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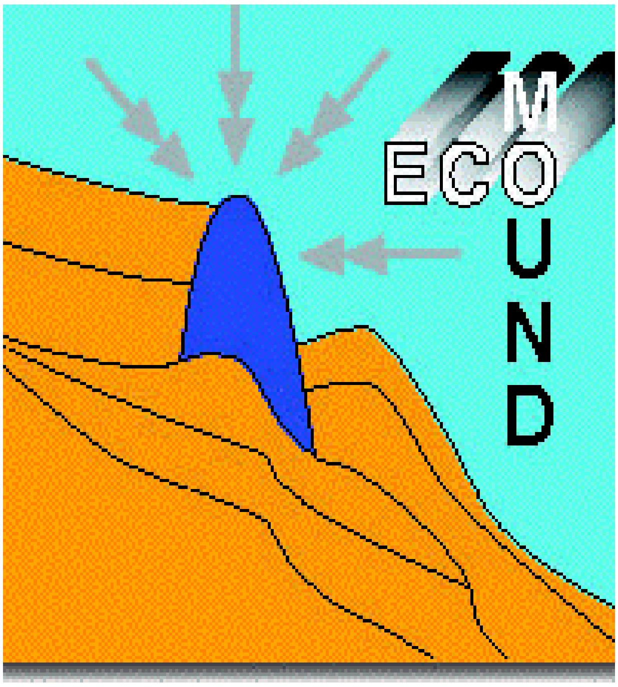

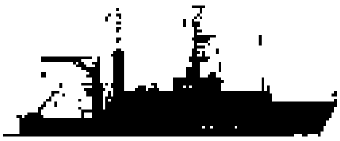

Cruise Report

RV Poseidon Cruise 265

Thòrshavn – Galway – Kiel

13th September — 1st October 2000

André Freiwald, Christian Dullo & Shipboard Party

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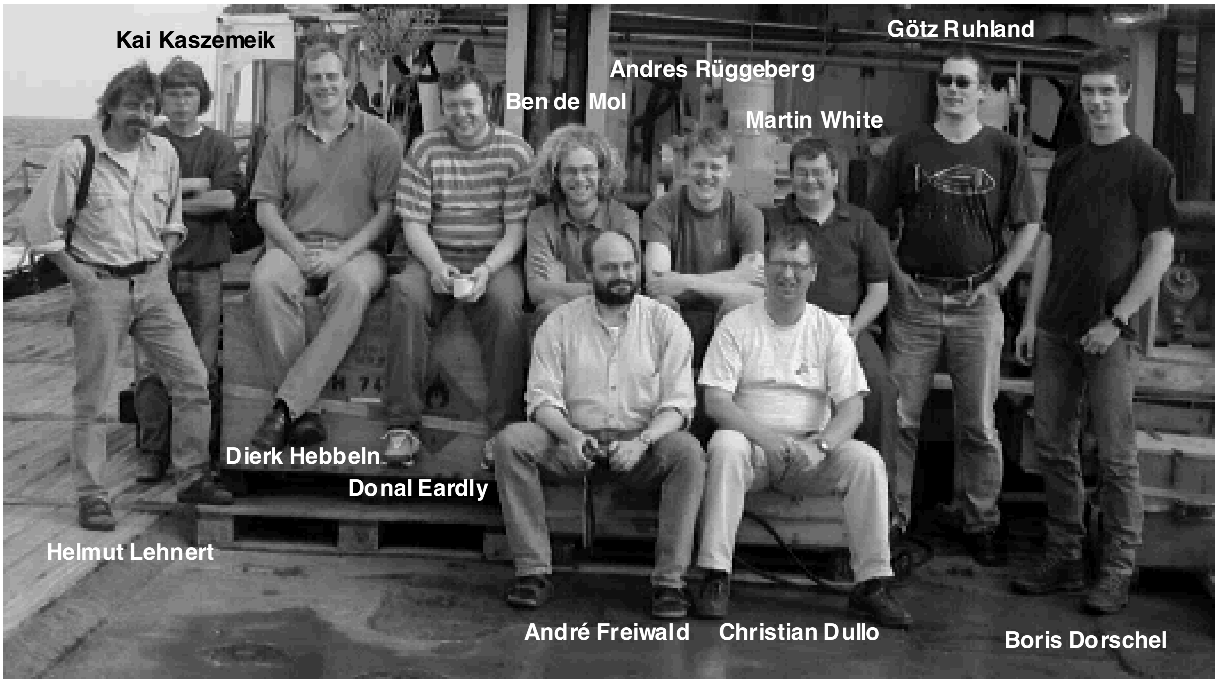

Fig. 1. Scientific team on the POS-265 cruise.

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1. Scientific Objectives

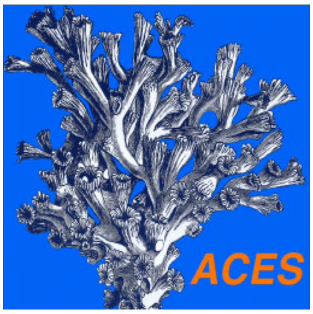
The Poseidon cruise 265 is dedicated to carry out tasks for two EU projects which sail under the 5th Framework Programme. These two projects are:

ACES
Atlantic Coral Ecosystem Study [Contract EVK3-CT-1999-00008]

ECOMOUND
Ecological Controls on Mound Formation along the European Continental Margin
[Contract EVK3-CT-1999-00013]

Both projects shared off shore working sites which calls for joint cruises to increase synergy through exchange of scientific expertise. In addition, both ACES and ECOMOUND joined the recently formed EU-Cluster related to continental margin research — OMARC (Ocean Margin deep-water Research Consortium).

1.1 The ACES Objectives



Coral reefs are something we usually associate with warm, tropical waters, but not with cold, deep and dark waters of the North Atlantic. It is now known that cold-water coral species also produce reefs, which rival their tropical counterparts in terms of their species richness and diversity. Increasing commercial operations in deep waters, and the use of advanced offshore technology have slowly revealed the true extent of Europe's hidden coral ecosystems. Our aim is a margin-wide environmental baseline assessment of the status of **Europe's deep-water coral margin** with recommendations for essential monitoring and methodology requirements for future sustainable development.

In a pan-European margin study, five coral inhabiting locations will be studied, i.e. on the Galicia Bank (43° N), the Porcupine Slope (51° N), the Rockall Trough (59° N), Kosterfjord (59° N) and the Norwegian Shelf (64° N; Fig. 2).

To meet that challenge, ACES will focus on three main scientific objectives which will provide the scientific data necessary to carry out our final objective which is to provide impartial practical recommendations for enlightened management of this spectacular deep-water coral (DWC) ecosystem:

Objective 1:

To map the structural and genetic variability, the framework-constructing potential, and the longevity of DWC ecosystems. High resolution maps of DWC buildups are essential to determine the spatial distribution and the status of the ecosystem in the various working areas.

The framework-constructing potential in DWC largely depends on the annual extensional growth rate, the intensity of secondary thickening of the coral skeleton and the intensity of post-mortem destruction by endolithic borers. We aim to utilise molecular genetic techniques to assess the spatial genetic structure and population dynamics of *Lophelia* at several scales (between regions, within regions and within individual coral reefs).

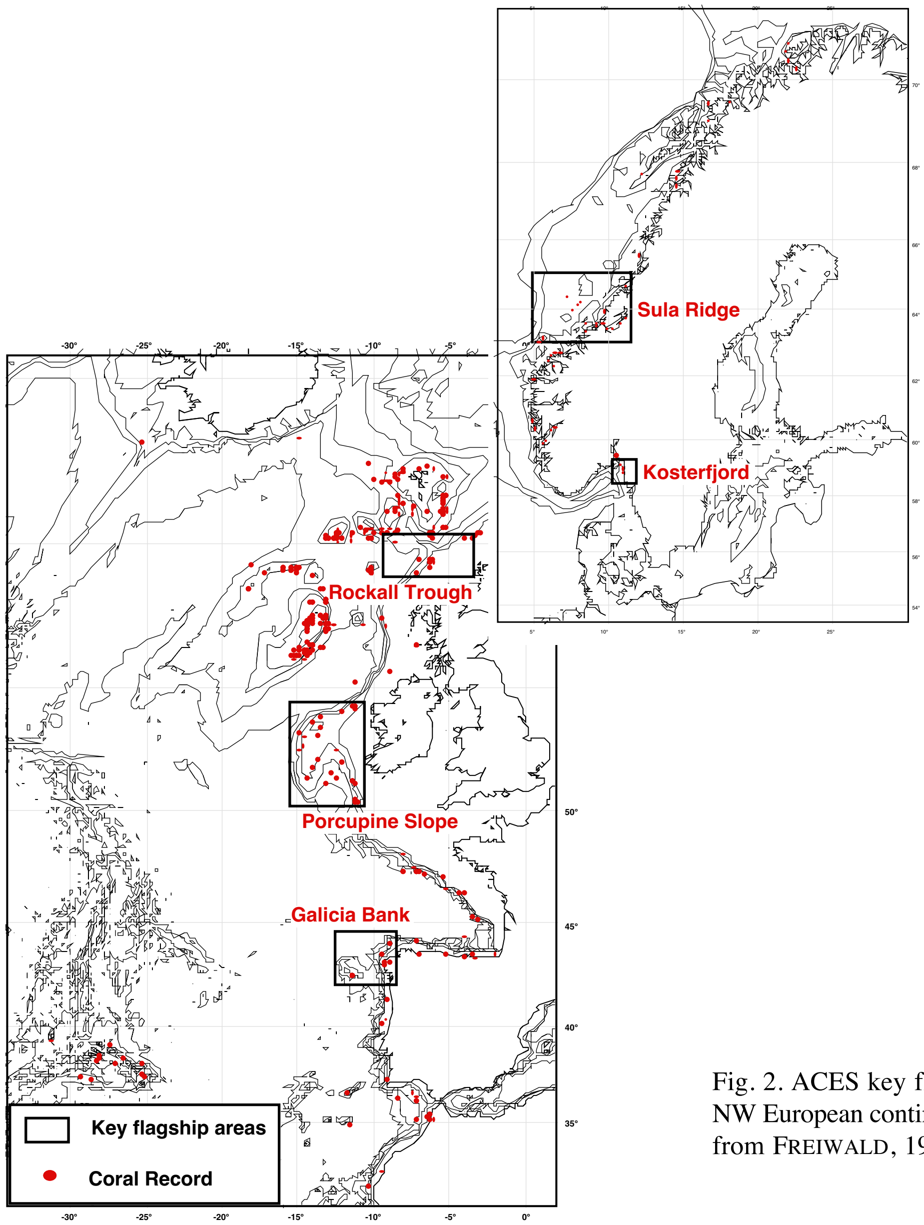


Fig. 2. ACES key flagship sites along the NW European continental margin (modified from FREIWALD, 1998).

Objective 2:

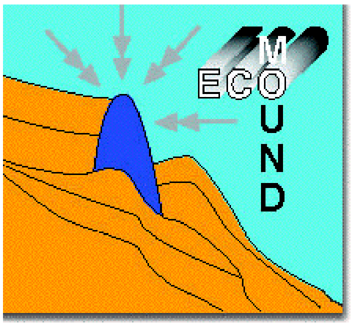
To assess hydrographic and other local physical forcing factors affecting the benthic boundary layer sediment particle dynamics and POC supply in the vicinity of DWC ecosystems. DWC ecosystems are often found at or near oceanographic boundaries - even in fjords - but the detailed effect of hydrographic conditions on DWC buildups remains a matter of speculation. The poleward flowing warm and saline NE Atlantic slope current is a well-documented feature at the shelf break which extends from the Iberian to the Norwegian Sea margin. Predominantly poleward (northward) slope currents at an eastern boundary tend to drive downward near seabed currents in the frictional layer. This has implications for the transport of suspended material in the benthic boundary layer (BBL) and hence for the nutrition and distribution of corals. In addition, the suspected contribution of hydrocarbon enrichment in the vicinity of the coral ecosystem will be assessed.

Objective 3:
To describe the DWC ecosystem, its dynamics and functioning; investigate coral biology and behaviour and assess coral sensitivity to natural and anthropogenic stressors. This objective takes a whole ecosystem approach addressing not only important aspects of coral biology such as reproduction, recruitment and feeding behaviour, but also intraspecific biotic interactions such as the importance of coral stands as refugia (particularly for juvenile commercially important fish species) in promoting the high associated biodiversity of the coral ecosystem fauna. Detailed food web analysis will help elucidate individual species response to local variations in physical forcing and BBL organic carbon characteristics related to the presence of the coral framework. Coral sensitivity to natural and anthropogenic stressors will be determined both *in situ* and in controlled laboratory experiments.

Objective 4:
To assign a sensitivity code, identify the major conservation issues (and increase public awareness), and make recommendations for the sustainable use of the DWC ecosystem. The principal aim is to translate the scientific discoveries and conclusions from the objectives above into a form which is accessible to endusers. A major goal is to ascertain the sensitivity and vulnerability of DWC ecosystems in the key flagship areas. Consultation with environmental managers, industry and NGO's will be an important step in the identification of the principal conservation issues and enduser requirements. Recommendations based on sensitivity coding will inform stakeholders on the necessary measures which will permit future sustainable resource development in the vicinity of the cold DWC ecosystem.

This cruise is devoted to collect data about the spatial distribution, diversity and hydrographic environment of one particular coral mound in the Hovland Mound Province, Porcupine Seabight.

1.2 The ECOMOUND Objectives



Prominent carbonate mound reefs have been features of Earth's history ever since Cambrian times. These mounds frequently form giant host rocks for hydrocarbon accumulation. However, their formation and environmental controls are the subject of much discussion and disagreement. The discovery of spectacular **modern carbonate mounds** along the European continental margin provides an outstanding opportunity to study the processes that create carbonate mounds. Our present day knowledge of reef growth and reef formation is limited to the shallow water reef environments in tropical regions and to a few observations of „reefs„ from the cool water coral margin off Europe. Data and observations on modern carbonate mounds are entirely missing.

Modern mounds are up to 300m high and many of them are made up of carbonate. However, mud mounds exist as well in almost the same settings. In particular, seabed and sub-seabed mounds of strongly different dimensions, and therefore of possibly different origin and controlled by different formation processes, have been recognised in the Porcupine Seabight, the SE and SW Rockall Trough (on the flanks of the Porcupine and Rockall Banks), the N Rockall Trough the Faroe-Shetland Channel and along the Norwegian Margin (Fig. 3).

The major objective of this cruise is to define the environmental controls and processes involved in the development and distribution of carbonate mounds on the NW European continental margin. The project will establish the relationship between carbonate mound biota and recent watermass characteristics and dynamics, as well as with sedimentological properties of the surrounding seabed.

Two major areas for investigations have been selected where clusters of carbonate mounds have been reported within the Porcupine and Rockall Basins off western Ireland. These are the **Hovland Mound** Province and the **Belgica Mound** Province (Fig. 3) with the following objectives:

Objective 1

To establish the relationship between hydrography and local dynamics to the presence of carbonate mounds and their specific fauna, with special emphasis on detailed characterisation of the water masses, by using CTD and moored current meters. Water mass dynamics will be related to the seasonal growth of the benthic biota to analyse relevant hydro-biosphere interactions, as recorded in the carbonate skeletons of benthic organisms. These geochemical signatures will be calibrated against recent water mass geochemical proxies. Such relationships will be used to validate the determination of past seasonalities of the relevant hydrodynamic parameters. In addition, the food supply to the benthic community, the flux of organic matter (OM) as well as of skeletal grains and non-organic particles, will be determined.

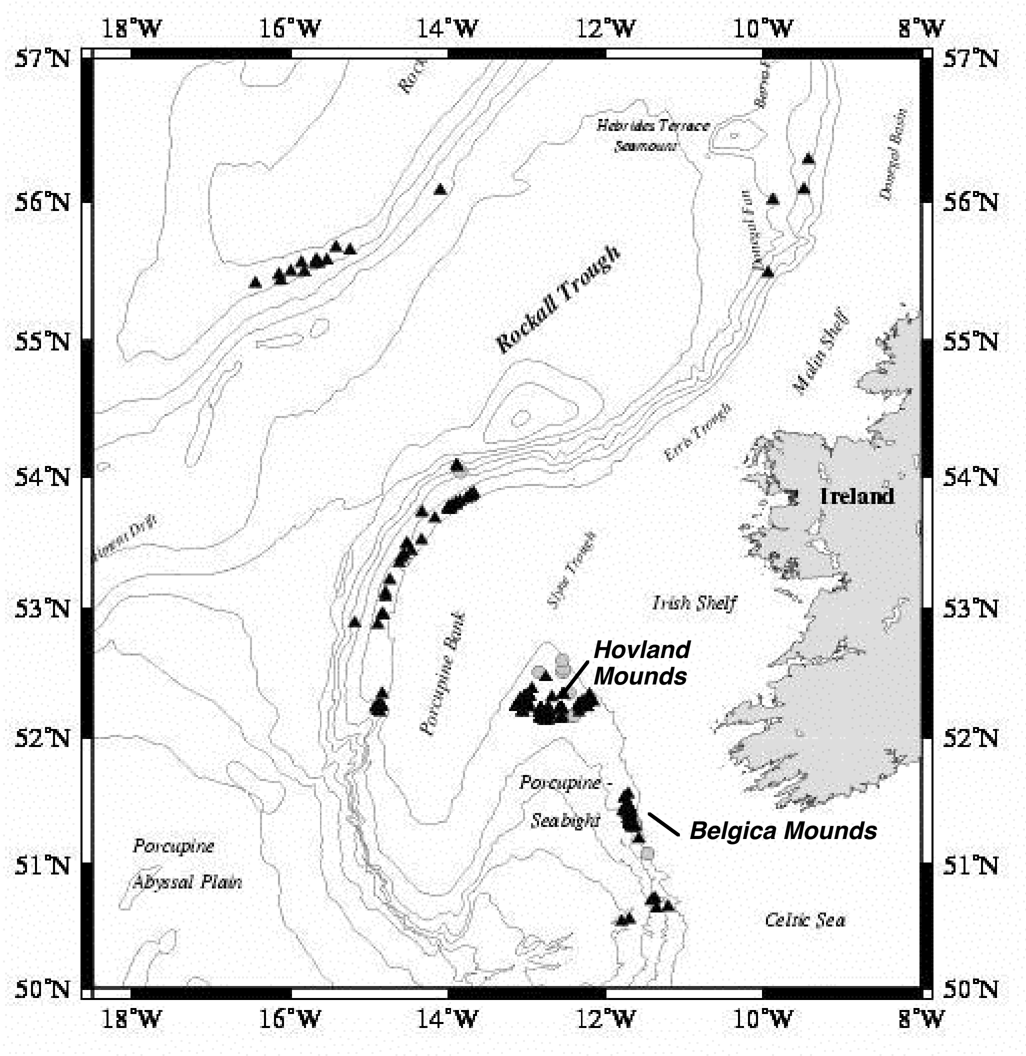


Fig. 3. Location of the Hovland and Belgica Mound Provinces in the Porcupine Seabight.

Objective 2

To quantify the particle flux, which delivers most of the food to the organisms living on the carbonate mounds. Therefore, we deployed a sediment trap in the area of active mound growth. The sediment trap will be recovered after approximately one year to sample a full seasonal cycle. The main result will be a highly resolved seasonal flux pattern, differentiated for the total flux and the main flux constituents as e.g. carbonate, biogenic opal, organic matter and lithogenic material.

