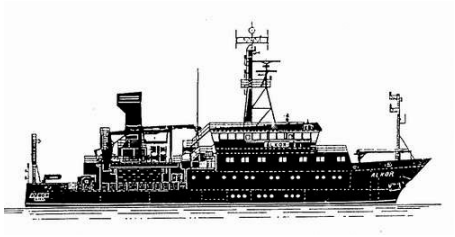
Leibniz-Institut für Meereswissenschaften
an der Universität Kiel
Germany

IFM-GEOMAR

Date: February 2004

Cruise Report



Compiled by:
O. Pfannkuche & cruise participants

F.S.ALKOR **Cruise No.:232**

Dates of Cruise: 30. Oct. – 11. Nov. 2003

Areas of Research: Paleo-oceanography, biological oceanography

Port Calls: Strömstad, Sweden

Institute: IFM-GEOMAR,.Leibniz-Institut für Meereswissenschaften, Dienstgebäude Ostufer, Wischhofstr. 1-3, 24148 Kiel, Germany

Chief Scientist: Dr. Olaf Pfannkuche

Number of Scientists: 10

Project title:
Geobiological investigations of aphotic coral reef ecosystems in the NE- Skagerrak

Cruise Report

This cruise report consists of 37 pages including cover:

1. Scientific crew

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03. Floss, J.	Technician	IFM-GEOMAR
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05. Greinert, J.	Scientist	IFM-GEOMAR
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2. Research Programme

Cold- and deep-water coral reefs have become a major research topic in the past decade. The culmination was an integrated study of three EU-FP5-RTD projects in the period 2000 – 2003: ACES, ECOMOUND and GEOMOUND. These projects targeted on deep-water coral ecosystems along the European continental margins and deep shelves with a focus on biological, sedimentological, oceanographical and geophysical processes. These studies further developed into the ESF-EUROMARGINS programme with the MOUNDFORCE project (2003 – 2005). This integrated research activity focuses on the postglacial geobiological evolution of deep-water coral reefs along a latitudinal gradient and forms the scientific backbone of the ALK-232 cruise together with partners from the Swedish Tjärnö Marine Laboratory (TMBL), who brought in their valuable expertise to the research programme.

Deep-water Coral Reefs and Scientific Objectives

Deep-water coral ecosystems are widely distributed along the continental margins, oceanic banks, seamounts and deep shelves of the NE-Atlantic. In the North Atlantic the major reef constructing coral is the colonial azooxanthellate *Lophelia pertusa* (Scleractinia) that has the potential to build substantial reefs in the aphotic zone (Fig. 1). Under the absence of light, the coral ecosystem is nourished by bentho-pelagic coupling processes through the transfer of food and nutrients from the fertile surface waters to the deeper water aphotic environments. The local environmental conditions measured in and near coral ecosystems show some common features: (1) the availability of hard substrate to settle on such as dropstone boulders, exhumed carbonate hardgrounds, larger calcareous skeletons of various origin and – although rarely observed – outcropping rock exposures, (2) the preferred location on pre-existing topographic highs such as moraine ridges, iceberg ploughmark levees, flutes, carbonate mounds and submerged oceanic banks and seamount flanks which create topographically confined current flow patterns of various scales, (3) the existence of periodic vigorous currents driven by tidal rectification to prevent sedimentation of particles, (4) an ambient water temperature window between 3° and 13°C and (5) fully aerobic to slightly oxygen-depleted conditions.

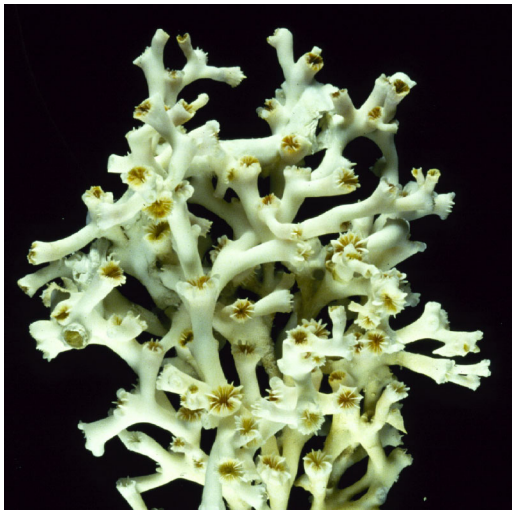


Fig. 1: The cold-water, reef-building scleractinian, *Lophelia pertusa* (L.).

The reefs themselves provide a series of habitats for thousands of species that live permanently or temporarily in the coral ecosystem. Compared to off-reef environments, the richness of species and biomass can be ten times higher in the reef environment. Like their tropical cousins, deep-water coral reefs seem to play an important role in the life cycle of demersal fishes. There is convincing evidence that many fishes deposit their eggcases between the corals (sharks, rayfishes). Others form huge schools of fish in the summit regions of the reefs for a certain time period (redfish, cod). For this reason, deep-water reefs are substantial for fishes acting as nursery, breeding and spawning sites. Therefore, habitat-destructive fishing methods such as rock-hopper trawls have created irreversible damage to the reefs in many places within the European EEZ. Ongoing stakeholder discussions on various political levels in order to mitigate or to prevent further uncontrolled reef destruction underpin the socio-economic importance of the ALK-232 seabed coral inspection at the entrance of the Oslofjord.

Previous work on deep-water corals in the study area

Corals were mentioned to occur in the eastern Skagerrak initially by Elias and Wahrberg (1926). Later on Jägerskiöld (1971) provided a compilation of the benthic communities found in this area. The Swedish occurrences are intensely studied by T. Lundälv (TMBL) who discovered new coral reefs both alive and dead in Norwegian waters of the southern Oslofjord entrance (Lundälv 2002). One of the larger reef complexes in the area, the Tisler Reef, was taken under governmental protection immediately after the discovery and received the “Gift to the Earth” award from the WWF in June 2003.

