle	ROV	Shuttle
PS64/326-1	02.07.03	09:08	72° 0.07' N	14° 43.19' E	1290.0	SE 2	290.0	1.0	Remote operated vehicle	ROV	Shuttle
PS64/326-1	02.07.03	09:23	72° 0.11' N	14° 44.32' E	1292.0	SSE 2	76.2	1.0	Remote operated vehicle	ROV	Shuttle
PS64/326-1	02.07.03	09:25	72° 0.12' N	14° 44.41' E	1291.0	SSE 2	58.4	0.7	Remote operated vehicle	ROV	Shuttle
PS64/327-1	02.07.03	09:26	72° 0.12' N	14° 44.43' E	1291.0	SSE 2	44.7	0.3	Bottom lander	LANDER	Information
PS64/326-1	02.07.03	09:28	72° 0.13' N	14° 44.42' E	1290.0	SSE 2	315.7	0.1	Remote operated vehicle	ROV	Shuttle
PS64/327-1	02.07.03	09:30	72° 0.13' N	14° 44.41' E	1292.0	SSE 2	44.0	0.0	Bottom lander	LANDER	released
PS64/327-1	02.07.03	09:35	72° 0.12' N	14° 44.36' E	1292.0	SE 2	30.0	0.8	Bottom lander	LANDER	Information
PS64/327-1	02.07.03	09:53	71° 59.93' N	14° 44.55' E	1290.0	SE 3	103.7	0.6	Bottom lander	LANDER	Information
PS64/327-1	02.07.03	10:05	72° 0.22' N	14° 44.32' E	1287.0	SE 2	16.9	0.5	Bottom lander	LANDER	on Deck
PS64/328-1	02.07.03	10:26	72° 0.17' N	14° 43.86' E	1287.0	SE 2	292.9	0.2	CTD/rosette water sampler	CTD/RO	surface
PS64/328-1	02.07.03	10:56	72° 0.15' N	14° 43.83' E	1287.0	SE 2	264.6	0.0	CTD/rosette water sampler	CTD/RO	at depth
PS64/328-1	02.07.03	11:28	72° 0.16' N	14° 43.81' E	1288.0	SE 1	52.6	0.2	CTD/rosette water sampler	CTD/RO	on deck
PS64/329-1	02.07.03	11:43	72° 0.16' N	14° 43.83' E	1289.0	SE 1	319.4	0.1	Bottom water sampler	BWS	surface
PS64/329-1	02.07.03	12:26	72° 0.15' N	14° 43.84' E	1288.0	ESE 1	266.8	0.0	Bottom water sampler	BWS	at sea bottom
PS64/329-1	02.07.03	12:31	72° 0.16' N	14° 43.85' E	1288.0	SE 1	11.4	0.1	Bottom water sampler	BWS	off bottom
PS64/329-1	02.07.03	13:03	72° 0.15' N	14° 43.86' E	1288.0	E 1	336.5	0.4	Bottom water sampler	BWS	on deck
PS64/330-1	02.07.03	13:19	72° 0.31' N	14° 43.52' E	1288.0	SSW 0	64.3	0.5	Gravity corer	GC	surface
PS64/330-1	02.07.03	13:39	72° 0.30' N	14° 43.60' E	1287.0	SSE 0	73.9	0.1	Gravity corer	GC	at sea bottom
PS64/330-1	02.07.03	13:49	72° 0.30' N	14° 43.60' E	1286.0	E 0	244.0	0.0	Gravity corer	GC	off ground hoisting
PS64/330-1	02.07.03	14:13	72° 0.35' N	14° 43.84' E	1287.0	N 0	243.9	0.0	Gravity corer	GC	on deck
PS64/331-1	02.07.03	14:22	72° 0.30' N	14° 43.65' E	1287.0	N 0	215.6	0.3	CTD/rosette water sampler	CTD/RO	surface
PS64/331-1	02.07.03	14:24	72° 0.30' N	14° 43.64' E	1287.0	NW 0	130.2	0.1	CTD/rosette water sampler	CTD/RO	Information
PS64/331-1	02.07.03	14:46	72° 0.29' N	14° 43.61' E	1288.0	NNW 0	31.0	0.1	CTD/rosette water sampler	CTD/RO	surface
PS64/331-1	02.07.03	15:10	72° 0.31' N	14° 43.64' E	1286.0	ESE 1	254.6	0.0	CTD/rosette water sampler	CTD/RO	at depth
PS64/331-1	02.07.03	15:33	72° 0.31' N	14° 43.66' E	1288.0	NNE 1	11.0	0.1	CTD/rosette water sampler	CTD/RO	on deck
PS64/332-1	02.07.03	16:18	72° 0.26' N	14° 43.69' E	1287.0	NNE 1	232.0	0.4	Gravity corer	GC	surface
PS64/332-1	02.07.03	16:37	72° 0.28' N	14° 43.57' E	1288.0	NNE 2	284.0	0.0	Gravity corer	GC	at sea bottom
PS64/332-1	02.07.03	16:45	72° 0.28' N	14° 43.56' E	1287.0	N 2	72.6	0.1	Gravity corer	GC	off ground hoisting
PS64/332-1	02.07.03	17:10	72° 0.29' N	14° 43.62' E	1287.0	NNW 2	38.4	0.1	Gravity corer	GC	on deck
PS64/333-1	02.07.03	17:47	72° 0.23' N	14° 42.63' E	1293.0	NW 2	273.8	0.3	Heat Flow	HF	in the water
PS64/333-1	02.07.03	18:21	72° 0.25' N	14° 42.60' E	1294.0	NNW 2	90.9	0.1	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	18:38	72° 0.25' N	14° 42.58' E	1293.0	NNW 3	206.6	0.1	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	18:56	72° 0.24' N	14° 42.78' E	1291.0	NNW 2	274.2	0.0	Heat Flow	HF	at the bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/333-1	02.07.03	19:10	72° 0.24' N	14° 42.79' E	1288.0	N 3	349.6	0.2	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	19:26	72° 0.24' N	14° 42.97' E	1285.0	N 2	274.0	0.0	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	19:42	72° 0.24' N	14° 42.93' E	1286.0	N 3	273.9	0.0	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	19:57	72° 0.24' N	14° 43.14' E	1295.0	N 3	78.9	0.2	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	20:12	72° 0.23' N	14° 43.14' E	1285.0	NNE 4	233.8	0.1	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	20:26	72° 0.24' N	14° 43.30' E	1286.0	NE 5	262.8	0.2	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	20:42	72° 0.24' N	14° 43.28' E	1287.0	NE 4	263.4	0.1	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	20:55	72° 0.24' N	14° 43.50' E	1288.0	NE 4	78.5	0.2	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	21:09	72° 0.24' N	14° 43.48' E	1288.0	NE 5	82.0	0.2	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	21:25	72° 0.24' N	14° 43.65' E	1289.0	ENE 4	273.7	0.0	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	21:39	72° 0.23' N	14° 43.67' E	1287.0	ENE 4	273.8	0.0	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	21:50	72° 0.24' N	14° 43.84' E	1287.0	NE 8	273.9	0.0	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	22:06	72° 0.24' N	14° 43.82' E	1287.0	ENE 5	274.1	0.0	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	22:19	72° 0.25' N	14° 44.01' E	1287.0	NE 5	214.6	0.2	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	22:35	72° 0.23' N	14° 43.99' E	1287.0	NE 6	221.4	0.1	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	22:49	72° 0.24' N	14° 44.20' E	1289.0	NE 6	268.6	0.1	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	23:03	72° 0.23' N	14° 44.19' E	1289.0	NE 6	335.0	0.2	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	23:17	72° 0.23' N	14° 44.33' E	1291.0	NE 7	164.7	0.3	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	23:31	72° 0.24' N	14° 44.33' E	1291.0	NNE 7	274.7	0.0	Heat Flow	HF	off bottom
PS64/333-1	02.07.03	23:44	72° 0.24' N	14° 44.49' E	1292.0	NE 7	179.1	0.1	Heat Flow	HF	at the bottom
PS64/333-1	02.07.03	23:58	72° 0.23' N	14° 44.46' E	1290.0	NE 6	271.7	0.3	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	00:15	72° 0.25' N	14° 44.72' E	1289.0	NE 7	235.8	0.2	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	00:29	72° 0.25' N	14° 44.72' E	1291.0	NE 7	253.8	0.2	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	01:07	72° 0.55' N	14° 43.71' E	1291.0	NE 5	114.6	0.1	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	01:20	72° 0.55' N	14° 43.74' E	1291.0	NE 5	0.2	0.0	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	01:38	72° 0.48' N	14° 43.71' E	1288.0	NE 5	164.8	0.1	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	01:51	72° 0.48' N	14° 43.70' E	1289.0	NE 4	0.1	0.0	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	02:07	72° 0.43' N	14° 43.72' E	1287.0	NE 5	0.3	0.0	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	02:21	72° 0.43' N	14° 43.72' E	1287.0	NNE 5	123.7	0.1	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	02:36	72° 0.38' N	14° 43.70' E	1286.0	NNE 5	195.5	0.1	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	02:50	72° 0.38' N	14° 43.71' E	1286.0	NNE 5	152.3	0.1	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	03:07	72° 0.32' N	14° 43.69' E	1286.0	NNE 6	0.3	0.0	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	03:20	72° 0.32' N	14° 43.70' E	1286.0	N 6	0.1	0.0	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	03:35	72° 0.28' N	14° 43.69' E	1287.0	N 5	35.6	0.1	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	03:48	72° 0.28' N	14° 43.68' E	1287.0	N 5	168.3	0.2	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	04:01	72° 0.22' N	14° 43.69' E	1289.0	N 5	231.3	0.2	Heat Flow	HF	at the bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/333-1	03.07.03	04:14	72° 0.23' N	14° 43.71' E	1292.0	N 5	107.1	0.1	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	04:34	72° 0.17' N	14° 43.67' E	1288.0	N 5	351.1	0.2	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	04:47	72° 0.17' N	14° 43.69' E	1288.0	N 4	0.4	0.0	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	05:05	72° 0.11' N	14° 43.72' E	1288.0	N 4	0.6	0.0	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	05:19	72° 0.11' N	14° 43.69' E	1289.0	N 4	67.3	0.4	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	05:35	72° 0.06' N	14° 43.69' E	1294.0	N 4	0.8	0.0	Heat Flow	HF	at the bottom
PS64/333-1	03.07.03	05:50	72° 0.06' N	14° 43.69' E	1289.0	N 4	145.7	0.3	Heat Flow	HF	Information
PS64/333-1	03.07.03	05:50	72° 0.06' N	14° 43.69' E	1289.0	N 4	145.7	0.3	Heat Flow	HF	off bottom
PS64/333-1	03.07.03	06:23	72° 0.12' N	14° 44.20' E	1288.0	N 4	0.2	0.3	Heat Flow	HF	on deck
PS64/334-1	03.07.03	06:46	71° 59.82' N	14° 44.44' E	1291.0	N 4	331.4	0.2	Remote operated vehicle	ROV	surface
PS64/334-1	03.07.03	06:56	71° 59.83' N	14° 44.48' E	1290.0	N 3	109.8	0.3	Remote operated vehicle	ROV	Depressor into water
PS64/334-1	03.07.03	08:31	72° 0.03' N	14° 44.72' E	1289.0	NNW 3	25.6	0.2	Remote operated vehicle	ROV	at depth
PS64/334-1	03.07.03	09:17	72° 0.03' N	14° 44.23' E	1292.0	NW 2	214.6	0.3	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	09:28	71° 59.97' N	14° 43.92' E	1291.0	N 2	236.4	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	09:40	71° 59.96' N	14° 43.91' E	1292.0	NNW 1	232.9	0.3	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	09:52	71° 59.95' N	14° 43.87' E	1285.6	NNW 1	130.3	0.3	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	10:21	71° 59.94' N	14° 42.91' E	1288.0	NNW 1	273.0	0.9	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	10:58	71° 59.92' N	14° 42.80' E	1288.6	NW 2	240.2	0.1	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	11:47	71° 59.92' N	14° 44.08' E	1286.2	WNW 2	298.0	0.3	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	12:02	71° 59.96' N	14° 43.86' E	1285.8	W 2	303.4	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	12:40	71° 59.95' N	14° 42.83' E	1289.4	W 1	230.1	0.3	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	13:05	72° 0.00' N	14° 42.65' E	1290.1	NW 2	5.7	0.4	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	13:35	71° 59.96' N	14° 44.18' E	1286.8	NW 3	81.1	0.4	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	13:48	72° 0.00' N	14° 44.22' E	1286.5	NNE 6	344.8	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	14:32	71° 59.98' N	14° 42.76' E	1290.2	NNE 6	219.9	0.4	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	15:05	72° 0.06' N	14° 43.02' E	1285.1	N 5	80.5	0.6	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	15:50	72° 0.01' N	14° 44.43' E	1286.5	NNW 6	79.3	0.7	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	16:00	72° 0.05' N	14° 44.55' E	1286.3	NNE 6	97.0	0.3	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	17:05	72° 0.06' N	14° 42.38' E	1291.0	N 5	301.7	0.0	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	18:04	72° 0.10' N	14° 44.62' E	1285.3	N 4	271.5	0.8	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	19:00	72° 0.09' N	14° 42.28' E	1289.9	NNW 5	290.6	0.4	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	20:00	72° 0.12' N	14° 44.80' E	1282.5	N 2	30.7	0.6	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	21:06	72° 0.17' N	14° 42.16' E	1289.4	N 3	262.6	0.7	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	21:13	72° 0.17' N	14° 42.19' E	1289.5	NNE 2	252.1	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	03.07.03	22:18	72° 0.18' N	14° 44.92' E	1280.3	NW 6	103.4	0.8	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/334-1	03.07.03	23:24	72° 0.19' N	14° 42.04' E	1291.5	NNW 2	281.6	0.8	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	00:30	72° 0.21' N	14° 44.91' E	1281.9	NNW 4	56.8	0.6	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	00:40	72° 0.26' N	14° 44.88' E	1281.9	NW 5	342.9	0.4	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	01:51	72° 0.34' N	14° 42.31' E	1291.0	WNW 4	63.2	0.8	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	02:42	72° 0.28' N	14° 44.79' E	1283.7	NNW 5	96.3	0.6	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	02:55	72° 0.35' N	14° 44.77' E	1284.1	NNW 3	266.1	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	04:00	72° 0.31' N	14° 42.03' E	1292.8	NNW 6	292.0	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	05:10	72° 0.37' N	14° 45.03' E	1278.4	WNW 4	350.0	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	06:15	72° 0.36' N	14° 42.05' E	1292.8	NW 3	280.9	0.9	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	07:25	72° 0.38' N	14° 44.93' E	1279.5	N 3	76.1	1.2	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	08:37	72° 0.41' N	14° 41.98' E	1293.9	NNE 5	238.1	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	09:56	72° 0.47' N	14° 44.94' E	1277.0	NNE 2	341.4	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	10:08	72° 0.46' N	14° 44.70' E	1282.1	N 3	272.8	1.3	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	11:23	72° 0.46' N	14° 44.53' E	1283.4	NNW 6	192.2	0.3	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	11:48	72° 0.46' N	14° 44.80' E	1279.3	NNW 5	355.3	0.1	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	12:49	72° 0.47' N	14° 42.20' E	1292.7	NNW 4	40.6	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	12:55	72° 0.51' N	14° 42.33' E	1291.3	NW 4	78.5	0.8	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	13:39	72° 0.51' N	14° 44.73' E	1280.0	NW 4	15.9	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	13:51	72° 0.53' N	14° 44.69' E	1280.1	NNW 4	300.6	0.7	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	14:36	72° 0.55' N	14° 42.49' E	1291.5	NW 4	257.8	1.0	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	14:45	72° 0.58' N	14° 42.40' E	1292.7	NW 5	357.4	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	15:35	72° 0.59' N	14° 44.57' E	1280.9	NNW 3	30.1	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	15:44	72° 0.60' N	14° 44.43' E	1282.1	NNW 4	251.7	0.7	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	16:34	72° 0.57' N	14° 42.47' E	1291.8	NW 4	263.4	0.7	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	17:25	72° 0.60' N	14° 44.53' E	1281.2	NW 4	76.2	1.0	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	18:13	72° 0.64' N	14° 42.57' E	1291.8	NW 3	278.4	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	18:53	72° 0.66' N	14° 44.33' E	1281.3	WNW 4	59.5	0.6	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	19:33	72° 0.68' N	14° 42.79' E	1289.8	NW 3	192.5	0.1	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	19:46	72° 0.67' N	14° 42.76' E	1290.0	NNW 2	216.2	0.8	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	20:06	72° 0.47' N	14° 42.05' E	1293.8	NW 4	196.5	0.7	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	20:27	72° 0.17' N	14° 42.03' E	1292.3	NW 4	186.5	1.0	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	20:33	72° 0.12' N	14° 42.26' E	1289.2	NW 4	49.9	0.8	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	20:43	72° 0.12' N	14° 42.33' E	1289.6	NW 4	99.6	0.0	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	21:22	72° 0.54' N	14° 42.32' E	1291.8	WNW 3	347.5	1.1	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	21:30	72° 0.64' N	14° 42.57' E	1290.7	WNW 6	65.5	1.2	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	21:38	72° 0.60' N	14° 42.82' E	1289.1	WNW 7	26.5	0.2	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/334-1	04.07.03	21:50	72° 0.61' N	14° 42.88' E	1288.9	NNW 5	12.4	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	22:36	71° 59.94' N	14° 42.77' E	1288.9	NW 3	106.2	0.5	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	22:53	71° 59.96' N	14° 42.93' E	1287.7	WNW 3	56.3	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	04.07.03	23:40	72° 0.68' N	14° 43.03' E	1288.5	WNW 4	23.7	0.7	Remote operated vehicle	ROV	Information
PS64/334-1	05.07.03	00:50	71° 59.93' N	14° 43.65' E	1286.2	WNW 4	34.4	0.6	Remote operated vehicle	ROV	Information
PS64/334-1	05.07.03	01:45	72° 0.70' N	14° 43.83' E	1285.0	WNW 3	103.2	0.6	Remote operated vehicle	ROV	Information
PS64/334-1	05.07.03	02:40	71° 59.99' N	14° 44.04' E	1287.0	WNW 3	110.2	0.4	Remote operated vehicle	ROV	Information
PS64/334-1	05.07.03	03:30	72° 0.54' N	14° 44.50' E	1283.1	SW 2	134.8	0.2	Remote operated vehicle	ROV	Information
PS64/334-1	05.07.03	04:02	72° 0.16' N	14° 44.86' E	1283.3	W 4	95.4	0.3	Remote operated vehicle	ROV	Information
PS64/334-1	05.07.03	05:18	72° 0.47' N	14° 41.97' E	1295.5	W 3	247.4	0.6	Remote operated vehicle	ROV	Information
PS64/334-1	05.07.03	05:30	72° 0.35' N	14° 41.97' E	1294.1	W 4	196.4	0.8	Remote operated vehicle	ROV	coming back to the surface
PS64/334-1	05.07.03	06:17	72° 0.50' N	14° 41.32' E	1300.6	W 3	340.9	0.4	Remote operated vehicle	ROV	Depressor on deck
PS64/334-1	05.07.03	06:45	72° 0.61' N	14° 41.26' E	1299.8	SW 3	329.4	0.3	Remote operated vehicle	ROV	on deck
PS64/335-1	05.07.03	07:15	72° 0.37' N	14° 43.54' E	1278.0	WSW 2	277.2	0.6	Bottom lander	LANDER	surface
PS64/336-1	05.07.03	08:05	72° 0.03' N	14° 44.18' E	1285.6	WSW 2	193.0	0.3	Gravity corer	GC	surface
PS64/336-1	05.07.03	08:23	72° 0.02' N	14° 44.13' E	1286.4	W 3	188.0	0.1	Gravity corer	GC	at sea bottom
PS64/336-1	05.07.03	08:33	72° 0.02' N	14° 44.10' E	1286.8	W 2	18.7	0.2	Gravity corer	GC	off ground hoisting
PS64/336-1	05.07.03	09:03	72° 0.04' N	14° 44.22' E	1287.6	S 1	79.7	0.3	Gravity corer	GC	on deck
PS64/337-1	05.07.03	09:19	72° 0.53' N	14° 43.95' E	1286.1	S 1	259.4	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/337-1	05.07.03	10:56	72° 0.19' N	14° 43.39' E	0.0	SW 1	82.3	0.2	CTD/rosette water sampler	CTD/RO	surface
PS64/337-1	05.07.03	11:24	72° 0.18' N	14° 43.33' E	0.0	WSW 2	359.5	0.2	CTD/rosette water sampler	CTD/RO	at depth
PS64/337-1	05.07.03	12:00	72° 0.18' N	14° 43.31' E	1283.7	WSW 1	162.1	0.3	CTD/rosette water sampler	CTD/RO	on deck
PS64/338-1	05.07.03	12:10	72° 0.18' N	14° 43.26' E	1283.7	WSW 1	127.9	0.1	Bottom water sampler	BWS	surface
PS64/338-1	05.07.03	12:48	72° 0.20' N	14° 43.28' E	1283.6	W 2	285.7	0.2	Bottom water sampler	BWS	at sea bottom
PS64/338-1	05.07.03	12:56	72° 0.19' N	14° 43.28' E	1283.5	WSW 2	266.3	0.0	Bottom water sampler	BWS	off bottom
PS64/338-1	05.07.03	13:30	72° 0.15' N	14° 43.41' E	1282.0	WSW 1	4.0	0.3	Bottom water sampler	BWS	on deck
PS64/339-1	05.07.03	13:40	72° 0.16' N	14° 43.81' E	1284.4	WNW 1	135.2	0.1	Gravity corer	GC	surface
PS64/339-1	05.07.03	13:57	72° 0.13' N	14° 43.81' E	1284.4	W 1	158.3	0.1	Gravity corer	GC	at sea bottom
PS64/339-1	05.07.03	14:07	72° 0.12' N	14° 43.82' E	1284.9	SW 1	131.6	0.2	Gravity corer	GC	off ground hoisting
PS64/339-1	05.07.03	14:10	72° 0.12' N	14° 43.82' E	1284.3	SSW 1	342.4	0.1	Gravity corer	GC	information
PS64/339-1	05.07.03	14:34	72° 0.13' N	14° 43.61' E	1284.9	SE 3	280.1	0.8	Gravity corer	GC	on deck
PS64/340-1	05.07.03	15:03	72° 0.21' N	14° 43.27' E	1284.3	ESE 2	265.1	0.1	Multi corer	MUC	surface
PS64/340-1	05.07.03	15:23	72° 0.19' N	14° 43.23' E	1284.0	ENE 1	273.9	0.0	Multi corer	MUC	at sea bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/340-1	05.07.03	15:43	72° 0.22' N	14° 43.13' E	1283.6	E 0	289.9	0.2	Multi corer	MUC	on deck
PS64/341-1	05.07.03	16:24	72° 0.17' N	14° 43.81' E	1284.7	SE 1	122.0	0.4	Gravity corer	GC	surface
PS64/341-1	05.07.03	16:40	72° 0.17' N	14° 43.85' E	1285.2	E 1	3.9	0.1	Gravity corer	GC	at sea bottom
PS64/341-1	05.07.03	16:49	72° 0.17' N	14° 43.85' E	1284.8	ESE 2	48.9	0.2	Gravity corer	GC	off ground hoisting
PS64/341-1	05.07.03	17:15	72° 0.17' N	14° 43.72' E	1284.8	ESE 2	250.4	0.6	Gravity corer	GC	on deck
PS64/342-1	05.07.03	18:17	72° 0.48' N	14° 43.61' E	1280.8	E 2	96.0	0.3	Bottom lander	LANDER	released
PS64/342-1	05.07.03	18:45	72° 0.52' N	14° 43.69' E	1284.4	E 2	357.5	0.4	Bottom lander	LANDER	Information
PS64/342-1	05.07.03	18:57	72° 0.40' N	14° 43.80' E	1279.6	E 2	166.6	0.0	Bottom lander	LANDER	on Deck
PS64/343-1	05.07.03	19:31	72° 1.50' N	14° 43.37' E	1278.0	ESE 2	318.3	0.1	Heat Flow	HF	in the water
PS64/343-1	05.07.03	19:59	72° 1.51' N	14° 43.37' E	1278.1	ESE 0	180.3	0.0	Heat Flow	HF	at the bottom
PS64/343-1	05.07.03	20:17	72° 1.51' N	14° 43.35' E	1278.0	SE 1	16.8	0.3	Heat Flow	HF	off bottom
PS64/343-1	05.07.03	20:33	72° 1.39' N	14° 43.36' E	1273.3	S 1	144.7	0.3	Heat Flow	HF	at the bottom
PS64/343-1	05.07.03	20:49	72° 1.40' N	14° 43.34' E	1278.8	SW 1	332.3	0.2	Heat Flow	HF	off bottom
PS64/343-1	05.07.03	21:04	72° 1.29' N	14° 43.34' E	1280.0	SSW 1	356.3	0.3	Heat Flow	HF	at the bottom
PS64/343-1	05.07.03	21:20	72° 1.30' N	14° 43.35' E	1279.9	SSE 1	212.9	0.1	Heat Flow	HF	off bottom
PS64/343-1	05.07.03	21:35	72° 1.18' N	14° 43.36' E	1281.2	S 1	30.1	0.1	Heat Flow	HF	at the bottom
PS64/343-1	05.07.03	21:41	72° 1.17' N	14° 43.36' E	0.0	SSW 0	347.4	0.1	Heat Flow	HF	off bottom
PS64/343-1	05.07.03	21:59	72° 1.08' N	14° 43.34' E	1281.6	ENE 1	98.0	0.3	Heat Flow	HF	at the bottom
PS64/343-1	05.07.03	22:15	72° 1.08' N	14° 43.35' E	1281.7	ENE 0	237.6	0.2	Heat Flow	HF	off bottom
PS64/343-1	05.07.03	22:30	72° 0.96' N	14° 43.32' E	0.0	NNE 1	185.1	0.0	Heat Flow	HF	at the bottom
PS64/343-1	05.07.03	22:37	72° 0.96' N	14° 43.28' E	0.0	ENE 1	9.9	0.2	Heat Flow	HF	off bottom
PS64/343-1	05.07.03	22:52	72° 0.86' N	14° 43.34' E	1285.6	NE 1	184.6	0.0	Heat Flow	HF	at the bottom
PS64/343-1	05.07.03	23:07	72° 0.85' N	14° 43.29' E	1286.5	NNE 2	254.7	0.3	Heat Flow	HF	off bottom
PS64/343-1	05.07.03	23:23	72° 0.76' N	14° 43.29' E	1287.6	NE 1	199.3	0.2	Heat Flow	HF	at the bottom
PS64/343-1	05.07.03	23:40	72° 0.76' N	14° 43.34' E	1287.3	N 1	65.7	0.1	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	00:08	72° 0.65' N	14° 43.32' E	1287.6	N 2	171.0	0.1	Heat Flow	HF	on deck
PS64/343-1	06.07.03	00:38	72° 0.65' N	14° 43.31' E	1287.6	N 2	303.2	0.1	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	00:44	72° 0.64' N	14° 43.31' E	1287.5	NNE 2	189.9	0.0	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	00:59	72° 0.55' N	14° 43.30' E	0.0	NNW 2	1.0	0.1	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	01:12	72° 0.55' N	14° 43.28' E	1291.6	NNW 2	288.7	0.1	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	01:33	72° 0.40' N	14° 43.27' E	1280.8	NNE 2	190.2	0.0	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	01:48	72° 0.39' N	14° 43.27' E	1280.8	NNW 2	190.0	0.0	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	02:04	72° 0.35' N	14° 43.29' E	1281.5	NNE 1	356.7	0.2	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	02:16	72° 0.34' N	14° 43.29' E	1281.2	NNE 2	149.5	0.2	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	02:34	72° 0.19' N	14° 43.30' E	1283.6	NNE 2	190.2	0.0	Heat Flow	HF	at the bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/343-1	06.07.03	02:49	72° 0.19' N	14° 43.28' E	1284.8	N 2	190.5	0.0	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	03:03	72° 0.13' N	14° 43.26' E	1284.8	N 2	190.5	0.0	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	03:17	72° 0.13' N	14° 43.24' E	1282.9	NNE 3	189.9	0.0	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	03:33	72° 0.02' N	14° 43.22' E	1287.6	NNE 3	328.8	0.1	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	03:47	72° 0.02' N	14° 43.22' E	1274.0	N 3	190.3	0.0	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	04:08	71° 59.88' N	14° 43.28' E	1288.4	NNE 3	264.5	0.1	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	04:22	71° 59.88' N	14° 43.26' E	1288.4	N 3	179.9	0.0	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	04:39	71° 59.79' N	14° 43.26' E	1291.2	N 3	179.9	0.0	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	04:52	71° 59.77' N	14° 43.25' E	1291.6	NNE 3	266.7	0.1	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	05:11	71° 59.67' N	14° 43.25' E	1294.3	N 3	180.1	0.0	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	05:15	71° 59.67' N	14° 43.24' E	1294.4	N 4	106.8	0.1	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	05:29	71° 59.57' N	14° 43.25' E	1278.8	N 3	180.0	0.0	Heat Flow	HF	at the bottom
PS64/343-1	06.07.03	05:35	71° 59.56' N	14° 43.23' E	1297.6	NNE 3	180.3	0.0	Heat Flow	HF	off bottom
PS64/343-1	06.07.03	06:09	71° 59.55' N	14° 43.16' E	1291.2	NNE 4	302.4	0.2	Heat Flow	HF	on deck
PS64/344-1	06.07.03	06:26	72° 0.09' N	14° 44.01' E	1247.9	NNE 4	9.9	0.0	Large Box Corer	GKG	surface
PS64/344-1	06.07.03	06:44	72° 0.10' N	14° 44.07' E	1284.4	NE 4	85.2	0.2	Large Box Corer	GKG	at sea bottom
PS64/344-1	06.07.03	07:03	72° 0.11' N	14° 43.87' E	1285.6	NNE 4	22.8	0.2	Large Box Corer	GKG	on deck
PS64/345-1	06.07.03	07:19	72° 0.07' N	14° 44.24' E	1287.2	N 3	339.7	0.1	Large Box Corer	GKG	surface
PS64/345-1	06.07.03	07:37	72° 0.08' N	14° 44.22' E	1287.6	N 3	93.8	0.4	Large Box Corer	GKG	at sea bottom
PS64/345-1	06.07.03	07:57	72° 0.15' N	14° 44.17' E	1264.3	NNE 3	340.6	0.2	Large Box Corer	GKG	on deck
PS64/346-1	06.07.03	08:16	72° 0.08' N	14° 43.51' E	1283.1	NNE 3	135.6	0.2	Bottom lander	LANDER	surface
PS64/346-1	06.07.03	08:20	72° 0.09' N	14° 43.50' E	1285.2	NNE 3	284.5	0.2	Bottom lander	LANDER	surface
PS64/347-1	06.07.03	09:21	72° 0.23' N	14° 42.99' E	1279.7	N 2	150.1	0.0	Remote operated vehicle	ROV	Shuttle
PS64/347-1	06.07.03	09:40	71° 59.99' N	14° 43.64' E	1286.8	N 2	113.2	0.1	Remote operated vehicle	ROV	surface
PS64/347-1	06.07.03	09:51	72° 0.00' N	14° 43.57' E	1287.2	N 2	298.9	0.1	Remote operated vehicle	ROV	Depressor into water
PS64/347-1	06.07.03	10:30	71° 59.91' N	14° 43.73' E	904.4	NNW 2	299.7	0.3	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	10:50	72° 0.11' N	14° 43.53' E	1284.8	NNW 2	136.7	0.6	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	10:56	72° 0.09' N	14° 43.54' E	1284.0	NNW 2	151.4	0.0	Remote operated vehicle	ROV	at depth
PS64/347-1	06.07.03	12:55	72° 0.09' N	14° 43.52' E	0.0	N 2	99.4	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	13:07	72° 0.08' N	14° 43.45' E	0.0	NNW 2	270.6	0.3	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	13:19	72° 0.06' N	14° 43.43' E	0.0	N 2	288.6	0.3	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	13:31	72° 0.05' N	14° 43.37' E	0.0	NNW 2	251.3	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	13:39	72° 0.06' N	14° 43.33' E	0.0	NNW 2	315.8	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	13:49	72° 0.06' N	14° 43.22' E	0.0	NNW 2	179.5	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	13:54	72° 0.05' N	14° 43.28' E	0.0	NNW 2	40.4	0.5	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/347-1	06.07.03	14:40	72° 0.32' N	14° 43.36' E	0.0	NNE 2	23.7	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	20:18	72° 0.31' N	14° 42.87' E	0.0	SSE 5	264.9	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	20:32	72° 0.30' N	14° 43.29' E	0.0	SSE 5	181.7	0.0	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	21:39	72° 0.30' N	14° 43.35' E	0.0	SE 6	162.2	0.0	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	21:52	72° 0.26' N	14° 43.81' E	0.0	SSE 6	126.3	0.3	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	22:45	72° 0.25' N	14° 43.90' E	0.0	SE 6	180.6	0.0	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	23:05	72° 0.24' N	14° 43.11' E	0.0	SE 8	247.8	0.6	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	23:17	72° 0.24' N	14° 43.12' E	0.0	SSE 8	245.2	0.3	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	23:28	72° 0.23' N	14° 42.75' E	0.0	SE 7	274.0	1.3	Remote operated vehicle	ROV	Information
PS64/347-1	06.07.03	23:51	72° 0.26' N	14° 42.90' E	0.0	SSE 8	307.5	0.1	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	01:00	72° 0.38' N	14° 44.18' E	0.0	SSE 7	319.2	0.7	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	01:34	72° 0.33' N	14° 43.41' E	0.0	SSE 7	344.2	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	02:33	72° 0.34' N	14° 43.35' E	0.0	SE 8	150.4	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	02:51	72° 0.34' N	14° 42.71' E	0.0	SE 8	117.3	0.4	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	03:39	72° 0.28' N	14° 43.45' E	0.0	SSE 9	190.0	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	04:40	72° 0.30' N	14° 43.59' E	0.0	SE 8	88.0	0.6	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	05:10	72° 0.33' N	14° 44.10' E	0.0	SE 9	310.7	0.5	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	05:40	72° 0.34' N	14° 43.41' E	0.0	SE 9	148.4	0.2	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	07:15	72° 0.34' N	14° 43.00' E	0.0	SE 10	284.6	0.7	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	07:34	72° 0.45' N	14° 42.70' E	0.0	SE 9	11.1	0.1	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	07:47	72° 0.48' N	14° 42.79' E	0.0	SSE 10	92.6	0.6	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	08:03	72° 0.48' N	14° 43.14' E	0.0	SSE 9	125.0	0.4	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	08:19	72° 0.34' N	14° 43.52' E	0.0	SSE 9	158.2	0.4	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	08:58	72° 0.31' N	14° 43.57' E	0.0	SE 8	169.3	0.0	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	09:03	72° 0.31' N	14° 43.57' E	0.0	SE 8	169.1	0.0	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	09:25	72° 0.35' N	14° 43.57' E	0.0	SE 8	169.3	0.0	Remote operated vehicle	ROV	Information
PS64/347-1	07.07.03	20:09	72° 0.26' N	14° 42.89' E	0.0	S 7	264.3	0.1	Remote operated vehicle	ROV	coming back to the surface
PS64/347-1	07.07.03	20:55	72° 0.05' N	14° 42.86' E	0.0	S 7	188.9	0.3	Remote operated vehicle	ROV	Depressor on deck
PS64/347-1	07.07.03	21:23	72° 0.21' N	14° 43.00' E	0.0	S 6	11.3	2.2	Remote operated vehicle	ROV	on deck
PS64/347-1	07.07.03	21:32	72° 0.46' N	14° 43.06' E	0.0	SSW 6	35.9	0.1	Remote operated vehicle	ROV	Shuttle
PS64/347-1	07.07.03	21:49	72° 0.44' N	14° 42.97' E	0.0	SSW 5	66.0	0.4	Remote operated vehicle	ROV	Shuttle
PS64/347-1	07.07.03	22:02	72° 0.47' N	14° 43.09' E	0.0	S 5	10.2	1.2	Remote operated vehicle	ROV	Shuttle
PS64/347-1	07.07.03	22:05	72° 0.52' N	14° 43.16' E	1291.5	S 4	37.2	1.1	Remote operated vehicle	ROV	Shuttle
PS64/348-1	07.07.03	22:18	72° 0.44' N	14° 43.59' E	1284.4	S 5	35.9	0.8	Bottom lander	LANDER	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/348-1	07.07.03	22:21	72° 0.45' N	14° 43.63' E	1282.0	S 5	261.5	0.2	Bottom lander	LANDER	released
PS64/348-1	07.07.03	22:28	72° 0.49' N	14° 43.65' E	1280.9	S 6	31.9	0.4	Bottom lander	LANDER	Information
PS64/348-1	07.07.03	22:45	72° 0.39' N	14° 43.53' E	1280.5	S 6	58.7	0.2	Bottom lander	LANDER	Information
PS64/348-1	07.07.03	23:03	72° 0.33' N	14° 43.74' E	1281.7	S 4	6.1	0.7	Bottom lander	LANDER	Information
PS64/348-1	07.07.03	23:07	72° 0.40' N	14° 43.82' E	1279.2	SSE 6	21.6	0.6	Bottom lander	LANDER	on Deck
PS64/349-1	07.07.03	23:44	72° 0.56' N	14° 43.93' E	1288.0	SSE 5	254.3	0.1	Bottom lander	LANDER	surface
PS64/350-1	07.07.03	23:59	72° 0.06' N	14° 44.22' E	1286.5	S 5	187.5	0.0	CTD/rosette water sampler	CTD/RO	surface
PS64/350-1	08.07.03	00:29	72° 0.05' N	14° 44.16' E	1287.6	SSE 6	346.7	0.1	CTD/rosette water sampler	CTD/RO	at depth
PS64/350-1	08.07.03	01:01	72° 0.04' N	14° 44.14' E	1286.5	S 6	208.4	0.1	CTD/rosette water sampler	CTD/RO	on deck
PS64/351-1	08.07.03	01:14	72° 0.05' N	14° 44.20' E	1286.4	S 6	211.7	0.0	Bottom water sampler	BWS	surface
PS64/351-1	08.07.03	01:51	72° 0.03' N	14° 44.09' E	1287.6	S 4	199.8	0.0	Bottom water sampler	BWS	at sea bottom
PS64/351-1	08.07.03	01:58	72° 0.04' N	14° 44.14' E	1288.4	S 5	67.0	0.6	Bottom water sampler	BWS	off bottom
PS64/351-1	08.07.03	02:28	71° 59.94' N	14° 44.08' E	1286.3	SSE 4	249.9	0.3	Bottom water sampler	BWS	on deck
PS64/352-1	08.07.03	02:54	72° 0.80' N	14° 44.58' E	1275.8	SSE 5	182.0	1.5	Fischereilotsurvey	FLS	Start Track
PS64/352-1	08.07.03	03:40	71° 59.92' N	14° 43.08' E	0.0	SSE 5	176.2	1.1	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	03:53	71° 59.94' N	14° 42.66' E	0.0	SSE 6	31.1	3.1	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	04:17	72° 0.79' N	14° 44.48' E	0.0	SSE 5	60.5	2.3	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	04:33	72° 0.88' N	14° 44.15' E	0.0	SSE 5	203.6	1.4	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	05:19	71° 59.95' N	14° 42.58' E	0.0	SSE 5	202.6	1.8	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	05:41	72° 0.45' N	14° 41.97' E	0.0	SSE 6	124.3	2.1	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	06:14	71° 60.00' N	14° 44.43' E	0.0	SSE 7	132.2	1.4	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	06:28	72° 0.09' N	14° 44.95' E	0.0	SSE 7	288.7	3.4	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	06:50	72° 0.54' N	14° 42.41' E	0.0	SSE 7	302.4	2.2	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	07:04	72° 0.67' N	14° 42.52' E	0.0	SSE 6	111.6	3.7	Fischereilotsurvey	FLS	Course Change
PS64/352-1	08.07.03	07:40	72° 0.18' N	14° 45.27' E	0.0	SSE 6	130.2	1.9	Fischereilotsurvey	FLS	End of Track
PS64/353-1	08.07.03	08:06	72° 0.37' N	14° 43.74' E	1283.4	SSE 6	264.3	0.3	Multi corer	MUC	surface
PS64/353-1	08.07.03	08:52	72° 0.37' N	14° 43.52' E	1281.1	SE 6	272.3	0.2	Multi corer	MUC	at sea bottom
PS64/353-1	08.07.03	08:54	72° 0.36' N	14° 43.52' E	1281.0	SE 5	157.4	0.3	Multi corer	MUC	information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/353-1	08.07.03	08:55	72° 0.36' N	14° 43.52' E	1282.2	SE 5	239.9	0.2	Multi corer	MUC	at sea bottom
PS64/353-1	08.07.03	08:57	72° 0.36' N	14° 43.52' E	1282.4	SSE 5	92.1	0.2	Multi corer	MUC	information
PS64/353-1	08.07.03	09:17	72° 0.32' N	14° 43.66' E	1284.5	SSE 5	1.9	0.4	Multi corer	MUC	at sea bottom
PS64/353-1	08.07.03	09:44	72° 0.33' N	14° 43.66' E	1283.1	SE 4	146.7	0.2	Multi corer	MUC	on deck
PS64/354-1	08.07.03	10:05	72° 0.32' N	14° 43.65' E	1283.8	SE 5	313.4	0.3	Multi corer	MUC	surface
PS64/354-1	08.07.03	10:30	72° 0.32' N	14° 43.62' E	1282.3	SE 5	234.2	0.3	Multi corer	MUC	at sea bottom
PS64/354-1	08.07.03	10:57	72° 0.33' N	14° 43.69' E	1282.0	SE 5	102.5	0.5	Multi corer	MUC	on deck
PS64/355-1	08.07.03	11:24	72° 0.77' N	14° 44.51' E	0.0	ESE 5	226.3	1.2	Fischereilotsurvey	FLS	Start Track
PS64/355-1	08.07.03	12:05	71° 59.92' N	14° 42.78' E	0.0	ESE 5	212.8	1.5	Fischereilotsurvey	FLS	Course Change
PS64/355-1	08.07.03	12:17	71° 59.94' N	14° 42.28' E	0.0	SE 6	45.2	2.9	Fischereilotsurvey	FLS	Information
PS64/355-1	08.07.03	12:52	72° 0.64' N	14° 43.93' E	0.0	ESE 6	32.6	0.9	Fischereilotsurvey	FLS	Information
PS64/355-1	08.07.03	13:06	72° 0.58' N	14° 42.84' E	0.0	ESE 7	135.9	1.8	Fischereilotsurvey	FLS	Information
PS64/355-1	08.07.03	13:26	72° 0.32' N	14° 44.01' E	0.0	ESE 7	128.5	1.9	Fischereilotsurvey	FLS	Information
PS64/355-1	08.07.03	13:37	72° 0.11' N	14° 44.45' E	0.0	ESE 7	309.4	2.2	Fischereilotsurvey	FLS	Information
PS64/355-1	08.07.03	13:54	72° 0.42' N	14° 42.98' E	0.0	ESE 7	305.8	1.9	Fischereilotsurvey	FLS	Course Change
PS64/355-1	08.07.03	14:08	72° 0.38' N	14° 42.45' E	0.0	ESE 8	106.1	3.1	Fischereilotsurvey	FLS	Start Track
PS64/355-1	08.07.03	14:28	72° 0.06' N	14° 43.78' E	0.0	ESE 7	127.4	1.5	Fischereilotsurvey	FLS	End of Track
PS64/355-1	08.07.03	14:35	72° 0.05' N	14° 44.12' E	0.0	ESE 8	54.7	0.7	Fischereilotsurvey	FLS	End of Track
PS64/356-1	08.07.03	14:53	72° 0.06' N	14° 44.20' E	1287.7	ESE 8	73.0	0.1	Multi corer	MUC	surface
PS64/356-1	08.07.03	15:23	72° 0.05' N	14° 44.18' E	1288.2	ESE 8	176.1	0.1	Multi corer	MUC	at sea bottom
PS64/356-1	08.07.03	15:49	72° 0.05' N	14° 44.11' E	1287.3	ESE 8	140.0	0.0	Multi corer	MUC	on deck
PS64/357-1	08.07.03	16:10	72° 0.05' N	14° 44.08' E	1287.2	ESE 9	4.8	0.2	Multi corer	MUC	surface
PS64/357-1	08.07.03	16:36	72° 0.05' N	14° 44.14' E	1287.5	ESE 9	137.1	0.0	Multi corer	MUC	at sea bottom
PS64/357-1	08.07.03	17:04	72° 0.06' N	14° 44.06' E	1287.9	ESE 9	161.7	0.2	Multi corer	MUC	on deck
PS64/358-1	08.07.03	17:32	72° 0.77' N	14° 43.72' E	1285.9	ESE 10	69.4	0.1	Bottom lander	LANDER	released
PS64/358-1	08.07.03	17:54	72° 0.80' N	14° 43.85' E	1284.8	ESE 10	317.0	0.9	Bottom lander	LANDER	Information
PS64/358-1	08.07.03	18:05	72° 0.76' N	14° 43.95' E	1284.5	ESE 10	320.0	0.5	Bottom lander	LANDER	on Deck
PS64/359-1	08.07.03	18:40	72° 0.44' N	14° 43.23' E	1281.1	ESE 10	339.9	0.5	Remote operated vehicle	ROV	Shuttle
PS64/359-1	08.07.03	19:17	72° 0.01' N	14° 42.34' E	1294.5	ESE 9	327.1	0.2	Remote operated vehicle	ROV	surface
PS64/359-1	08.07.03	19:27	72° 0.06' N	14° 42.26' E	1293.8	ESE 8	263.9	0.4	Remote operated vehicle	ROV	Depressor into water
PS64/359-1	08.07.03	20:54	71° 59.85' N	14° 42.61' E	0.0	ESE 8	210.4	0.4	Remote operated vehicle	ROV	at depth
PS64/359-1	08.07.03	21:03	71° 59.87' N	14° 42.63' E	0.0	ESE 8	359.0	0.5	Remote operated vehicle	ROV	Information
PS64/359-1	08.07.03	21:16	71° 59.88' N	14° 42.84' E	0.0	ESE 8	105.8	0.6	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/359-1	08.07.03	21:47	71° 59.87' N	14° 44.08' E	0.0	ESE 9	349.3	0.8	Remote operated vehicle	ROV	Information
PS64/359-1	08.07.03	21:53	71° 59.91' N	14° 44.14' E	0.0	ESE 9	206.1	0.2	Remote operated vehicle	ROV	Information
PS64/359-1	08.07.03	22:44	71° 59.99' N	14° 42.60' E	0.0	ESE 8	287.4	0.3	Remote operated vehicle	ROV	Information
PS64/359-1	08.07.03	22:46	72° 0.00' N	14° 42.59' E	0.0	ESE 7	248.7	0.2	Remote operated vehicle	ROV	Information
PS64/359-1	08.07.03	23:33	72° 0.01' N	14° 44.54' E	0.0	ESE 7	315.6	0.3	Remote operated vehicle	ROV	Information
PS64/359-1	08.07.03	23:42	72° 0.04' N	14° 44.55' E	0.0	ESE 7	210.4	0.5	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	00:32	72° 0.12' N	14° 42.34' E	0.0	ESE 6	307.2	0.2	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	00:57	72° 0.18' N	14° 42.51' E	0.0	ESE 6	101.3	0.7	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	01:46	72° 0.18' N	14° 44.59' E	0.0	ESE 5	340.1	0.3	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	02:15	72° 0.20' N	14° 44.49' E	0.0	ESE 5	284.2	0.4	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	02:58	72° 0.19' N	14° 42.23' E	0.0	ESE 5	303.8	0.7	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	03:30	72° 0.28' N	14° 42.10' E	0.0	ESE 5	62.1	0.5	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	03:39	72° 0.29' N	14° 42.20' E	0.0	ESE 5	42.3	0.2	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	04:37	72° 0.23' N	14° 44.89' E	0.0	ESE 5	85.6	0.9	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	06:21	72° 0.33' N	14° 42.42' E	0.0	E 3	174.3	0.0	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	07:15	72° 0.36' N	14° 44.99' E	0.0	ESE 2	2.1	0.6	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	08:13	72° 0.42' N	14° 42.34' E	0.0	E 3	269.3	0.9	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	08:31	72° 0.41' N	14° 42.22' E	0.0	ENE 4	172.9	0.7	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	09:24	72° 0.48' N	14° 44.57' E	0.0	ENE 3	300.8	0.5	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	09:29	72° 0.47' N	14° 44.48' E	0.0	ENE 4	48.1	0.2	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	10:14	72° 0.54' N	14° 42.68' E	0.0	E 3	276.6	0.5	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	11:00	72° 0.57' N	14° 44.40' E	0.0	ENE 3	246.0	0.2	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	11:35	72° 0.32' N	14° 43.13' E	0.0	ENE 3	228.7	0.4	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	16:49	72° 0.33' N	14° 43.37' E	0.0	SSE 6	75.5	0.3	Remote operated vehicle	ROV	Information
PS64/359-1	09.07.03	20:08	72° 0.48' N	14° 43.21' E	1286.8	SSE 8	303.2	0.1	Remote operated vehicle	ROV	coming back to the surface
PS64/359-1	09.07.03	20:43	72° 0.26' N	14° 42.94' E	1281.5	SSE 9	234.9	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/359-1	09.07.03	20:44	72° 0.26' N	14° 42.93' E	1280.6	SSE 10	6.0	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/359-1	09.07.03	20:45	72° 0.26' N	14° 42.91' E	1280.6	SSE 9	300.0	0.5	Remote operated vehicle	ROV	Depressor on deck
PS64/359-1	09.07.03	21:09	72° 0.33' N	14° 42.52' E	1293.2	S 10	312.6	0.6	Remote operated vehicle	ROV	on deck
PS64/359-1	09.07.03	21:12	72° 0.36' N	14° 42.46' E	1292.9	S 10	337.0	0.6	Remote operated vehicle	ROV	Shuttle
PS64/359-1	09.07.03	21:39	72° 0.60' N	14° 41.94' E	1297.0	S 9	290.0	0.6	Remote operated vehicle	ROV	Shuttle
PS64/359-1	09.07.03	22:02	72° 0.69' N	14° 43.26' E	1288.9	S 9	346.6	0.7	Remote operated vehicle	ROV	Shuttle
PS64/359-1	09.07.03	22:06	72° 0.74' N	14° 43.23' E	1288.8	S 9	12.8	0.9	Remote operated vehicle	ROV	Shuttle