Objective 3

To determine how environmental signals are transferred into the carbonate shells of marine organisms in these special environments, detailed comparisons between water column data and carbonate data from collected living benthic foraminifera, corals, and other selected calcifying biota will be carried out.

Objective 4

To investigate the role of the mound biota in the sequestration and biotransformation of organic matter (OM) at the water/mound interface, in order to evaluate the genesis of carbonate mounds, their relationship with the ambient epifauna and their value as proxies for paleo-environmental studies. The microbial community structure will be studied in order to identify which groups of bacteria are associated and involved with carbonate mound formation and maintenance using stand alone pump systems.

Objective 5

To evaluate and assess the aspects of hydro- and geosphere interactions with special focus on sediment parameters in relation to mound geometry and orientation. Mound build up is essentially based on carbonate production and lithification processes, which both will be quantified. Temporal variations of these processes will be studied to unravel the dynamics of the factors controlling mound formation. Growth rate variability (or continuity) through time is assumed to be closely linked to those processes determining carbonate mound dynamics. Therefore box cores and gravity cores were sampled from different locations, from the mound tops, their flanks and from off mound areas.

2. Narrative Report

2.1 Harbour days in Thórshavn (10.—12. September)

Most of us arrived late afternoon on Sunday to enjoy a pleasure trip from the airport to the Hotel above Thórshavn. The small airport is located on Vágar Island so that we had to take a short ferry to cross the Vestmannasund to Streymoy, the main island of the Faeroe Archipelago.

The archipelago consists of 18 islands which cover a total area of 1399 km^2. The general morphology of the basaltic islands is characterised by gently sloping eastern and southern shorefaces while the western and northern coasts are steep in places with cliffs measuring 700m in vertical distance. The now deeply eroded plateau basalts started to develop in the Danian and continued to flow until the Eocene. Distal volcanic deposits are the numerous ash layers found in the Danish Fur-Formation, also known as Moler. The capital and most important harbour of the Faeroe Islands is Thórshavn (Fig. 4).

Fig. 4. Thórshavn harbour with RV POSEIDON (below the container carrier).

Thórshavn is located on the southern part of the Island of Streymoy. It is known since the times of the Vikings and evolved to a place of trade. Nowadays, it is one of the smallest capitals of the world, with its own charm. The coloured wooden houses, many of which have roofs covered by grass, provide a nice atmosphere in the treeless landscape.

The harbour is full of small and picturesque fishing boats and few older sailing vessels (Fig. 5). Further, there is a daily ferry operating to the other islands and maybe one container ship, all in all a very peaceful place, even in terms of pubs.

We entered RV POSEIDON early in the morning on Monday to be ready to unload the two containers packed with scientific equipment. All supplies and gears were placed on the sterndeck to provide a little basar atmosphere (Fig. 6).

Fig. 5. View of the scenic waterfront in Thórshavn habour.

Everything was cleared up the next day. In the evening our Irish guests arrived and noted that one major pallet was missing. Some phone calls to the agent cleared the situation so that all logistic problems could be solved until Tuesday afternoon. Now we are ready to leave the rough but charming atmosphere of Thórshavn to sail south to the Wyville-Thompson-Ridge where the famous Darwin Mounds are located. Weather forecast is between windy and stormy. Therefore, all of us were busy to fix each item of our equipment safely and we are looking forward to leaving the Faeroes at 8:00 a.m. on 13th of September.

Fig. 6. Loading RV POSEIDON with equipment.

2.2 Transit to Rockall Trough and Porcupine Basin (13.—16. September)

After leaving Thórshavn on Sept. 13th we were heading to the Wyville-Thompson-Ridge. First operation envisaged taking place was a test of the CTD we loaned from the Institut für Meereskunde in Kiel, which is gratefully acknowledged.

First runs on deck showed that there were problems relating to proper electrical cable connections. After contacts at home, we were able to solve the malfunction and we had a perfect reading of the data, however, the releaser for closing the bottles suddenly was on strike. Again advise from home and a perfect work by GÖTZ RUHLAND and ANDRES RÜGGEBERG solved this final obstacle (Fig. 7).

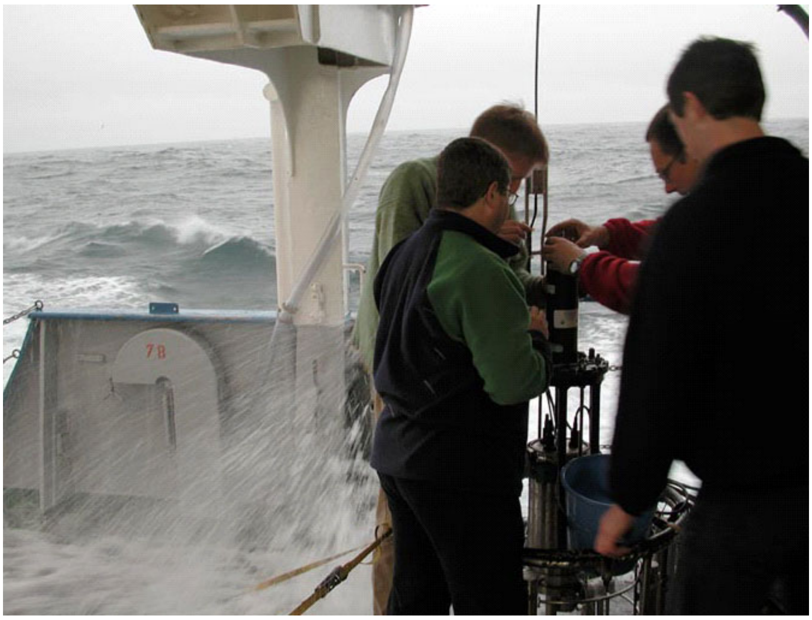


Fig. 7. CTD repair under typical northern Atlantic conditions...

We arrived at Wyville-Thompson-Ridge were the Darwin Mounds are located in the evening at 22:00 (UTC) and all was running perfectly. After the CTD we tested the Stand-Alone-Pump-System (SAPS) at 728 m water depth for 1 hour, during which 468 litres of water were pumped through the filters. The following days, we were heading for a mooring (ECO 1) station at 55° 36' N 15° 28' W for recovery, where our Irish colleagues deployed material two months ago. Sea conditions during these days were enormously perfect, almost flat surface. These two days of transit gave us ample time to set up our sampling strategy for the selected mound areas (Fig. 8).

Fig. 8. BEN DE MOL and DIERK HEBBELN prepare coordinates for geological sampling.

During our approach, our colleagues started to become more and more nervous. Will the releaser do its job? Has the mooring been trawled off (Fig. 9)?

We arrived at the site on Sept. 15th at 16:25 (UTC). The hydrophone was bend over the side and the releaser answered promptly and reacted as well. The mooring showed up 10 minutes later at the surface. An exact manoeuvre of the master and his crew enabled a perfect recovery of the equipment. We all were very happy after this successful operation. First readings of the data revealed very high flow rates of up to 40cm/sec in 850m of water depth.

Fig. 9. Concentrated waiting for the mooring to surface.

The next morning (16th) we arrived at 53° 47' N 14° 01' W for running another CTD for collecting water for the sediment trap. The recovery of the second mooring at the same site was smoothly as during the previous evening. At present, we are en route to the Northern Porcupine Seabight to an area called the Hovland Mound Province, where we intend to perform some hydroacoustic mapping during night over one particular coral-bearing mound to set up our proper sample localities for the next days.

2.3 Northern Porcupine Basin: Hovland Mound Province Programme (17. – 19. September)

Arriving in the Hovland Mound Province in the evening of 16th September we were performing a very detailed hydroacoustic mapping of the mounds so far known from previous cruises of our colleagues from Gent-University. Our particular target mound is the now-called „Propeller Mound“ because of the system of three spurs which are aligned in the shape of a propeller. The set up of the grid had a line spacing of one cable in order to determine precisely mound tops, flanks and the onset of drift sediments around the mounds.

Before we started our mound sampling campaign, we deployed the ACES 2 mooring south of the Hovland Mound Province in 1200m water depth. It is intended to collect physical oceanographic data around the Hovland Mound Province with 3 moorings in total.

Most of the daytime was devoted to take giant box corer sediment samples from the mound and off-mound sites. Those recovered in the off mound region exhibited silty sands of light olive brown colour. Small non- calcified worm tubes were sticking out of the sediment surface. These tubes measure up to 15cm in length. On the sediment surface few white pteropod tests occurred. The box cores from the mound tops, of course, were really spectacular. Some of them were full of dead colonies of *Lophelia pertusa, Madrepora oculata* and some very large *Desmophyllum* pseudocolonies (Fig. 10).

Fig. 10. Live and dead *Lophelia pertusa and Madrepora oculata* colonies from the Propeller Mound.

Some box corers show a downcore change in the style of sedimentation, starting with foraminifer sands on top and stiff grayish silty clay beneath. The latter is rich in ice-rafted deposits. However, coral colonies at different stages of completeness are found all the way downcore. Living *Lophelia* colonies were sampled in large numbers in the last box corer already under severe swell conditions. All these outstanding samples were carefully washed and sieved in order to get a complete information about the biocoenosis and its record as taphocoenosis. This sieving procedure was tough work as we had to face increasing swells deriving from a low-pressure cell west of our working area. Periodically large waves were splashing on deck providing a cold shower for those of us being in action (Fig. 11).

Fig. 11. Facing the North Atlantic....

Fig. 12. Deployment of a sediment trap mooring from the Bremen Group.

In the afternoon of 17th of Sept., we deployed a sediment trap from the Bremen group near the living mounds for collecting an annual cycle to see if there is the typical North Atlantic seasonality present or a regional modulation of this signal may prevail. The deployment, although under quite rough swell conditions was smoothly performed (Fig. 12). During the following night we run a very detailed CTD section of the mound areas to identify the small regional differences around the mounds. The next day we continued with box coring and started gravity coring. Even within the mound areas, were coral debris accumulated, we were able to recover more than 4m of sediment cores. This will allow for a sediment

coring even on top of the living mounds. In the evening and night of the 18th we continued our hydroacoustic mapping. The scheduled CTD runs for 2:00 a.m. on 19th, however, had to be cancelled due to increasing swell conditions (5m). Weather forecast reported another, much more intense low-pressure cell to arrive the next day, which forced us to leave the working area to get shelter in the Bay of Galway, where we dropped anchor around 4:00 a.m. the next morning.

2.4 Galway shelter and back to the Hovland Mound Province (20.—24. September)

Crew and scientists enjoyed the visit in Galway very much. Galway with its charming atmosphere, nice pubs and shops provided fun and relaxation for everyone. Apart of touristic locations there are also traditional inns around the pier just opposite the ships. POSEIDON stayed next to the CELTIC VOYAGER, the Irish research vessel. On Friday 22nd, we visited the perfectly designed Atlantaquarium, where they had living corals from the mounds sampled during our cruise on display (Fig. 13).

Fig. 13. The recently opened Atlantaquarium in Galway where we passed our living corals for a public exhibition display on deep-water corals.

Fig. 14. Deployment of ACES 1 mooring in the Porcupine Seabight.

On Saturday, we decided to leave the village despite of the stormy winds which strongly hit Galway that morning. It was our strategy to find the perfect weather window with sufficiently good working conditions between two major low-pressure systems. There is one low-pressure system announced for Tuesday which is really not funny and the forecasts seem to confirm the long-term prediction day by day. En route we passed the spectacular cliffs of Moher in the afternoon of September 23rd. So we went back to sea and reached the Propeller Mound in the Hovland Mound Province at morning.

The first major operation was the deployment of the ACES 1 mooring (Fig. 14) northeast of the Propeller Mound, still under windy and swell conditions. We have now a good transect of moorings laid out over the mounds and the deeper-water sponge belt. Under unexpectedly good weather conditions (Fig. 15) starting the later morning, we were able to core

6 stations which include all major steep sloping flanks and the plateaus which already had been sampled with the box corer. Together with the core from the adjacent basin, we may have completed the site so far.

For the upcoming night, a dense CTD and SAPS oceanographic survey over the coral-bearing mound. We are hoping for another good working day before we must leave the theatre because of the well-predicted severe storm.

Fig. 15. Cleaning the gravity core after recovery from Propeller Mound.

2.5 Working between low-pressure systems (25. – 26. September)

All our work was extremely limited by the not promising weather forecast. A short term fair weather period between two low-pressure systems was predicted for 25th and 26th .

The first day was used for short distance dredge hauls on the three mapped plateaus of the Propeller Mound in the Hovland Mound Province. Highest concentrations of live corals *Madrepora oculata*, *Lophelia pertusa* and *Desmophyllum cristagalli* was found along the southerly exposed plateau of the Propeller Mound. Samples had to be washed and to be sieved and the rear deck resembled more a gold mine camp rather than a vessel. Sampling was very delicate and patience was needed. It took a long time to document all what we got properly in order to establish a relieable working base for taxonomic in-depth studies. Samples have been dried and one of the labs still has an outstanding smell, forcing all of us to leave this room as soon as possible.

In the evening, RV POSEIDON sailed from our now well-known working area for a short visit to the Belgica Mound Province. Box corers revealed a completely different type of coral assemblage which is entirely dominated by extremely fan-shaped *Madrepora oculata* (Fig. 16). The live coral colonies are intensely colonised by hydrozoans, whereas the dead coral portions serve as anchor for hexactinellid sponges.

For one of our participants this event was the overall highlight as he waited the whole cruise patiently for getting sponges. Several big colonies were recovered and it was remarkable that these delicate structures arrived on deck undisturbed (Fig. 17). The sediment beneath is an extremely well-sorted foraminiferal sand above a stiff silty clay.

Fig. 16. A delicately branched *Madrepora oculata* from Theresa Mound, Belgica Mound Province.

Fig. 17. Hexactinellid sponge.

Gravity coring showed only poor results in the Belgica Mounds and the preservational style of dead corals is completely different in the Belgica Mounds compared to the Hovland Mounds. This calls for detailed taxonomy in-depth studies.

Although, we had a perfect working day, the giant low-pressure cell was rapidly approaching forcing us to leave the site early in the afternoon. Weather at that time was still very nice, with bright sunshine and a calm sea. The storm hit us at 4 a.m. the next morning, while we were steaming in the Celtic Sea heading for the Scilly Islands (Fig. 18). Despite of the weather conditions, which reduced our working time, all parties on the vessel got what they expected, some even more.

Both ACES and ECOMOUND are well on their track — and we are on our long way home to Kiel harbour where we are expected to arrive on October 1st.

Fig. 18. The final storm (during our cruise).

3. Technical Report and first Results

3.1 Navigation, echosounding and mapping

ANDRÉ FREIWALD, BEN DE MOL

Shipboard navigation based on a GPS system. Bathymetric data were collected with a 30 kHz echosounder and stored on the ship-based computer data logging system. This was carried out for the cruise track (Fig. 19) and for detailed mapping purposes. In our main survey area, the GPS- and bathymetric data were subsequently compiled with Surfer© Software to generate a contour map of the Propeller Mound and adjacent seabed in the Hovland Mound Province (Fig. 19). To minimise artefacts, the database was updated on a daily basis. The basic mapping was carried out during two nights (Stations GeoB 6705, 6723). The grids had an east-west distance of 3nm and a north-south distance of 1nm. The overall enveloping co-ordinates are 52°08.5N, 12°48W, 52°08.5N, 12°45W, 52°10.5N, 12°48W and 52°10.5N, 12°45W (Fig. 19).

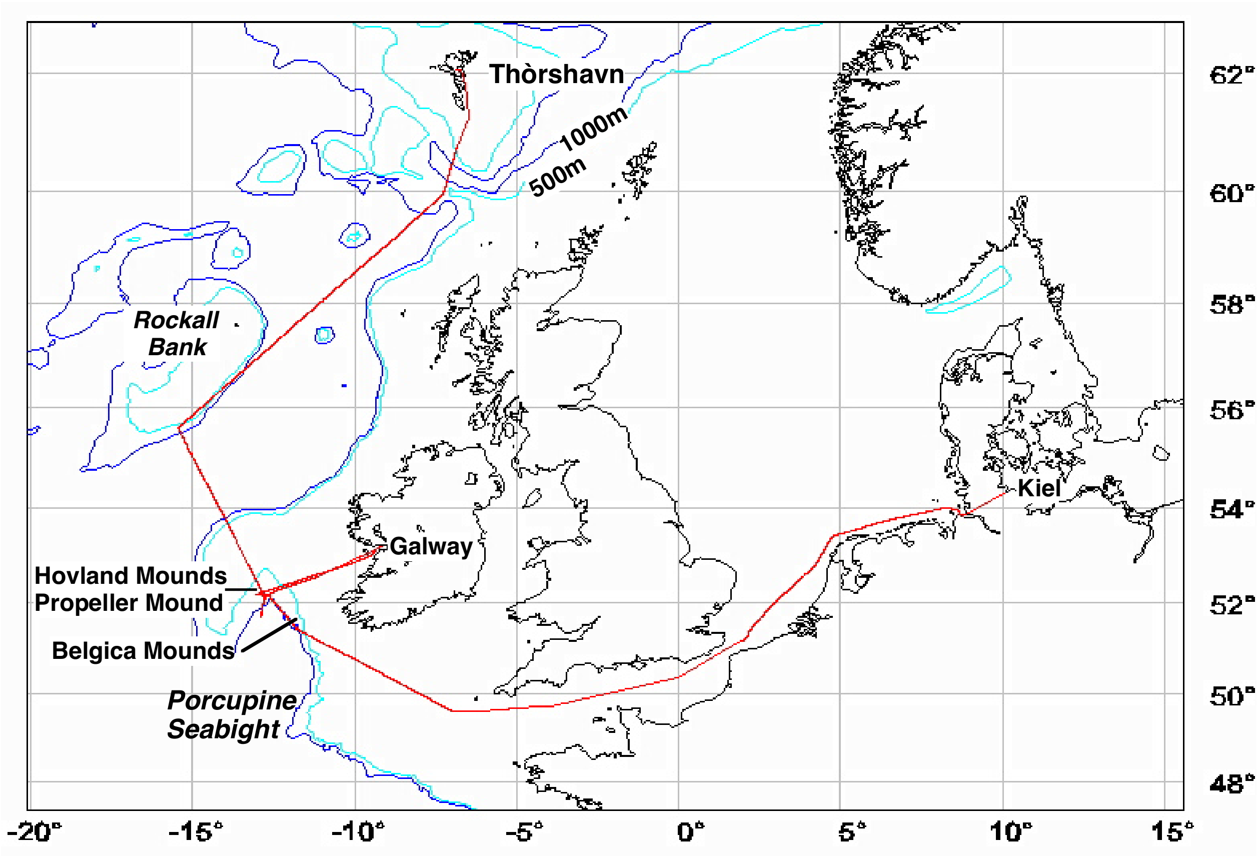


Fig. 19. POS-265 cruise track and surveyed mound sites are indicated.

The Propeller Mound **ANDRÉ FREIWALD, BEN DE MOL**

The main survey site during POS-265 was the Propeller Mound of which seismic lines were provided by the Gent group in order to differentiate between drift sediment wedges and coral-bearing mounds. Propeller Mound belongs to the latter category and is located at the northern part of the Porcupine Seabight Basin.

The Propeller Mound is part of the Hovland Mound Province, named after MARTIN HOVLAND who presented an early paper arguing strongly for emanating hydrocarbon seeps as an intrinsic control for mound formation (HOVLAND et al., 1994).