Major cruise objectives

In general, the occurrence of deep-water corals in the eastern Skagerrak region differs in some aspects from the coral reefs found under open Atlantic conditions: (1) The known reefs exist in quite shallow water depths of less than 200m, (2) the existence of an estuarine circulation creates pronounced salinity-stratified water bodies with a brackish water layer on top that is underflown by the intruding waters from the Atlantic through the deep Norwegian Channel. This low-salinity cap forms an environmental barrier for the deep-water corals.

The scientific objectives and methods of the ALK-232 cruise were:

- To map the seabed with multibeam echosounder to locate the coral reefs with a focus on previously unknown reef sites both in the SE-Skagerrak and around the Soester Islands, southern Oslofjord.

- To analyse the physical properties (temperature, salinity, oxygen and flourescence) of the water masses which passes the narrow gateways into the Oslofjord.

- To collect surface sediment samples using a Van Veen grab.

- To inspect potential new coral reef locations and document the zonation patterns and distribution of megafauna, the sedimentary environment and checking for physical damages using a ROV.

- To avoid further damage to living reefs only known and new visually ground-truthed dead reefs were cored with the box-corer and a vibro-corer to study the recent past geological evolution of the coral reefs in the Oslo Fjord's gateways.

3. Narrative

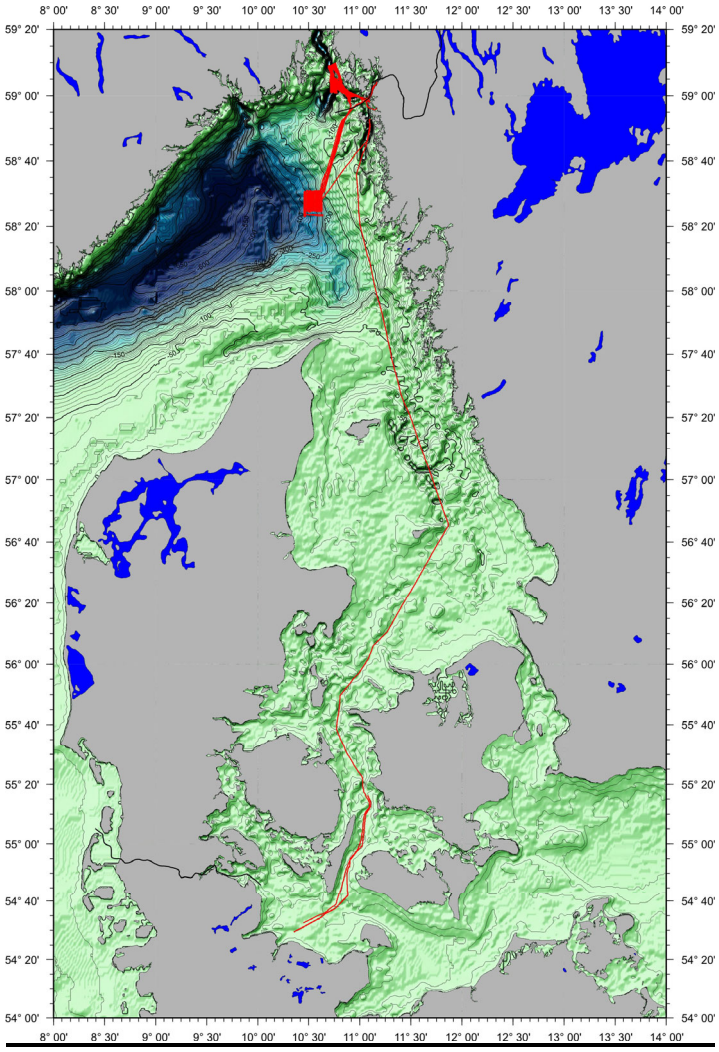


Fig.2: Cruise Track ALKOR 232

30. Oct. 03

FS ALKOR departed from the IFM-GEOMAR Pier in Kiel at 09.30h after loading the scientific equipment. Seven scientists from IFM-GEOMAR and the University of Erlangen boarded the vessel. After leaving Kiel Fjord the ship headed towards the Great Belt and continued its journey through the Kattegatt.

31. Oct. 03
We continued our journey through the Kattegat and Skagerrak until 14.00h when RV ALKOR docked at Strömstad harbour. In the afternoon the Swedish participants from the Tjärnö Laboratory delivered their equipment to the vessel. We spent the night at Strömstad harbour.

01. Nov. 03
Two Swedish scientist and an additional scientist from the University of Erlangen boarded the ship at 08.00h. At 10.00h RV ALKOR left Strömstad harbour and took course to the Sekken Fjord. Our station works (***Stat. 993 - 1002***) comprised of 2 CTD/Rosette Sampler casts, 2 Multi-beam bathymetric surveys and 6 Backengreifer sediment samples (van Veen type sampler). We left the Sekken area at 18.10h and took course to the open Skagerrak towards an area called Bratten at 58° 23.7´N, 10° 32.3'E where we started another multi-beam bathymetric survey (***Stat. 1003***)

02. Nov. 03
The multi-beam survey (***Stat. No 1003***) was performed during the whole night and was finished in the mornig at 08.49h. further activities in the Bratten area were a CTD/ Ro cast and a series 7 Backengreifer bottom samples of soft sediments. ***(Stat. 1004-12).*** Since the weather conditions deteriorated we left the Bratten area at mid day and headed back to the more sheltered area of the Sekken. We tried to sample a dead carbonate reef structure with the Vibrocorer ***(Stat. 1013)*** but the gear failed because it was obviously turned over. Activities at Sekken were finished at 20.00h after a short multi beam survey ***(Stat. 1014).***. ALKOR changed position to the nearby Tisler area where we spent the evening with a multi-beam survey ***(Stat. 1015).***

03.Nov. 03
The night was dedicated to another multi-beam survey in the Oslo Fjord trough east of the Söster Islands ***(Stat. 1016***) In the morning we returned to the Sekken to take another Vibrocorer ***(Stat. 1017)*** but the gear failed again on the steep flank of the carbonate reef. We returned to a larger reef in the Tisler area to take Vibrocorer samples ***(Stat. 1018-19)*** which also failed. After a CTD/Ro cast ***(Stat. 1020)*** we took 3 successful box corer samples of the reef with abundant dead Lophelias ***(Stat. 1021-1022).*** We left the Tisler area in the afternoon and headed back to the Bratten area. Upon our arrival at 20.21h we continued our multi beam profiles from the 2. Nov. ***(Stat. 1023).***

04. Nov. 03
Station 1023 was finished at 11.05h. As a result of our multi-beam survey we took a CTD/Ro and 2 box corer samples in a canyon system ***(Stat. 1024-26)***. We left the Bratten area in the early afternoon and headed back north to the Söster area. En route we performed a calibration of the multi-beam arry which included a CTD/Ro cast to obtain a sound velocity profile (Stat. 1027). This was followed by multi-beam survey along the western deep trough of the Oslo Fjord ***(Stat. 1028)***.