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/360-1	09.07.03	22:27	72° 0.24' N	14° 43.49' E	1284.3	S 8	303.0	0.5	Bottom lander	LANDER	surface
PS64/361-1	09.07.03	23:13	72° 0.05' N	14° 42.64' E	1292.0	SW 7	288.1	0.2	Heat Flow	HF	in the water
PS64/361-1	09.07.03	23:40	72° 0.02' N	14° 42.56' E	1292.0	SW 7	333.9	0.2	Heat Flow	HF	at the bottom
PS64/361-1	09.07.03	23:56	72° 0.01' N	14° 42.58' E	1291.4	SW 6	82.6	0.2	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	00:11	72° 0.05' N	14° 42.83' E	1289.7	WSW 6	22.1	0.1	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	00:28	72° 0.06' N	14° 42.81' E	1287.4	WSW 4	294.6	0.3	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	00:41	72° 0.08' N	14° 43.06' E	1285.2	WSW 4	105.3	0.2	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	00:57	72° 0.08' N	14° 43.07' E	1287.2	WSW 4	300.5	0.3	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	01:10	72° 0.13' N	14° 43.24' E	1282.2	WSW 3	236.6	0.3	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	01:22	72° 0.13' N	14° 43.24' E	1283.6	WSW 3	124.0	0.3	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	01:35	72° 0.13' N	14° 43.40' E	1281.7	WSW 3	271.7	0.4	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	01:37	72° 0.13' N	14° 43.39' E	1282.7	W 3	190.7	0.0	Heat Flow	HF	Information
PS64/361-1	10.07.03	01:41	72° 0.13' N	14° 43.37' E	1282.4	W 3	326.9	0.1	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	01:55	72° 0.13' N	14° 43.41' E	1281.9	W 3	186.8	0.2	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	02:10	72° 0.15' N	14° 43.57' E	1284.7	W 3	253.6	0.3	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	02:24	72° 0.14' N	14° 43.55' E	1285.5	WSW 3	190.6	0.0	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	02:40	72° 0.16' N	14° 43.75' E	1285.2	W 4	273.2	0.2	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	02:54	72° 0.16' N	14° 43.75' E	1284.7	W 4	190.4	0.0	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	03:08	72° 0.17' N	14° 43.90' E	1284.4	W 4	207.7	0.2	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	03:21	72° 0.17' N	14° 43.90' E	1285.0	W 6	273.7	0.3	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	03:35	72° 0.17' N	14° 44.07' E	1284.3	W 5	205.8	0.2	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	03:49	72° 0.17' N	14° 44.08' E	1284.6	WNW 4	164.5	0.2	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	04:01	72° 0.16' N	14° 44.25' E	1284.4	W 3	161.1	0.2	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	04:16	72° 0.15' N	14° 44.25' E	1284.1	W 5	296.3	0.3	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	04:28	72° 0.15' N	14° 44.42' E	1288.1	W 5	189.9	0.0	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	04:43	72° 0.15' N	14° 44.43' E	1287.8	W 7	165.1	0.2	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	04:55	72° 0.15' N	14° 44.61' E	1286.9	W 8	58.6	0.2	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	05:11	72° 0.15' N	14° 44.63' E	1286.6	W 7	27.8	0.3	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	05:23	72° 0.15' N	14° 44.77' E	1285.6	W 8	168.9	0.1	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	05:38	72° 0.13' N	14° 44.77' E	1286.4	W 7	190.7	0.0	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	05:57	72° 0.14' N	14° 45.12' E	1280.4	W 6	258.2	0.4	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	06:12	72° 0.15' N	14° 45.12' E	1280.5	W 6	190.8	0.0	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	06:58	71° 59.76' N	14° 44.15' E	1290.6	WSW 6	179.8	0.0	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	07:11	71° 59.75' N	14° 44.14' E	1291.0	WSW 6	308.2	0.2	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	07:30	71° 59.87' N	14° 44.16' E	1290.0	WSW 8	180.3	0.0	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	07:44	71° 59.86' N	14° 44.16' E	1289.9	WSW 8	154.9	0.1	Heat Flow	HF	off bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/361-1	10.07.03	08:00	71° 59.96' N	14° 44.18' E	1287.8	WSW 6	187.9	0.4	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	08:14	71° 59.97' N	14° 44.17' E	1287.9	SW 6	267.2	0.1	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	08:25	72° 0.02' N	14° 44.15' E	1288.1	SW 6	180.9	0.0	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	08:41	72° 0.02' N	14° 44.14' E	1287.3	WSW 7	179.9	0.0	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	08:50	72° 0.08' N	14° 44.11' E	1288.1	SW 7	262.4	0.2	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	09:05	72° 0.07' N	14° 44.13' E	1289.0	SW 7	150.3	0.2	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	09:16	72° 0.13' N	14° 44.20' E	1285.0	WSW 8	117.0	0.3	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	09:32	72° 0.12' N	14° 44.18' E	1285.0	SW 7	307.0	0.2	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	09:40	72° 0.19' N	14° 44.15' E	1284.0	SW 7	196.0	0.1	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	09:55	72° 0.18' N	14° 44.16' E	1284.4	SW 7	90.4	0.1	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	10:04	72° 0.23' N	14° 44.14' E	1284.1	SW 8	180.6	0.0	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	10:19	72° 0.24' N	14° 44.14' E	1285.0	SW 8	270.1	0.3	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	10:27	72° 0.30' N	14° 44.16' E	1281.3	SW 8	344.6	0.2	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	10:35	72° 0.29' N	14° 44.12' E	1282.0	SW 9	180.5	0.0	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	10:46	72° 0.35' N	14° 44.15' E	1282.2	SW 8	180.9	0.0	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	10:47	72° 0.35' N	14° 44.14' E	1281.7	SW 8	105.3	0.2	Heat Flow	HF	Information
PS64/361-1	10.07.03	10:49	72° 0.35' N	14° 44.16' E	1280.6	SW 9	110.4	0.3	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	10:57	72° 0.40' N	14° 44.14' E	1283.9	SW 8	273.5	0.3	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	11:05	72° 0.41' N	14° 44.15' E	1288.4	SW 8	180.7	0.0	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	11:15	72° 0.50' N	14° 44.16' E	1287.1	SW 9	62.2	0.3	Heat Flow	HF	at the bottom
PS64/361-1	10.07.03	11:31	72° 0.51' N	14° 44.17' E	1286.7	WSW 8	27.3	0.6	Heat Flow	HF	off bottom
PS64/361-1	10.07.03	12:00	72° 0.56' N	14° 43.92' E	1287.5	SW 7	10.6	0.4	Heat Flow	HF	on deck
PS64/362-1	10.07.03	12:31	72° 0.22' N	14° 42.54' E	1289.6	SW 6	20.3	0.1	Multi corer	MUC	surface
PS64/362-1	10.07.03	12:57	72° 0.21' N	14° 42.47' E	1290.4	WSW 7	270.1	0.2	Multi corer	MUC	at sea bottom
PS64/362-1	10.07.03	13:24	72° 0.22' N	14° 42.54' E	1289.7	SW 6	96.0	0.1	Multi corer	MUC	on deck
PS64/363-1	10.07.03	13:39	72° 0.21' N	14° 42.48' E	1289.6	SW 7	308.9	0.1	Multi corer	MUC	surface
PS64/363-1	10.07.03	14:08	72° 0.23' N	14° 42.47' E	1289.4	WSW 8	293.4	0.1	Multi corer	MUC	at sea bottom
PS64/363-1	10.07.03	14:37	72° 0.21' N	14° 42.46' E	1289.5	SW 8	115.4	0.2	Multi corer	MUC	on deck
PS64/364-1	10.07.03	14:43	72° 0.21' N	14° 42.48' E	1289.6	SW 8	318.9	0.2	CTD/rosette water sampler	CTD/RO	surface
PS64/364-1	10.07.03	15:12	72° 0.22' N	14° 42.47' E	1288.8	SW 8	12.7	0.2	CTD/rosette water sampler	CTD/RO	at depth
PS64/364-1	10.07.03	15:51	72° 0.21' N	14° 42.49' E	1288.8	SW 8	149.9	0.2	CTD/rosette water sampler	CTD/RO	on deck
PS64/365-1	10.07.03	16:05	72° 0.22' N	14° 42.46' E	1289.6	WSW 9	31.4	0.2	Bottom water sampler	BWS	surface
PS64/365-1	10.07.03	16:43	72° 0.19' N	14° 42.39' E	1290.0	WSW 9	53.2	0.2	Bottom water sampler	BWS	at sea bottom
PS64/365-1	10.07.03	16:51	72° 0.20' N	14° 42.39' E	1290.1	SW 9	272.4	0.1	Bottom water sampler	BWS	off bottom
PS64/365-1	10.07.03	17:15	72° 0.14' N	14° 42.37' E	1291.2	WSW 6	84.2	0.2	Bottom water sampler	BWS	on deck
PS64/366-1	10.07.03	17:40	72° 0.17' N	14° 43.56' E	1284.5	SW 6	172.2	0.2	Multi corer	MUC	surface