As mentioned already, the Propeller Mound has the outline of a triple-bladed propeller formed by spurs (Fig. 20). The base of the 140m high mound is at 800m water depth and the summit was sounded at 660 water depth. The three spurs point to NE (spur A), NW (spur B) and SSW (spur C) directions. Calculated from the summit to the 800m isobath, the spurs measure 1100m (spurs A and B) and 1700m (Spur C) across. The slope inclination calculated over the long-axis of the three spurs varies between 8° and 9° while the interspur slopes are much steeper with 12° to 15° respectively.

A moat, developed around the Propeller Mound, thus indicating an erosive hydrodynamic regime at present and/or in the past. The vicinity of the Propeller Mound is dominated by an extended north-west to south-east sloping drift sediment wedge with 740m water depth in the western section, and 920m water depth in the eastern section of the surveyed grid (Fig. 20). More mounds exist in the neighbourhood of the Propeller Mound. These mounds are smaller in dimension and have deeper-seated summits around 720 – 740m water depth (Fig. 20).

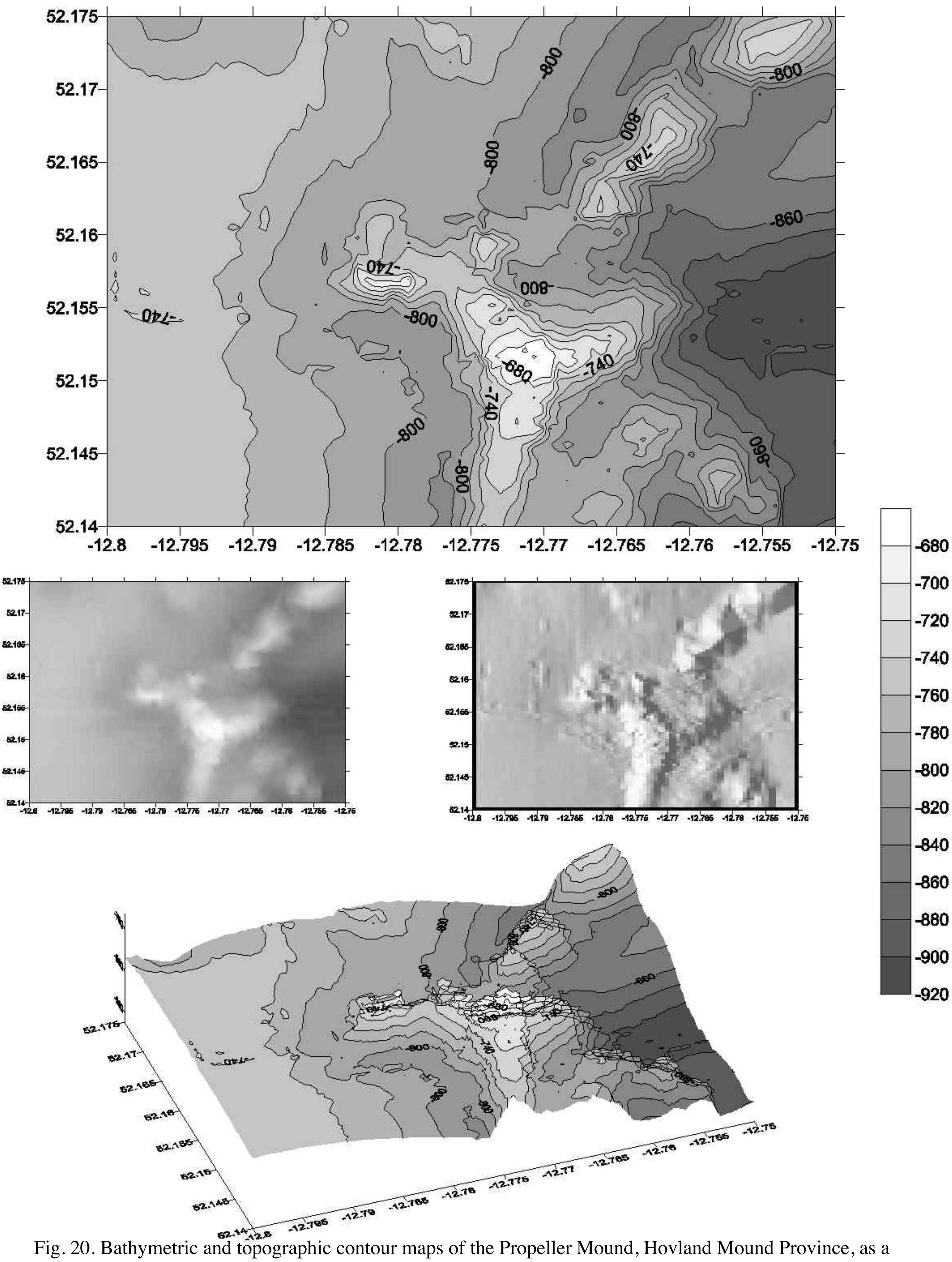


Fig. 20. Bathymetric and topographic contour maps of the Propeller Mound, Hovland Mound Province, as a result of the mapping surveys during POS-265.

3.2 Moorings MARTIN WHITE

Currents near the seabed are being measured as part of both the ECOMOUND and ACES projects. As well as comparing and contrasting the current regimes in different carbonate mound/coral reef locations in the Rockall Trough and Porcupine regions, the effect of changes in the slope current on the benthic, and internal wave dynamics (if present), were also to be studied.

In late July/early August two moorings were deployed in the mound regions of the North Porcupine Bank Slope and in the SW Rockall Trough during the joint project survey of the RV PELAGIA. Currents were to be measured at 10m and 150m above the seabed. These moorings were deployed a short distance (500-80m) upstream (in the context of the local slope current) of the NIOZ BOBO lander. In this way the affect of changes in the slope current could be related to the variability in the high resolution measurements within 2.5m of the seabed made by the BOBO downward looking ADCP.

The objectives during this cruise were:

- To recover one or both of the moorings deployed in the Rockall Trough

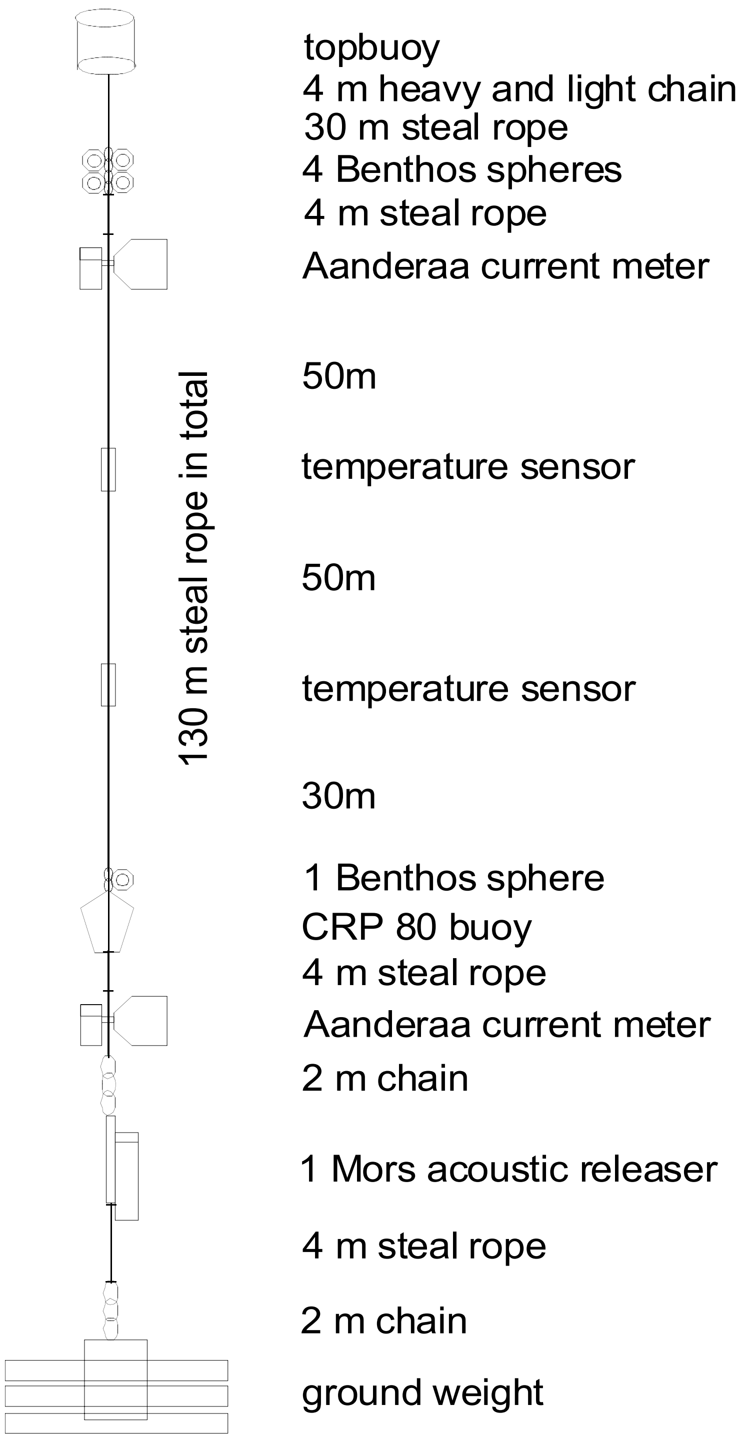
- To deploy two moorings in the northern Porcupine Sea Bight, one at the depth range where corals (and the Hovland Mounds) are present (700-800m) and one in deeper water (1200m) where the hexactinellid sponge *Pheronema carpenteri* is found.

It was hoped to contrast the current regimes at the two different depths. It has been postulated (RICE et al., 1990) that the sponges can not tolerate the high current speeds at the shallower depths, possibly caused by internal waves resonance conditions with the bottom slope, but utilise the transported material suspended upstream and upslope. In addition, the two moorings also form an array with a sediment trap mooring deployed by the Bremen group.

Mooring Recoveries **MARTIN WHITE**

The acoustic release of the ECO 1 mooring sited at 55° 36.36'N, 15° 27.69'W, in 818m water depth, was interrogated successfully in late afternoon of the 15th September and released (GeoB 6703-1). The mooring surfaced nearly ten minutes later and easily brought on board within an hour. After data was downloaded, a full data set was recovered from both the two current meters (20 min sampling at 10 and 15m above the seabed, (asb)) and the temperature sensors at 50 and 100m asb, measuring every 10 minutes (Fig. 21). In total, 42 days of data have been recorded, of which about 12 days will be in parallel with the BOBO lander deployed 800m along the slope.
Following an overnight steam to the north Porcupine Bank mooring ECO 2 (53° 46.798'N, 14° 00.553'W), this mooring was also successfully recovered in a similar manner to the previous mooring (GeoB 6704-1). This mooring also had a pair of current meters and two temperature sensors positioned at similar heights above the seabed, but in a water depth of 930m (Fig. 21). The near seabed current meter functioned perfectly but the meter at 150m asb experienced significant data drop out. Processing of that particular data set has not, therefore, proceeded until the end of the cruise.

Daily averaged current vectors for the two current meters at the SW Rockall (ECO 2) mooring are shown in Figure 22. Above the bottom boundary layer at 150m above seabed (asb), a strong residual flow to the southwest, along the isobaths, was clearly evident. The mean velocity in direction 250T was 16cm/s. The mean current speed was 20.6cm/s, within individual measurements, speeds reached up to a 52cm/s. Two periods of particularly strong along-isobath currents were measured and it seems the residual flow is modulated by low frequency waves or possibly by a spring-neap cycle, something that was hoped for in the measurement period. Nearer the seabed, currents were also relatively strong, with a mean and maximum current speed of 17.3cm/s and 42.1cm/s recorded respectively. The mean residual flow was 7.7cm/s at 233T, directed to the left of the upper current meter in agreement with EKMAN dynamics for a bottom boundary layer. There is a strong diurnal variability in the currents, stronger than that at the semi-diurnal period, which also appears to be larger nearer the seabed. Scatter plots of east and north velocity components indicate a lot of cross slope motion, probably associated with this diurnal variability. Such variability has been noted before around the Rockall Bank.



Mooring 1: 55° 36.360 'N 15° 27.690 'W
Mooring 2: 53° 46.798'N 14° 00.553'W

Fig. 21. Arrangement and set-up of the ECO 1 and ECO 2 moorings recovered in the Rockall Trough.

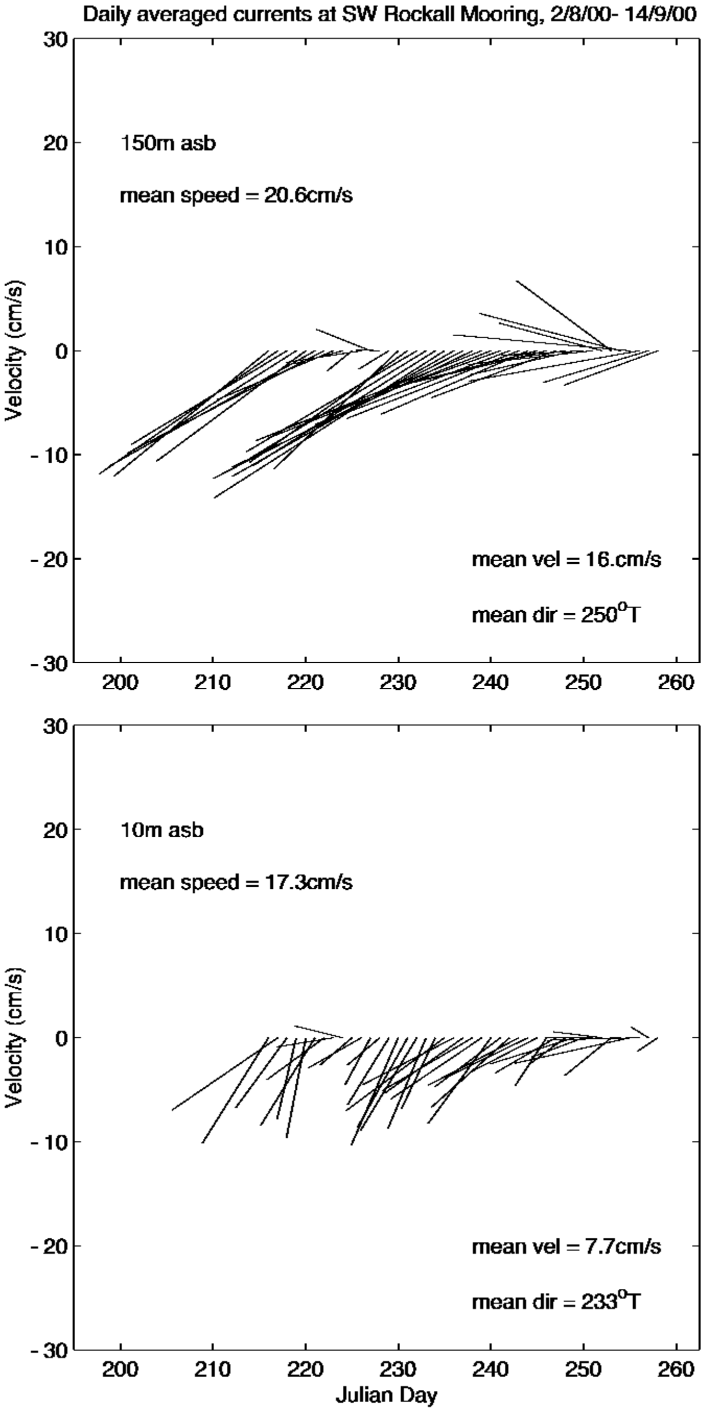


Fig. 22. Time series of daily averaged currents at (A) 150m above seabed and (B) 10m above seabed for the SW Rockall mooring.

The effect of the change in the along isobath flow at subtidal periods (10-14 days) in the benthic dynamics is summarised in Figure 23. This figure shows the time series of daily averaged flow at 150m above seabed in direction 70°T (i.e. positive along isobath flow is poleward), the corresponding temperature gradient between the two current meters, normalised by dividing by the mean temperature gradient (i.e. a value below 1 is less than average temperature gradient, >1 a higher than mean value). The two periods of strong southward along isobath flow are clearly observed, and these correspond to lower than average temperature gradient in the lower 150m. This is consistent with basic EKMAN dynamics in the benthic boundary layer, where a quasi-geostrophic flow with shallower water to the right, will drive a downslope flow in the bottom frictional layer. This brings relatively warmer water from upslope below cooler water resulting in a reduced temperature (density) gradient in the bottom waters. This can further be seen in the scatter plots of both the along isobath and cross isobath (+ve in off slope direction 160°T). These show a strong regression between the two components of flow and the normalised vertical temperature gradient.

Currents near the seabed (10m asb) at the north Porcupine mooring were also quite strong (Fig. 24). Again, a persistent along isobath current (this time poleward flowing) was mea-sured, and would appear to be the topographically steered slope current found along the NE Atlantic margin. There are only a few days with no significant daily mean flow in the preferred slope current direction. A mean speed of 16.4cm/s and maximum of 46.7cm/s is similar to that observed at the near sea bed mooring at the SW Rockall site, as is the general distribution of current speeds. The scatter plot further indicates the topographically constrained nature of the current at the seabed, although also indicates times of off slope flow. The causes of this will need to be further investigated. Initial analysis of the temperature records indicate that some internal activity may also be present in the time series.