05. Nov. 03
We continued the multi-beam survey of the western Oslo Fjord trough through the whole night and stopped at 09:05h. This survey was followed by a short multibeam profile east of the Söster Island ***(Stat. 1029)***. Based on the results of the multibeam survey of the previous night potential sites of Lophelia occurrence were identified in the western trough of the Oslo Fjord. These sites were sampled with the Backengreifer and in the deepest part of the area we additionally drove a CTD/Ro ***(Stat. 1030-56.)*** Two samples contained live Lophelia ***(Stat. 1050 and 1059)***. The evening and night was dedicated to further multi-beam profiles around the Söster Islands, to close gaps from the previuos survey.

06. Nov. 03
After the overnight MB-survey at 08.45h we continued our Backengreifer survey of potential coral reef sites in the western trough of the Oslo Fjord ***(Stat. 1058-1066).*** In the afternoon we revisitet Stat. ***1050 and 1059*** to groundtruth our Lophelia findings from the previous day. We deployed the Tjärnö Laboratory ROV on two successful dives ***(Stat. 1067-68)***. In both cases we detected large and healthy looking Lophelia reefs. The evening and night was spent again with further multi-beam profiles around the Söster Islands.

07. Nov. 03
In the course of the morning we finished our Backengreifer transect though the western Oslo Fjord trough ***(Stat. 1070-1080)***. This was followed by a Backengreifer survey in the Djupekrak area during the afternoon ***(Stat. 1081-1084)*** and in the entrance area to the eastern trough of the Oslo Fjord ***(Stat. 1085-1092)***. After a short MB profile in the evening ***(Stat. 1093)*** we spent the whole night with a highly resolved CTD/Ro-transect through the western Oslo Fjord trough ***(Stat. 1094-1123)***.

08. Nov. 03
The CTD/Ro-transect was finished at 08.30h. The time until noon was dedicated to two ROV surveys at potential Lophelia reefs ***(Stat 1124-25).*** We found degenerated reef structures largely overgrown by sponges. The Backengreifer survey of the eastern Oslo Fjord trough was continued during the rest of the day ***(Stat 1026-53).*** Multi-beam profiles followed during the night in the Söster and Tisler area ***(Stat. 1154)***.

09.Nov. 03
The MB-profile ended at 09.45h in the Tisler area. We headed back to the entrance area of the eastern Oslo Fjord trough. At ***Stat. 1155*** the Vibrocorer failed again, but we retrieved a well perserved box grab sample of a decayed reef overgrown with sponges. In the afternon we continued our Backengreifer profile of the previous day ***(Stat 156-64)*** . We detected a substantial Lophelia reef which was hitherto unknown ***(Stat. 1158 and 1164***). We left the area at 16.30h and headed south towards Bratten to carry out another multi-beam survey ***(Stat. 1165).***

10.Nov. 03
The Bratten MB-profile ended at 03.45h and with this the scientific investigations of ALKOR Cruise. 232. Afterwards ALKOR headed into the Koster Fjord where we had a rendevouz around 08.00h off Tjärnö with RV. Nereus from the Tjärno Laboratory. RV Nereus took over the Swedish scientist and their equipment. We then started our voyage back to Kiel through the Skagerrak and Kattegatt.

11.Nov. 03
We continued our journey through the southern Kattegatt, Great Belt and Kiel Bight. FS ALKOR docked at 13.00h at the IFM-GEOMAR Pier in Kiel thus finishing ALKOR Cruise 232.

4. Scientific report and first results

Multibeam Bathymetry and Study Sites

Jens Greinert, Jasmin Floss, André Freiwald

For a detailed sampling of small-scaled morphological features such as cold-water reefs a highly resolved bathymetric mapping is essential for the positioning of grab sampling, ROV dives and CTD casts. Thus bathymetric data were recorded and immediately processed to create maps.

Two areas were mapped, one in Norwegian waters north of Tisler Island and around the Söster Islands. The second one 'Bratten' in Swedish waters on the westward dipping shelf plain (Fig. 3).