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/366-1	10.07.03	18:12	72° 0.17' N	14° 43.55' E	1284.8	WSW 8	270.1	0.1	Multi corer	MUC	at sea bottom
PS64/366-1	10.07.03	18:38	72° 0.15' N	14° 43.46' E	1285.0	WSW 11	204.7	0.2	Multi corer	MUC	on deck
PS64/367-1	10.07.03	19:03	72° 0.03' N	14° 44.08' E	1292.0	WSW 8	231.7	0.3	Multi corer	MUC	surface
PS64/367-1	10.07.03	19:28	72° 0.05' N	14° 44.04' E	1294.0	SW 6	329.7	0.2	Multi corer	MUC	at sea bottom
PS64/367-1	10.07.03	19:53	71° 59.98' N	14° 43.90' E	1292.0	SW 5	224.0	0.8	Multi corer	MUC	on deck
PS64/368-1	10.07.03	20:01	71° 59.92' N	14° 42.78' E	1297.0	SSW 6	359.4	8.5	HydroSweep/ParaSound profile	HS_PS	start track
PS64/368-1	10.07.03	20:15	72° 2.32' N	14° 42.74' E	1276.0	SW 6	0.6	8.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/368-1	10.07.03	20:43	71° 57.75' N	14° 41.98' E	1332.0	WSW 8	181.2	11.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/368-1	10.07.03	22:18	72° 15.34' N	14° 43.43' E	1049.0	SSW 5	359.6	12.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/368-1	10.07.03	23:01	72° 15.02' N	14° 19.48' E	1131.0	SW 6	267.6	11.0	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/368-1	11.07.03	00:42	71° 59.09' N	14° 45.45' E	1294.0	S 6	155.2	10.9	HydroSweep/ParaSound profile	HS_PS	profile end
PS64/369-1	11.07.03	01:12	72° 0.02' N	14° 43.57' E	1292.0	S 5	77.3	0.3	Heat Flow	HF	in the water
PS64/369-1	11.07.03	01:39	72° 0.01' N	14° 43.98' E	1293.0	S 6	195.1	0.6	Heat Flow	HF	at the bottom
PS64/369-1	11.07.03	01:50	72° 0.02' N	14° 43.96' E	1293.0	S 5	93.0	0.5	Heat Flow	HF	off bottom
PS64/369-1	11.07.03	02:32	71° 59.57' N	14° 44.86' E	1293.0	SSE 5	252.2	0.3	Heat Flow	HF	at the bottom
PS64/369-1	11.07.03	02:45	71° 59.56' N	14° 44.85' E	1292.0	SSE 5	94.7	0.1	Heat Flow	HF	off bottom
PS64/369-1	11.07.03	03:28	71° 59.13' N	14° 45.86' E	1292.0	SE 6	177.6	0.0	Heat Flow	HF	at the bottom
PS64/369-1	11.07.03	03:34	71° 59.13' N	14° 45.85' E	1291.0	SE 5	131.9	0.2	Heat Flow	HF	off bottom
PS64/369-1	11.07.03	04:20	71° 58.67' N	14° 46.84' E	1271.0	ESE 6	254.8	0.5	Heat Flow	HF	at the bottom
PS64/369-1	11.07.03	04:34	71° 58.65' N	14° 46.81' E	1264.0	SE 6	54.4	0.2	Heat Flow	HF	off bottom
PS64/369-1	11.07.03	05:26	71° 58.20' N	14° 47.79' E	1239.0	ESE 6	232.4	0.2	Heat Flow	HF	at the bottom
PS64/369-1	11.07.03	05:31	71° 58.20' N	14° 47.78' E	1239.0	ESE 5	2.4	0.1	Heat Flow	HF	off bottom
PS64/369-1	11.07.03	06:29	71° 57.79' N	14° 48.69' E	1232.0	SE 6	256.3	0.1	Heat Flow	HF	at the bottom
PS64/369-1	11.07.03	06:43	71° 57.79' N	14° 48.62' E	1233.0	SE 6	286.9	0.1	Heat Flow	HF	off bottom
PS64/369-1	11.07.03	07:33	71° 57.37' N	14° 49.67' E	1226.0	E 6	66.9	0.1	Heat Flow	HF	at the bottom
PS64/369-1	11.07.03	07:40	71° 57.36' N	14° 49.67' E	1222.0	ESE 7	255.6	0.2	Heat Flow	HF	off bottom
PS64/369-1	11.07.03	08:32	71° 56.92' N	14° 50.75' E	1222.0	E 7	68.2	0.0	Heat Flow	HF	at the bottom
PS64/369-1	11.07.03	08:47	71° 56.91' N	14° 50.76' E	1222.0	E 7	160.9	0.2	Heat Flow	HF	off bottom
PS64/369-1	11.07.03	09:11	71° 56.87' N	14° 50.69' E	1223.0	E 7	228.3	0.8	Heat Flow	HF	on deck
PS64/370-1	11.07.03	09:49	72° 0.41' N	14° 42.45' E	1298.0	E 8	275.3	0.5	Bottom lander	LANDER	Information
PS64/370-1	11.07.03	09:51	72° 0.41' N	14° 42.42' E	1298.0	E 8	279.4	0.1	Bottom lander	LANDER	released
PS64/370-1	11.07.03	09:54	72° 0.41' N	14° 42.41' E	1297.0	E 8	315.7	0.2	Bottom lander	LANDER	Information
PS64/370-1	11.07.03	10:14	72° 0.38' N	14° 42.53' E	1297.0	E 7	223.2	0.2	Bottom lander	LANDER	Information
PS64/370-1	11.07.03	10:29	72° 0.31' N	14° 42.94' E	1289.0	E 7	279.6	1.1	Bottom lander	LANDER	Information
PS64/370-1	11.07.03	10:33	72° 0.32' N	14° 42.75' E	1293.0	E 7	276.4	0.7	Bottom lander	LANDER	on Deck
PS64/371-1	11.07.03	10:54	72° 0.20' N	14° 43.86' E	1289.0	E 7	181.8	0.4	Gravity corer	GC	surface