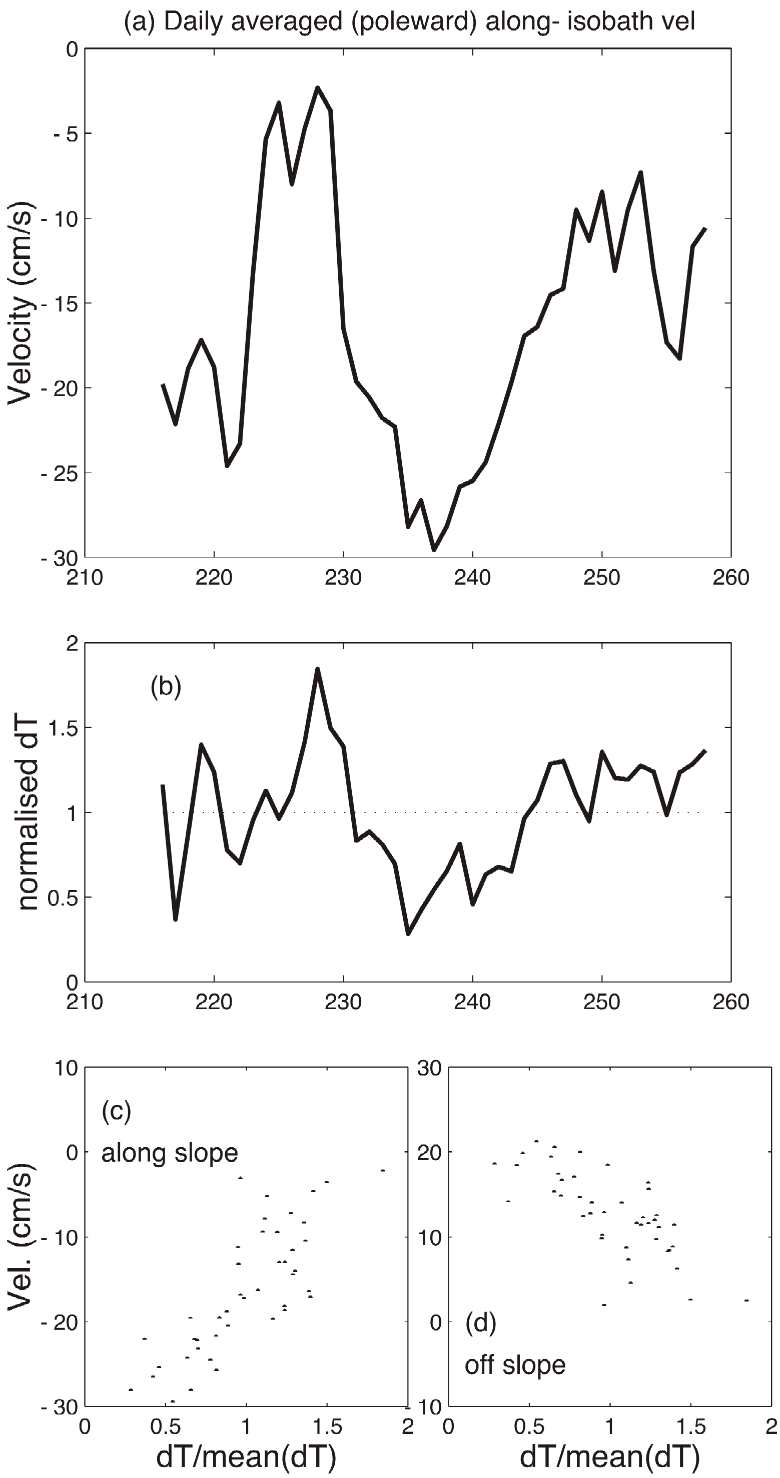
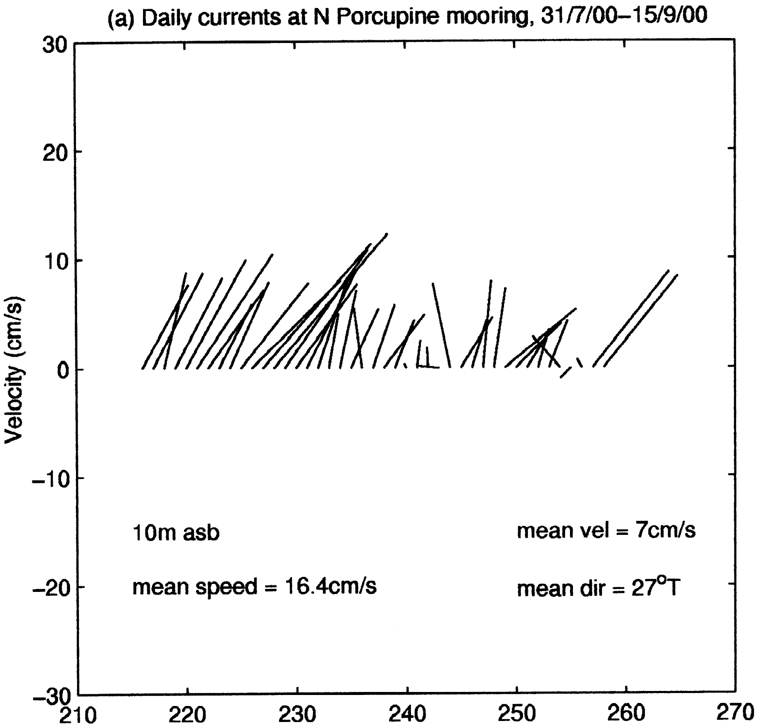


Fig. 23. Time series of (a) daily averaged flow in direction 70°T (along isobath direction) at the SW Rockall mooring (ECO 1) 150m above seabed, (b) the temperature difference between 150m and 10m norma-lised by dividing by the mean temperature difference between the two current meters and (c, d) scatter plots of the two velocity components (along isobath and across isobath (+ve 160°T)) at 150m against the normalised temperature gradient.



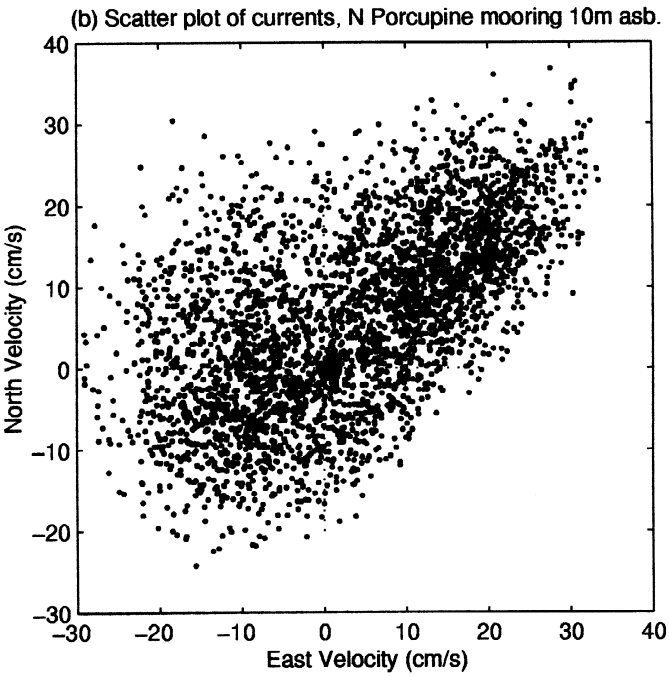


Fig. 24. Time series of (a) daily averaged currents at 10m above seabed for the North Porcupine mooring (ECO 2) and (b) scatter plot of east and north component velocities for the same mooring.

Mooring deployments

MARTIN WHITE

The first mooring (ACES 2) to be deployed was the deep mooring within the sponge belt. Again two current meters were positioned at 10 and 150m above the seabed. The mooring layouts are given in Figures 25 and 26.

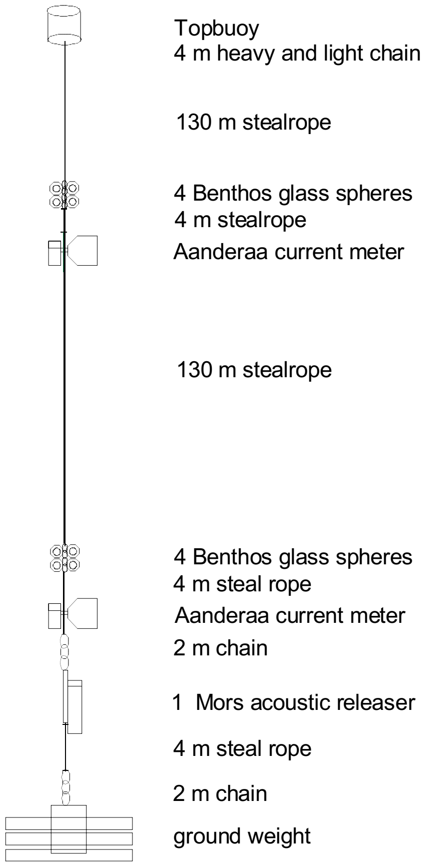


Fig. 25. Mooring ACES 2, deployed on Sept. 17th, 2000 at 51°43.754N 12°54,635W.

No temperature sensors were added for these two ACES moorings. Current meters were set to record every 30 minutes, with a capacity to measure for up to a year if necessary. The mooring was deployed on the morning of the 17th Sept (0738 GMT) at the location 51° 43.754'N, 12° 54.635'W in 1220m water depth. This location is also to the SSW of the Hovland Mounds and the top current meter will be at 1070m, within the influence of Mediterranean Water if present at this location in the northern Porcupine Sea Bight. No problems were encountered during the deployment.

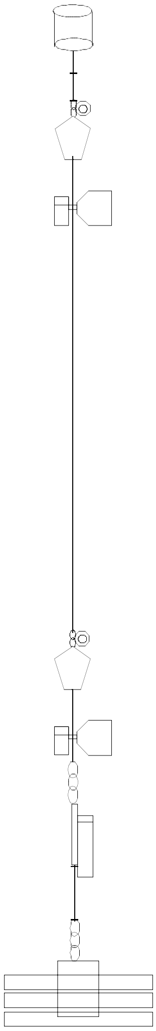


Fig. 26. Mooring ACES 1 deployed on Sept. 24th, 2000 at 52°14.96N 12°29.88W.

The 2nd, shallower mooring (ACES 1) was deployed after the Galway port call on the 24th Sept at 0744 GMT in 697m of water (Fig. 26). The mooring was located at 52° 14.96'N, 12° 29.88'W, to the north east of the target mounds for coring and also from the sediment trap located in a deep drift sediment region in between a ring of mounds, although the upper current meter will be at a similar depth to the sediment trap current meter.

The ease and safety of both mooring recovery and deployments was due to the skill and enthusiasm of captain, bosun and crew of the POSEIDON, together with the Bremen group personnel, all of whose help I very much appreciate.

Sediment trap mooring deployment **DIERK HEBBELN, GÖTZ RUHLAND, BORIS DORSCHEL**

As part of the ECOMOUND workpackage 2, a sediment trap mooring has been deployed in the Hovland Mound area. The mooring consists mainly of a sediment trap accompanied by a current meter for current monitoring and an acoustic release, allowing for the recovery of the whole mooring (Fig. 27). A number of glass spheres provides the necessary buoyancy to keep the mooring upright and to bring it back to the surface once the acoustic release has been activated. The sediment trap is a conventional cone-shaped Kiel-type model SMT 230 with a collection area of 0.5 m^2. It has 20 sample cups which rotate under the funnel in preset time intervals of 18 days, allowing for a total sampling period of 360 days, i.e. one full year. The sample cups are filled with seawater from 600m depth taken with the rosette sampler at station GeoB 6704-1. 20 ml of NaCl-solution as well as 3.5 ml of saturated $HgCl_2$-solution have been added, to increase the density of the sample solution and to poison it to avoid any bacterial activity as well as any feeding by bypassing animals.

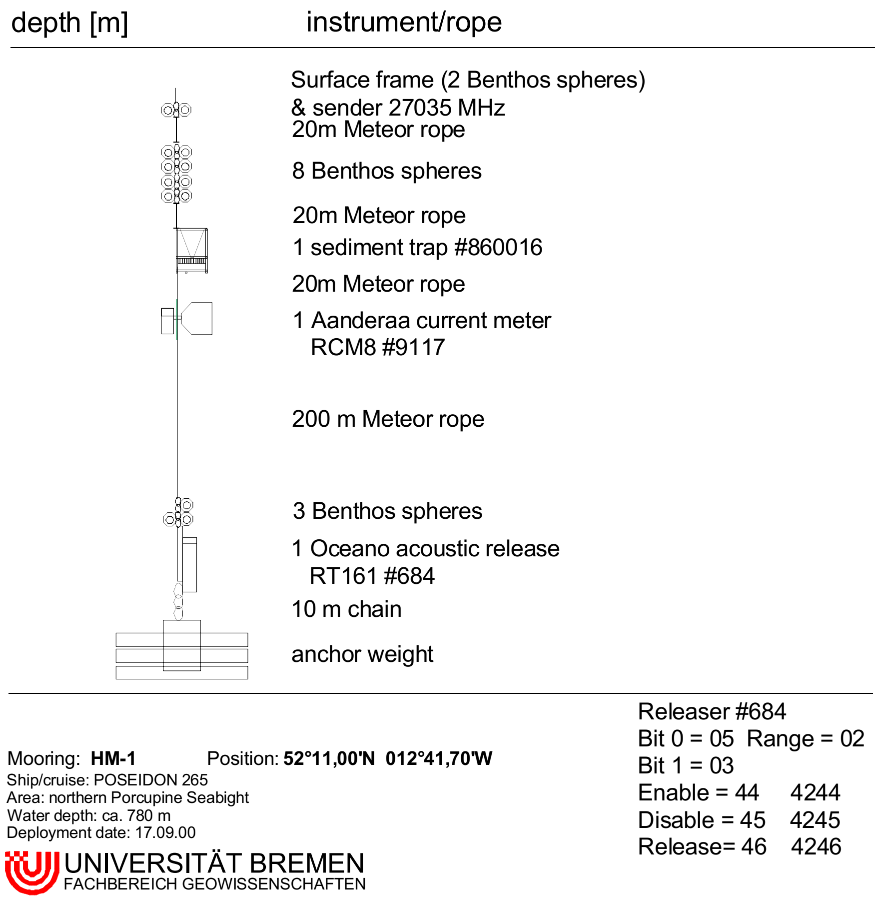


Fig. 27. Sketch of the sediment trap mooring HM-1 (GeoB 6709-1) deployed in the Hovland Mound area.

3.3 CTD with water sampler MARTIN WHITE, ANDRES RÜGGEBERG

Water properties were measured using a General Oceanics Neil Brown mark III CTD, equipped with a 12-bottle rosette, but with no extra sensors except a bottom trip indicator. Initially a few problems were found with communication between CTD and software interface, and these were quickly solved with the help of the ship's Electrician. Upon further testing, it was noted that the rosette did not fire due to a fault in the motor driving the release pin. The unit was dismantled and the motor reset. Pictures of the operation were taken using the digital camera to allow future maintenance to be carried out by those personnel that are not completely familiar with the operation of this particular type of CTD. Once these problems were solved, the CTD functioned well throughout the cruise period.

Vertical profiles were made at two of the mooring sites, one recovery (ECO1) and one deployment site (ACES 2), one at the Theresa Mound site and two transects across individual mounds at the Hovland site. These profiles were made down to 10m above the bottom when the bottom detector indicated the presence of the seafloor. Sample bottles were fired at this depth 15m and also 35m above the seafloor.

Water sampling for stable carbon isotope analyses

In order to study the stable isotope composition of carbon dissolved in the water close to the seafloor, on which the benthic organisms partly rely when building their skeletons, water samples have been taken mostly from two bottom-near levels with a rosette sampler, deployed with every CTD cast (Tab. 1). After recovery the samples were transferred to 100 ml dark glass bottles and subsequently they were poisoned with 2 ml of saturated $HgCl_2$-solution to avoid any further bacteria activity, which probably would alter the original isotope signal.

Tab. 1. Water samples taken for stable carbon isotope analyses during cruise POS 265.

station no.	latitude	longitude	water depth	sampling depths	
GeoB 6706-1	51° 43.190´ N	12° 54.796´ W	1223 m	1218 m	1198 m
GeoB 6709-3	52° 12.019´ N	12° 41.895´ W	815 m	800 m	780 m
GeoB 6710-2	52° 08.357´ N	12° 46.257´ W	786 m	771 m	751 m
GeoB 6711-1	52° 08.370´ N	12° 46.576´ W	796 m	781 m	761 m
GeoB 6712-1	52° 08.432´ N	12° 46.684´ W	805 m	790 m	770 m
GeoB 6714-1	52° 08.315´ N	12° 46.185´ W	802 m	787 m	767 m
GeoB 6715-1	52° 08.186´ N	12° 46.031´ W	849 m	834 m	814 m
GeoB 6716-1	52° 08.091´ N	12° 46.605´ W	833 m	818 m	798 m
GeoB 6731-1	52° 09.436´ N	12° 45.454´ W	884 m	869 m	849 m
GeoB 6732-2	52° 09.237´ N	12° 45.674´ W	853 m	848 m	828 m
GeoB 6733-1	52° 09.192´ N	12° 48.037´ W	737 m	722 m	702 m
GeoB 6734-1	52° 08.886´ N	12° 46.119´ W	772 m	757 m	737 m
GeoB 6735-1	52° 08.793´ N	12° 46.612´ W	799 m	784 m	764 m
GeoB 6736-1	52° 08.973´ N	12° 46.704´ W	794 m	779 m	759 m
GeoB 6744-1	51° 25.679´ N	11° 46.129´ W	922 m	907 m	887 m

First results obtained from CTD data **MARTIN WHITE**

Generally, water masses followed a similar trend at all CTD sites ranging from the Belgica Mounds, through the Porcupine Sea Bight/Hovland Mounds and North Porcupine Bank. A seasonal thermocline of depth 40-50m was present at all stations and generally capped a core of high salinity presumably indicating the presence of the shelf edge current (SEC). Below this Eastern North Atlantic Water was present down to a salinity minimum of between 500-600m depth. Mediterranean Water was evident as a high salinity core at the ACES 2 site and also north of Porcupine Bank, although it was less evident there (there is, at present, some discussion as to how much Med. Water enters the northern Rockall Trough). At the Hovland Mound sections, it appeared that the water depth was too shallow for the presence of Mediterranean Water. Although the profiles below the salinity minimum showed increased salinity with depth but temperature continued to decrease. This was also the case at Theresa Mound.

There was an interesting variation observed between the two CTD sections made across two individual mounds north and south in the Hovland Mound region. The southern section showed the normal SEC high salinity core at 100m below the seasonal thermocline. At the northern section and more apparent to the east of the mounds, however, a 2^{nd} core at 200m depth was apparent, with an increased temperature signal. The source of this high salinity core is not known at present, but may be an indication of an interaction between two separate shelf edge currents either side of the Seabight. Further analysis of the T-S signals at different depths (density contours) will hopefully produce further insights into the distribution of water masses over the Hovland Mounds.

3.4 Microbiology: Stand-alone-pump-system (SAPS) DONAL EARDLY

Two main types of samples were taken; water samples for organic geochemistry were collected with the Stand-Alone-Pumping-System (SAPS) and sediment samples for microbiology were taken by sub-sampling box cores. Particulate material in the water column was collected using SAPS (Fig. 28). This is a system for filtering large volumes of water *in situ*.

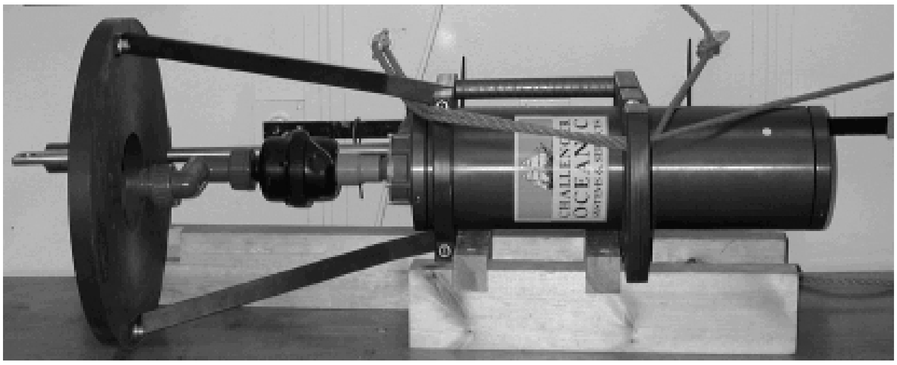


Fig. 28. The SAPS system (without filtering unit).

It consists of a large diameter filter holder, capable of taking 293 mm diameter filters, and a sealed centrifugal pump with a magnetic switch which is activated just before deployment (Fig. 28). In this cruise (Tab. 2; Fig. 29), 293 mm GFF type filters were used to collect particulate samples in the water column for chemical analysis by the University of Liverpool biogeochemistry group.

Tab. 2. SAPS samples taken during POS-265.