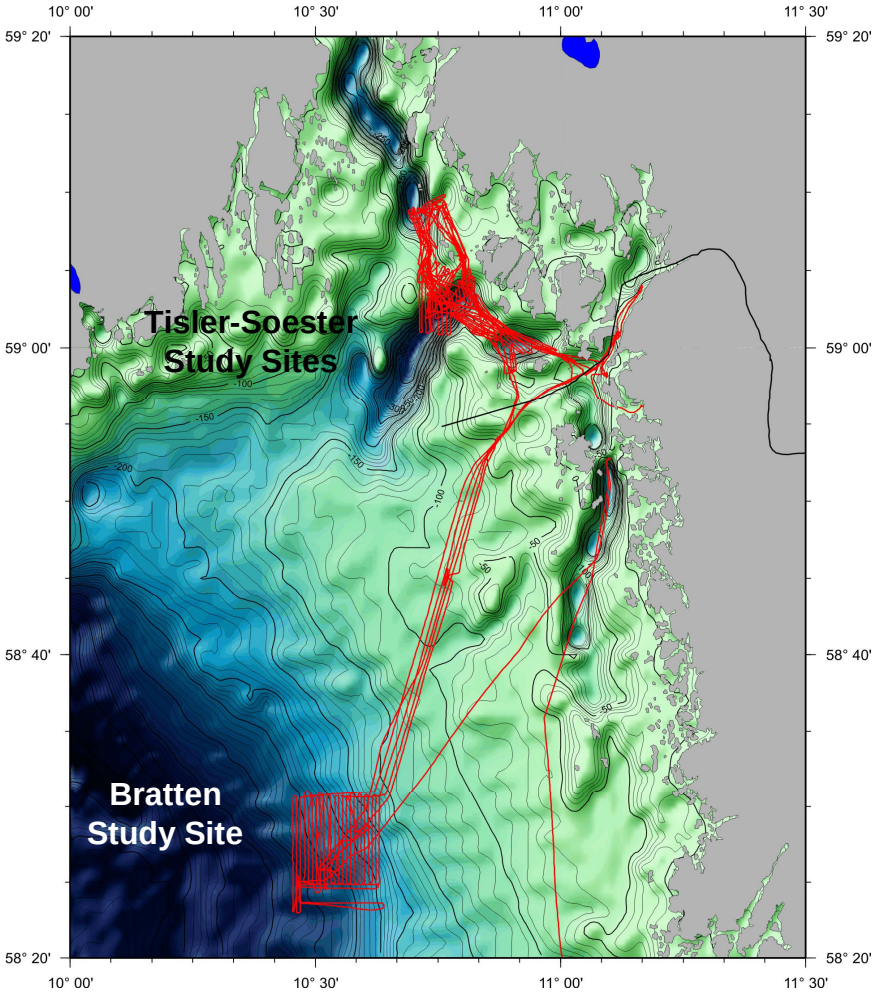


Fig. 3. Geographic map showing the major study sites of the ALKOR-232 Cruise.

Method

We used a 180kHz Seabeam 1180 swath system with 126 beams with 3x3° beam angle. The system was installed in the moon pool of RV ALKOR together with an OCTANS 3000 motion sensor (which also provide the heading) and a sound velocity probe (Veleport Mini-SVP). Sound velocity profiles of the water column were taken from CTD casts. Cruising speed was between 8 and 3 knots.

The data were recorded with the Hydrostar Online software from ELAC-Nautik (Version 3.3.3) and edited by HDP_Edit. DTMs were processed by HDP_Ppost and grids of different grid space (10m and 1 m) were exported as latitude - longitude - depth data in ASCII format. These data were fine edited with Fledermaus software which results in the final data set used to create bathymetric maps. For map visualization we used GMT (version 3.4.3) with WGS84 as reference ellipsoid and Mercator projection.

Results

The overview map of the Norwegian area shows the north-eastern end of the Norwegian Trench as dominant bathymetric feature. At its end it spreads to the SE into the Djupekrak area, characterized by a small and deep valley. Eastward of a broader basin with a central uplift, follows the Tisler area north of Tisler Island. At its end, the Norwegian Trench forms a broader valley to the north that becomes shallower and morphologically more structured east of the Soester Islands. Southwest of the Soester Islands is the Fjellknausene area characterized by a N-S striking valley with a partly very steep morphology and smaller reef structures of several 100m-length and 10 to 30m height.

In contrast, the southward Bratten area shows a gently SW dipping slope with steep canyon structures of more than 100m depth. Several deep, pockmark-like features in the northwest of the Bratten area represent other morphological features (see Fig. 4).

The Swedish Bratten area

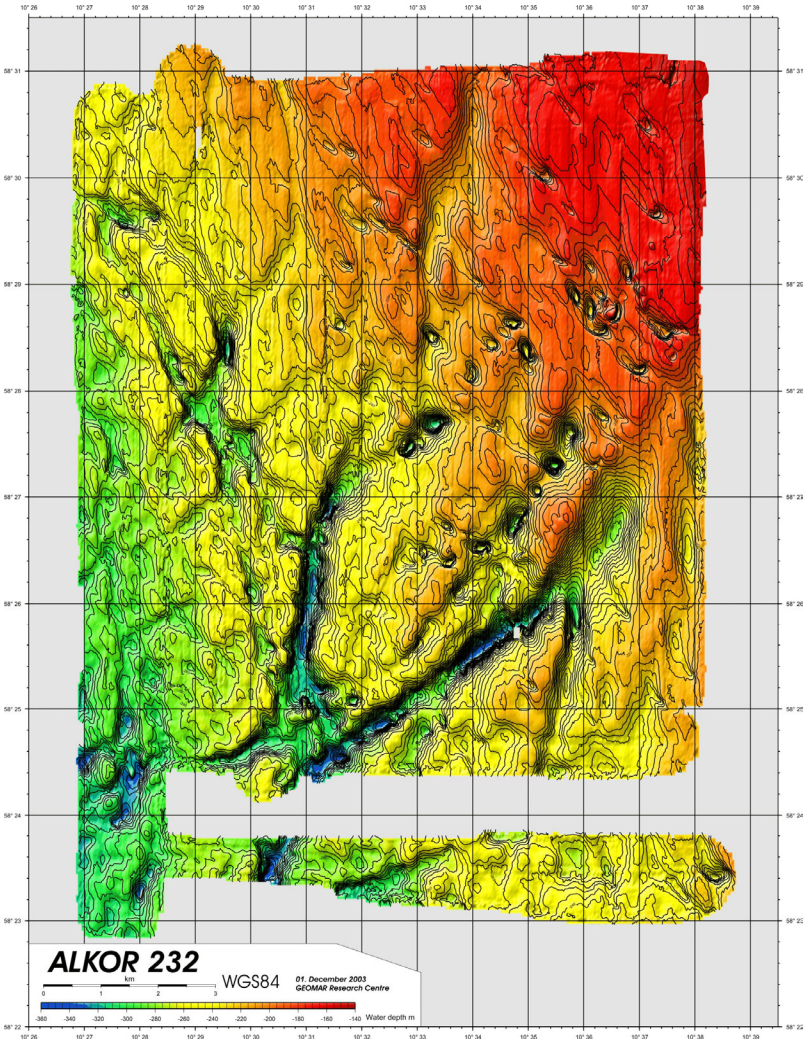


Fig. 4. Multibeam map of the Bratten area. The data gap results from the presence of trawlers in that particular area.