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/371-1	11.07.03	11:12	72° 0.20' N	14° 43.88' E	1289.0	ESE 7	53.4	0.2	Gravity corer	GC	at sea bottom
PS64/371-1	11.07.03	11:20	72° 0.20' N	14° 43.86' E	1289.0	E 7	184.5	0.2	Gravity corer	GC	off ground hoisting
PS64/371-1	11.07.03	11:23	72° 0.20' N	14° 43.85' E	1288.0	ESE 8	356.8	0.2	Gravity corer	GC	information
PS64/371-1	11.07.03	11:48	72° 0.34' N	14° 43.57' E	1286.0	E 8	62.1	0.3	Gravity corer	GC	on deck
PS64/372-1	11.07.03	12:34	72° 0.26' N	14° 43.50' E	1289.0	E 8	112.2	0.0	Gravity corer	GC	surface
PS64/372-1	11.07.03	12:52	72° 0.26' N	14° 43.59' E	1288.0	E 8	97.6	0.0	Gravity corer	GC	at sea bottom
PS64/372-1	11.07.03	12:59	72° 0.27' N	14° 43.60' E	1288.0	E 8	253.2	0.2	Gravity corer	GC	off ground hoisting
PS64/372-1	11.07.03	13:22	72° 0.27' N	14° 43.56' E	1287.0	E 8	114.9	0.2	Gravity corer	GC	on deck
PS64/373-1	11.07.03	13:59	72° 0.22' N	14° 43.66' E	1287.0	E 7	98.9	0.0	Gravity corer	GC	surface
PS64/373-1	11.07.03	14:17	72° 0.21' N	14° 43.66' E	1288.0	E 7	98.8	0.0	Gravity corer	GC	at sea bottom
PS64/373-1	11.07.03	14:25	72° 0.21' N	14° 43.68' E	1288.0	E 7	38.8	0.1	Gravity corer	GC	off ground hoisting
PS64/373-1	11.07.03	14:49	72° 0.24' N	14° 43.83' E	1288.0	E 6	59.8	0.3	Gravity corer	GC	on deck
PS64/374-1	11.07.03	15:25	72° 0.38' N	14° 43.61' E	1287.0	E 6	112.0	0.3	Gravity corer	GC	surface
PS64/374-1	11.07.03	15:41	72° 0.38' N	14° 43.61' E	1286.0	E 7	55.9	0.1	Gravity corer	GC	at sea bottom
PS64/374-1	11.07.03	15:48	72° 0.37' N	14° 43.61' E	1286.0	E 7	99.0	0.0	Gravity corer	GC	off ground hoisting
PS64/374-1	11.07.03	16:11	72° 0.38' N	14° 43.56' E	1288.0	E 6	315.3	0.3	Gravity corer	GC	on deck
PS64/375-1	11.07.03	17:20	72° 0.26' N	14° 43.84' E	1287.0	E 7	331.0	0.4	Bottom lander	LANDER	surface
PS64/375-1	11.07.03	18:40	72° 0.25' N	14° 43.84' E	1289.0	E 6	181.0	0.2	Bottom lander	LANDER	released
PS64/375-1	11.07.03	19:03	72° 0.22' N	14° 43.87' E	1289.0	ENE 6	74.7	0.2	Bottom lander	LANDER	Information
PS64/376-1	11.07.03	19:22	72° 0.15' N	14° 43.87' E	1290.0	ENE 6	5.1	0.5	Bottom lander	LANDER	surface
PS64/377-1	11.07.03	19:49	72° 0.45' N	14° 43.18' E	1291.0	E 8	79.8	0.0	Remote operated vehicle	ROV	Shuttle
PS64/377-1	11.07.03	20:17	72° 0.00' N	14° 44.18' E	1294.0	ENE 7	104.6	0.2	Remote operated vehicle	ROV	surface
PS64/377-1	11.07.03	20:28	71° 59.97' N	14° 44.00' E	1293.0	ENE 7	252.0	0.6	Remote operated vehicle	ROV	Depressor into water
PS64/377-1	11.07.03	20:38	71° 59.99' N	14° 44.10' E	1294.0	ENE 6	82.0	0.4	Remote operated vehicle	ROV	Information
PS64/377-1	11.07.03	21:20	72° 0.03' N	14° 44.57' E	1292.0	ENE 6	78.8	0.0	Remote operated vehicle	ROV	at depth
PS64/377-1	11.07.03	21:33	72° 0.02' N	14° 44.48' E	0.0	E 6	287.5	0.1	Remote operated vehicle	ROV	Information
PS64/377-1	11.07.03	21:39	72° 0.05' N	14° 44.42' E	0.0	E 6	304.4	1.0	Remote operated vehicle	ROV	Information
PS64/377-1	11.07.03	22:46	72° 0.08' N	14° 44.42' E	0.0	ENE 6	28.4	0.1	Remote operated vehicle	ROV	Information
PS64/377-1	11.07.03	23:14	72° 0.35' N	14° 43.62' E	0.0	E 7	341.8	0.9	Remote operated vehicle	ROV	Information
PS64/377-1	11.07.03	23:25	72° 0.37' N	14° 43.64' E	0.0	ENE 6	265.3	0.6	Remote operated vehicle	ROV	Information
PS64/377-1	11.07.03	23:30	72° 0.34' N	14° 43.64' E	0.0	ENE 6	125.3	0.6	Remote operated vehicle	ROV	Information
PS64/377-1	11.07.03	23:38	72° 0.34' N	14° 43.65' E	0.0	ENE 6	87.0	0.0	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/377-1	12.07.03	01:30	72° 0.41' N	14° 43.65' E	0.0	ENE 7	319.7	0.9	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	02:34	72° 0.43' N	14° 43.40' E	0.0	NE 6	127.7	1.1	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	06:20	72° 0.29' N	14° 43.71' E	0.0	E 7	91.2	0.0	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	07:10	72° 0.18' N	14° 43.80' E	0.0	E 4	204.7	0.1	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	09:04	72° 0.09' N	14° 43.90' E	0.0	ENE 6	89.4	0.0	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	09:27	72° 0.07' N	14° 43.85' E	0.0	ENE 7	189.2	0.2	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	09:29	72° 0.05' N	14° 43.85' E	0.0	ENE 7	167.1	0.6	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	09:39	71° 59.99' N	14° 43.70' E	0.0	ENE 8	241.6	0.5	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	09:45	71° 59.95' N	14° 43.56' E	0.0	ENE 8	219.4	0.6	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	10:30	72° 0.34' N	14° 43.53' E	0.0	ENE 7	75.6	0.0	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	20:14	72° 0.43' N	14° 43.50' E	0.0	E 4	294.6	0.3	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	20:58	72° 0.49' N	14° 42.32' E	0.0	ENE 2	309.5	0.3	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	21:03	72° 0.46' N	14° 42.27' E	0.0	E 2	79.5	0.2	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	22:06	72° 0.42' N	14° 44.33' E	0.0	N 1	100.2	0.0	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	22:10	72° 0.43' N	14° 44.28' E	0.0	NE 1	239.9	0.3	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	23:00	72° 0.37' N	14° 42.95' E	0.0	NNE 3	34.2	0.2	Remote operated vehicle	ROV	Information
PS64/377-1	12.07.03	23:43	72° 0.39' N	14° 42.84' E	0.0	NNE 4	66.4	0.5	Remote operated vehicle	ROV	Information
PS64/377-1	13.07.03	07:35	72° 0.36' N	14° 43.58' E	0.0	W 6	273.7	0.3	Remote operated vehicle	ROV	Shuttle
PS64/377-1	13.07.03	07:57	72° 0.34' N	14° 43.32' E	0.0	WNW 7	144.7	0.4	Remote operated vehicle	ROV	Shuttle
PS64/377-1	13.07.03	07:58	72° 0.33' N	14° 43.33' E	0.0	W 7	140.6	0.3	Remote operated vehicle	ROV	Shuttle
PS64/377-1	13.07.03	08:14	72° 0.44' N	14° 41.99' E	0.0	W 6	28.4	0.3	Remote operated vehicle	ROV	Shuttle
PS64/377-1	13.07.03	08:17	72° 0.46' N	14° 41.96' E	0.0	W 7	290.1	0.2	Remote operated vehicle	ROV	Shuttle
PS64/377-1	13.07.03	08:32	72° 0.55' N	14° 41.49' E	0.0	WSW 7	352.2	0.6	Remote operated vehicle	ROV	Information
PS64/377-1	13.07.03	09:22	72° 0.50' N	14° 43.06' E	0.0	W 7	323.6	0.4	Remote operated vehicle	ROV	Shuttle
PS64/377-1	13.07.03	09:27	72° 0.53' N	14° 43.04' E	0.0	W 6	330.9	0.4	Remote operated vehicle	ROV	Information
PS64/377-1	13.07.03	09:47	72° 0.57' N	14° 42.96' E	0.0	W 8	229.6	0.7	Remote operated vehicle	ROV	Information
PS64/377-1	13.07.03	10:10	72° 0.52' N	14° 42.83' E	0.0	W 7	214.7	0.4	Remote operated vehicle	ROV	Information
PS64/377-1	13.07.03	10:47	72° 0.56' N	14° 42.94' E	0.0	W 6	240.9	0.4	Remote operated vehicle	ROV	Information
PS64/377-1	13.07.03	11:09	72° 0.40' N	14° 43.70' E	0.0	W 6	177.9	0.5	Remote operated vehicle	ROV	Information
PS64/377-1	13.07.03	18:12	72° 0.27' N	14° 43.30' E	0.0	W 8	67.0	0.4	Remote operated vehicle	ROV	coming back to the surface
PS64/377-1	13.07.03	18:56	72° 0.16' N	14° 42.38' E	0.0	W 7	265.7	0.8	Remote operated vehicle	ROV	Depressor on deck
PS64/377-1	13.07.03	19:20	72° 0.12' N	14° 41.28' E	0.0	W 7	256.9	0.8	Remote operated vehicle	ROV	on deck
PS64/377-1	13.07.03	19:38	72° 0.25' N	14° 42.83' E	0.0	W 8	263.5	1.0	Remote operated vehicle	ROV	Shuttle
PS64/377-1	13.07.03	19:57	72° 0.22' N	14° 42.58' E	0.0	W 8	143.6	0.4	Remote operated vehicle	ROV	Shuttle

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/377-1	13.07.03	20:07	72° 0.54' N	14° 41.97' E	0.0	W 8	195.8	0.5	Remote operated vehicle	ROV	Shuttle
PS64/377-1	13.07.03	20:12	72° 0.50' N	14° 41.91' E	1298.2	W 8	198.3	0.3	Remote operated vehicle	ROV	Shuttle
PS64/378-1	13.07.03	20:27	72° 0.25' N	14° 42.85' E	1283.0	WNW 9	70.1	0.2	Bottom lander	LANDER	Information
PS64/378-1	13.07.03	20:29	72° 0.24' N	14° 42.85' E	1281.8	WNW 7	201.4	0.4	Bottom lander	LANDER	released
PS64/378-1	13.07.03	20:32	72° 0.26' N	14° 42.87' E	1282.0	WNW 8	3.4	0.6	Bottom lander	LANDER	Information
PS64/378-1	13.07.03	20:34	72° 0.28' N	14° 42.88' E	1282.6	WNW 6	351.9	0.6	Bottom lander	LANDER	Information
PS64/378-1	13.07.03	20:57	72° 0.53' N	14° 42.74' E	1291.4	WNW 6	339.7	0.6	Bottom lander	LANDER	Information
PS64/378-1	13.07.03	21:17	72° 0.19' N	14° 42.84' E	1284.5	W 7	15.0	0.6	Bottom lander	LANDER	Information
PS64/378-1	13.07.03	21:18	72° 0.20' N	14° 42.84' E	1284.5	W 7	0.3	0.7	Bottom lander	LANDER	on Deck
PS64/379-1	13.07.03	21:40	72° 0.18' N	14° 43.22' E	0.0	W 5	48.6	1.6	Fischereilotsurvey	FLS	Start Track
PS64/379-1	13.07.03	23:18	72° 0.34' N	14° 44.70' E	1287.0	WSW 6	79.7	1.7	Fischereilotsurvey	FLS	End of Track
PS64/380-1	13.07.03	23:36	72° 0.39' N	14° 43.66' E	0.0	WSW 6	111.3	0.7	CTD/rosette water sampler	CTD/RO	surface
PS64/380-1	14.07.03	00:05	72° 0.35' N	14° 43.66' E	0.0	WSW 7	219.8	0.2	CTD/rosette water sampler	CTD/RO	at depth
PS64/380-1	14.07.03	00:13	72° 0.40' N	14° 43.57' E	0.0	WSW 6	160.4	0.0	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	00:17	72° 0.40' N	14° 43.60' E	0.0	WSW 6	223.3	0.2	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	00:23	72° 0.38' N	14° 43.52' E	0.0	WSW 6	304.5	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	00:25	72° 0.39' N	14° 43.49' E	0.0	WSW 6	319.9	0.4	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	00:29	72° 0.39' N	14° 43.47' E	0.0	WSW 6	121.6	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	00:38	72° 0.33' N	14° 43.47' E	0.0	WSW 6	117.5	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	00:52	72° 0.34' N	14° 43.66' E	0.0	WSW 6	89.3	0.1	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	00:59	72° 0.37' N	14° 43.77' E	0.0	WSW 6	151.1	0.0	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	01:04	72° 0.38' N	14° 43.85' E	0.0	WSW 6	58.9	0.6	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	01:08	72° 0.40' N	14° 43.93' E	0.0	WSW 6	83.4	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	01:10	72° 0.40' N	14° 43.97' E	0.0	WSW 6	62.7	0.5	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	01:16	72° 0.41' N	14° 44.07' E	0.0	WSW 5	71.5	0.4	CTD/rosette water sampler	CTD/RO	Information
PS64/380-1	14.07.03	01:28	72° 0.42' N	14° 44.22' E	1280.0	WSW 6	56.0	0.6	CTD/rosette water sampler	CTD/RO	on deck
PS64/381-1	14.07.03	01:56	72° 0.39' N	14° 43.37' E	0.0	SW 6	189.0	0.4	Bottom water sampler	BWS	surface
PS64/381-1	14.07.03	02:25	72° 0.38' N	14° 43.43' E	0.0	SW 7	180.5	0.0	Bottom water sampler	BWS	at sea bottom
PS64/381-1	14.07.03	02:32	72° 0.38' N	14° 43.41' E	0.0	SW 6	233.3	0.4	Bottom water sampler	BWS	off bottom
PS64/381-1	14.07.03	02:56	72° 0.37' N	14° 43.37' E	1280.0	SSW 6	188.9	0.2	Bottom water sampler	BWS	on deck
PS64/382-1	14.07.03	03:32	72° 0.37' N	14° 43.47' E	0.0	SW 6	259.9	0.1	Bottom water sampler	BWS	surface
PS64/382-1	14.07.03	04:02	72° 0.38' N	14° 43.51' E	0.0	SW 4	304.6	0.1	Bottom water sampler	BWS	at sea bottom
PS64/382-1	14.07.03	04:09	72° 0.38' N	14° 43.48' E	0.0	SW 4	57.7	0.3	Bottom water sampler	BWS	off bottom
PS64/382-1	14.07.03	04:34	72° 0.36' N	14° 43.47' E	1283.0	SSW 5	180.1	0.0	Bottom water sampler	BWS	on deck
PS64/383-1	14.07.03	05:04	72° 0.37' N	14° 43.46' E	0.0	S 5	325.1	0.2	Bottom water sampler	BWS	surface
PS64/383-1	14.07.03	05:34	72° 0.37' N	14° 43.47' E	0.0	S 5	19.5	0.1	Bottom water sampler	BWS	at sea bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/383-1	14.07.03	05:41	72° 0.38' N	14° 43.45' E	0.0	S 5	180.3	0.0	Bottom water sampler	BWS	off bottom
PS64/383-1	14.07.03	06:07	72° 0.39' N	14° 43.45' E	0.0	S 6	179.0	0.0	Bottom water sampler	BWS	on deck
PS64/384-1	14.07.03	06:20	72° 0.35' N	14° 43.46' E	0.0	S 5	359.5	0.3	CTD/rosette water sampler	CTD/RO	surface
PS64/384-1	14.07.03	06:48	72° 0.37' N	14° 43.44' E	0.0	S 6	155.2	0.1	CTD/rosette water sampler	CTD/RO	at depth
PS64/384-1	14.07.03	06:57	72° 0.37' N	14° 43.45' E	0.0	S 6	248.8	0.4	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:02	72° 0.37' N	14° 43.45' E	0.0	S 6	359.0	0.2	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:10	72° 0.35' N	14° 43.59' E	0.0	S 6	12.0	0.4	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:17	72° 0.39' N	14° 43.36' E	0.0	S 6	293.1	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:21	72° 0.38' N	14° 43.33' E	0.0	S 6	180.5	0.0	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:25	72° 0.38' N	14° 43.30' E	0.0	S 6	28.4	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:27	72° 0.38' N	14° 43.31' E	0.0	S 6	125.0	0.2	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:28	72° 0.38' N	14° 43.31' E	0.0	S 6	277.0	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:32	72° 0.41' N	14° 43.19' E	0.0	S 6	312.3	0.5	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:38	72° 0.39' N	14° 43.16' E	0.0	S 6	153.6	0.6	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:42	72° 0.36' N	14° 43.21' E	0.0	S 6	271.1	0.2	CTD/rosette water sampler	CTD/RO	Information
PS64/384-1	14.07.03	07:56	72° 0.37' N	14° 43.37' E	1283.0	S 7	120.6	0.3	CTD/rosette water sampler	CTD/RO	on deck
PS64/385-1	14.07.03	08:01	72° 0.36' N	14° 43.37' E	0.0	S 7	32.3	0.4	In situ pump	ISP	into water
PS64/385-1	14.07.03	08:22	72° 0.37' N	14° 43.33' E	0.0	S 7	61.9	0.2	In situ pump	ISP	into water
PS64/385-1	14.07.03	08:32	72° 0.37' N	14° 43.36' E	0.0	SSE 8	212.2	0.4	In situ pump	ISP	into water
PS64/385-1	14.07.03	08:45	72° 0.37' N	14° 43.39' E	1282.5	SSE 8	220.0	0.4	In situ pump	ISP	pump at depth
PS64/385-1	14.07.03	08:53	72° 0.37' N	14° 43.37' E	1283.9	S 8	165.0	0.0	In situ pump	ISP	Information
PS64/385-1	14.07.03	10:00	72° 0.38' N	14° 43.38' E	1284.5	S 8	228.8	0.2	In situ pump	ISP	Information
PS64/385-1	14.07.03	10:37	72° 0.37' N	14° 43.43' E	1284.1	S 8	159.8	0.0	In situ pump	ISP	Information
PS64/385-1	14.07.03	12:43	72° 0.46' N	14° 43.50' E	1283.9	S 10	96.8	0.4	In situ pump	ISP	Information
PS64/385-1	14.07.03	12:59	72° 0.40' N	14° 43.48' E	1284.0	S 9	44.0	0.1	In situ pump	ISP	on deck
PS64/386-1	14.07.03	13:09	72° 0.39' N	14° 43.47' E	1284.4	S 10	55.0	0.2	CTD/rosette water sampler	CTD/RO	surface
PS64/386-1	14.07.03	13:38	72° 0.37' N	14° 43.51' E	1283.6	SSW 9	170.2	0.3	CTD/rosette water sampler	CTD/RO	at depth
PS64/386-1	14.07.03	13:39	72° 0.36' N	14° 43.51' E	1284.4	S 9	197.4	0.2	CTD/rosette water sampler	CTD/RO	Information
PS64/386-1	14.07.03	13:51	72° 0.40' N	14° 43.53' E	1284.6	SSW 10	88.8	0.2	CTD/rosette water sampler	CTD/RO	Information
PS64/386-1	14.07.03	13:57	72° 0.38' N	14° 43.58' E	1282.6	S 10	194.3	0.3	CTD/rosette water sampler	CTD/RO	Information
PS64/386-1	14.07.03	14:05	72° 0.39' N	14° 43.59' E	1282.3	SSW 10	42.0	0.4	CTD/rosette water sampler	CTD/RO	Information
PS64/386-1	14.07.03	14:08	72° 0.41' N	14° 43.63' E	1282.6	SSW 10	47.1	0.5	CTD/rosette water sampler	CTD/RO	Information
PS64/386-1	14.07.03	14:11	72° 0.42' N	14° 43.66' E	1285.1	SSW 10	32.3	0.5	CTD/rosette water sampler	CTD/RO	Information
PS64/386-1	14.07.03	14:15	72° 0.45' N	14° 43.72' E	1284.7	SSW 10	42.4	0.8	CTD/rosette water sampler	CTD/RO	surface
PS64/386-1	14.07.03	14:19	72° 0.47' N	14° 43.77' E	1284.6	SSW 10	359.8	0.4	CTD/rosette water sampler	CTD/RO	surface
PS64/386-1	14.07.03	14:21	72° 0.48' N	14° 43.76' E	1287.5	SSW 10	37.1	0.1	CTD/rosette water sampler	CTD/RO	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/386-1	14.07.03	14:23	72° 0.46' N	14° 43.79' E	1284.3	SSW 10	126.9	0.7	CTD/rosette water sampler	CTD/RO	Information
PS64/386-1	14.07.03	14:27	72° 0.44' N	14° 43.86' E	1281.9	SSW 10	226.8	0.3	CTD/rosette water sampler	CTD/RO	surface
PS64/386-1	14.07.03	14:36	72° 0.42' N	14° 43.74' E	1286.0	SSW 10	110.7	0.2	CTD/rosette water sampler	CTD/RO	surface
PS64/386-1	14.07.03	14:49	72° 0.43' N	14° 43.84' E	1281.2	SSW 10	173.9	0.2	CTD/rosette water sampler	CTD/RO	on deck
PS64/387-1	14.07.03	15:14	71° 58.99' N	14° 45.51' E	1291.6	S 10	218.8	0.3	Bottom lander	LANDER	surface
PS64/387-1	14.07.03	15:50	71° 58.86' N	14° 45.72' E	1294.0	SSW 10	4.9	0.6	Bottom lander	LANDER	Information
PS64/388-1	14.07.03	16:01	71° 59.12' N	14° 45.54' E	1295.0	SSW 10	189.4	7.9	HydroSweep/ParaSound profile	HS_PS	start track
PS64/388-1	14.07.03	16:11	71° 57.60' N	14° 47.86' E	1244.0	SSW 11	153.9	10.9	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	17:30	71° 45.50' N	15° 6.50' E	1065.0	SSW 10	167.8	10.3	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	18:09	71° 45.15' N	14° 44.20' E	1248.0	SSW 9	270.5	11.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	20:40	71° 41.20' N	13° 12.47' E	1958.0	SSW 8	261.8	11.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	20:52	71° 43.25' N	13° 11.60' E	1943.0	SSW 8	359.9	11.3	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	21:42	71° 36.59' N	13° 30.25' E	1842.0	SSW 10	142.5	11.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	21:50	71° 37.14' N	13° 33.86' E	1812.0	SSW 10	49.4	11.4	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	22:40	71° 44.74' N	13° 16.12' E	1910.0	SSW 9	320.8	11.7	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	22:48	71° 45.76' N	13° 19.01' E	1890.0	SSW 9	51.9	11.7	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	23:39	71° 38.67' N	13° 38.10' E	1765.0	SW 10	142.6	11.3	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	14.07.03	23:48	71° 39.21' N	13° 42.19' E	1739.0	SW 9	54.2	12.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/388-1	15.07.03	00:34	71° 46.65' N	13° 24.43' E	1862.0	SSW 8	320.7	12.4	HydroSweep/ParaSound profile	HS_PS	profile end
PS64/389-1	15.07.03	01:17	71° 42.14' N	13° 25.92' E	1887.0	SSW 8	253.8	0.1	Heat Flow	HF	in the water
PS64/389-1	15.07.03	01:55	71° 42.12' N	13° 25.99' E	1886.0	SSW 8	202.4	0.0	Heat Flow	HF	at the bottom
PS64/389-1	15.07.03	02:08	71° 42.12' N	13° 25.98' E	1887.0	SSW 7	172.2	0.1	Heat Flow	HF	off bottom
PS64/389-1	15.07.03	02:24	71° 41.99' N	13° 26.05' E	1885.0	SSW 7	294.2	0.2	Heat Flow	HF	at the bottom
PS64/389-1	15.07.03	02:36	71° 41.99' N	13° 26.05' E	1885.0	SSW 8	194.3	0.0	Heat Flow	HF	off bottom
PS64/389-1	15.07.03	02:50	71° 41.90' N	13° 26.11' E	1887.0	SSW 8	195.0	0.0	Heat Flow	HF	at the bottom
PS64/389-1	15.07.03	03:02	71° 41.89' N	13° 26.10' E	1887.0	SSW 8	189.4	0.0	Heat Flow	HF	off bottom
PS64/389-1	15.07.03	03:27	71° 41.68' N	13° 26.21' E	1892.0	SSW 8	214.7	0.2	Heat Flow	HF	at the bottom
PS64/389-1	15.07.03	03:36	71° 41.67' N	13° 26.20' E	1894.0	SSW 9	310.2	0.2	Heat Flow	HF	off bottom
PS64/389-1	15.07.03	04:01	71° 41.35' N	13° 26.31' E	1896.0	SSW 8	29.7	0.8	Heat Flow	HF	Information
PS64/389-1	15.07.03	04:34	71° 41.48' N	13° 26.44' E	1894.0	SSW 8	331.1	0.2	Heat Flow	HF	on deck
PS64/389-2	15.07.03	05:35	71° 39.55' N	13° 26.97' E	1897.0	SSW 8	279.8	0.1	Heat Flow	HF	in the water
PS64/389-2	15.07.03	06:12	71° 39.50' N	13° 26.94' E	1897.0	SSW 8	191.7	0.3	Heat Flow	HF	at the bottom
PS64/389-2	15.07.03	06:27	71° 39.50' N	13° 26.97' E	1897.0	SSW 8	210.3	0.0	Heat Flow	HF	off bottom
PS64/389-2	15.07.03	06:40	71° 39.42' N	13° 26.97' E	1898.0	SSW 8	104.1	0.1	Heat Flow	HF	at the bottom
PS64/389-2	15.07.03	06:56	71° 39.42' N	13° 26.98' E	1898.0	SSW 7	108.9	0.1	Heat Flow	HF	off bottom
PS64/389-2	15.07.03	07:33	71° 39.35' N	13° 26.95' E	1896.0	SSW 7	187.1	0.1	Heat Flow	HF	on deck