Date	Coordinates	Station	Depth deployed [m]	Volume pumped (litres)
13/9/00	59°56.60' N 07°17.12' W	GeoB 6702-1	580	439
17/9/00	52°08.332'N 12°46.377'W	GeoB 6710-1	691	319
18/9/00	52°08.235'N 12°46.407'W	GeoB 6713-1	670	78
24/9/00	52°09.246'N 12°45.884'W	GeoB 6732-1	700	274
25/9/00	52°08.855'N 12°46.598'W	GeoB 6735-2	750	0 (Failed)
26/9/00	51°25.808'N 11°46.152'W	GeoB 6742-1	830	213

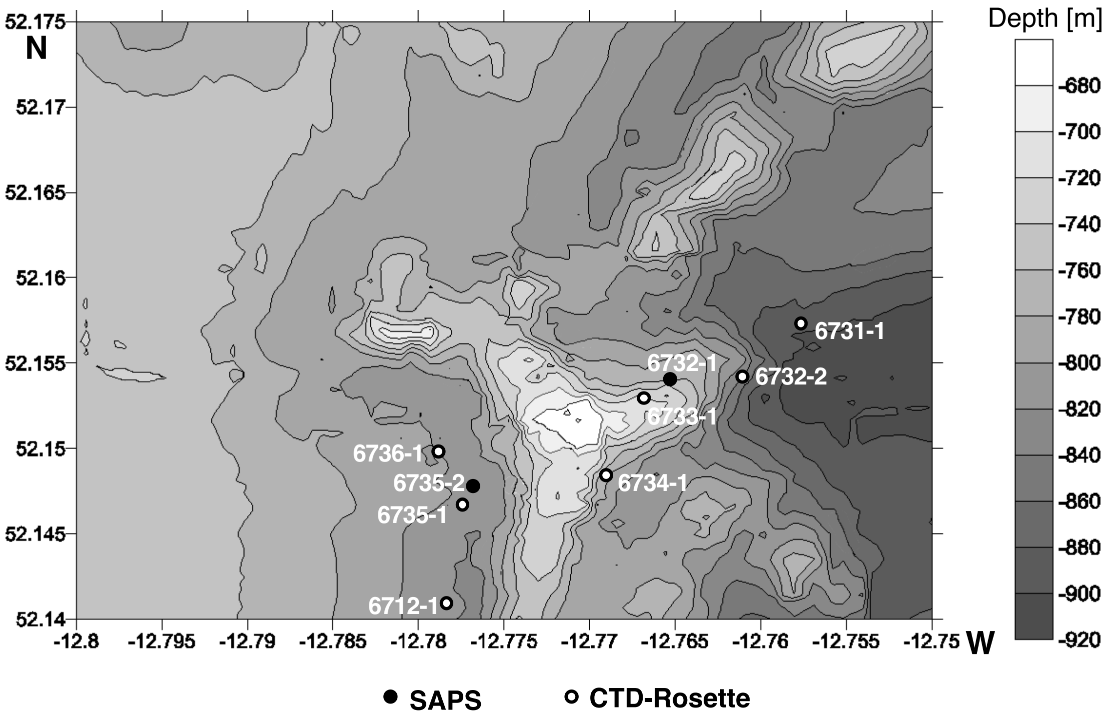


Fig. 29. SAPS and CTD-rosette stations at the Propeller Mound site.

Sediment samples for microbiology

Subcores from box core samples were taken for microbial abundance and community structure analysis. Cores were sectioned as follows, 0-1cm, 1-2 cm, 2-3 cm, 3-4 cm, 4-5 cm, 5-6 cm, 6-7 cm, 7-8 cm, 8-9 cm, 9-10 cm, 10-12 cm, 12-14 cm, 14-16 cm, 16-18 cm and 18-20 cm. A set of 1cc sub- samples were taken from the first 10 sections and preserved in 2% formaldehyde for determination of microbial abundance by epifluorescence microscopy. The rest of the sections were frozen at -20^0C for community structure analysis. Upon return to Galway, DNA will be extracted from the frozen core samples. The variable V3 region of the 16S rRNA gene will be amplified by the Polymerase Chain Reaction and the amplification products analysed by Denaturing Gradient Gel Electrophoresis. This separates DNA molecules of the same length but different sequence and provides information on the complexity and spatial variability of microbial populations. Full-length 16S rRNA gene libraries will also be constructed using PCR primers specific for the domains Bacteria and Archaea. Selected clones will be sequenced and their phylogeny determined. One subcore was collected for biogeochemical analysis for the University of Liverpool. Table 3 summarizes the cores collected during the cruise.

Tab. 3. Microbiological sediment samples from giant box corers.

Date	Coordinates	Station	Microbiology	Geochemistry
17/9/00	$51^0$43.147'N $12^0$53.147'W	GeoB 6707-2	1	0
17/9/00	$52^0$09.253'N $12^0$46.190'W	GeoB 6708-1	1	0
17/9/00	$52^0$12.024'N $12^0$41.998'W	GeoB 6709-2	1	0
18/9/00	$52^0$09.216'N $12^0$46.313'W	GeoB 6721-1	0	1

Other Samples

About 5 litres of water from a CTD deployment, station GeoB 6734-1; 765m depth, was filtered through a 0.2 micron pore size PTFE filter using a peristaltic pump and frozen at –20^0C for geochemical analysis of particulates (University of Liverpool). Single specimens of *Lophelia pertusa* and *Madrepora oculata* were taken from Station GeoB 6739-1 and Station GeoB 6741-3 for ANTHONY GREHAN (MRI, NUI Galway).

3.5 Sediment Sampling

DIERK HEBBELN

Sediments were recovered at several sites in the Hovland Mound area (GeoB 6708 to GeoB 6741) and at two sites in the Belgica Mound area (GeoB 6742 and GeoB 6743). Surface sediments have been retrieved with a giant box corer (GKG) (Tab. 4), while a gravity corer (SL) was used to recover longer sediment sequences (Tab. 5). In the Hovland Mound area sampling focused on the triangular Propeller Mound, where the box corer and the gravity corer have been deployed at six sites, respectively (Fig. 30), with four additional sites in the wider Hovland Mound area, two of them sampled by box corer and gravity corer (deep basin to the NE of the Propeller Mound (GeoB 6718) and a site close to the HM-1 mooring site (GeoB 6709, 6741)), one only by box corer (close to ACES 2 mooring site (GeoB 6708)) and one only by gravity corer (drift sediments north of the Propeller Mound (GeoB 6725)).

3.5.1 Sediment surface sampling with giant box corer

The main tool for the recovery of surface sediment samples was the giant box corer, with a sampling area of 50 * 50 cm, which is able to penetrate as deep as 50 cm into the sediments. The giant box corer was used at 16 stations (Tab. 4). The core recovery was variable, due to the nature of the sampled material. At those sites where mainly sediments have been retrieved, recovery was on average 20 to 30 cm with reasonably well preserved sediment surfaces. In coral dominated samples the fine sediments mostly have been washed out during handling of the instrument, however, thereby not affecting the corals.

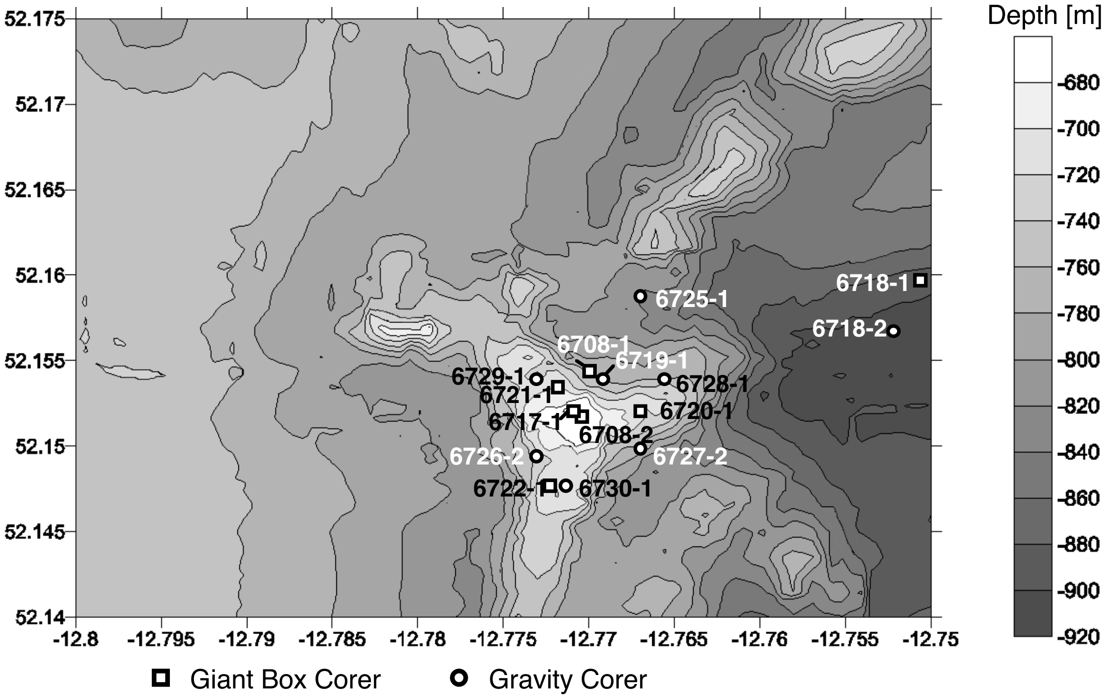


Fig. 30. Giant box corer stations at the Propeller Mound site.

Tab. 4. Giant box corer sampling during POS-265.

Station		latitude N		longitude W		Depth	main content
GeoB	6707-1	51°	42.936	12°	53.393	1243 m	no recovery
GeoB	6707-2	51°	43.147	12°	53.147	1242 m	sediments
GeoB	6708-1	52°	09.253	12°	46.190	742 m	sediments
GeoB	6708-2	52°	09.076	12°	46.218	657 m	corals
GeoB	6709-2	52°	12.024	12°	41.998	817 m	sediments
GeoB	6717-1	52°	09.102	12°	46.234	686 m	corals
GeoB	6718-1	52°	09.577	12°	44.999	890 m	sediments
GeoB	6720-1	52°	09.126	12°	45.988	729 m	corals
GeoB	6721-1	52°	09.216	12°	46.313	696 m	sediments
GeoB	6722-1	52°	08.884	12°	46.303	890 m	corals
GeoB	6739-2	52°	08.899	12°	46.310	729 m	no recovery
GeoB	6739-3	52°	08.939	12°	46.280	726 m	no recovery
GeoB	6740-1	52°	08.699	12°	46.277	749 m	no recovery
GeoB	6742-3	51°	25.499	11°	46.373	935 m	corals
GeoB	6743-1	51°	27.030	11°	44.962	840 m	no recovery
GeoB	6743-2	51°	27.014	11°	44.955	840 m	corals

Tab. 5. Gravity corer sampling during POS-265.

Station		latitude N		longitude W		depth	length
GeoB	6718-2	52°	09.379	12°	45.158	900 m	450 cm
GeoB	6719-1	52°	09.233	12°	46.127	758 m	480 cm
GeoB	6725-1	52°	09.520	12°	46.010	820 m	450 cm
GeoB	6726-1	52°	08.990	12°	46.350	690 m	no recovery
GeoB	6726-2	52°	08.967	12°	46.385	730 m	530 cm
GeoB	6727-1	52°	08.976	12°	46.019	804 m	no recovery
GeoB	6727-2	52°	09.017	12°	45.970	794 m	470 cm
GeoB	6728-1	52°	09.246	12°	45.920	749 m	590 cm
GeoB	6729-1	52°	09.231	12°	46.380	711 m	460 cm
GeoB	6730-1	52°	08.861	12°	46.282	704 m	360 cm
GeoB	6741-1	52°	12.013	12°	42.008	818 m	465 cm
GeoB	6743-3	51°	27.025	11°	44.990	835 m	no recovery
GeoB	6743-4	51°	27.017	11°	44.921	845 m	20 cm

Due to various reasons, five of the deployments of the giant box corer failed and no sediments were recovered.

In the sediment dominated samples the sampling scheme included intense sampling of the sediment surface with two subsamples for foraminifera studies, one for organic matter analyses, and one for saving remaining surface sediment material. Foraminifera samples were stained with a solution of 1g of rose bengal in 1 l ethanol. The whole sediment column has been sampled by three series of syringes (10 cm^3), taken every 3 cm. The A- and B-series will be analysed in Bremen for physical properties, elemental compositions and foraminifera, while the K-series will be studied in Kiel, focusing on biogenic hardparts. In addition, where possible, an archive tube has been taken, containing the whole retrieved sequence. At some sites the Galway group took another tube for bacteria analyses while the Gent group collected samples for meiofauna and biodiversity investigations. Genetic samples of living *Lophelia* was collected for ALEX ROGERS (SOC) from Geob 6722-1.

Those sediment-dominated samples also containing corals as well as the coral-dominated samples have been washed stratigraphically in 10cm-thick slices over a series of sieves with 2cm, 1cm and 0.5cm mesh size. In addition, a subsample was washed with a 125μm-sieve to obtain a coarse sand fraction sample for further component analysis.

The various kinds of samples taken from the individual giant box corers are listed in Tab. 6.

Tab. 6. Sampling scheme for the giant box corer retrieved during cruise POS-265.

GeoB Station	Corals & Macrofauna Tübingen	surface Forams Bremen	surface Forams Kiel	surface organic matter	surface Rest	syringe A-series	syringe B-series	syringe K-series	archive tube	bacteria	meio-fauna & biodi-versity
6707-2	-	x	x	x	x	-	-	-	x	x	x
6708-1	x	x	x	x	x	x	x	x	x		
6708-2	x	x	-	-	-	-	-	-	-		
6709-2	-	x	x	x	x	x	x	x	x	x	
6717-1	x	x	-	x	-	-	-	-	-		
6718-1	-	x	x	x	x	x	x	x	x		
6720-1	x	x	-	-	-	-	-	-	-		
6721-1	x	x	x	x	x	x	x	x	x	x	
6722-1	x	-	-	-	-	-	-	-	-		
6742-3	x	x	x	x	-	-	-	-	-		
6743-2	x	x	x	x	-	-	-	-	-		x

Visual inspection of the sediment surfaces mostly revealed a light brownish grey slightly sandy mud, which generally was very soft. Often it contained drop stones, sometimes up to 10 cm in size. In the coral-dominated samples, the remaining sediments were significantly coarser consisting mainly of sand sized particles. However, as these samples mostly have been washed out during recovery, this coarse composition might be at least partly an artefact. Inspection of the side of the box corer sample in most cases revealed a significant shift in the sediment appearance. In 5 cm to 10 cm depth the colour changed at a sharp boundary to an olive grey silty clay, which was much stiffer than the overlying layer (Fig. 31). Also this layer contained dropstones. The coral topic will be discussed in section 3.8.

Fig. 31. Opened GKG GeoB 6708-1 with a light brownish grey slightly sandy mud on top and an olive grey silty clay, which is much stiffer than the overlying layer beneath.

3.5.2 Sediment sampling with gravity corer

The gravity corer used during this cruise was equipped with a core barrel of 5.75m length and a weight of 1 ton on top to push it into the sediments. During the work in the Hovland Mound area 9 gravity cores with a total of 42.55 m of sediments were recovered (Tab. 5). Six of these stations with a total recovery of 28.90 m are located at the Propeller Mound with individual core lengths ranging between 3.60 m and 5.90 m. The other three sample locations include a sediment drift (GeoB 6725, 4.50 m), a deep site (GeoB 6718, 4.50 m) and a site close to the sediment trap mooring HM-1 (GeoB 6741, 4.65 m). Gravity coring in the Belgica Mound area proved to be quite difficult. In two attempts at a mound slightly to the NE of the Theresa Mound only 20 cm of sediment have been retrieved. In the first attempt the gravity corer hit the seafloor and immediately fell on its side, without penetrating the sediments. In the second attempt, it penetrated ~40cm into the sediments before it fell on its side, this time bending the core barrel. Thus, in contrast to the relatively soft sediments of the Propeller Mound, the sediment surface at this mound is extremely hard, almost impossible to penetrate with the available instrument.

A dredge with a rectangular toothed frame was used on three stations (6737-1, 6738-1, 6739-1; Fig. 32). Each haul took 15 min with 1,400m cable paid out. The drag speed was 0.5 to 1 kn over ground. Dredge haul 6737-1 was launched on the NE plateau of the Propeller Mound at 781m water depth and was trawled over a small summit in 660m depth. The haul ended in 700m depth. Few dead *Lophelia pertusa* and *Madrepora oculata* colonies were sampled together with large quantities of silty sand and clay and large, polymict dropstones (20cm across). Principally the result was obtained from a haul over the NW plateau of the mound (6738-1) which started at 690m and was trawled over a 650m deep summit and ended at 720m water depth. The last haul 6739-1 was a slightly downslope haul over the southern plateau of the mound (start: 670m, end: 730m). Only corals *(Lophelia pertusa, Madrepora oculata, Desmophyllum cristagalli)* both live and dead were in the net, but no sediment. In addition, octocorals, sea urchins *(Echinus, Cidaris),*

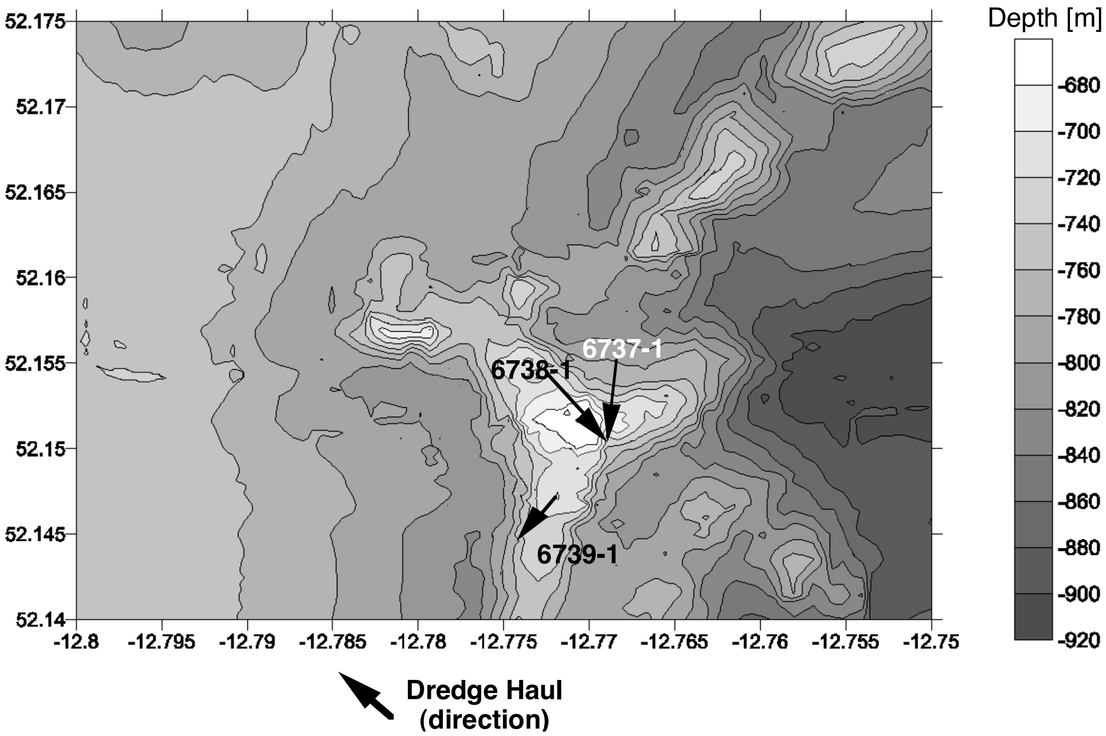


Fig. 32. Dredge hauls on Propeller Mound.

ophiuroids, shrimps, decapods, errant polychaetes, bivalves *(Hiatella arctica, Bathyarca)* and trochid gastropods. Summing up, the dredge hauls mirror the surface facies as can be deduced from the box corer samples. This means that richest coral framework exists along the southern plateau, while the two northern plateaus have a much thinner veneer of predominantly dead corals on a winnowed sediment surface.