The Bratten is located on the open shelf off Bohuslän in Swedish EEZ waters. This area is known as one of the remaining areas rich of economic important fish. During our mapping surveys many trawlers were observed particularly in this area. The major intention of this survey was to find evidence of cold-water corals in the open Skagerrak. The mapped area is characterised by a south-westward dipping slope ranging from 140m in the north-eastern part to average depths of 320m in the south-western part (Fig. 4). Particular morphological structures are narrow canyon-like depressions with water depths exceeding

320m. Pockmark-like holes, often circular or elongated in shape, are common just north of the canyon area. The elongated holes are oriented parallel to the residual currents flowing to north-west. The scientific gear used in the Bratten area were the CTD-Rosette, the box-corer and the Van Veen grab.

The Norwegian Cold-water Coral study sites

In Norwegian waters three major cold-water coral areas were mapped in great detail: Tisler Reef, the Djupekrak sill and the Oslofjord inlets east and west of the Soester Islands (Fig. 5a-c).

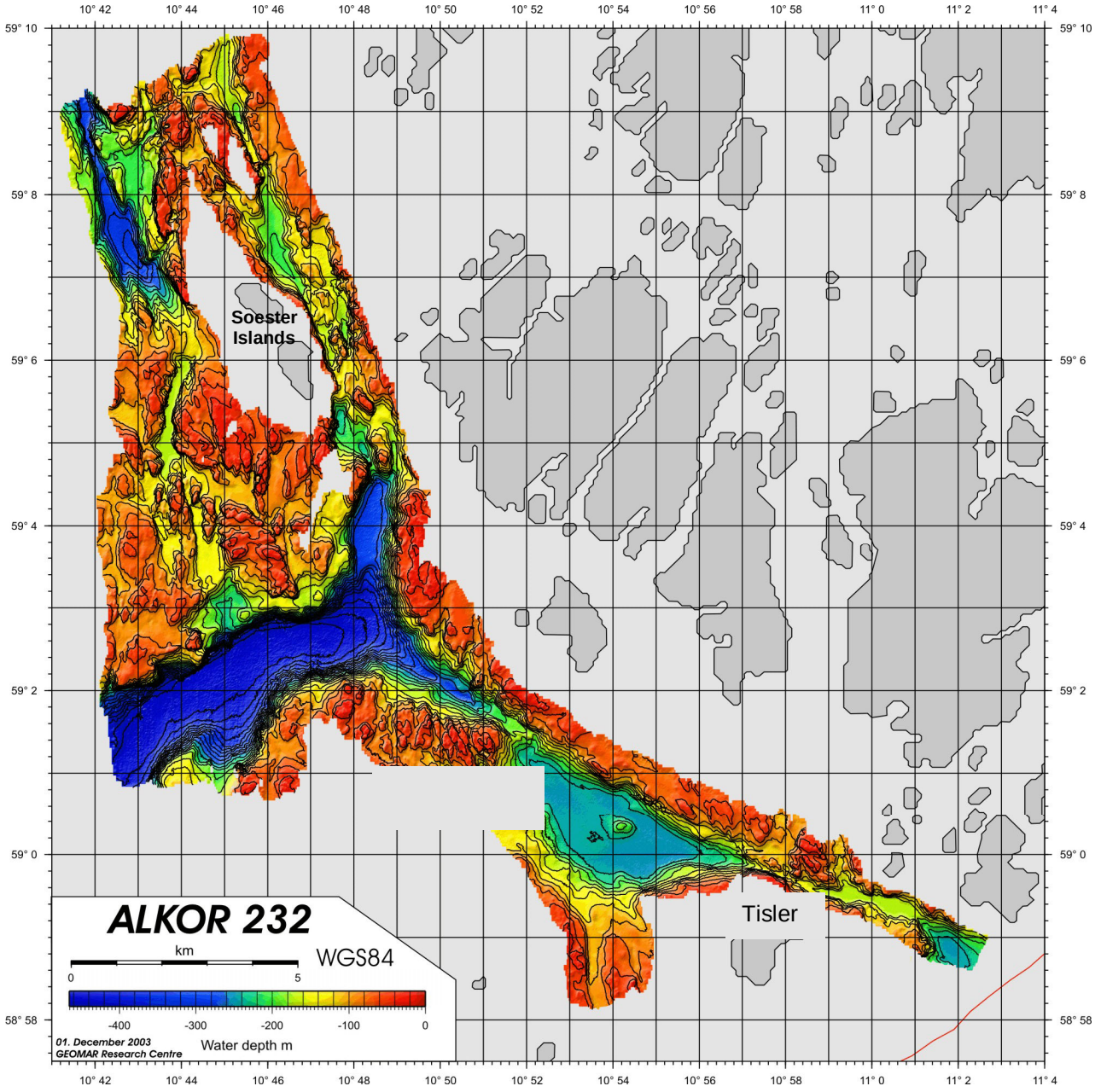


Fig. 5a: Overview of the Norwegian research area with the Tissler, Djupekrak and Soester area (from east to west).