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/390-1	15.07.03	08:19	71° 42.02' N	13° 26.03' E	1884.0	SSW 6	175.7	0.6	Multi corer	MUC	surface
PS64/390-1	15.07.03	09:04	71° 41.96' N	13° 26.10' E	1885.0	SSW 7	74.4	0.4	Multi corer	MUC	at sea bottom
PS64/390-1	15.07.03	09:41	71° 41.96' N	13° 26.13' E	1884.0	SSW 8	240.3	0.4	Multi corer	MUC	on deck
PS64/391-1	15.07.03	09:50	71° 41.95' N	13° 26.16' E	1885.0	SSW 7	316.8	0.3	CTD/rosette water sampler	CTD/RO	surface
PS64/391-1	15.07.03	10:27	71° 41.97' N	13° 26.07' E	1884.0	SSW 7	20.0	0.2	CTD/rosette water sampler	CTD/RO	at depth
PS64/391-1	15.07.03	11:14	71° 41.96' N	13° 26.09' E	1886.0	SSW 8	199.8	0.0	CTD/rosette water sampler	CTD/RO	on deck
PS64/392-1	15.07.03	11:23	71° 41.96' N	13° 26.13' E	1884.0	SW 8	103.6	0.3	Bottom water sampler	BWS	surface
PS64/392-1	15.07.03	12:04	71° 41.95' N	13° 26.07' E	1885.0	SW 10	224.5	0.1	Bottom water sampler	BWS	at sea bottom
PS64/392-1	15.07.03	12:12	71° 41.95' N	13° 26.07' E	1885.0	SW 10	4.3	0.2	Bottom water sampler	BWS	off bottom
PS64/392-1	15.07.03	13:02	71° 42.00' N	13° 25.96' E	1884.0	SW 10	345.3	0.6	Bottom water sampler	BWS	on deck
PS64/393-1	15.07.03	13:09	71° 41.99' N	13° 26.01' E	1886.0	SW 11	221.9	0.4	CTD/rosette water sampler	CTD/RO	surface
PS64/393-1	15.07.03	13:46	71° 41.91' N	13° 26.01' E	1886.0	SW 10	69.8	0.2	CTD/rosette water sampler	CTD/RO	at depth
PS64/393-1	15.07.03	13:53	71° 41.92' N	13° 26.05' E	1887.0	SW 11	219.8	0.0	CTD/rosette water sampler	CTD/RO	Information
PS64/393-1	15.07.03	14:30	71° 41.99' N	13° 25.95' E	1884.0	SW 9	0.7	0.1	CTD/rosette water sampler	CTD/RO	on deck
PS64/394-1	15.07.03	18:27	71° 59.05' N	14° 44.79' E	1303.0	SW 8	20.0	0.2	Bottom lander	LANDER	Information
PS64/394-1	15.07.03	18:31	71° 59.04' N	14° 44.74' E	1302.0	WSW 8	284.5	0.2	Bottom lander	LANDER	released
PS64/394-1	15.07.03	18:54	71° 59.27' N	14° 45.15' E	1297.0	WSW 8	7.3	1.1	Bottom lander	LANDER	Information
PS64/394-1	15.07.03	19:08	71° 59.04' N	14° 45.16' E	1299.0	WSW 8	32.9	0.4	Bottom lander	LANDER	on Deck
PS64/395-1	15.07.03	19:21	71° 59.03' N	14° 45.32' E	1297.0	WSW 8	216.2	0.5	Multi corer	MUC	surface
PS64/395-1	15.07.03	19:44	71° 58.97' N	14° 45.41' E	1296.0	WSW 8	149.4	0.3	Multi corer	MUC	at sea bottom
PS64/395-1	15.07.03	20:08	71° 58.99' N	14° 45.28' E	1297.0	WSW 7	270.8	0.3	Multi corer	MUC	on deck
PS64/396-1	15.07.03	20:24	72° 0.33' N	14° 43.39' E	1288.0	WSW 8	53.0	11.7	HydroSweep/ParaSound profile	HS_PS	start track
PS64/396-1	15.07.03	21:46	72° 7.62' N	15° 29.31' E	889.7	WSW 7	62.9	12.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	15.07.03	22:25	72° 0.39' N	15° 30.78' E	751.4	W 8	187.3	11.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	15.07.03	23:47	72° 0.25' N	14° 38.71' E	1339.0	NW 5	275.5	12.1	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	00:26	72° 2.22' N	14° 48.56' E	1233.0	NNW 6	329.6	11.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	00:33	72° 2.31' N	14° 44.25' E	1266.0	NNW 6	270.1	12.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	01:50	71° 47.41' N	14° 43.61' E	1228.0	NNW 6	180.5	12.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	03:09	72° 2.07' N	14° 40.91' E	1297.0	NW 4	0.9	12.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	03:38	71° 57.43' N	14° 42.59' E	1312.0	NW 4	157.2	10.7	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	04:05	72° 2.36' N	14° 43.35' E	1275.0	WNW 5	64.1	9.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	04:34	71° 57.36' N	14° 44.32' E	1287.0	WNW 4	104.0	9.6	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	05:00	72° 2.12' N	14° 44.87' E	1273.0	W 5	2.5	11.8	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	05:40	71° 59.76' N	15° 3.06' E	1116.0	WNW 4	117.1	10.5	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	05:54	72° 0.26' N	15° 0.21' E	1141.0	WNW 5	267.4	6.2	HydroSweep/ParaSound profile	HS_PS	alter course
PS64/396-1	16.07.03	06:10	72° 0.47' N	14° 53.35' E	1214.0	WNW 6	268.5	10.9	HydroSweep/ParaSound profile	HS_PS	profile end

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/397-1	16.07.03	06:56	72° 0.38' N	14° 43.51' E	1287.0	WNW 3	184.6	0.3	Bottom water sampler	BWS	surface
PS64/397-1	16.07.03	07:25	72° 0.37' N	14° 43.45' E	1288.0	WNW 4	206.8	0.3	Bottom water sampler	BWS	at sea bottom
PS64/397-1	16.07.03	07:37	72° 0.37' N	14° 43.38' E	1288.0	W 4	301.7	0.3	Bottom water sampler	BWS	off bottom
PS64/397-1	16.07.03	08:06	72° 0.37' N	14° 43.23' E	1288.0	WNW 3	260.1	0.4	Bottom water sampler	BWS	on deck
PS64/398-1	16.07.03	08:23	72° 0.42' N	14° 43.15' E	1292.0	W 3	278.2	0.0	Remote operated vehicle	ROV	Shuttle
PS64/398-1	16.07.03	08:26	72° 0.41' N	14° 43.11' E	1292.0	W 4	251.2	0.2	Remote operated vehicle	ROV	Shuttle
PS64/398-1	16.07.03	08:50	72° 0.29' N	14° 43.06' E	1290.0	W 3	246.9	0.7	Remote operated vehicle	ROV	surface
PS64/398-1	16.07.03	09:00	72° 0.26' N	14° 42.81' E	1139.7	WNW 3	257.2	0.5	Remote operated vehicle	ROV	Depressor into water
PS64/398-1	16.07.03	09:44	72° 0.08' N	14° 41.42' E	1139.3	WNW 4	188.0	0.4	Remote operated vehicle	ROV	Information
PS64/398-1	16.07.03	10:12	72° 0.13' N	14° 42.21' E	1139.2	WNW 3	57.7	1.1	Remote operated vehicle	ROV	at depth
PS64/398-1	16.07.03	10:20	72° 0.22' N	14° 42.60' E	1139.2	WNW 3	52.4	1.1	Remote operated vehicle	ROV	Information
PS64/398-1	16.07.03	10:59	72° 0.20' N	14° 42.45' E	0.0	W 3	54.0	0.2	Remote operated vehicle	ROV	Information
PS64/398-1	16.07.03	11:10	72° 0.27' N	14° 42.76' E	0.0	WSW 3	44.5	0.8	Remote operated vehicle	ROV	Information
PS64/398-1	16.07.03	11:33	72° 0.38' N	14° 43.37' E	0.0	WSW 3	94.8	0.4	Remote operated vehicle	ROV	Information
PS64/398-1	16.07.03	22:22	72° 0.23' N	14° 43.18' E	0.0	W 7	172.0	0.2	Remote operated vehicle	ROV	Information
PS64/398-1	16.07.03	22:43	72° 0.37' N	14° 43.33' E	0.0	W 6	56.7	0.1	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	00:20	72° 0.38' N	14° 42.98' E	0.0	W 6	260.0	1.0	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	03:46	72° 0.17' N	14° 42.06' E	0.0	WSW 8	149.4	0.1	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	08:25	72° 0.36' N	14° 43.17' E	0.0	WSW 11	329.5	0.5	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	08:25	72° 0.36' N	14° 43.17' E	0.0	WSW 11	329.5	0.5	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	09:09	72° 0.38' N	14° 42.94' E	0.0	W 11	42.6	0.4	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	09:36	72° 0.28' N	14° 43.06' E	0.0	W 8	104.6	0.3	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	09:55	72° 0.31' N	14° 43.11' E	0.0	W 11	247.7	0.3	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	10:28	72° 0.43' N	14° 42.75' E	0.0	W 11	248.9	0.1	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	10:41	72° 0.43' N	14° 42.68' E	0.0	W 11	156.7	0.2	Remote operated vehicle	ROV	Information
PS64/398-1	17.07.03	11:15	72° 0.42' N	14° 42.62' E	0.0	W 11	220.1	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/398-1	17.07.03	11:58	72° 0.43' N	14° 41.64' E	0.0	WNW 10	258.2	0.4	Remote operated vehicle	ROV	coming back to the surface
PS64/398-1	17.07.03	12:00	72° 0.43' N	14° 41.59' E	0.0	W 10	270.8	0.5	Remote operated vehicle	ROV	coming back to the surface
PS64/398-1	17.07.03	12:27	72° 0.43' N	14° 40.75' E	0.0	W 10	279.3	0.9	Remote operated vehicle	ROV	on deck
PS64/398-1	17.07.03	12:51	72° 0.38' N	14° 43.62' E	0.0	W 10	275.3	1.1	Remote operated vehicle	ROV	Shuttle
PS64/398-1	17.07.03	13:21	72° 0.51' N	14° 42.43' E	1295.0	W 10	282.6	0.2	Remote operated vehicle	ROV	Shuttle
PS64/399-1	20.07.03	10:06	79° 0.55' N	4° 21.14' E	2595.2	N 9	293.0	0.9	Mooring	MOR	Hydrophone into the water

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/399-1	20.07.03	10:09	79° 0.54' N	4° 20.94' E	2596.0	N 9	224.9	0.9	Mooring	MOR	released
PS64/399-1	20.07.03	10:10	79° 0.53' N	4° 20.89' E	2596.4	N 9	210.9	0.9	Mooring	MOR	Hydrophone on Deck
PS64/399-1	20.07.03	10:12	79° 0.50' N	4° 20.80' E	2597.2	N 9	208.8	0.8	Mooring	MOR	on the surface
PS64/399-1	20.07.03	10:38	79° 1.06' N	4° 19.12' E	2588.8	N 9	3.0	0.7	Mooring	MOR	action
PS64/399-1	20.07.03	10:40	79° 1.05' N	4° 19.11' E	2589.2	N 8	199.7	0.8	Mooring	MOR	on deck
PS64/399-1	20.07.03	10:43	79° 1.01' N	4° 19.05' E	2590.4	N 8	202.7	0.8	Mooring	MOR	action
PS64/399-1	20.07.03	10:51	79° 0.94' N	4° 18.82' E	2594.0	N 8	220.7	0.6	Mooring	MOR	on deck
PS64/399-1	20.07.03	10:54	79° 0.91' N	4° 18.73' E	2594.8	N 8	220.3	0.5	Mooring	MOR	action
PS64/399-1	20.07.03	11:13	79° 0.95' N	4° 18.09' E	2596.8	N 8	272.3	0.5	Mooring	MOR	on deck
PS64/399-1	20.07.03	11:20	79° 0.95' N	4° 17.86' E	2597.6	N 8	259.1	0.3	Mooring	MOR	action
PS64/399-1	20.07.03	11:42	79° 0.97' N	4° 17.47' E	2599.2	NNW 7	228.9	0.4	Mooring	MOR	on deck
PS64/399-1	20.07.03	11:48	79° 0.93' N	4° 17.30' E	2601.6	NNW 7	224.4	0.4	Mooring	MOR	on deck
PS64/399-1	20.07.03	11:59	79° 0.89' N	4° 16.94' E	2606.8	NNW 6	270.0	0.4	Mooring	MOR	on deck
PS64/400-1	20.07.03	15:33	78° 58.17' N	6° 42.56' E	1402.5	NNW 7	132.3	0.3	Remote operated vehicle	ROV	surface
PS64/400-1	20.07.03	15:43	78° 58.15' N	6° 42.62' E	1403.2	NNW 7	168.5	0.3	Remote operated vehicle	ROV	Depressor into water
PS64/400-1	20.07.03	16:44	78° 58.12' N	6° 42.47' E	0.0	NW 7	1.8	0.4	Remote operated vehicle	ROV	at depth
PS64/400-1	20.07.03	21:00	78° 58.26' N	6° 42.31' E	0.0	NW 5	332.5	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/400-1	20.07.03	21:58	78° 58.20' N	6° 39.65' E	0.0	NW 5	237.2	0.5	Remote operated vehicle	ROV	coming back to the surface
PS64/400-1	20.07.03	22:01	78° 58.19' N	6° 39.51' E	0.0	NW 5	242.7	0.5	Remote operated vehicle	ROV	coming back to the surface
PS64/400-1	20.07.03	22:03	78° 58.18' N	6° 39.42' E	0.0	NW 5	244.2	0.6	Remote operated vehicle	ROV	Depressor on deck
PS64/400-1	20.07.03	22:27	78° 58.07' N	6° 38.48' E	1467.0	NW 5	252.9	0.7	Remote operated vehicle	ROV	on deck
PS64/401-1	20.07.03	23:54	79° 8.03' N	6° 5.58' E	1278.0	WNW 4	3.0	0.8	Bottom water sampler	BWS	surface
PS64/401-1	21.07.03	00:29	79° 8.01' N	6° 5.57' E	1277.0	WNW 4	309.8	0.0	Bottom water sampler	BWS	at sea bottom
PS64/401-1	21.07.03	00:36	79° 8.00' N	6° 5.56' E	1277.0	WNW 4	309.9	0.0	Bottom water sampler	BWS	off bottom
PS64/401-1	21.07.03	01:10	79° 8.00' N	6° 5.42' E	1277.0	W 4	315.1	0.0	Bottom water sampler	BWS	on deck
PS64/402-1	21.07.03	01:21	79° 8.01' N	6° 5.40' E	1278.0	WSW 4	317.1	0.0	Multi corer	MUC	surface
PS64/402-1	21.07.03	01:50	79° 8.00' N	6° 5.54' E	1277.0	WSW 4	317.0	0.0	Multi corer	MUC	at sea bottom
PS64/402-1	21.07.03	02:20	79° 8.03' N	6° 5.51' E	1278.0	WSW 3	262.6	0.1	Multi corer	MUC	on deck
PS64/403-1	21.07.03	02:32	79° 8.00' N	6° 5.42' E	1278.0	WSW 3	177.3	0.3	Multi corer	MUC	surface
PS64/403-1	21.07.03	02:59	79° 7.98' N	6° 5.64' E	1277.0	SW 3	161.0	0.2	Multi corer	MUC	at sea bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/403-1	21.07.03	03:23	79° 8.02' N	6° 5.73' E	1278.0	SSW 3	204.9	0.0	Multi corer	MUC	on deck
PS64/404-1	21.07.03	03:49	79° 7.98' N	6° 5.50' E	1278.0	SSW 4	205.1	0.0	Box corer	BC	surface
PS64/404-1	21.07.03	04:14	79° 8.01' N	6° 5.45' E	1278.0	SSW 4	302.2	0.1	Box corer	BC	at sea bottom
PS64/404-1	21.07.03	04:39	79° 8.00' N	6° 5.63' E	1278.0	SSW 5	204.5	0.0	Box corer	BC	on deck
PS64/405-1	21.07.03	04:46	79° 8.00' N	6° 5.68' E	1278.0	SSW 5	41.7	0.2	Large Box Corer	GKG	surface
PS64/405-1	21.07.03	05:12	79° 7.99' N	6° 5.65' E	1278.0	S 5	212.9	0.0	Large Box Corer	GKG	at sea bottom
PS64/405-1	21.07.03	05:36	79° 8.00' N	6° 5.71' E	1278.0	S 6	91.1	0.1	Large Box Corer	GKG	on deck
PS64/406-1	21.07.03	07:36	79° 7.83' N	4° 53.74' E	1553.0	S 9	158.1	0.0	Bottom water sampler	BWS	surface
PS64/406-1	21.07.03	08:17	79° 7.80' N	4° 53.96' E	1550.0	S 10	166.8	0.0	Bottom water sampler	BWS	at sea bottom
PS64/406-1	21.07.03	08:26	79° 7.81' N	4° 53.96' E	1552.0	S 10	163.7	0.1	Bottom water sampler	BWS	off bottom
PS64/406-1	21.07.03	08:56	79° 7.80' N	4° 54.04' E	1551.0	S 10	350.1	0.2	Bottom water sampler	BWS	on deck
PS64/407-1	21.07.03	09:01	79° 7.81' N	4° 54.01' E	1551.6	SSW 10	173.7	0.0	Multi corer	MUC	surface
PS64/407-1	21.07.03	09:33	79° 7.80' N	4° 54.04' E	1551.6	SSW 10	177.1	0.0	Multi corer	MUC	at sea bottom
PS64/407-1	21.07.03	10:04	79° 7.80' N	4° 54.00' E	1552.4	S 9	355.9	0.2	Multi corer	MUC	on deck
PS64/408-1	21.07.03	10:14	79° 7.79' N	4° 54.06' E	1551.6	SSW 10	122.8	0.2	Multi corer	MUC	surface
PS64/408-1	21.07.03	10:43	79° 7.81' N	4° 53.93' E	1552.0	SSW 10	128.6	0.1	Multi corer	MUC	at sea bottom
PS64/408-1	21.07.03	11:15	79° 7.83' N	4° 54.06' E	1548.0	SSW 9	106.2	0.1	Multi corer	MUC	on deck
PS64/409-1	21.07.03	11:29	79° 7.80' N	4° 54.02' E	1551.6	SSW 10	340.3	0.2	Large Box Corer	GKG	surface
PS64/409-1	21.07.03	12:00	79° 7.81' N	4° 54.04' E	1549.6	SSW 9	13.6	0.1	Large Box Corer	GKG	at sea bottom
PS64/409-1	21.07.03	12:33	79° 7.83' N	4° 53.99' E	1548.8	SSW 9	6.1	0.2	Large Box Corer	GKG	on deck
PS64/410-1	21.07.03	12:47	79° 7.84' N	4° 53.91' E	1549.2	SSW 9	164.4	0.4	Large Box Corer	GKG	surface
PS64/410-1	21.07.03	13:17	79° 7.83' N	4° 54.19' E	1546.4	SSW 10	142.5	0.4	Large Box Corer	GKG	at sea bottom
PS64/410-1	21.07.03	13:46	79° 7.84' N	4° 54.32' E	1544.0	SSW 10	328.9	0.1	Large Box Corer	GKG	on deck
PS64/411-1	21.07.03	15:02	79° 3.86' N	4° 11.43' E	2460.4	SW 10	155.8	0.3	CTD/rosette water sampler	CTD/RO	surface
PS64/411-1	21.07.03	15:42	79° 3.80' N	4° 11.54' E	2462.4	SW 9	225.0	0.0	CTD/rosette water sampler	CTD/RO	at depth
PS64/411-1	21.07.03	16:13	79° 3.81' N	4° 11.53' E	2462.8	SW 10	225.4	0.0	CTD/rosette water sampler	CTD/RO	on deck
PS64/412-1	21.07.03	16:33	79° 3.67' N	4° 11.39' E	2476.8	SW 11	148.4	0.4	Remote operated vehicle	ROV	Shuttle
PS64/412-1	21.07.03	17:08	79° 3.68' N	4° 11.47' E	0.0	SSW 10	25.9	0.2	Remote operated vehicle	ROV	surface
PS64/412-1	21.07.03	17:20	79° 3.70' N	4° 11.46' E	0.0	SSW 10	307.3	0.2	Remote operated vehicle	ROV	Depressor into water
PS64/412-1	21.07.03	18:50	79° 3.69' N	4° 11.67' E	0.0	SSW 11	215.1	0.0	Remote operated vehicle	ROV	at depth
PS64/412-1	21.07.03	22:17	79° 3.70' N	4° 11.32' E	0.0	SW 9	147.9	0.2	Remote operated vehicle	ROV	Information
PS64/412-1	21.07.03	22:32	79° 3.86' N	4° 11.16' E	0.0	WSW 9	10.9	0.7	Remote operated vehicle	ROV	Information
PS64/412-1	22.07.03	13:00	79° 3.76' N	4° 11.25' E	0.0	SW 10	199.8	0.1	Remote operated vehicle	ROV	Information
PS64/412-1	22.07.03	13:53	79° 4.31' N	4° 8.34' E	0.0	SW 10	166.4	0.1	Remote operated vehicle	ROV	Information
PS64/412-1	22.07.03	15:30	79° 4.33' N	4° 8.44' E	0.0	SW 12	196.7	0.0	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/412-1	22.07.03	21:24	79° 2.60' N	4° 5.45' E	0.0	SSW 8	268.3	0.9	Remote operated vehicle	ROV	Information
PS64/412-1	23.07.03	07:09	79° 2.23' N	4° 3.53' E	0.0	S 9	98.9	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/412-1	23.07.03	08:38	79° 2.13' N	4° 3.63' E	0.0	S 9	175.0	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/412-1	23.07.03	08:43	79° 2.12' N	4° 3.65' E	0.0	S 9	153.2	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/412-1	23.07.03	08:46	79° 2.11' N	4° 3.66' E	0.0	S 9	154.7	0.2	Remote operated vehicle	ROV	Depressor on deck
PS64/412-1	23.07.03	09:15	79° 2.09' N	4° 4.48' E	0.0	S 10	95.4	0.5	Remote operated vehicle	ROV	on deck
PS64/412-1	23.07.03	09:48	79° 4.29' N	4° 11.49' E	0.0	S 8	169.7	0.8	Remote operated vehicle	ROV	Shuttle
PS64/412-1	23.07.03	09:54	79° 4.22' N	4° 11.46' E	0.0	S 8	293.9	0.1	Remote operated vehicle	ROV	Shuttle
PS64/412-1	23.07.03	10:05	79° 4.06' N	4° 11.31' E	0.0	S 9	184.0	0.7	Remote operated vehicle	ROV	Shuttle
PS64/412-1	23.07.03	10:27	79° 4.08' N	4° 11.44' E	0.0	S 9	188.8	3.0	Remote operated vehicle	ROV	Shuttle
PS64/412-1	23.07.03	10:41	79° 3.78' N	4° 11.31' E	2464.0	S 8	53.5	0.6	Remote operated vehicle	ROV	Shuttle
PS64/413-1	23.07.03	12:03	79° 3.97' N	3° 43.68' E	0.0	S 8	261.5	0.4	Bottom water sampler	BWS	surface
PS64/413-1	23.07.03	12:35	79° 3.94' N	3° 42.97' E	2879.2	S 8	253.1	0.2	Bottom water sampler	BWS	action
PS64/413-1	23.07.03	12:48	79° 3.90' N	3° 42.62' E	2907.6	S 8	238.8	0.3	Bottom water sampler	BWS	action
PS64/413-1	23.07.03	13:08	79° 3.85' N	3° 42.15' E	2946.4	S 8	235.1	0.3	Bottom water sampler	BWS	at sea bottom
PS64/413-1	23.07.03	13:15	79° 3.84' N	3° 42.00' E	2962.8	S 8	233.2	0.3	Bottom water sampler	BWS	off bottom
PS64/413-1	23.07.03	14:08	79° 3.78' N	3° 40.82' E	3035.2	S 8	256.6	0.3	Bottom water sampler	BWS	on deck
PS64/414-1	23.07.03	14:15	79° 3.77' N	3° 40.64' E	3049.2	S 8	293.9	0.4	Multi corer	MUC	surface
PS64/414-1	23.07.03	15:17	79° 3.78' N	3° 39.43' E	3129.2	S 8	295.7	0.2	Multi corer	MUC	at sea bottom
PS64/414-1	23.07.03	16:16	79° 3.91' N	3° 38.80' E	3159.2	SSW 7	311.3	0.3	Multi corer	MUC	on deck
PS64/415-1	23.07.03	16:48	79° 3.35' N	3° 41.06' E	3082.8	SSW 6	183.1	0.4	Multi corer	MUC	surface
PS64/415-1	23.07.03	17:43	79° 3.29' N	3° 41.26' E	3073.6	SW 6	332.9	0.2	Multi corer	MUC	at sea bottom
PS64/415-1	23.07.03	18:44	79° 3.23' N	3° 41.49' E	3062.0	SW 5	174.1	0.4	Multi corer	MUC	on deck
PS64/416-1	23.07.03	19:00	79° 3.21' N	3° 41.52' E	3043.6	SW 5	173.5	0.1	Large Box Corer	GKG	surface
PS64/416-1	23.07.03	19:53	79° 3.22' N	3° 41.54' E	3032.0	SW 4	180.0	0.0	Large Box Corer	GKG	at sea bottom
PS64/416-1	23.07.03	20:50	79° 3.19' N	3° 41.26' E	3017.2	WSW 3	162.6	0.4	Large Box Corer	GKG	on deck
PS64/417-1	23.07.03	21:28	79° 3.20' N	3° 41.69' E	2994.8	SW 3	67.0	0.0	Large Box Corer	GKG	surface
PS64/417-1	23.07.03	22:22	79° 3.24' N	3° 41.68' E	3006.8	SW 3	14.6	0.1	Large Box Corer	GKG	at sea bottom
PS64/417-1	23.07.03	23:17	79° 3.22' N	3° 41.49' E	3008.0	SSW 2	176.3	0.8	Large Box Corer	GKG	on deck
PS64/418-1	23.07.03	23:57	79° 5.06' N	3° 32.27' E	3583.6	SW 3	247.7	0.3	Bottom water sampler	BWS	surface
PS64/418-1	24.07.03	01:15	79° 5.11' N	3° 31.66' E	3576.0	SW 3	106.0	0.0	Bottom water sampler	BWS	at sea bottom
PS64/418-1	24.07.03	02:30	79° 5.20' N	3° 28.15' E	3773.2	S 3	323.9	0.3	Bottom water sampler	BWS	on deck
PS64/419-1	24.07.03	03:18	79° 3.60' N	3° 35.29' E	3435.6	SSW 3	277.5	0.5	Multi corer	MUC	surface