3.7 Corals ANDRÉ FREIWALD, HELMUT LEHNERT, KAI KASZEMEIK

In total four scleractinian corals and one calcifying hydrocoral were identified in the samples: *Desmophyllum cristagalli, Flabellum macandrewi, Lophelia pertusa* and *Madrepora oculata*. One hydrocoral colony, *Stylaster gemmascens,* was identified in the box corer GeoB 6708-2. First impressions on:

- the spatial distribution of corals,
- the colour variations and colony growth habits,
- the associated fauna, and

from the Propeller Mound in the Hovland area in comparison to the Belgica Mounds are presented.

The spatial distribution of corals

A major question concerning the Propeller Mound survey was to retrieve information on the spatial information and status of coral cover on the mound surface with a dense box corer sampling grid over the three spurs and their adjacent flanks. In addition, three dredge hauls were taken from the spurs. Densest coral cover and most living corals were located along the southern spur with both, box corer and dredge. Here no deposits could be sampled because of the dense coral colonies which prevent a deep penetration into the sediment, thus proposing the existence of a healthy *Lophelia-Madrepora-Desmophyllum* reef (Fig. 33). On the summit of Propeller Mound coral colonies seem to have a more patchy distribution with large sediment fields in between. Only few living colonies but a dense coverage of recently and longer dead colonies dominate the sediment surface and the sub surface sedimentary regime (Fig. 33). The northerly directed spurs show a sparser coral colonisation with dead and fragmented coral debris on the sediment surface (NW spur), or highly diluted with a mollusc-foraminifer-rich coarse sand (NE spur).

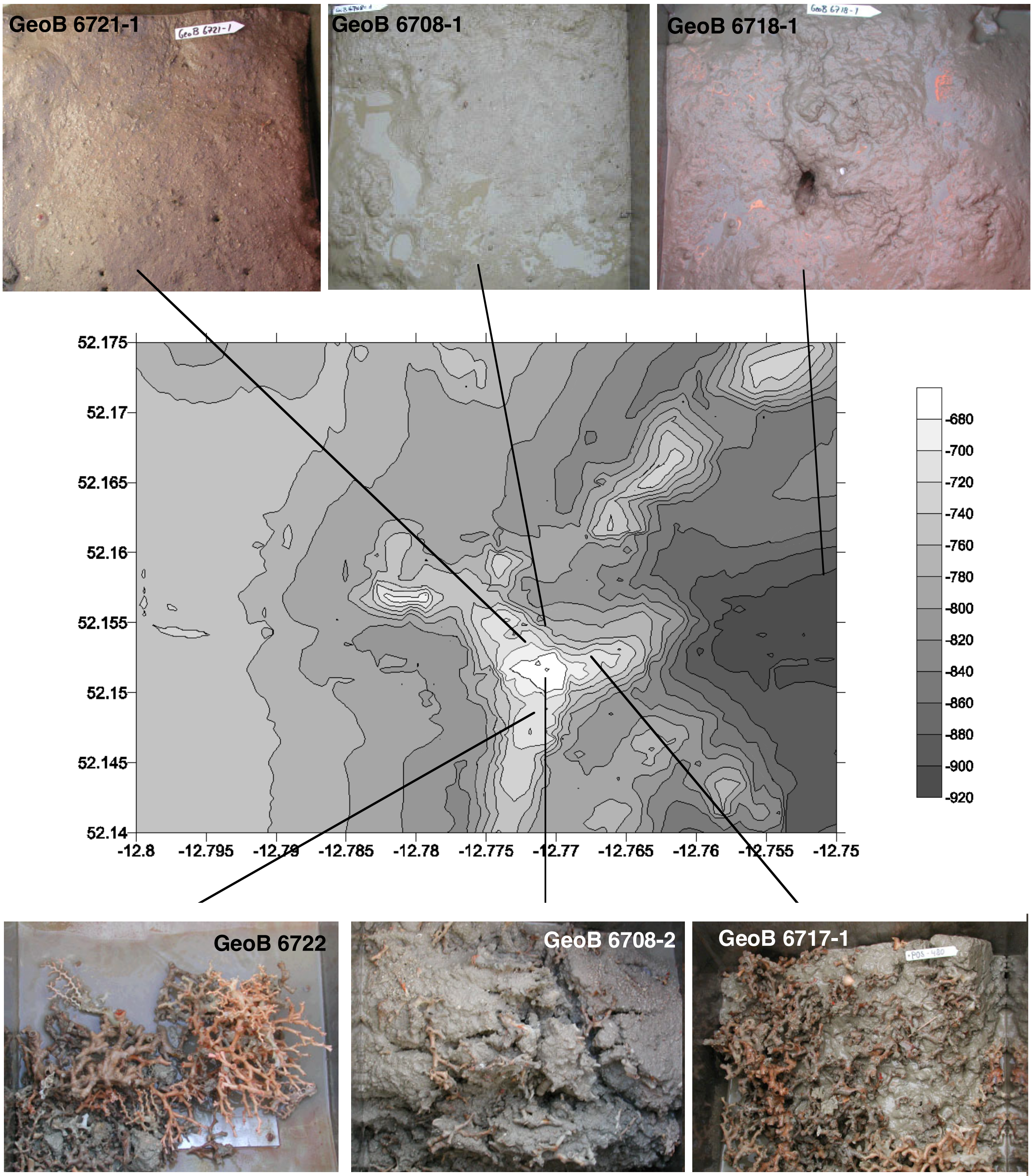


Fig. 33. Sediment facies on and near Propeller Mound.

The two box corer from the Belgica Mounds show a completely different facies. Station GeoB 6742-3 from Theresa Mound yielded an almost complete cover of hexactinellid sponges which settle on dead coral *(Madrepora* mostly and *Lophelia* colonies; Fig. 34), while the living portion of corals was quite sparse.

Fig. 34. Hexactinellid *(Aphrocallistes)* sponge dominance on Theresa Mound, Belgica Mound Province (GeoB 6742-3, —935m).

The last box corer of POS-265 was on an unnamed mound north of Theresa Mound in the Belgica Mound Province. The sediment surface was entirely dominated by *Madrepora oculata*, octocorals and few hexactinellid sponges. The colonies measure 30cm across and the coverage was nearly 90% (GeoB 6743-2; Fig. 35).

Fig. 35. *Madrepora oculata* thickets colonised by hydroids, octocorals and hexactinellid sponges, Belgica Mound Province (GeoB 6743-2, —840m).

The colour variations and colony growth habits

Both *Lophelia pertusa* but also *Madrepora oculata* occur in different colour variations in different regional locations, or at the same reef site and even the same colony (FREIWALD, 1998). Samples of different colour variations were fixed in a specific liquid for further genetic studies carried out by ALEX ROGERS (SOC, U.K.). On Propeller Mound *Lophelia* occurs in three different morphs (Fig. 36): (1) red soft tissue and white skeleton, (2) red soft tissue and reddish-brown skeleton, and (3) translucent soft tissue and white skeleton. All morphs were collected from dredge haul GeoB 6739-1.

Fig. 36. Three different colour morphs of *Lophelia pertusa* from Propeller Mound (GeoB 6739-1).

The growth shape of coral colonies varies considerably when comparing Propeller Mound with the two samples from the Belgica Mound area. While on Propeller Mound the corals show a thickly calcified anastomosing or bushy colony shape, the Belgica Mound corals are extremely two-dimensional, or fan-shaped (Fig. 37). This observation is consistent for *Lophelia pertusa* and *Madrepora oculata*. The former seems to be relatively rare on the Belgica Mound area. Moreover, even the living corals on the Belgica Mound area are colonised i.e. by hydroids or octocorals. This is quite unusual compared to Propeller Mound corals or other sites in the North Atlantic.

Fig. 37. Fan-shaped *Madrepora oculata* colony from Belgica Mound Province (GeoB 6742-3).

The associated fauna with special reference to sponges

On Propeller Mound sponges played a minor role in terms of diversity and size. If present, sponges were found attached to dead coral skeletons as thin-encrusting morphotypes with less than 1mm thickness. These sponges presumably belong to the order Poecilosclerida and are represented by 7 species. The blue *Hymedesmia paupertas* and the yellow *Hymedesmia rugosa* have been identified so far. No sponge covered more than a few cm^2 on the coral skeletons.

Two box-corer samples from the Belgica Mound Province revealed the largest sponges of the cruise. The up to 25cm large hexactinellid *Aphrocallistes beatrix* is very dominant in number and size on Station GeoB 6742-3 (Figs. 34 and 38). *Aphrocallistes* occurs with numerous elongated protrusions occurred in 3 colour varieties: living yellow, freshly dead white and longer dead brown spicule skeletons. *Aphrocallistes* uses dead coral framework as a hard substrate to settle on. Despite of the fact that only two samples had been taken from that mound province, it seems likely that the relatively large amount of this single hexactinellid species points the presence of large but monospecific popula-tions. All sponges collected were deep-freezed in dry ice and stored in a Dewar cask.

Fig. 38. *Aphrocallistes beatrix* from Theresa Mound, Belgica Mound Province.

Acknowledgements

This cruise was made possible through generous funding of the ACES (Contract EVK3-CT-1999-00008) and ECOMOUND (Contract EVK3-CT-1999-00013) Projects of the 5th EU-Framework Programme. The scientific crew wants to express there sincere thanks to the captain and crew of RV POSEIDON for splendid assistance in finding weather windows which provide moderate to good working conditions in this time of the year for that rough part of the NE Atlantic. Also the work with the deck crew was extremely co-operative.

4. References

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5. Station List

Poseidon Coding	Station #	Gear/ Equipm.	Date	Bottom UTC	Latitude	Longitude	Depth [m]	Recovery/Remarks
461-1	GeoB 6701-1	CTD	13.09.00	22:16	59°56,22 N	07°16,860W	768	all bottles released
462-1	GeoB 6702-1	SAPS		23:17	59°56,60 N	07°17,120W	728	1h pumping in 580m
463-1	GeoB 6703-1	ECO 1	15.09.00	17:44	55°36,35 N	15°27,373W	810	recovery of mooring for ECOMOUND
464-1	GeoB 6704-1	CTD	16.09.00	6:08	53°47,897N	14°00,989W	996	all bottles filled at 600m for sediment trap
464-2	GeoB 6704-2	ECO 2		7:32	53°47,094N	13°59,667W	940	recovery of mooring for ECOMOUND
465	GeoB 6705	Echosounder		18:00-2:00	52°09,50 N	12°48,00 W	780	hydroacoustic measurements
					52°08,50 N	12°45,00 W		
466-1	GeoB 6706-1	CTD	17.09.00	5:53	51°43,190N	12°54,796W	1223	6 bottles 1218m, 6 bottles 1198m
466-2	GeoB 6706-2	ACES 2		7:38	51°43,194N	12°54,635W	1218	deployment of ACES mooring
467-1	GeoB 6707-1	GKG		8:25	51°42,936N	12°53,393W	1243	no recovery
467-2	GeoB 6707-2	GKG		9:15	51°43,147N	12°53,147W	1242	27cm recovery
468-1	GeoB 6708-1	GKG		13:07	52°09,253N	12°46,190W	742	31cm recovery
468-2	GeoB 6708-2	GKG		14:12	52°09,076N	12°46,218W	657	*Lophelia* colonies
469-1	GeoB 6709-1	HM1		15:55	52°11,074N	12°41,747W	781	mooring of sediment trap ECOMOUND
469-2	GeoB 6709-2	GKG		16:31	52°12,024N	12°41,998W	817	40cm recovery
469-3	GeoB 6709-3	CTD		17:29	52°12,019N	12°41,895W	815	2 bottles 800m, 2 bottles 780 m
470-1	GeoB 6710-1	SAPS		19:55	52°08,332N	12°46,377W	719	2h pumping at 690m
470-2	GeoB 6710-2	CTD		21:50	52°08,357N	12°46,257W	786	2 bottles at 771m, 2 bottles at 751m
471-1	GeoB 6711-1	CTD		22:35	52°08,370N	12°46,576W	796	2 bottles at 781m, 2 bottles at 761m
472-1	GeoB 6712-1	CTD		23:24	52°08,432N	12°46,684W	805	2 bottles at 790m, 2 bottles at 770m
473-1	GeoB 6713-1	SAPS	18.09.00	0:21	52°08,235N	12°46,407W	670	2h pumping at 670m
474-1	GeoB 6714-1	CTD		3:14	52°08,315N	12°46,185W	802	2 bottles at 787m, 2 bottles at 767m
475-1	GeoB 6715-1	CTD		4:05	52°08,186N	12°46,031W	849	2 bottles at 834m, 2 bottles at 814m
476-1	GeoB 6716-1	CTD		4:54	52°08,091N	12°46,605W	833	2 bottles at 818m, 2 bottles at 798m
477-1	GeoB 6717-1	GKG		7:34	52°09,102N	12°46,234W	686	*Lophelia* colonies plus silt and sand
478-1	GeoB 6718-1	GKG		8:34	52°09,577N	12°44,999W	890	27cm recovery
478-2	GeoB 6718-2	SL		10:57	52°09,379N	12°45,158W	900	450cm recovery
479-1	GeoB 6719-1	SL		12:57	52°09,233N	12°46,127W	758	480cm recovery
480-1	GeoB 6720-1	GKG		14:12	52°09,126N	12°45,988W	729	*Lophelia* and *Desmophyllum*
481-1	GeoB 6721-1	GKG		15:09	52°09,216N	12°46,313W	696	22cm recovery
482-1	GeoB 6722-1	GKG		16:11	52°08,884N	12°46,303W	890	*Lophelia* and *Desmophyllum*, partly living
483	GeoB 6723	Echosounder		19:00-2:00	52°09,50 N	12°48,000W		hydroacoustic measurements
					52°10,50 N	12°45,000W		
484-1	GeoB 6724-1	ACES 1	24.09.00	7:44	52°14,952N	12°29,880W	696	deployment of ACES mooring

485-1	GeoB 6725-1	SL		9:35	52°09,520N	12°46,010W	820	450cm recovery
486-1	GeoB 6726-1	SL		10:48	52°08,990N	12°46,350W	690	no recovery
486-2	GeoB 6726-2	SL		11:33	52°08,967N	12°46,385W	730	530cm recovery
487-1	GeoB 6727-1	SL		12:59	52°08,976N	12°46,019W	804	no recovery
487-2	GeoB 6727-2	SL		13:40	52°08,017N	12°45,970W	794	470cm recovery
488-1	GeoB 6728-1	SL		14:47	52°09,240N	12°45,920W	749	590cm recovery
489-1	GeoB 6729-1	SL		16:11	52°09,231N	12°46,380W	711	460cm recovery
490-1	GeoB 6730-1	SL		17:34	52°08,861N	12°46,282W	704	360cm recovery
491-1	GeoB 6731-1	CTD		18:40	52°09,436N	12°45,454W	884	2 bottles at 869m, 2 bottles at 849m
492-1	GeoB 6732-1	SAPS		19:31-20:31	52°09,246N	12°45,884W	750	274 l 1h pumping
492-2	GeoB 6732-2	CTD		21:21	52°09,237N	12°45,674W	853	2 bottles at 848m, 2 bottles at 828m
493-1	GeoB 6733-1	CTD		22:07	52°09,192N	12°46,037W	737	2 bottles at 722m, 2 bottles at 702m
494-1	GeoB 6734-1	CTD		23:05	52°08,886N	12°46,119W	772	2 bottles at 757m, 2 bottles at 737m
495-1	GeoB 6735-1	CTD		23:52	52°08,793N	12°46,612W	799	2 bottles at 784m, 2 bottles at 764m
495-2	GeoB 6735-2	SAPS	25.09.00	01:08-03:08	52°08,855N	12°46,598W	750	1h pumping
496-1	GeoB 6736-1	CTD		3:48	52°08,973N	12°46,704W	794	2 bottles at 779m, 2 bottles at 759m
497-1	GeoB 6737-1	Dredge		07:52-08:07	52°09,330N	12°46,070W	771	HDG 190°, sediment and dead corals
498-1	GeoB 6738-1	Dredge		09:29-09:44	52°09,250N	12°46,340W	780	HDG 160°, sediment and dead corals
499-1	GeoB 6739-1	Dredge		11:21-11:36	52°08,710N	12°46,330W	780	HDG 203°, sediment, living and dead corals
499-2	GeoB 6739-2	GKG		12:55	52°08,899N	12°46,310W	729	no recovery turned over
499-3	GeoB 6739-3	GKG		14:06	52°08,939N	12°46,280W	726	no recovery turned over
500-1	GeoB 6740-1	GKG		14:48	52°08,699N	12°46,277W	749	no recovery, not released
501-1	GeoB 6741-1	SL		16:02	52°12,013N	12°42,008W	818	465cm recovery
502-1	GeoB 6742-1	SAPS	26.09.00	00:30-02:30	51°25,808N	11°46,152W	830	2h pumping 213 l
502-2	GeoB 6742-2	CTD		23:43	51°25,808N	11°46,152W	10	no reading, station quit
502-3	GeoB 6742-3	GKG		7:17	51°25,499N	11°46,373W	935	Corals and sponges dead and living
503-1	GeoB 6743-1	GKG		8:35	51°27,030 N	11°44,962 W	840	no recovery
503-2	GeoB 6743-2	GKG		9:15	51°27,014 N	11°44,955 W	840	living and dead corals, sponges
503-3	GeoB 6743-3	SL		10:14	51°27,025 N	11°44,990 W	835	tumbled over the side, hardground
503-4	GeoB 6743-4	SL		10:53	51°27,017 N	11°44,921 W	845	0,4m penetration, 20cm recovery, tumbled
504-1	GeoB 6744-1	CTD		12:43	51°25,679 N	11°46,129 W	922	11 bottles at 907m, 1 bottles at 887m

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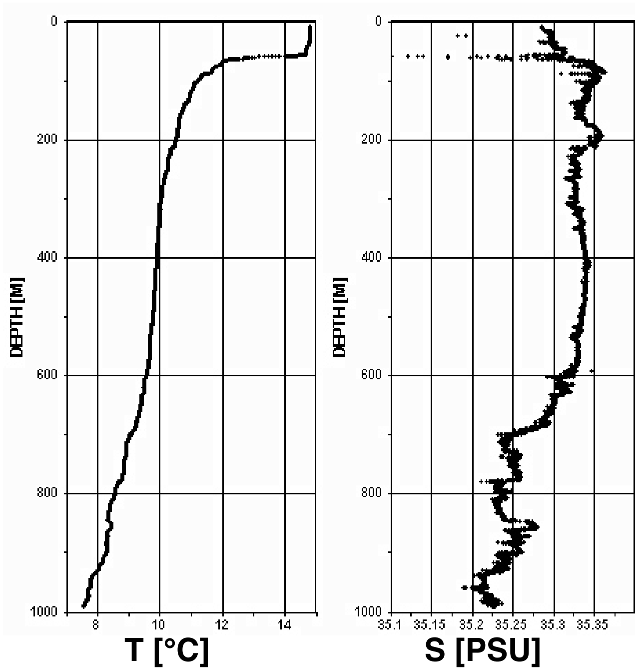