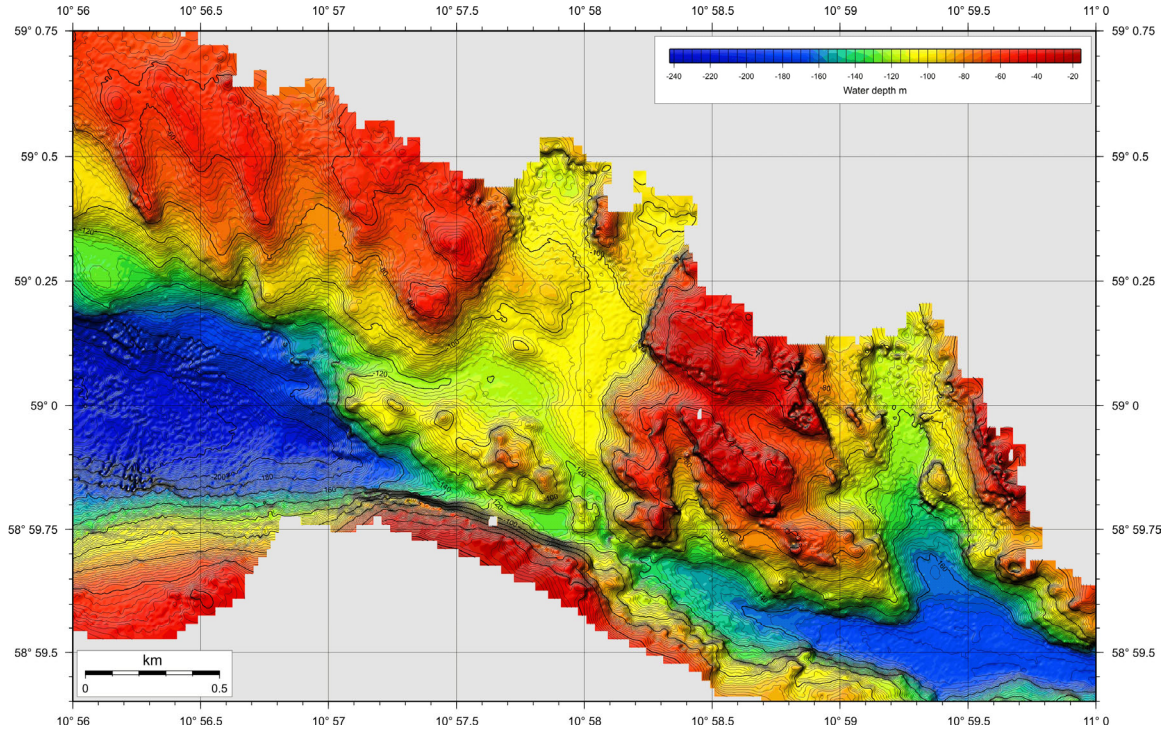


Fig. 5b: Overview of the Tissler area. The reef builds up a morphologically dominant structure at the sill between two basins (east and west). Remarkable is the broad canyon north of the reef, which might be used for sediment transport to the sill where the reef grows on.

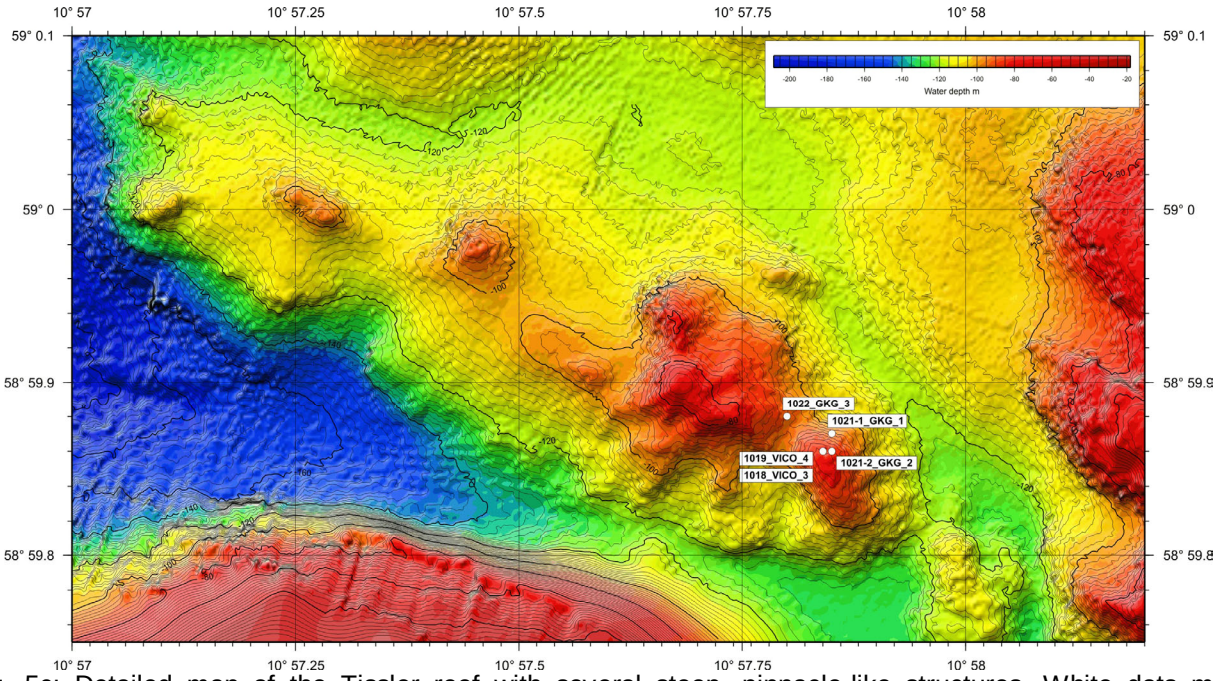


Fig. 5c: Detailed map of the Tissler reef with several steep, pinnacle-like structures. White dots mark sampling sites.

Fig. **5a-c**: Geographic overview of the area investigated for cold-water coral occurrences. The major focus was set on the Oslofjord inlets east and west of the Soester Islands. Reconnaissance surveys were carried out in the Djupekrak and Tisler area. The thin red line in the lower right portion of the map indicates the Swedish-Norwegian border.

The Oslo Fjord inlets east and west of the Soester Islands

Of particular interest were about 7 nm-long inlets that pass the Soester Islands on both sides. These inlets are connected to the main Oslofjord Trough in the North, and the eastward continuation of the Norwegian Channel in the South (Fig. 4). Both inlets exhibit a complex seabed topography with steep inclined rock outcrops, mud-rich troughs and

drumlins as the major elements. The Western Oslofjord Inlet (WOI) consist of 140 to 320m deep troughs that are separated by narrow and generally less than 120m deep thresholds. These thresholds often are accentuated by moraine deposits with consolidated clays, boulder-rich drumlins and exposed rocks, all seabed types generally attract a diverse epibenthic community including corals.
The Eastern Oslofjord Inlet (EOI) shows the same topographic elements, however, the troughs rarely exceed 200m water depth. Two larger areas in the EOI are rich in corals: the inlet due east of the southern Soester Island and a narrow confined channel about 1.5nm north of the northern Soester Island.