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/419-1	24.07.03	04:27	79° 3.53' N	3° 34.54' E	3491.2	SSW 3	210.1	0.2	Multi corer	MUC	at sea bottom
PS64/419-1	24.07.03	05:34	79° 3.49' N	3° 34.52' E	3568.0	WSW 4	65.3	0.0	Multi corer	MUC	on deck
PS64/420-1	24.07.03	05:48	79° 3.48' N	3° 34.48' E	3548.8	WSW 4	289.6	0.1	Large Box Corer	GKG	surface
PS64/420-1	24.07.03	06:54	79° 3.49' N	3° 34.71' E	3508.0	WSW 2	73.6	0.1	Large Box Corer	GKG	at sea bottom
PS64/420-1	24.07.03	08:04	79° 3.47' N	3° 35.74' E	3406.4	W 0	79.5	0.2	Large Box Corer	GKG	on deck
PS64/421-1	24.07.03	09:25	79° 4.12' N	4° 7.06' E	2514.4	SE 1	48.9	0.0	Bottom lander	LANDER	Information
PS64/421-1	24.07.03	09:43	79° 4.11' N	4° 6.93' E	2516.4	SE 1	48.8	0.0	Bottom lander	LANDER	Information
PS64/421-1	24.07.03	10:00	79° 4.12' N	4° 6.99' E	2514.8	SE 1	49.0	0.0	Bottom lander	LANDER	released
PS64/421-1	24.07.03	10:04	79° 4.13' N	4° 7.00' E	2514.8	SSE 1	49.2	0.0	Bottom lander	LANDER	Information
PS64/421-1	24.07.03	10:36	79° 4.11' N	4° 7.40' E	2510.8	SSE 2	126.6	0.1	Bottom lander	LANDER	Information
PS64/421-1	24.07.03	10:52	79° 4.07' N	4° 8.77' E	2487.6	SSE 2	248.0	0.5	Bottom lander	LANDER	on Deck
PS64/422-1	24.07.03	11:04	79° 4.14' N	4° 13.08' E	2432.0	S 2	82.1	10.6	Colonization Tray	CTR	hydrophon into water
PS64/422-2	24.07.03	11:15	79° 4.29' N	4° 17.89' E	2361.6	S 2	189.9	0.4	Hand net	HN	surface
PS64/422-1	24.07.03	11:21	79° 4.24' N	4° 17.93' E	2365.2	S 2	163.2	0.5	Colonization Tray	CTR	information
PS64/422-2	24.07.03	11:21	79° 4.24' N	4° 17.93' E	2365.2	S 2	163.2	0.5	Hand net	HN	on deck
PS64/422-1	24.07.03	11:25	79° 4.22' N	4° 17.98' E	2367.6	S 2	155.8	0.3	Colonization Tray	CTR	released
PS64/422-1	24.07.03	11:30	79° 4.20' N	4° 17.98' E	2370.0	S 2	144.7	0.1	Colonization Tray	CTR	information
PS64/422-1	24.07.03	11:39	79° 4.18' N	4° 17.93' E	2372.8	SSW 2	266.0	0.1	Colonization Tray	CTR	hydrophon on deck
PS64/422-1	24.07.03	11:45	79° 4.17' N	4° 17.90' E	2374.4	SSW 2	150.9	0.1	Colonization Tray	CTR	information
PS64/422-1	24.07.03	12:18	79° 3.89' N	4° 17.77' E	2402.4	WSW 3	196.0	1.2	Colonization Tray	CTR	on surface
PS64/422-1	24.07.03	12:42	79° 3.33' N	4° 16.55' E	2465.2	W 3	96.7	0.5	Colonization Tray	CTR	on deck
PS64/423-1	24.07.03	12:52	79° 3.34' N	4° 16.77' E	2458.0	W 2	261.7	0.7	Bottom lander	LANDER	surface
PS64/423-1	24.07.03	12:54	79° 3.33' N	4° 16.62' E	2461.6	W 2	264.1	0.9	Bottom lander	LANDER	Information
PS64/424-1	24.07.03	13:22	79° 3.98' N	4° 7.54' E	2513.2	WSW 1	208.7	0.2	Remote operated vehicle	ROV	Shuttle
PS64/424-1	24.07.03	15:11	79° 3.84' N	4° 10.91' E	2466.0	WSW 1	325.4	0.6	Remote operated vehicle	ROV	surface
PS64/424-1	24.07.03	15:21	79° 3.85' N	4° 10.79' E	2466.4	WSW 1	257.3	0.1	Remote operated vehicle	ROV	Depressor into water
PS64/424-1	24.07.03	16:56	79° 3.80' N	4° 11.29' E	2465.2	WSW 1	137.1	0.1	Remote operated vehicle	ROV	at depth
PS64/424-2	25.07.03	09:25	79° 3.91' N	4° 7.46' E	2518.0	SW 2	322.1	0.2	Hand net	HN	surface
PS64/424-2	25.07.03	09:32	79° 3.91' N	4° 7.51' E	2517.2	SSW 2	250.5	0.0	Hand net	HN	on deck
PS64/424-1	25.07.03	10:42	79° 3.95' N	4° 7.34' E	2517.6	WSW 2	355.0	0.2	Remote operated vehicle	ROV	Information
PS64/424-1	25.07.03	11:15	79° 4.40' N	4° 8.02' E	2492.8	SSW 2	319.3	0.7	Remote operated vehicle	ROV	Information
PS64/424-1	25.07.03	13:04	79° 4.41' N	4° 7.79' E	2494.8	SSW 4	89.0	0.1	Remote operated vehicle	ROV	Information
PS64/424-1	25.07.03	13:40	79° 3.97' N	4° 7.82' E	2504.8	SSW 3	174.5	0.0	Remote operated vehicle	ROV	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/424-1	25.07.03	14:24	79° 3.93' N	4° 7.68' E	2513.2	SSW 4	209.3	0.1	Remote operated vehicle	ROV	coming back to the surface
PS64/424-1	25.07.03	15:46	79° 3.91' N	4° 7.18' E	2520.8	S 4	251.6	0.5	Remote operated vehicle	ROV	coming back to the surface
PS64/424-1	25.07.03	15:50	79° 3.91' N	4° 7.05' E	2522.8	S 4	268.6	0.2	Remote operated vehicle	ROV	Depressor on deck
PS64/424-1	25.07.03	16:15	79° 3.93' N	4° 6.43' E	2530.0	S 3	254.2	0.3	Remote operated vehicle	ROV	on deck
PS64/424-1	25.07.03	16:42	79° 4.02' N	4° 6.69' E	2522.4	SSW 5	58.8	0.4	Remote operated vehicle	ROV	Shuttle
PS64/424-1	25.07.03	17:16	79° 4.13' N	4° 7.32' E	2511.2	SSW 4	352.4	0.4	Remote operated vehicle	ROV	Shuttle
PS64/424-1	25.07.03	17:31	79° 3.98' N	4° 8.40' E	2497.6	S 5	36.4	0.2	Remote operated vehicle	ROV	Shuttle
PS64/425-1	25.07.03	17:50	79° 3.36' N	4° 16.02' E	2468.8	SSW 5	33.3	0.5	Bottom lander	LANDER	Information
PS64/425-1	25.07.03	17:54	79° 3.41' N	4° 16.10' E	2464.8	SSW 5	4.8	0.9	Bottom lander	LANDER	released
PS64/425-1	25.07.03	18:06	79° 3.58' N	4° 15.86' E	2448.4	SSW 5	349.6	0.7	Bottom lander	LANDER	Information
PS64/425-1	25.07.03	18:36	79° 3.62' N	4° 16.73' E	2432.8	SSW 6	180.0	0.0	Bottom lander	LANDER	Information
PS64/425-1	25.07.03	18:51	79° 3.35' N	4° 17.21' E	2448.0	SSW 5	179.1	0.2	Bottom lander	LANDER	on Deck
PS64/426-1	25.07.03	19:18	79° 4.32' N	4° 7.25' E	2504.4	SW 4	99.2	0.2	Bottom water sampler	BWS	surface
PS64/426-1	25.07.03	20:08	79° 4.30' N	4° 7.34' E	2504.0	SSW 3	273.6	0.1	Bottom water sampler	BWS	at sea bottom
PS64/426-1	25.07.03	20:15	79° 4.30' N	4° 7.37' E	2503.6	SSW 3	270.5	0.1	Bottom water sampler	BWS	off bottom
PS64/426-1	25.07.03	21:00	79° 4.32' N	4° 7.42' E	2502.8	SSW 4	68.0	0.2	Bottom water sampler	BWS	on deck
PS64/427-1	25.07.03	21:10	79° 4.32' N	4° 7.46' E	2502.0	SSW 4	265.3	0.2	Large Box Corer	GKG	surface
PS64/427-1	25.07.03	21:47	79° 4.30' N	4° 7.48' E	2502.8	SSW 5	210.1	0.0	Large Box Corer	GKG	at sea bottom
PS64/427-1	25.07.03	22:36	79° 4.33' N	4° 7.57' E	2500.8	SSW 6	148.9	0.3	Large Box Corer	GKG	on deck
PS64/428-1	25.07.03	23:01	79° 4.32' N	4° 7.54' E	2501.2	SSW 6	2.5	0.4	Large Box Corer	GKG	surface
PS64/428-1	25.07.03	23:37	79° 4.32' N	4° 7.59' E	2500.8	S 8	161.8	0.2	Large Box Corer	GKG	at sea bottom
PS64/428-1	26.07.03	00:18	79° 4.30' N	4° 7.43' E	2503.2	SSW 6	173.7	0.2	Large Box Corer	GKG	on deck
PS64/429-1	26.07.03	00:38	79° 4.32' N	4° 7.41' E	2503.2	SSW 6	173.9	0.0	Multi corer	MUC	surface
PS64/429-1	26.07.03	01:24	79° 4.31' N	4° 7.57' E	2501.2	SSW 7	173.9	0.0	Multi corer	MUC	at sea bottom
PS64/429-1	26.07.03	02:11	79° 4.33' N	4° 7.57' E	2500.4	SSW 7	181.1	0.0	Multi corer	MUC	on deck
PS64/430-1	26.07.03	02:32	79° 4.31' N	4° 7.59' E	2500.8	SSW 6	189.4	0.0	Multi corer	MUC	surface
PS64/430-1	26.07.03	03:17	79° 4.28' N	4° 7.59' E	2501.6	SSW 6	210.9	0.0	Multi corer	MUC	at sea bottom
PS64/430-1	26.07.03	04:05	79° 4.30' N	4° 7.57' E	2500.8	SW 6	210.9	0.0	Multi corer	MUC	on deck
PS64/431-1	26.07.03	05:12	79° 3.06' N	4° 15.21' E	2498.0	SSW 5	41.3	1.1	Bottom lander	LANDER	released
PS64/431-1	26.07.03	06:45	79° 2.81' N	4° 14.11' E	2531.6	SSW 4	163.2	0.4	Bottom lander	LANDER	Information
PS64/431-1	26.07.03	06:50	79° 2.82' N	4° 14.23' E	2530.8	SSW 4	26.0	0.7	Bottom lander	LANDER	Information
PS64/432-1	26.07.03	07:07	79° 4.11' N	4° 19.09' E	2370.0	SSW 6	25.0	9.2	Colonization Tray	CTR	released
PS64/432-1	26.07.03	08:08	79° 4.43' N	4° 17.16' E	2358.4	SSW 6	22.4	0.1	Colonization Tray	CTR	on deck

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/433-1	26.07.03	08:48	79° 6.48' N	4° 36.27' E	0.0	SW 6	181.0	0.9	Bottom water sampler	BWS	surface
PS64/433-2	26.07.03	09:34	79° 6.51' N	4° 36.39' E	1910.4	SSW 4	316.0	0.1	Hand net	HN	surface
PS64/433-1	26.07.03	09:45	79° 6.50' N	4° 36.46' E	1913.2	SSW 6	162.4	0.0	Bottom water sampler	BWS	at sea bottom
PS64/433-2	26.07.03	09:45	79° 6.50' N	4° 36.46' E	1913.2	SSW 6	162.4	0.0	Hand net	HN	on deck
PS64/433-1	26.07.03	09:51	79° 6.51' N	4° 36.47' E	1918.4	SSW 6	165.3	0.0	Bottom water sampler	BWS	off bottom
PS64/433-1	26.07.03	10:35	79° 6.53' N	4° 36.52' E	1911.6	SSW 7	20.3	0.3	Bottom water sampler	BWS	on deck
PS64/434-1	26.07.03	10:46	79° 6.51' N	4° 36.49' E	1919.6	SSW 6	180.5	0.0	Multi corer	MUC	surface
PS64/434-1	26.07.03	11:22	79° 6.50' N	4° 36.38' E	1912.0	SSW 7	153.6	0.2	Multi corer	MUC	at sea bottom
PS64/434-1	26.07.03	11:59	79° 6.52' N	4° 36.46' E	1910.4	S 7	172.0	0.0	Multi corer	MUC	on deck
PS64/435-1	26.07.03	13:00	79° 4.32' N	4° 7.62' E	2500.8	SSW 8	12.2	0.4	Remote operated vehicle	ROV	Shuttle
PS64/435-1	26.07.03	14:31	79° 4.29' N	4° 8.24' E	2492.4	SSW 8	219.6	0.3	Remote operated vehicle	ROV	surface
PS64/435-1	26.07.03	14:40	79° 4.27' N	4° 8.15' E	2494.4	SSW 10	20.7	0.1	Remote operated vehicle	ROV	Depressor into water
PS64/435-1	26.07.03	16:15	79° 4.32' N	4° 8.19' E	2492.4	SSW 9	55.5	0.1	Remote operated vehicle	ROV	at depth
PS64/435-1	27.07.03	03:45	79° 4.29' N	4° 8.89' E	2481.2	SSW 11	95.3	0.6	Remote operated vehicle	ROV	Information
PS64/435-1	27.07.03	06:08	79° 2.75' N	4° 13.77' E	2539.6	SSW 10	167.0	0.5	Remote operated vehicle	ROV	Information
PS64/435-1	27.07.03	06:46	79° 2.72' N	4° 13.87' E	2540.0	SSW 9	199.1	0.3	Remote operated vehicle	ROV	Information
PS64/436-1	27.07.03	07:17	79° 2.70' N	4° 13.78' E	2542.8	S 9	117.1	0.6	Bottom lander	LANDER	released
PS64/435-1	27.07.03	07:17	79° 2.70' N	4° 13.78' E	2542.8	S 9	117.1	0.6	Remote operated vehicle	ROV	Information
PS64/436-1	27.07.03	08:07	79° 2.71' N	4° 14.28' E	2536.4	S 10	200.2	0.0	Bottom lander	LANDER	Information
PS64/436-1	27.07.03	08:20	79° 2.73' N	4° 13.67' E	2542.4	S 9	310.9	0.3	Bottom lander	LANDER	on Deck
PS64/435-1	27.07.03	08:20	79° 2.73' N	4° 13.67' E	2542.4	S 9	310.9	0.3	Remote operated vehicle	ROV	coming back to the surface
PS64/435-1	27.07.03	08:53	79° 2.65' N	4° 13.18' E	2552.8	S 8	192.2	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/435-1	27.07.03	09:00	79° 2.62' N	4° 13.18' E	2555.2	S 8	241.1	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/435-1	27.07.03	09:05	79° 2.61' N	4° 13.14' E	2556.4	S 10	192.1	0.0	Remote operated vehicle	ROV	Depressor on deck
PS64/435-1	27.07.03	09:29	79° 2.61' N	4° 12.90' E	2558.8	S 8	339.3	0.2	Remote operated vehicle	ROV	on deck
PS64/437-1	27.07.03	10:20	79° 6.52' N	4° 36.68' E	1917.2	S 10	6.2	0.3	Large Box Corer	GKG	surface
PS64/437-2	27.07.03	10:46	79° 6.49' N	4° 36.46' E	1916.0	S 10	243.5	0.1	Hand net	HN	surface
PS64/437-1	27.07.03	10:48	79° 6.49' N	4° 36.44' E	1914.8	S 10	243.4	0.1	Large Box Corer	GKG	at sea bottom
PS64/437-2	27.07.03	10:55	79° 6.48' N	4° 36.46' E	1918.8	S 10	191.3	0.0	Hand net	HN	on deck
PS64/437-1	27.07.03	11:16	79° 6.48' N	4° 36.52' E	1920.8	S 8	193.6	0.0	Large Box Corer	GKG	on deck
PS64/438-1	27.07.03	11:31	79° 6.49' N	4° 36.47' E	1921.2	S 9	194.2	0.0	Large Box Corer	GKG	surface
PS64/438-1	27.07.03	11:59	79° 6.49' N	4° 36.44' E	1917.2	S 9	199.7	0.0	Large Box Corer	GKG	at sea bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/438-1	27.07.03	12:36	79° 6.47' N	4° 36.65' E	1926.8	S 10	93.4	0.4	Large Box Corer	GKG	on deck
PS64/439-1	27.07.03	12:55	79° 6.47' N	4° 36.48' E	1919.6	S 9	205.0	0.0	Multi corer	MUC	surface
PS64/439-1	27.07.03	13:29	79° 6.49' N	4° 36.38' E	1912.8	S 10	194.8	0.0	Multi corer	MUC	at sea bottom
PS64/439-1	27.07.03	14:07	79° 6.39' N	4° 36.56' E	1938.8	S 9	159.6	0.2	Multi corer	MUC	on deck
PS64/440-1	27.07.03	15:17	79° 4.85' N	4° 5.92' E	2499.2	S 8	206.7	0.0	Large Box Corer	GKG	surface
PS64/440-1	27.07.03	15:48	79° 4.79' N	4° 6.05' E	2500.0	S 7	225.2	0.0	Large Box Corer	GKG	at sea bottom
PS64/440-1	27.07.03	16:36	79° 4.56' N	4° 6.15' E	2506.8	S 6	129.9	0.2	Large Box Corer	GKG	on deck
PS64/441-1	27.07.03	17:02	79° 5.11' N	4° 6.15' E	2485.6	S 7	186.6	0.7	Large Box Corer	GKG	surface
PS64/441-1	27.07.03	17:35	79° 4.89' N	4° 5.77' E	2499.6	SSE 6	180.2	0.3	Large Box Corer	GKG	at sea bottom
PS64/441-1	27.07.03	18:20	79° 4.51' N	4° 4.64' E	2529.2	S 6	185.0	0.2	Large Box Corer	GKG	on deck
PS64/442-1	27.07.03	18:40	79° 5.28' N	4° 6.12' E	2478.8	S 6	235.8	0.3	Large Box Corer	GKG	surface
PS64/442-1	27.07.03	19:12	79° 5.22' N	4° 6.13' E	2482.0	S 6	180.1	0.2	Large Box Corer	GKG	at sea bottom
PS64/442-1	27.07.03	19:59	79° 4.92' N	4° 6.32' E	2492.8	S 6	204.7	0.9	Large Box Corer	GKG	on deck
PS64/443-1	27.07.03	23:31	79° 1.01' N	4° 19.93' E	2588.0	S 6	48.9	0.4	CTD/rosette water sampler	CTD/RO	surface
PS64/443-2	27.07.03	23:47	79° 1.03' N	4° 19.80' E	2586.8	SSE 7	311.8	0.2	Hand net	HN	surface
PS64/443-2	27.07.03	23:54	79° 1.02' N	4° 19.80' E	2586.8	SSE 6	202.2	0.1	Hand net	HN	on deck
PS64/443-1	28.07.03	00:21	79° 1.05' N	4° 19.69' E	2586.4	SSE 6	350.1	0.1	CTD/rosette water sampler	CTD/RO	at depth
PS64/443-1	28.07.03	01:11	79° 0.99' N	4° 19.79' E	2588.4	SSE 6	159.3	0.0	CTD/rosette water sampler	CTD/RO	on deck
PS64/444-1	28.07.03	02:31	78° 54.95' N	4° 59.85' E	2637.6	SE 6	11.0	0.4	Bottom water sampler	BWS	surface
PS64/444-1	28.07.03	03:22	78° 55.03' N	5° 0.03' E	2635.6	SE 6	144.4	0.1	Bottom water sampler	BWS	at sea bottom
PS64/444-1	28.07.03	03:29	78° 55.03' N	5° 0.01' E	2636.0	SE 6	301.0	0.1	Bottom water sampler	BWS	off bottom
PS64/444-1	28.07.03	04:17	78° 55.02' N	5° 0.17' E	2635.2	SE 6	145.0	0.0	Bottom water sampler	BWS	on deck
PS64/445-1	28.07.03	04:25	78° 55.03' N	5° 0.18' E	2635.2	SE 5	322.5	0.2	Multi corer	MUC	surface
PS64/445-1	28.07.03	05:12	78° 55.00' N	5° 0.08' E	2636.0	SSE 7	142.2	0.2	Multi corer	MUC	at sea bottom
PS64/445-1	28.07.03	06:00	78° 55.06' N	4° 59.94' E	2635.6	SSE 6	150.7	0.3	Multi corer	MUC	on deck
PS64/446-1	28.07.03	06:14	78° 55.00' N	5° 0.10' E	2635.6	SSE 6	325.8	0.3	Large Box Corer	GKG	surface
PS64/446-1	28.07.03	06:47	78° 55.01' N	5° 0.10' E	2635.6	SSE 5	324.4	0.2	Large Box Corer	GKG	at sea bottom
PS64/446-1	28.07.03	07:33	78° 54.98' N	5° 0.41' E	2635.2	SSE 5	148.3	0.5	Large Box Corer	GKG	on deck
PS64/447-1	28.07.03	08:37	79° 0.24' N	4° 25.69' E	2571.2	SSE 5	61.0	0.5	Mooring	MOR	Hydrophone into the water
PS64/447-1	28.07.03	08:39	79° 0.24' N	4° 25.77' E	2570.8	SSE 5	85.2	0.4	Mooring	MOR	released
PS64/447-1	28.07.03	08:41	79° 0.24' N	4° 25.84' E	2570.0	SSE 5	119.3	0.5	Mooring	MOR	Hydrophone on Deck
PS64/447-1	28.07.03	08:53	79° 0.10' N	4° 26.56' E	2568.8	SSE 5	35.8	0.8	Mooring	MOR	Hydrophone into the water
PS64/447-1	28.07.03	08:56	79° 0.13' N	4° 26.52' E	2568.0	SSE 5	326.6	0.4	Mooring	MOR	released