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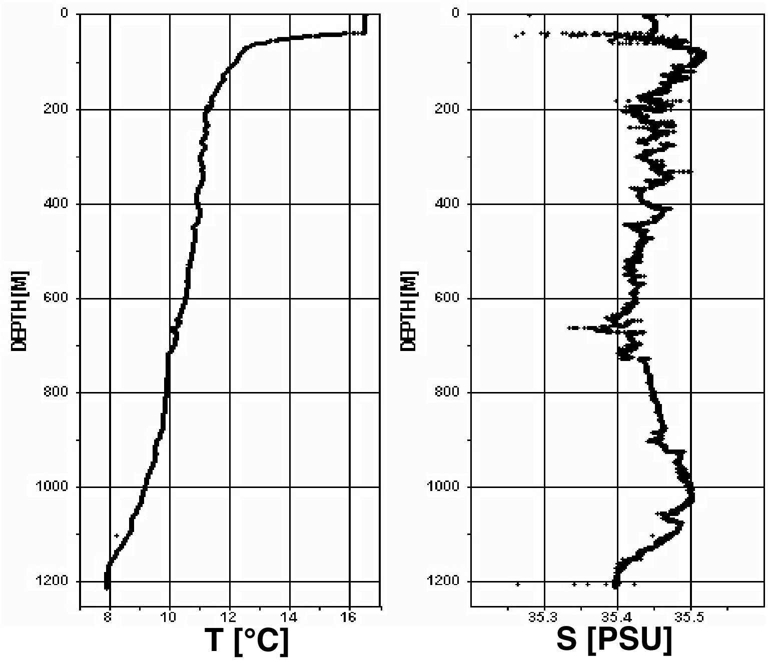

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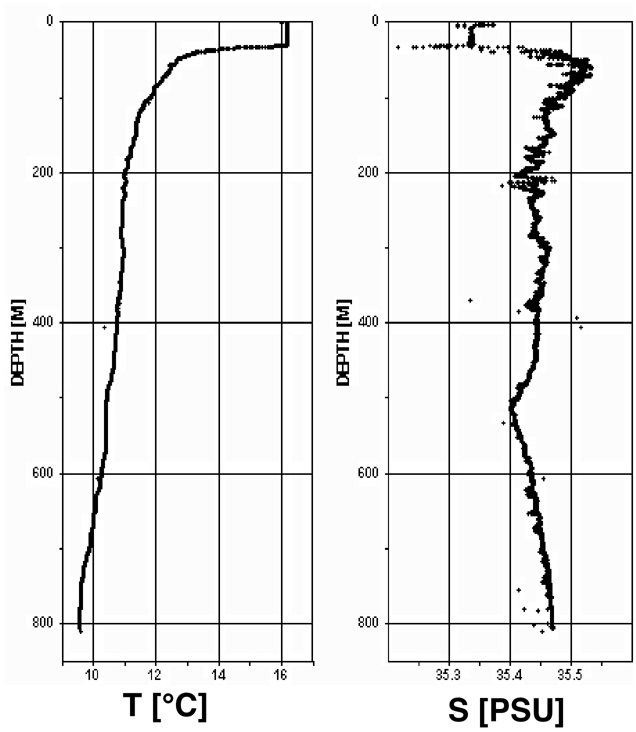

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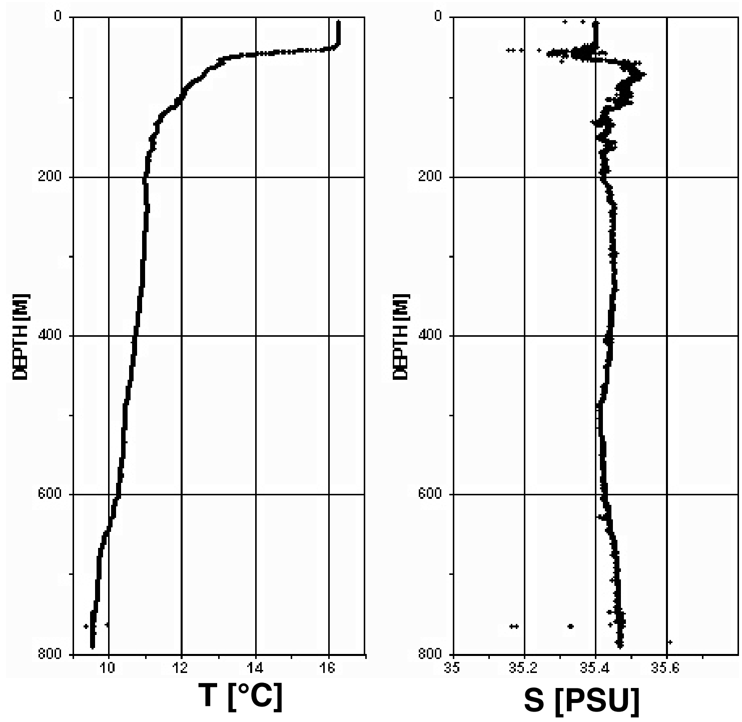

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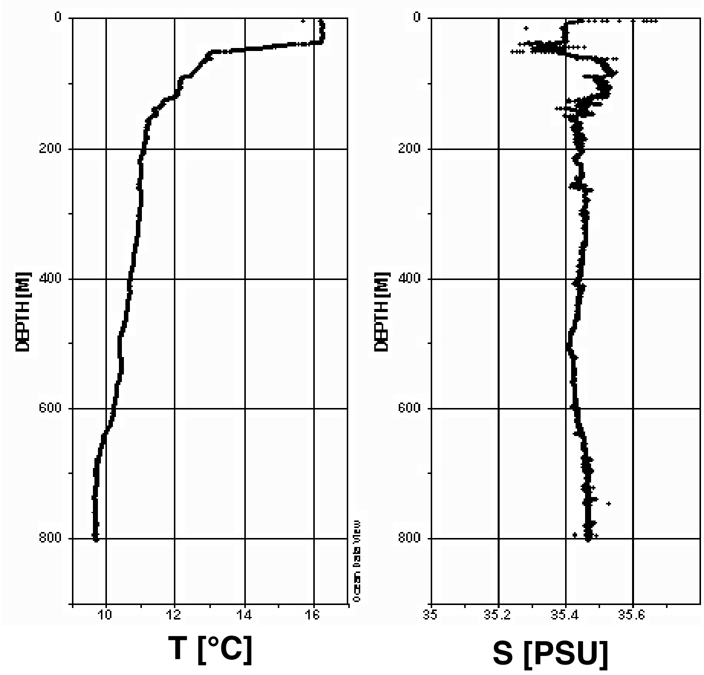

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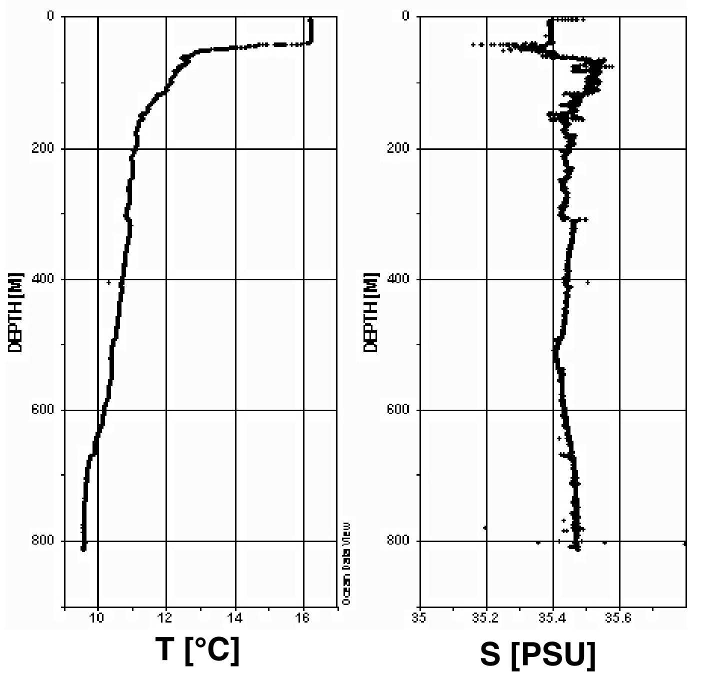

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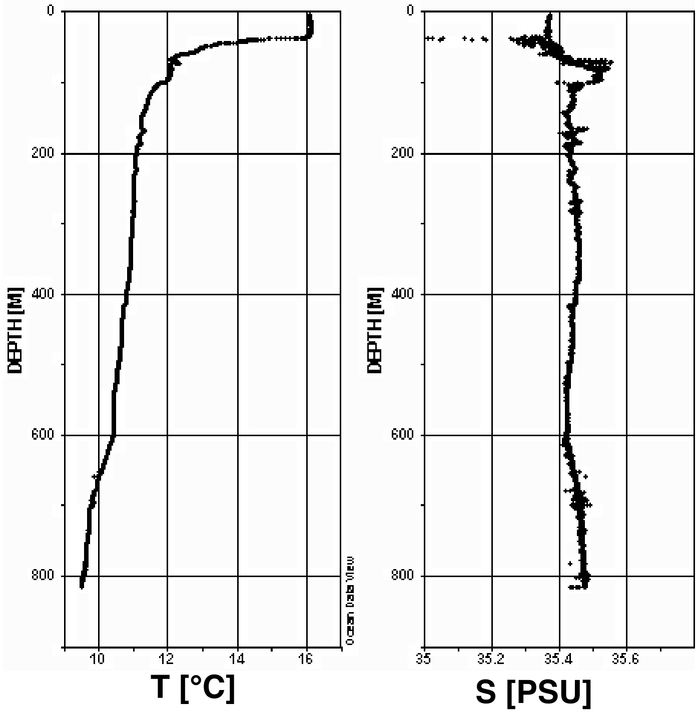

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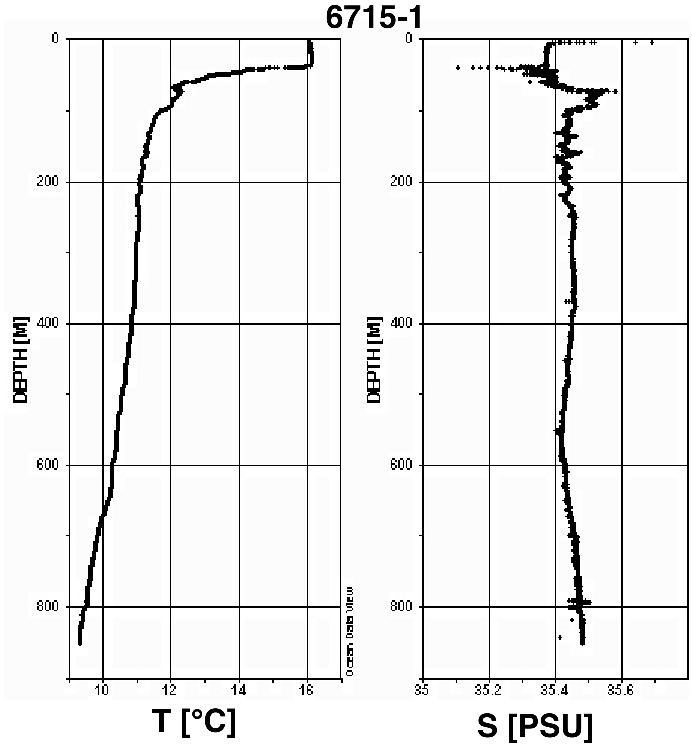

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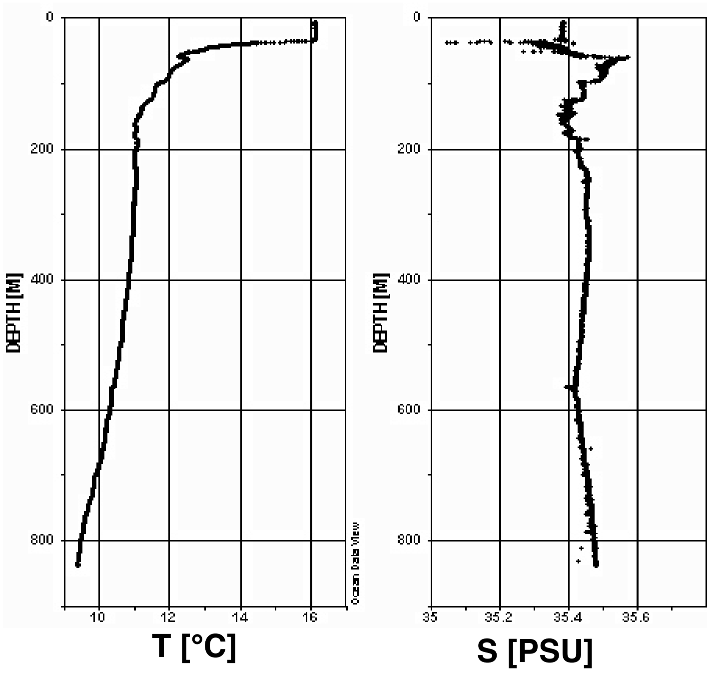

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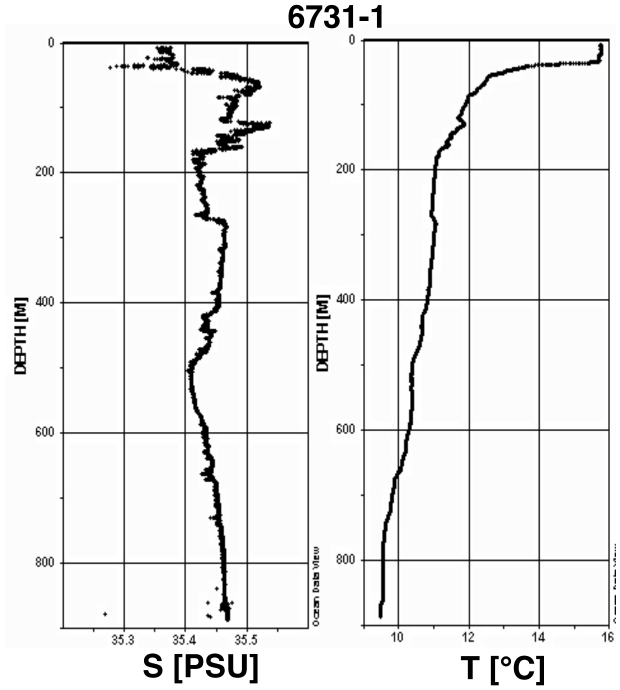

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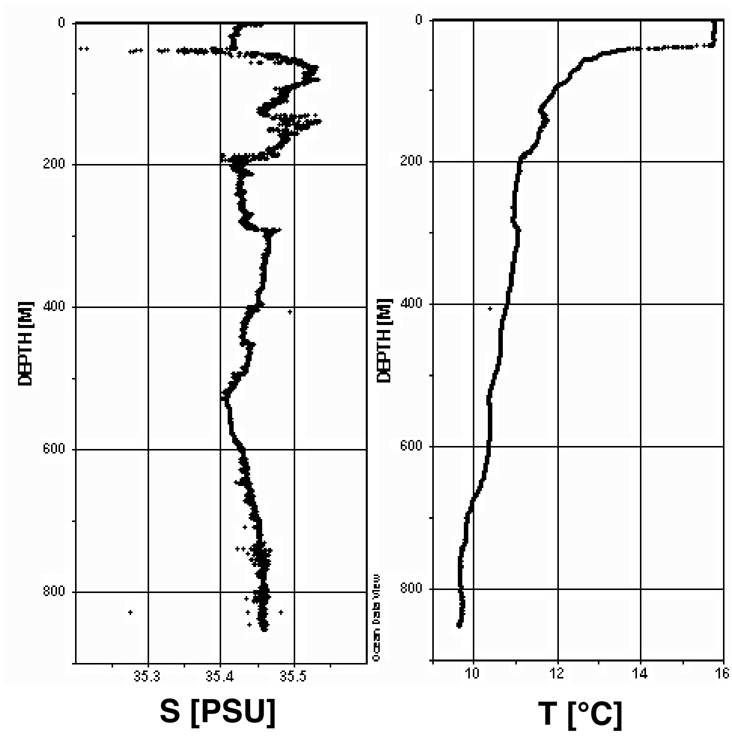

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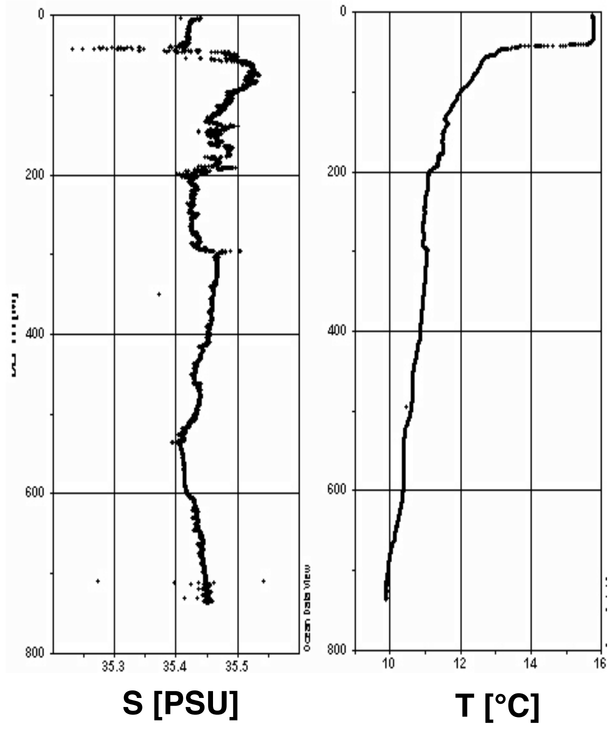

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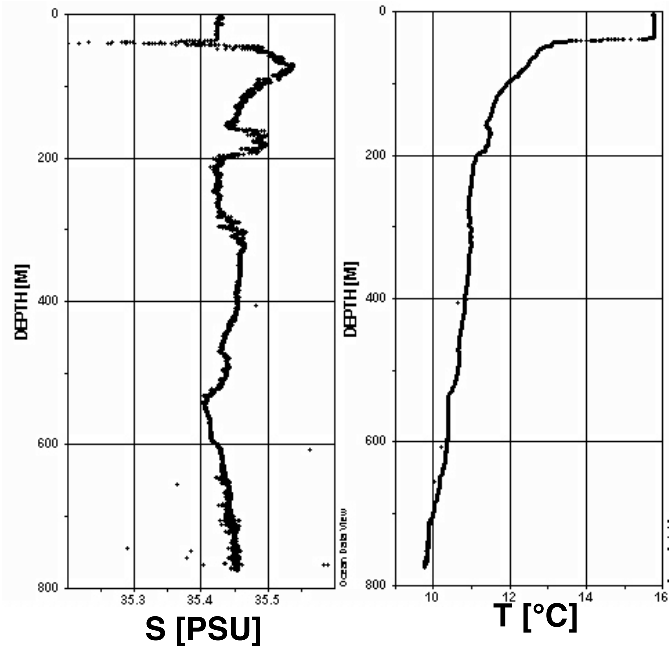