The Djupekrak Sill
This sill separates the deep channel that extends to the Kosterfjord in northwest-southeast direction into two subbasins (see Fig. 5c). The Djupekrak sill shallows up to about 170m water depth and consists of a pronounced 500m-long ridge structure densely covered with dead corals and live *Geodia* sponges. This feature was sampled with the Van Veen grab only.

The Tisler Sill
The Tisler Sill is the next sill further to the southeast of the same channel structure (see Fig. 5b). Here live and dead coral reefs are known through the surveys of Tomas Lundälv. Our work concentrates on one large dead coral mound using the vibro-corer, box-corer and the Van Veen grab.

Preliminary results of the geological sampling

André Freiwald, Andres Rüggeberg, Agostina Vertino, Max Wisshak

Three different types of geological samplers were used on ALK-232: Vibro-corer (5 Stations), box-corer (6 Stations) and the Van Veen grab (124 Stations).

Vibro-corer stations
The vibro-corer was intended to retrieve up to 3m-long sediment cores from dead (fossil) coral reef structures (Fig. 15 Vibro-corer). However, the arrangement of the quadrupod frame turned out not to be well-suited to operate on inclined and irregular reef surfaces. During 5 trials, the entire construction cap-sized on the seafloor and was recovered without any penetration into the sediment.

Box-corer stations
The box-corer contains a 50cm * 50cm * 60cm sampling box and was in operation on 6 stations (Tab. 1). The sampling protocol and sample distribution is shown in Appendix 1.

Tab. 1. Overview of box-corer stations

Area	Station	Latitude [°N]	Longitude [°E]	Depth [m]	Recovery
Tisler	1021-1	58:59,87	10:57,85	82	5cm, Coral rubble
Tisler	1021-2	58:59,86	10:57,85	81	31cm, Coral rubble
Tisler	1022-1	58:59,88	10:57,80	91	40cm, Coral rubble
Bratten	1025-1	58:25.88	10:31,05	326	60cm, Mud
Bratten	1026-1	58:27,75	10:33,31	287	50cm, Mud
WOI	1155-1	59:04,71	10:43,90	106	30cm, Coral rubble

Van Veen grab stations

The Van Veen grab was used 124 times (see station list for details) and proofed to be a valuable tool obtaining data on surface sedimentary distribution patterns. Moreover, in the search for corals, this grab created only limited destructive impact to the environment. If appropriate, all grab samples were photographed, sieved and dried. The few stations that yielded live corals were fixed in parts for molecular genetic studies and are housed at the TMBL. The remaining samples went to the IPAL, Erlangen.

Coral distribution patterns

The major scientific goal of the cruise was to obtain more and new data on the presence of life or dead (fossil) cold-water corals in the eastern Skagerrak area. In addition, the sedimentary environment of the coral sites and the adjacent seabed was taken into consideration as well. This survey will enable us to reconstruct the onset of cold-water coral ecosystems following the climatic amelioration after the end of the last glacial period.

The Bratten survey

The geological sampling in the Bratten concentrated in an area where corals accidently were recovered from an anchored boat. This area is a steeply inclined slope of a canyon at 58°23N and 10°31E (Fig. 6). Four Van Veen grab stations (1009 – 1012) yielded only highly bioturbated muddy-sand sediments rich in polychaetes. The shelly remains are dominated by nuculid bivalves added some portions of pectinids. Stick-like skeletons of pennatulaceans were frequently present. The surprise was the detection of highly fragmented pieces of *Lophelia pertusa* in the topmost and lowermost sedimentary layer of box-corer station 1025. Geological sampling from the shallower part of the Bratten with Van Veen grabs (1005 – 1008) yielded sandy mud deposits and boulder-rich sediments. The latter provided a clearly visisble signal in the multibeam backscatter datasets.

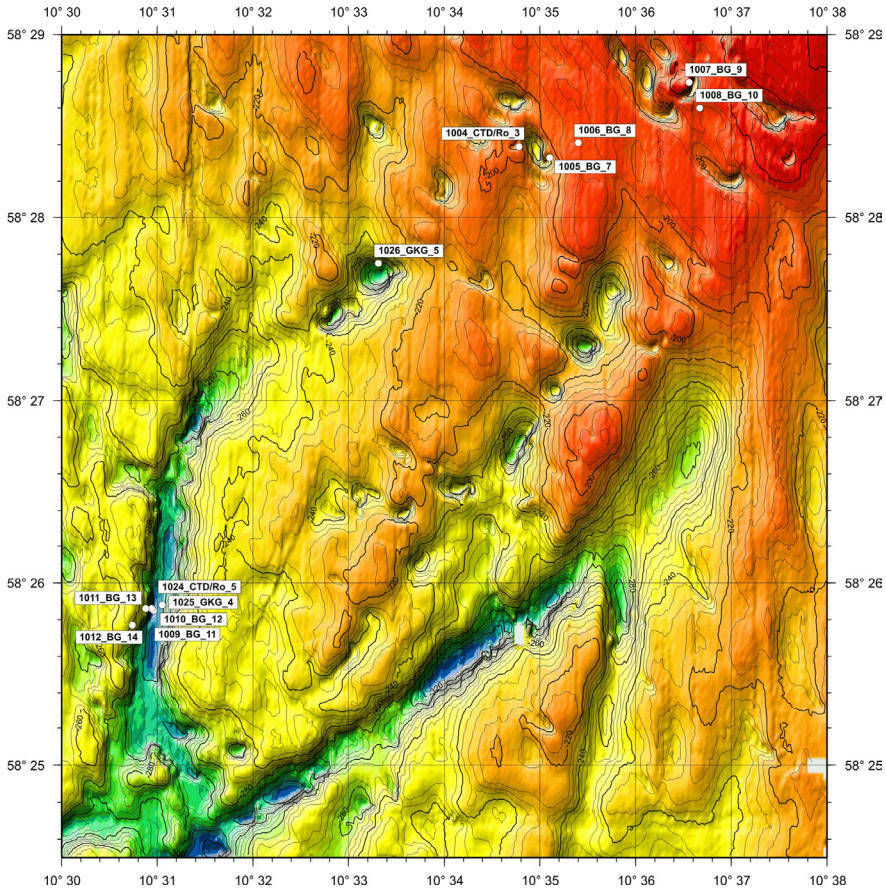


Fig. 6: Sampling survey with CTD/Rosette, box-corer and Van Veen grab in the Bratten area.