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/447-1	28.07.03	08:59	79° 0.14' N	4° 26.60' E	2566.4	SSE 5	29.1	0.7	Mooring	MOR	Hydrophone on Deck
PS64/447-1	28.07.03	09:20	79° 0.24' N	4° 27.08' E	2559.6	SE 5	321.9	0.2	Mooring	MOR	action
PS64/447-1	28.07.03	09:36	79° 0.15' N	4° 26.46' E	2568.0	SE 5	226.1	1.0	Mooring	MOR	on the surface
PS64/447-1	28.07.03	10:11	78° 59.87' N	4° 28.23' E	2562.0	SE 5	348.0	0.4	Mooring	MOR	on deck
PS64/447-1	28.07.03	10:21	78° 59.99' N	4° 28.38' E	2557.6	SSE 5	12.7	0.8	Mooring	MOR	on deck
PS64/447-1	28.07.03	10:44	79° 0.27' N	4° 29.22' E	2541.6	SE 5	339.0	1.0	Mooring	MOR	on deck
PS64/447-1	28.07.03	11:08	79° 0.45' N	4° 29.87' E	2532.0	SE 5	344.4	0.7	Mooring	MOR	on deck
PS64/447-1	28.07.03	11:17	79° 0.56' N	4° 29.78' E	2529.6	SE 5	336.5	0.8	Mooring	MOR	on deck
PS64/447-1	28.07.03	11:24	79° 0.62' N	4° 29.93' E	2526.0	SE 5	1.9	0.7	Mooring	MOR	on deck
PS64/447-1	28.07.03	11:26	79° 0.65' N	4° 29.87' E	2525.6	SE 5	332.8	1.0	Mooring	MOR	mooring on deck
PS64/448-1	28.07.03	17:03	78° 36.58' N	5° 3.65' E	2342.8	ESE 5	317.6	0.4	Remote operated vehicle	ROV	surface
PS64/448-1	28.07.03	17:14	78° 36.63' N	5° 3.76' E	2342.4	ESE 5	94.7	0.5	Remote operated vehicle	ROV	Depressor into water
PS64/448-1	28.07.03	18:46	78° 36.41' N	5° 4.67' E	0.0	E 5	128.3	0.3	Remote operated vehicle	ROV	at depth
PS64/448-1	29.07.03	07:07	78° 36.07' N	5° 6.23' E	0.0	ESE 4	115.9	0.0	Remote operated vehicle	ROV	coming back to the surface
PS64/448-1	29.07.03	08:34	78° 35.86' N	5° 8.18' E	0.0	ESE 4	116.8	0.6	Remote operated vehicle	ROV	coming back to the surface
PS64/448-1	29.07.03	08:37	78° 35.85' N	5° 8.30' E	2353.6	ESE 4	95.8	0.6	Remote operated vehicle	ROV	coming back to the surface
PS64/448-1	29.07.03	08:39	78° 35.84' N	5° 8.41' E	2354.4	ESE 4	113.7	0.9	Remote operated vehicle	ROV	Depressor on deck
PS64/448-1	29.07.03	09:07	78° 35.70' N	5° 9.25' E	2356.8	ESE 4	111.3	0.4	Remote operated vehicle	ROV	on deck
PS64/449-1	29.07.03	09:39	78° 36.43' N	5° 4.29' E	2342.4	ESE 4	168.8	0.3	Bottom water sampler	BWS	surface
PS64/449-1	29.07.03	10:44	78° 36.43' N	5° 4.58' E	2343.6	ESE 3	314.1	0.3	Bottom water sampler	BWS	at sea bottom
PS64/449-1	29.07.03	10:50	78° 36.44' N	5° 4.52' E	2343.2	ESE 3	42.5	0.3	Bottom water sampler	BWS	off bottom
PS64/449-1	29.07.03	11:50	78° 36.38' N	5° 4.74' E	2344.0	SE 3	192.4	0.3	Bottom water sampler	BWS	on deck
PS64/450-1	29.07.03	12:21	78° 36.29' N	5° 4.29' E	2343.2	S 3	181.4	0.3	Bottom lander	LANDER	surface
PS64/450-1	29.07.03	14:20	78° 36.28' N	5° 4.57' E	2343.2	SW 2	189.9	0.1	Bottom lander	LANDER	released
PS64/450-1	29.07.03	14:52	78° 36.28' N	5° 4.81' E	2343.6	WSW 3	284.6	0.3	Bottom lander	LANDER	on Deck
PS64/450-1	29.07.03	14:57	78° 36.28' N	5° 4.80' E	2343.6	WSW 3	123.1	0.0	Bottom lander	LANDER	surface
PS64/450-1	29.07.03	17:27	78° 36.28' N	5° 4.67' E	2342.8	W 4	105.3	0.1	Bottom lander	LANDER	released
PS64/450-1	29.07.03	18:01	78° 36.20' N	5° 4.82' E	2342.8	W 4	83.7	0.4	Bottom lander	LANDER	on Deck
PS64/451-1	29.07.03	18:26	78° 36.10' N	5° 6.27' E	2342.8	SW 5	301.3	0.0	Remote operated vehicle	ROV	surface

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/451-1	29.07.03	18:37	78° 36.09' N	5° 6.36' E	0.0	WSW 5	110.0	0.1	Remote operated vehicle	ROV	Depressor into water
PS64/451-1	29.07.03	23:15	78° 36.18' N	5° 4.17' E	0.0	SW 8	154.7	0.2	Remote operated vehicle	ROV	Information
PS64/451-1	29.07.03	23:18	78° 36.18' N	5° 4.13' E	0.0	SW 8	291.3	0.4	Remote operated vehicle	ROV	Information
PS64/451-1	29.07.03	23:21	78° 36.19' N	5° 4.05' E	0.0	SW 8	309.8	0.3	Remote operated vehicle	ROV	Information
PS64/451-1	29.07.03	23:25	78° 36.20' N	5° 4.11' E	0.0	SW 8	59.1	0.3	Remote operated vehicle	ROV	Information
PS64/451-1	29.07.03	23:53	78° 36.12' N	5° 3.84' E	0.0	SW 7	53.0	0.5	Remote operated vehicle	ROV	Information
PS64/451-1	29.07.03	23:54	78° 36.13' N	5° 3.88' E	0.0	SW 8	63.2	0.5	Remote operated vehicle	ROV	Information
PS64/451-1	29.07.03	23:56	78° 36.14' N	5° 3.96' E	0.0	SSW 8	73.3	0.5	Remote operated vehicle	ROV	Information
PS64/451-1	30.07.03	00:23	78° 36.17' N	5° 4.05' E	0.0	SSW 9	42.7	0.1	Remote operated vehicle	ROV	Information
PS64/451-1	30.07.03	00:28	78° 36.18' N	5° 4.08' E	0.0	SSW 8	46.1	0.2	Remote operated vehicle	ROV	Information
PS64/451-1	30.07.03	00:38	78° 36.23' N	5° 4.15' E	0.0	SSW 10	293.3	0.0	Remote operated vehicle	ROV	Information
PS64/451-1	30.07.03	00:55	78° 36.14' N	5° 4.01' E	0.0	SW 9	233.1	0.3	Remote operated vehicle	ROV	Information
PS64/451-1	30.07.03	00:57	78° 36.14' N	5° 3.99' E	0.0	SSW 10	219.2	0.3	Remote operated vehicle	ROV	Information
PS64/451-1	30.07.03	01:17	78° 36.23' N	5° 4.19' E	0.0	SSW 9	358.0	0.6	Remote operated vehicle	ROV	Information
PS64/451-1	30.07.03	11:55	78° 36.25' N	5° 4.28' E	0.0	SSW 12	34.8	0.4	Remote operated vehicle	ROV	Information
PS64/451-2	30.07.03	16:48	78° 36.18' N	5° 4.15' E	0.0	SSW 12	304.8	0.2	Hand net	HN	surface
PS64/451-2	30.07.03	16:57	78° 36.22' N	5° 4.41' E	2329.0	SSW 12	52.9	0.5	Hand net	HN	on deck
PS64/451-1	30.07.03	18:24	78° 36.18' N	5° 4.43' E	0.0	SSW 12	333.9	0.2	Remote operated vehicle	ROV	coming back to the surface
PS64/451-1	30.07.03	19:42	78° 35.74' N	5° 3.25' E	2348.4	S 11	199.0	0.2	Remote operated vehicle	ROV	Depressor on deck
PS64/451-1	30.07.03	20:09	78° 35.79' N	5° 2.77' E	2350.8	S 10	339.0	0.3	Remote operated vehicle	ROV	on deck
PS64/452-1	30.07.03	20:30	78° 36.54' N	5° 4.68' E	2343.6	S 10	150.2	0.6	Large Box Corer	GKG	surface
PS64/452-1	30.07.03	21:00	78° 36.49' N	5° 4.41' E	2342.8	S 9	187.1	0.0	Large Box Corer	GKG	at sea bottom
PS64/452-1	30.07.03	21:44	78° 36.50' N	5° 4.41' E	2343.2	SSE 7	356.7	0.2	Large Box Corer	GKG	on deck
PS64/453-1	30.07.03	22:06	78° 36.52' N	5° 4.38' E	2343.2	SSE 7	1.9	0.2	Multi corer	MUC	surface
PS64/453-1	30.07.03	22:50	78° 36.50' N	5° 4.32' E	2343.2	SSE 12	181.0	0.2	Multi corer	MUC	at sea bottom
PS64/453-1	30.07.03	23:35	78° 36.46' N	5° 3.92' E	2344.0	SE 9	260.1	0.2	Multi corer	MUC	on deck
PS64/454-1	31.07.03	01:57	78° 55.13' N	5° 0.09' E	2634.8	SE 11	152.3	0.6	Large Box Corer	GKG	surface
PS64/454-1	31.07.03	02:29	78° 55.01' N	5° 0.27' E	2636.8	SSE 12	157.1	0.4	Large Box Corer	GKG	at sea bottom
PS64/454-1	31.07.03	03:20	78° 54.98' N	5° 0.49' E	2636.8	S 10	149.0	0.0	Large Box Corer	GKG	on deck
PS64/455-1	31.07.03	03:34	78° 54.96' N	5° 0.43' E	2637.2	S 10	354.0	0.3	Large Box Corer	GKG	surface
PS64/455-1	31.07.03	04:09	78° 54.97' N	5° 0.24' E	2637.2	S 10	203.3	0.3	Large Box Corer	GKG	at sea bottom
PS64/455-1	31.07.03	04:56	78° 54.98' N	5° 0.21' E	2636.8	SW 9	199.6	0.0	Large Box Corer	GKG	on deck
PS64/456-1	31.07.03	05:11	78° 54.98' N	5° 0.10' E	2637.2	WSW 9	169.3	0.2	Large Box Corer	GKG	surface

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/456-1	31.07.03	05:46	78° 54.97' N	5° 0.04' E	2637.6	WSW 10	210.8	0.0	Large Box Corer	GKG	at sea bottom
PS64/456-1	31.07.03	06:35	78° 54.91' N	5° 0.25' E	2637.6	WSW 8	199.1	0.3	Large Box Corer	GKG	on deck
PS64/457-1	31.07.03	07:12	78° 56.03' N	4° 59.74' E	2608.4	SW 7	151.3	0.4	Bottom lander	LANDER	surface
PS64/458-1	31.07.03	10:13	79° 4.31' N	4° 8.19' E	2495.2	SSW 10	131.7	0.5	Remote operated vehicle	ROV	surface
PS64/458-1	31.07.03	10:24	79° 4.24' N	4° 8.48' E	2493.2	SSW 10	106.7	0.3	Remote operated vehicle	ROV	Depressor into water
PS64/458-1	31.07.03	11:04	79° 4.10' N	4° 8.42' E	0.0	S 9	199.0	0.2	Remote operated vehicle	ROV	Information
PS64/458-1	31.07.03	11:55	79° 4.38' N	4° 7.75' E	0.0	S 8	134.0	0.4	Remote operated vehicle	ROV	at depth
PS64/458-2	31.07.03	14:22	79° 4.44' N	4° 7.85' E	0.0	S 8	168.3	0.3	Hand net	HN	surface
PS64/458-2	31.07.03	14:29	79° 4.43' N	4° 7.89' E	2437.0	S 8	299.9	0.0	Hand net	HN	on deck
PS64/458-1	31.07.03	21:45	79° 4.41' N	4° 7.81' E	0.0	SW 13	37.6	0.3	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	01:25	79° 4.36' N	4° 7.51' E	0.0	SSW 7	176.1	0.6	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	02:50	79° 2.80' N	4° 4.97' E	0.0	SSW 9	190.0	0.3	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	08:12	79° 4.36' N	4° 8.05' E	0.0	SSW 9	305.9	0.9	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	08:20	79° 4.37' N	4° 7.47' E	0.0	SSW 9	338.8	0.5	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	09:17	79° 4.35' N	4° 7.38' E	0.0	SW 9	24.7	0.8	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	09:33	79° 4.53' N	4° 7.48' E	0.0	SW 10	33.3	0.5	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	09:36	79° 4.53' N	4° 7.51' E	0.0	SW 10	163.8	0.2	Remote operated vehicle	ROV	Shuttle
PS64/458-1	01.08.03	09:59	79° 4.57' N	4° 7.44' E	0.0	SSW 10	257.6	0.1	Remote operated vehicle	ROV	Shuttle
PS64/458-1	01.08.03	10:16	79° 4.55' N	4° 7.79' E	0.0	SSW 11	165.4	1.4	Remote operated vehicle	ROV	Shuttle
PS64/458-1	01.08.03	10:30	79° 4.15' N	4° 8.91' E	0.0	SSW 10	214.1	1.1	Remote operated vehicle	ROV	coming back to the surface
PS64/458-1	01.08.03	10:38	79° 4.17' N	4° 9.13' E	0.0	SSW 10	70.4	0.8	Remote operated vehicle	ROV	Shuttle
PS64/458-1	01.08.03	11:30	79° 3.98' N	4° 8.69' E	0.0	SW 10	196.0	0.5	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	11:35	79° 3.95' N	4° 8.62' E	0.0	SSW 10	207.1	0.6	Remote operated vehicle	ROV	Information
PS64/458-1	01.08.03	12:26	79° 3.82' N	4° 8.49' E	0.0	SW 10	132.6	0.2	Remote operated vehicle	ROV	Depressor on deck
PS64/458-1	01.08.03	13:00	79° 3.54' N	4° 9.15' E	2490.0	SW 9	187.2	0.7	Remote operated vehicle	ROV	on deck
PS64/459-1	01.08.03	14:30	79° 3.42' N	3° 29.16' E	3982.0	W 8	139.0	0.4	Bottom water sampler	BWS	surface
PS64/459-1	01.08.03	15:52	79° 3.52' N	3° 29.41' E	3964.4	W 7	131.9	0.1	Bottom water sampler	BWS	at sea bottom
PS64/459-1	01.08.03	15:59	79° 3.52' N	3° 29.41' E	3965.6	W 7	269.8	0.0	Bottom water sampler	BWS	off bottom
PS64/459-1	01.08.03	17:01	79° 3.51' N	3° 29.29' E	3969.2	W 6	187.5	0.2	Bottom water sampler	BWS	on deck
PS64/460-1	01.08.03	19:29	78° 56.04' N	4° 59.23' E	2610.8	W 6	169.7	0.6	Bottom lander	LANDER	released
PS64/460-1	01.08.03	19:50	78° 55.95' N	4° 59.23' E	2614.4	W 7	69.1	0.6	Bottom lander	LANDER	released
PS64/460-1	01.08.03	20:11	78° 55.95' N	4° 59.96' E	2611.2	W 5	75.2	0.5	Bottom lander	LANDER	released
PS64/460-1	01.08.03	20:14	78° 55.96' N	5° 0.09' E	2610.8	W 6	79.9	0.4	Bottom lander	LANDER	Information

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/460-1	01.08.03	20:51	78° 55.95' N	5° 0.16' E	2610.8	W 6	355.7	1.1	Bottom lander	LANDER	Information
PS64/460-1	01.08.03	21:01	78° 56.05' N	4° 59.98' E	2608.0	WNW 7	151.4	0.3	Bottom lander	LANDER	on Deck
PS64/461-1	01.08.03	21:31	78° 56.05' N	4° 59.74' E	2609.2	WNW 5	22.8	0.5	Large Box Corer	GKG	surface
PS64/461-1	01.08.03	22:02	78° 56.02' N	4° 59.60' E	2610.4	WNW 4	173.9	0.2	Large Box Corer	GKG	at sea bottom
PS64/461-1	01.08.03	22:53	78° 56.00' N	4° 59.54' E	2611.2	NW 5	27.3	0.5	Large Box Corer	GKG	on deck
PS64/462-1	01.08.03	23:10	78° 56.03' N	4° 59.66' E	2610.0	NNW 6	260.8	0.0	Large Box Corer	GKG	surface
PS64/462-1	01.08.03	23:42	78° 56.04' N	4° 59.62' E	2610.0	NNW 4	45.1	0.4	Large Box Corer	GKG	at sea bottom
PS64/462-1	02.08.03	00:28	78° 56.11' N	4° 59.65' E	2607.6	NNW 3	339.8	0.2	Large Box Corer	GKG	on deck
PS64/463-1	02.08.03	00:45	78° 56.08' N	4° 59.64' E	2609.2	N 1	350.0	0.3	Large Box Corer	GKG	surface
PS64/463-1	02.08.03	01:19	78° 56.21' N	4° 59.18' E	2606.0	NW 0	290.4	0.2	Large Box Corer	GKG	at sea bottom
PS64/463-1	02.08.03	02:06	78° 56.26' N	4° 58.66' E	2606.0	NNW 2	215.9	0.0	Large Box Corer	GKG	on deck
PS64/464-1	02.08.03	04:36	79° 3.63' N	3° 28.77' E	3988.0	NNE 4	221.5	0.3	Multi corer	MUC	surface
PS64/464-1	02.08.03	05:53	79° 3.57' N	3° 28.49' E	4097.6	ENE 2	49.9	0.1	Multi corer	MUC	at sea bottom
PS64/464-1	02.08.03	07:11	79° 3.66' N	3° 28.52' E	4022.8	NE 3	67.2	0.1	Multi corer	MUC	on deck
PS64/465-1	02.08.03	07:23	79° 3.65' N	3° 28.63' E	4011.6	ENE 3	86.7	0.1	Large Box Corer	GKG	surface
PS64/465-1	02.08.03	08:14	79° 3.58' N	3° 28.79' E	4003.2	ENE 3	30.0	0.2	Large Box Corer	GKG	at sea bottom
PS64/465-1	02.08.03	09:28	79° 3.51' N	3° 29.62' E	3959.6	E 4	96.7	0.2	Large Box Corer	GKG	on deck
PS64/466-1	02.08.03	10:14	79° 4.47' N	3° 19.77' E	5218.8	E 3	255.0	0.3	Bottom water sampler	BWS	surface
PS64/466-1	02.08.03	11:56	79° 4.46' N	3° 19.64' E	5218.8	E 3	48.2	0.2	Bottom water sampler	BWS	at sea bottom
PS64/466-1	02.08.03	12:03	79° 4.46' N	3° 19.68' E	5218.0	E 3	265.8	0.0	Bottom water sampler	BWS	off bottom
PS64/466-1	02.08.03	13:39	79° 4.38' N	3° 20.32' E	5213.2	ESE 4	227.7	0.3	Bottom water sampler	BWS	on deck
PS64/467-1	02.08.03	13:46	79° 4.36' N	3° 20.13' E	5210.0	ESE 5	244.8	0.3	Multi corer	MUC	surface
PS64/467-1	02.08.03	15:17	79° 3.85' N	3° 20.16' E	5098.8	ESE 2	211.1	0.3	Multi corer	MUC	at sea bottom
PS64/467-1	02.08.03	16:55	79° 3.80' N	3° 18.16' E	5115.2	E 3	325.4	4.4	Multi corer	MUC	on deck
PS64/468-1	02.08.03	22:13	79° 4.48' N	3° 19.91' E	5219.2	NNE 2	36.8	0.2	Large Box Corer	GKG	surface
PS64/468-1	02.08.03	23:16	79° 4.47' N	3° 20.01' E	5219.2	N 4	19.6	0.1	Large Box Corer	GKG	at sea bottom
PS64/468-1	03.08.03	00:48	79° 4.90' N	3° 21.39' E	4969.2	N 2	63.0	0.3	Large Box Corer	GKG	on deck
PS64/469-1	03.08.03	01:53	79° 8.15' N	2° 50.58' E	5577.6	N 4	150.7	0.5	Bottom water sampler	BWS	surface
PS64/469-1	03.08.03	03:41	79° 8.22' N	2° 50.77' E	5578.4	N 4	332.9	0.2	Bottom water sampler	BWS	at sea bottom
PS64/469-1	03.08.03	03:48	79° 8.22' N	2° 50.73' E	5578.8	N 4	343.8	0.0	Bottom water sampler	BWS	off bottom
PS64/469-1	03.08.03	05:31	79° 7.72' N	2° 49.08' E	5560.4	N 5	353.7	3.7	Bottom water sampler	BWS	on deck
PS64/470-1	03.08.03	05:45	79° 8.28' N	2° 51.98' E	5576.8	N 5	264.6	0.5	Large Box Corer	GKG	surface
PS64/470-1	03.08.03	06:55	79° 8.01' N	2° 49.19' E	5580.8	NNW 5	310.0	0.1	Large Box Corer	GKG	at sea bottom
PS64/470-1	03.08.03	08:36	79° 7.93' N	2° 45.91' E	5539.2	NNW 6	258.4	0.3	Large Box Corer	GKG	on deck
PS64/471-1	03.08.03	09:00	79° 8.29' N	2° 51.73' E	5576.4	NNW 6	203.2	0.3	Multi corer	MUC	surface
PS64/471-1	03.08.03	10:38	79° 7.99' N	2° 50.73' E	5573.6	NNW 7	167.1	0.5	Multi corer	MUC	at sea bottom