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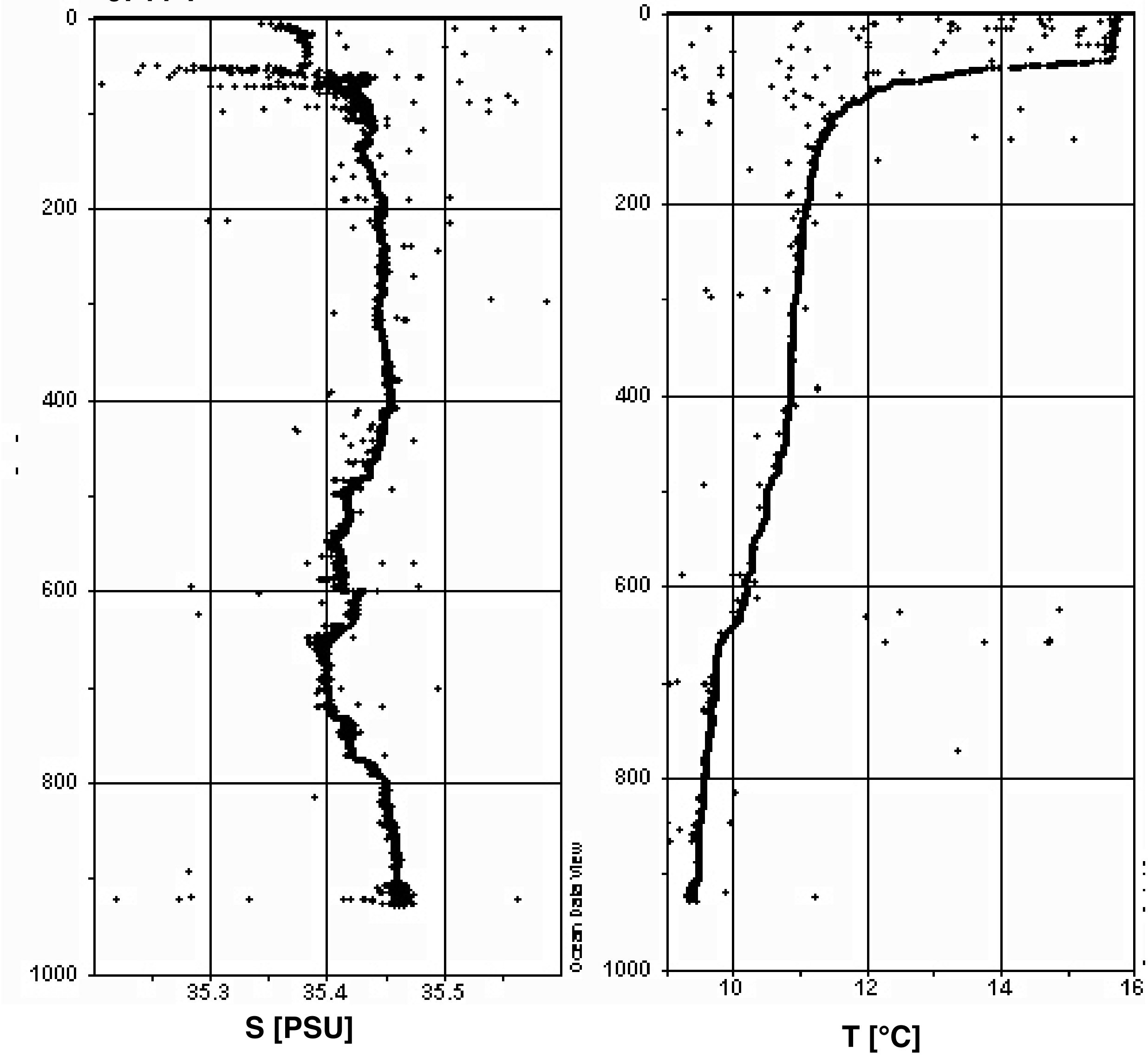

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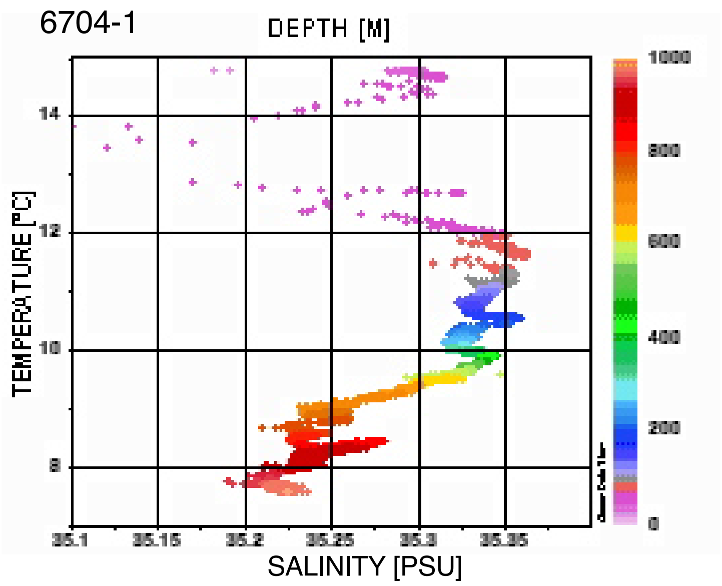
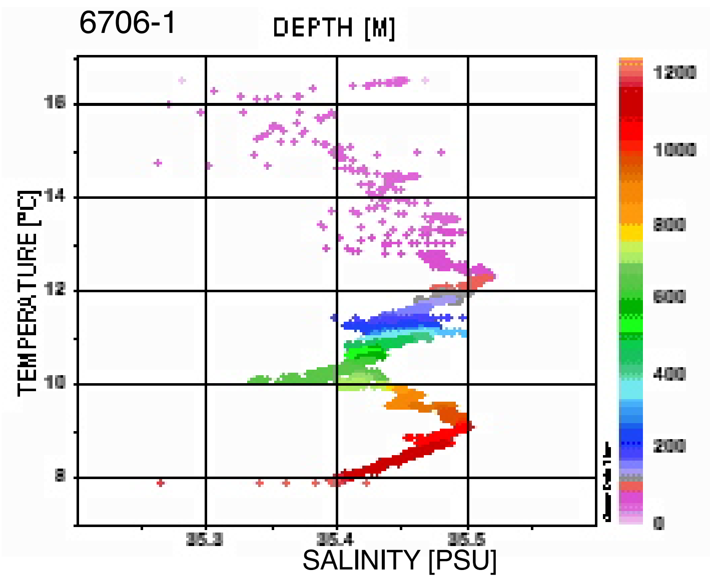
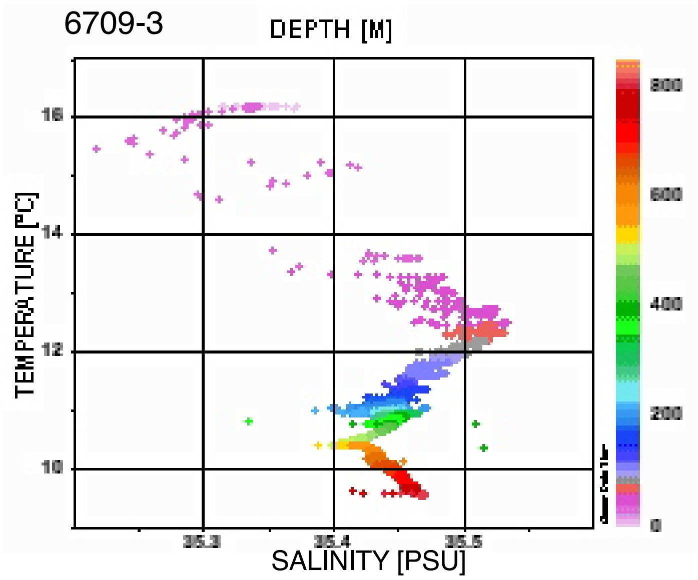
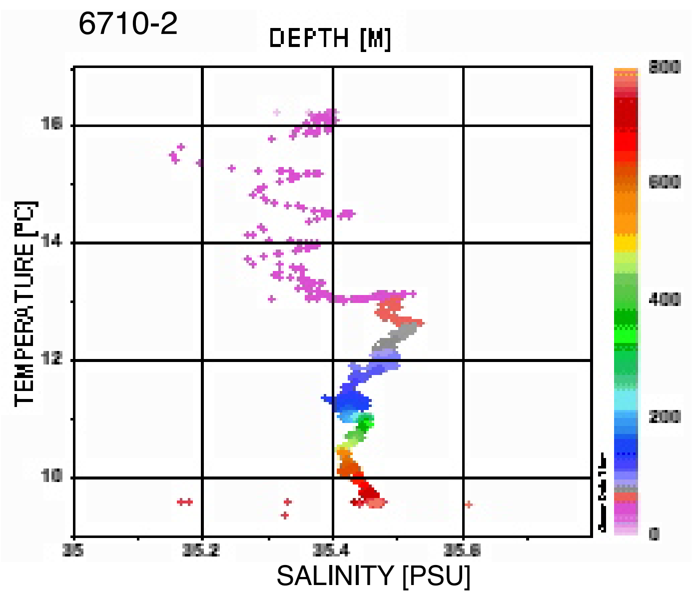
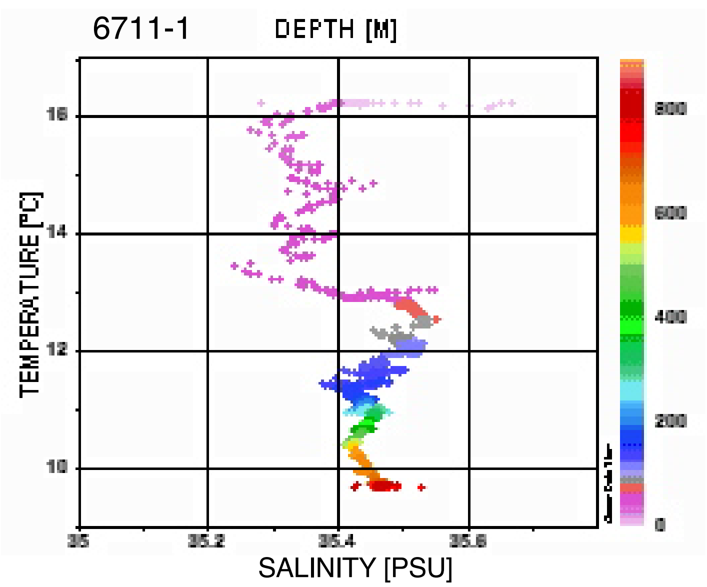
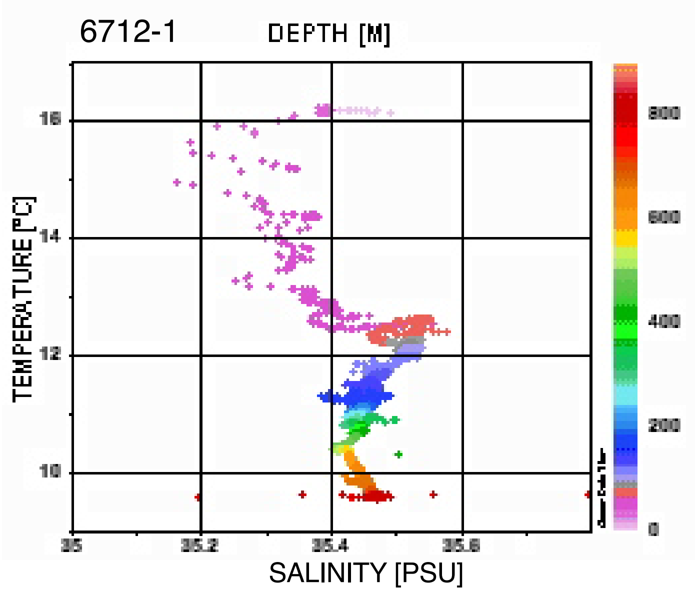




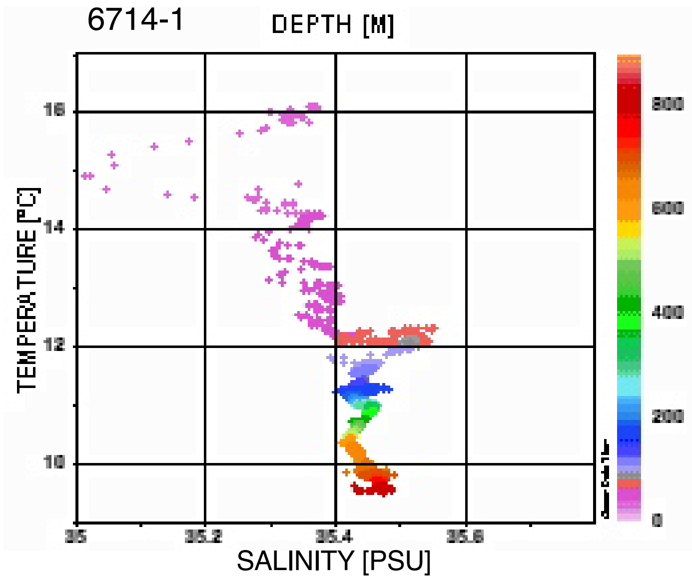


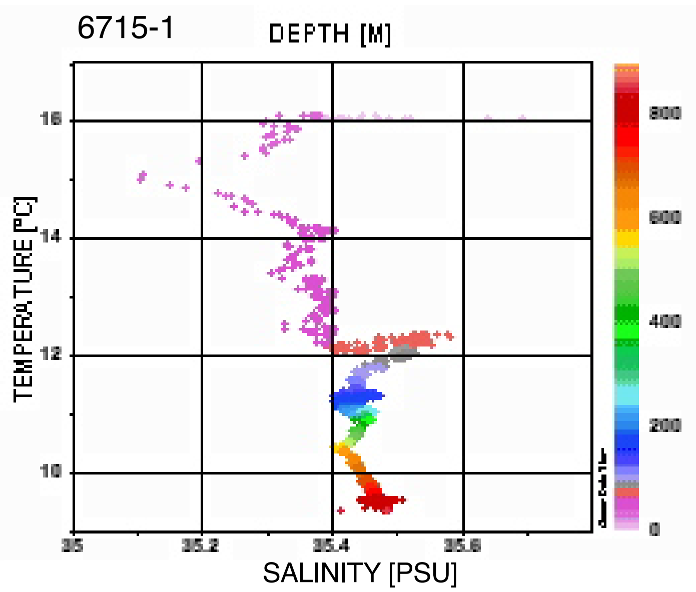


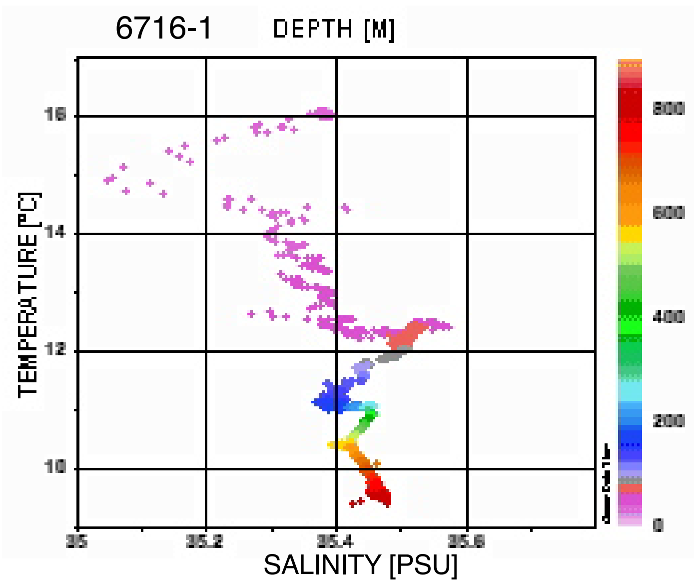


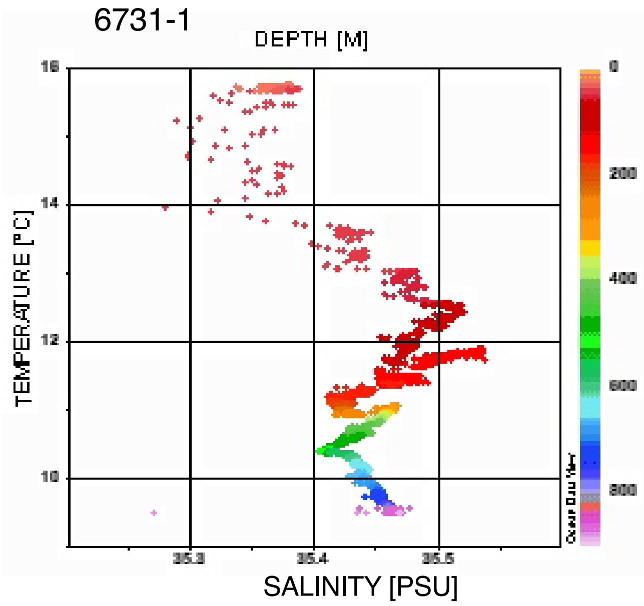


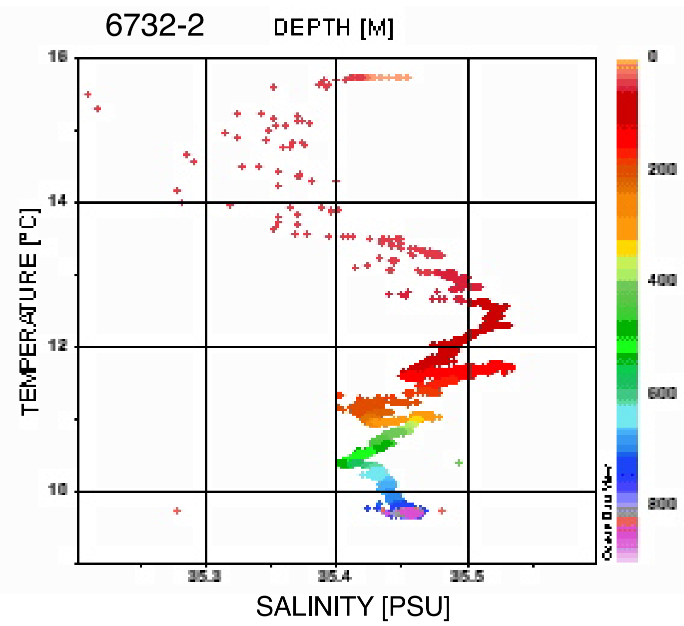
POS-265: T — S Plots

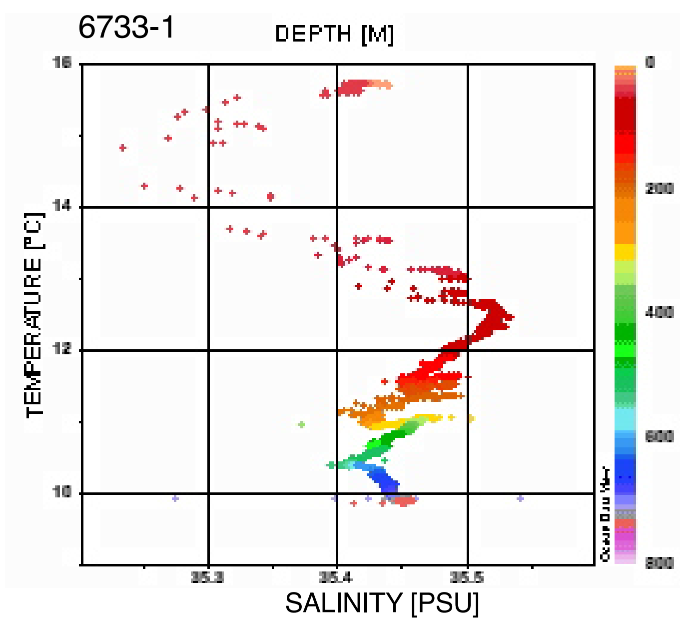












POS-265: T — S Plots