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/471-1	03.08.03	12:16	79° 7.93' N	2° 50.85' E	5572.8	NNW 5	13.4	0.2	Multi corer	MUC	on deck
PS64/472-1	03.08.03	14:30	79° 0.95' N	4° 20.54' E	2584.8	NNW 8	279.9	1.1	Mooring (year)	MOORY	surface
PS64/472-1	03.08.03	14:35	79° 0.96' N	4° 20.28' E	2586.0	NNW 8	149.1	0.2	Mooring (year)	MOORY	surface
PS64/472-1	03.08.03	14:47	79° 0.98' N	4° 20.06' E	2586.8	NNW 7	9.8	0.2	Mooring (year)	MOORY	surface
PS64/472-1	03.08.03	15:02	79° 0.97' N	4° 19.99' E	2587.6	NNW 8	326.7	0.0	Mooring (year)	MOORY	surface
PS64/472-1	03.08.03	15:53	79° 0.99' N	4° 19.99' E	2586.8	NNW 7	334.2	0.0	Mooring (year)	MOORY	surface
PS64/472-1	03.08.03	15:57	79° 0.99' N	4° 19.99' E	2586.8	NNW 6	335.0	0.0	Mooring (year)	MOORY	surface
PS64/472-1	03.08.03	16:17	79° 0.99' N	4° 19.97' E	2586.8	NNW 6	136.7	0.1	Mooring (year)	MOORY	surface
PS64/472-1	03.08.03	16:22	79° 0.98' N	4° 20.02' E	2587.6	NNW 6	352.5	0.2	Mooring (year)	MOORY	surface
PS64/472-1	03.08.03	16:28	79° 1.00' N	4° 19.99' E	2586.4	NNW 5	245.5	0.3	Mooring (year)	MOORY	surface
PS64/473-1	03.08.03	16:46	79° 1.64' N	4° 15.53' E	2595.6	NW 5	302.4	0.2	CTD/rosette water sampler	CTD/RO	surface
PS64/473-2	03.08.03	16:50	79° 1.65' N	4° 15.42' E	2595.6	NW 5	273.3	0.3	Hand net	HN	surface
PS64/473-2	03.08.03	16:56	79° 1.64' N	4° 15.37' E	2596.4	NW 5	198.0	0.4	Hand net	HN	on deck
PS64/473-1	03.08.03	18:20	79° 1.61' N	4° 14.25' E	2600.0	NW 5	293.9	0.3	CTD/rosette water sampler	CTD/RO	on deck
PS64/474-1	03.08.03	18:42	79° 3.38' N	4° 18.83' E	4864.0	NW 5	218.7	0.4	Colonization Tray	CTR	to water
PS64/474-1	03.08.03	18:50	79° 3.36' N	4° 18.72' E	2432.0	NW 5	220.8	0.2	Colonization Tray	CTR	released
PS64/474-1	03.08.03	18:51	79° 3.36' N	4° 18.70' E	2432.4	NW 6	177.2	0.3	Colonization Tray	CTR	hydrophon into water
PS64/474-1	03.08.03	19:03	79° 3.34' N	4° 18.68' E	0.0	NW 5	142.6	0.5	Colonization Tray	CTR	hydrophon on deck
PS64/475-1	03.08.03	19:36	79° 4.30' N	4° 19.30' E	2340.8	NW 5	354.7	0.5	Colonization Tray	CTR	to water
PS64/475-1	03.08.03	19:41	79° 4.28' N	4° 19.23' E	2342.8	NW 5	185.9	0.5	Colonization Tray	CTR	released
PS64/476-1	03.08.03	21:22	79° 17.03' N	4° 20.16' E	2402.0	WNW 6	273.5	0.6	Bottom water sampler	BWS	surface
PS64/476-1	03.08.03	22:10	79° 16.99' N	4° 20.04' E	2401.2	WNW 6	198.6	0.0	Bottom water sampler	BWS	at sea bottom
PS64/476-1	03.08.03	22:17	79° 16.99' N	4° 20.06' E	2401.2	WNW 6	203.6	0.0	Bottom water sampler	BWS	off bottom
PS64/476-1	03.08.03	23:02	79° 16.98' N	4° 19.83' E	2402.8	WNW 6	179.9	0.2	Bottom water sampler	BWS	on deck
PS64/477-1	03.08.03	23:09	79° 17.00' N	4° 19.88' E	2402.8	WNW 6	26.0	0.3	Multi corer	MUC	surface
PS64/477-1	03.08.03	23:53	79° 16.97' N	4° 20.06' E	2400.8	NW 6	133.6	0.1	Multi corer	MUC	at sea bottom
PS64/477-1	04.08.03	00:42	79° 16.90' N	4° 19.21' E	2403.6	NW 6	229.0	0.0	Multi corer	MUC	on deck
PS64/478-1	04.08.03	00:51	79° 16.92' N	4° 19.26' E	2404.0	WNW 6	34.7	0.1	Large Box Corer	GKG	surface
PS64/478-1	04.08.03	01:22	79° 16.99' N	4° 19.71' E	2403.6	WNW 6	54.3	0.2	Large Box Corer	GKG	at sea bottom
PS64/478-1	04.08.03	02:09	79° 17.14' N	4° 20.31' E	2408.0	W 6	38.4	0.6	Large Box Corer	GKG	on deck
PS64/479-1	04.08.03	03:28	79° 25.03' N	4° 41.11' E	2570.4	W 5	344.8	0.1	Bottom water sampler	BWS	surface
PS64/479-1	04.08.03	04:17	79° 24.96' N	4° 41.19' E	2565.6	W 5	174.5	0.2	Bottom water sampler	BWS	at sea bottom
PS64/479-1	04.08.03	04:26	79° 24.92' N	4° 41.23' E	2563.6	W 5	101.3	0.3	Bottom water sampler	BWS	off bottom
PS64/479-1	04.08.03	05:12	79° 24.80' N	4° 41.58' E	2555.6	W 5	350.5	0.1	Bottom water sampler	BWS	on deck

Station	Date	Time	PositionLat	PositionLon	Depth [m]	Windstrength [m/s]	Course [°]	Speed [kn]	Gear	Gear Abbreviation	Action
PS64/480-1	04.08.03	05:22	79° 24.74' N	4° 41.55' E	2552.8	W 6	204.2	0.4	Multi corer	MUC	surface
PS64/480-1	04.08.03	06:05	79° 24.61' N	4° 41.72' E	2545.6	W 6	168.1	0.2	Multi corer	MUC	at sea bottom
PS64/480-1	04.08.03	06:52	79° 24.54' N	4° 41.55' E	2543.2	W 5	241.5	0.2	Multi corer	MUC	on deck
PS64/481-1	04.08.03	07:06	79° 24.50' N	4° 41.28' E	2542.4	W 5	234.6	0.3	Large Box Corer	GKG	surface
PS64/481-1	04.08.03	07:40	79° 24.48' N	4° 40.85' E	2542.4	WSW 5	247.1	0.2	Large Box Corer	GKG	at sea bottom
PS64/481-1	04.08.03	08:26	79° 24.46' N	4° 39.87' E	2546.0	WSW 4	232.3	0.4	Large Box Corer	GKG	on deck
PS64/482-1	04.08.03	10:38	79° 3.87' N	4° 10.94' E	2464.4	SW 7	347.7	0.7	Bottom lander	LANDER	surface
PS64/483-1	04.08.03	13:30	78° 46.94' N	5° 20.11' E	2471.6	SW 6	173.9	0.2	Bottom water sampler	BWS	surface
PS64/483-1	04.08.03	14:20	78° 46.85' N	5° 19.80' E	2471.2	SSW 6	253.6	0.1	Bottom water sampler	BWS	at sea bottom
PS64/483-1	04.08.03	14:27	78° 46.85' N	5° 19.78' E	2471.6	SSW 6	287.9	0.2	Bottom water sampler	BWS	off bottom
PS64/483-1	04.08.03	15:23	78° 46.86' N	5° 19.60' E	2475.2	SW 6	49.4	0.1	Bottom water sampler	BWS	on deck
PS64/484-1	04.08.03	15:27	78° 46.86' N	5° 19.61' E	2475.2	SW 5	310.1	0.0	Multi corer	MUC	surface
PS64/484-1	04.08.03	16:17	78° 46.79' N	5° 19.49' E	2474.0	SSW 6	280.9	0.3	Multi corer	MUC	at sea bottom
PS64/484-1	04.08.03	17:04	78° 46.86' N	5° 18.42' E	2497.2	SSW 6	220.1	0.3	Multi corer	MUC	on deck
PS64/485-1	04.08.03	17:16	78° 46.90' N	5° 18.39' E	2499.2	SW 5	13.4	0.3	Large Box Corer	GKG	surface
PS64/485-1	04.08.03	17:46	78° 47.05' N	5° 18.36' E	2500.4	SSW 6	252.7	1.0	Large Box Corer	GKG	at sea bottom
PS64/485-1	04.08.03	18:28	78° 47.28' N	5° 18.44' E	2497.2	SSW 6	262.2	0.4	Large Box Corer	GKG	on deck
PS64/486-1	04.08.03	19:48	78° 36.44' N	5° 4.78' E	2342.8	SSW 6	240.4	0.1	Bottom lander, profile	BL_P	surface
PS64/486-1	04.08.03	19:51	78° 36.43' N	5° 4.80' E	2342.4	SSW 7	63.6	0.1	Bottom lander, profile	BL_P	released

E. Participating institutes / companies

	Acronym	Participants
Alfred Wegener Institute for Polar and Marine Research Columbusstr. 27568 Bremerhaven Germany	AWI	29
Akademie der Wissenschaften und der Literatur Geschwister-Scholl-Str. 2 55131 Mainz Germany	AWL	1
Department of Geology University College Dublin Belfield Dublin 4 Ireland	UCD	1
Department of Geology & Environment Research Institute University College Cork Cork Ireland	UCC	4
Department of Marine Sciences University of Plymouth Plymouth Devon, PL4 8AA United Kingdom	U Plymouth	1
Deutscher Wetterdienst Bernhard-Nocht Straße 20359 Hamburg Germany	DWD	5
FIELAX Gesellschaft für wissenschaftliche Datenverarbeitung mbH Schifferstr. 10 - 14 27568 Bremerhaven Germany	FIELAX	2 (6)
Friedrich-Schiller-Universität Jena Institut für Geowissenschaften Burgweg 11 07749 Jena Germany	U Jena	1

	Acronym	Participants
GENAVIR Zone Portuaire de Brégaillon B.P. 330 83507 La Seyne sur mer Cedex France	GENAVIR	28
Geological Survey of Ireland Beggars Bush, Haddington Road Dublin 4 Ireland	GSI	1
GEOMAR Forschungszentrum für Marine Geowissenschaften Wischhofstr. 1-3 24148 Kiel Germany	GEOMAR	1
Institut français de recherche pour l'exploitation de la mer BP70 29280 Plouzane France	IFREMER	16
Institut Royales des Sciences Naturelles de Belgique Rue Vautier 19 9000 Bruxelles Belgium	IRSNB	2
Institute for Applied Physics of the Russian Academy of Sciences Nishny Novgorod Russia	IAP	1
Institute for Polar Ecology of Kiel University Wischhofstr. 1-3 24148 Kiel Germany	IPÖ	1
Institute of Oceanology of the Polish Academy of Sciences P.B. 68 81-712 Sopot Poland	IOPAS	2
International University Bremen Campusring 1 28759 Bremen Germany	IUB	7

	Acronym	Participants
iSiTEC GmbH Stresemannstr. 46 27570 Bremerhaven Germany	ISITEC	1
Martin Ryan Marine Science Institute National University of Ireland Galway Ireland	NUIG	3
Max Planck Institute for Marine Microbiology Celsiusstr. 1 28359 Bremen Germany	MPI	9
Murmansk Marine Biological Institute Vladimirskaya Str. 17 183010 Murmansk Russia	MMBI	1
OPTIMARE Coloradostr. 5 27580 Bremerhaven Germany	OPTIMARE	1
P.P. Shirshov Institute of Oceanology of the Russian Academy of Sciences 23 Krasikova 117851 Moscow, Russia	SIO	1
Reederei F. Laeisz GmbH Barkhausenstr. 37 27568 Bremerhaven Germany	FL	43
Renard Centre of Marine Geology Department of Geology and Soil Science University of Ghent Krijgslaan 281 S8 9000 Gent Belgium	RCMG	2
School of Ocean Sciences University of Wales Bangor Askew Street Menai Bridge, LL59 5AB United Kingdom	SOS	1

	Acronym	Participants
Scottish Association for Marine Science Dunstaffnage Marine Laboratory Oban, Argyll, PA37 1QA United Kingdom	SAMS	1
Universität Bremen Klagenfurter Str. FB 5 Geowissenschaften 28334 Bremen Germany	U Bremen	3
Universität Erlangen Institute of Paleontology Loewenichstr. 28 91054 Erlangen Germany	U Erlangen	3
University Ghent Marine Biology Section Krijgslaan 281/S8 B-9000 Gent Belgium	U Ghent	2

F. Participants

F. 1 Participants ARK XIX/3a

Baussan	Clément	Genavir
Beck	Tim	U Erlangen
Beraud	Severine	Genavir
Berov	Dimitar	IUB
Beyer	Andreas	AWI
Boda	Mathieu	Genavir
Boge	Carsten	U Erlangen (TV)
Bohlmann	Harald	Isitec
Brennan	Clare	U Cork
Buldt	Klaus	DWD
Cheilan	Patrick	Genavir
Christophe	Alain	Genavir
Coudray	Sylvain	Ifremer
Dabrowski	Peter	IUB
Devanathan	Vinod	IUB
Dorschel	Boris	U Bremen
Fauvin	Olivier	Genavir
Foubert	Anneleen	RCMG Ghent
Gault	Jeremy	U Cork
Gektidis	Marcos	U Erlangen (TV)
Grehan	Anthony	U Galway
Guinan	Janine	U Galway
Gutt	Julian	AWI
Hall-Spencer	Jason	U Plymouth
Jouffroy	Jérome	Ifremer
Kaioun	Jean-Jacques	Genavir
Klages	Michael	AWI
Kozachenko	Max	U Cork
Krocker	Ralf	AWI
Kulaksiz	Serkan	IUB
Laurantin	Gérard	Genavir
Möller	Hans-Joachim	DWD
Monteys	Francisco X.	GSI Dublin
Opderbecke	Jan	Ifremer
Pfannkuche	Olaf	GEOMAR
Pokorná	Markéta	AWI
Rathlau	Rike	AWI
Roberts	John Murray	SAMS
Saint-Laurent	Xavier	Ifremer
Sharma	Pradesh	IUB
Sumoondur	Aryani Devi	IUB
Thiede	Jörn	AWI
Thomsen	Laurenz	IUB
Tous	Jean-Yves	Genavir
Tseu	George	RCMG Ghent
Unnithan	Vikram	U Dublin

Vultaggio	Gérard	Genavir
Wheeler	Andy	U Cork
Wilson	Margaret	U Galway

F. 2 Participants *A*RK XIX/3b

Armando	Magali	Genavir
Baumann	Ludmila	AWI
Beer, de	Dirk	MPI
Beier	Viola	MPI
Bergmann	Melanie	SOS
Beyer	Andreas	AWI
Bisquay	Hervé	Ifremer
Boetius	Antje	AWI
Bohlmann	Harald	Isitec
Buldt	Klaus	DWD
Duchi	Christophe	Genavir
Edy	Christian	Ifremer
Eickert	Gabriele	MPI
Fenouil	Julien	Genavir
Feseker	Tomas	AWI
Foucher	Jean-Paul	Ifremer
Gensheimer	Michael	AWI
Gini	Marc	Genavir
Heesemann	Bernd	U Bremen
Heinrich	Friederike	MPI
Jaussaud	Patrick	Genavir
Jerosch	Kerstin	AWI
Kanzog	Corinna	AWI
Kaul	Norbert	U Bremen
Klages	Michael	AWI
Kukina	Natalia	MMBI
Leclere	Guy	Genavir
Lensch	Norbert	AWI
Mear	Laurent	Ifremer
Müller	Imke	MPI
Muyakshin	Sergey	IAP
Niemann	Helge	MPI
Nordhausen	Axel	MPI
Potier	Yves	Genavir
Rathlau	Rike	AWI
Richard	Serge	Genavir
Rogenhagen	Johannes	Fielax
Rohr	Harald	Optimare
Sauter	Eberhard	AWI
Schlesier	Anne-Katrin	MPI
Schlüter	Michael	AWI
Siméoni	Patrick	Ifremer
Sußebach	Jürgen	DWD
Tailliez	Luc	Genavir
Triger	Pierre	Genavir
Usbeck	Regina	Fielax
Vanreusel	Ann	U Ghent

Vincent	Anne-Gaelle	Ifremer
Wegner	Jan	AWI
Witte	Ursula	MPI

F. 3 Participants ARK XIX/3c

Bauerfeind	Eduard	AWI
Baumann	Ludmila	AWI
Baussan	Clément	Genavir
Bergmann	Melanie	SOS
Boda	Mathieu	Genavir
Bohlmann	Harald	Isitec
Bonfiglio	André	Genavir
Broyer, de	Claude	IRSNB
Budaeva	Natalia	SIO
Chopin	Jean Pierre	Genavir
Christophe	Alain	Genavir
Delius	Judith	AWI
Dittmer	Klaus	DWD
Fauvin	Olivier	Genavir
Galgani	François	Ifremer
Hasemann	Christiane	AWI
Hoste	Eveline	U Ghent
Jankowska	Katarzyna	IOPAS
Juterzenka, von	Karen	AWI
Kaioun	Jean-Jacques	Genavir
Kanzog	Corinna	AWI
Klages	Michael	AWI
Kolar	Ingrid	AWI
Kukina	Natalia	MMBI
Kunz-Pirrung	Martina	AWI
Laurantin	Gérard	Genavir
Lecornu	Fabrice	Ifremer
Lubin	Patrice	Ifremer
Martin	Patrick	IRNSB
Matthiessen	Jens	AWI
Piepenburg	Dieter	IPÖ
Pirrung	Bernd Michael	U Jena
Potthoff	Michael	AWI
Röhrlich	Dagmar	Deutschlandfunk
Sablotny	Burkhard	AWI
Saint-Laurent	Xavier	Genavir
Sauter	Eberhard	AWI
Schewe	Ingo	AWI
Schmid	Michael	AWI
Soltwedel	Thomas	AWI
Sonnabend	Hartmut	DWD
Tous	Jean-Yves	Genavir
Urban-Malinga	Barbara	IOPAS
Vultaggio	Gérard	Genavir
Wegner	Jan	AWI

F. 4 Ship's Crew ARK XIX/3

Domke	Udo	Master
Grundmann	Uwe	1. Offc.
Pluder	Andreas	Ch. Eng.
Spielke	Steffen	2. Offc.
Hartung	René	2. Offc.
Peine	Lutz	2. Offc.
Schneider	Martina	Doctor
Koch	Georg	R.Offc.
Delff	Wolfgang	1. Eng.
Ziemann	Olaf	2. Eng.
Zornow	Martin	3. Eng.
Muhle	Heiko	Electr.
Bretfeld	Holger	FielaxElo
Muhle	Helmut	FielaxElo
Verhoeven	Roger	FielaxElo
Roschinsky	Jörg	FielaxElo
Loidl	Reiner	Boatsw.
Reise	Lutz	Carpenter
Gil Iglesias	Luis	A.B.
Pousada Martinez	S.	A.B.
Winkler	Michael	A.B.
Hagemann	Manfred	A.B.
Schmidt	Uwe	A.B.
Bastigkeit	Kai	A.B.
Hartwig-Labahn	Andreas	A.B.
Bäcker	Andreas	A.B.
Preußner	Jörg	Storekeeper
Ipsen	Michael	Mot-man
Voy	Bernd	Mot-man
Elsner	Klaus	Mot-man
Hartmann	Ernst-Uwe	Mot-man
Grafe	Jens	Mot-man
Haubold	Wolfgang	Cook
Völske	Thomas	Cooksmate
Silinski	Frank	Cooksmate
Jürgens	Monika	1. Stwdess
Wöckener	Martina	Stwdss/KS
Czyborra	Bärbel	2. Stwdess
Silinski	Carmen	2. Stwdess
Gaude	Hans-Jürgen	2. Steward
Möller	Wolfgang	2. Steward
Huang	Wu-Mei	2. Steward
Yu,	Kwok, Yuen	Laundryman