The Soester Island survey

A total of 103 Van Veen grab stations and all ROV surveys were carried out in this area (Figs. 6 to 9). The shallowest station was taken at 35m water depth (1030) and yielded boulders encrusted by live coralline algae, and the deepest sample was taken at 191m depth (1042) and yielded mud. There exists no correlation with decreasing grain-size spectra and depth. Depending on the submarine topography, muddy deposits can occur in quiet shallow depth, whereas coarse deposits can occur in relatively great depths. The latter is true for topographic constrictions such as narrows, or at the foot of cliffs at any water depths sampled. Sandy deposits always are rich in skeletal shell hash. The skeletal material is provided by molluscs (mostly epibenthic bivalves), brachiopods, serpulids, foraminifers and corals.

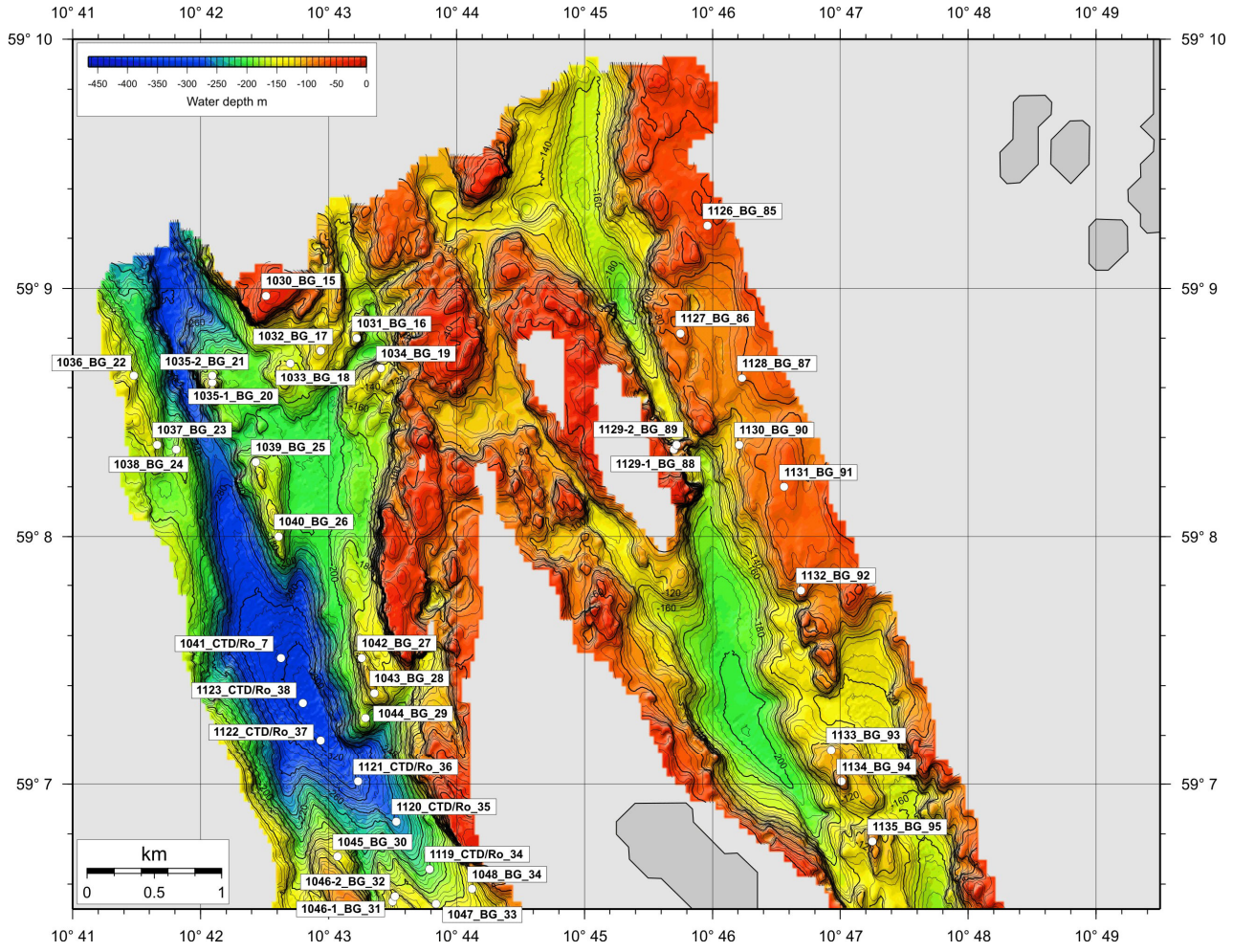


Fig. 7: Station plot from the northern part of the Soester Island survey. In this map section, coral deposits were sampled in the following stations: 1034 (dead, 128m), 1047 (dead, 161m), 1129-2 (dead, 121m), 1135 (dead, 88m)

Most of the coral reefs occur in the central and southern part of the inlets surveyed. One of the largest and previously unknown reefs was found due west of North Soester Island at 59°06.26N and 10°10°44.14E at 120 to 110m water depth (Fig. 8). This reef measures about 400m across and is about 10m thick. The reef was groundtruthed on ROV-dive 1067 and consists of *Lophelia pertusa* as the only framework constructor.

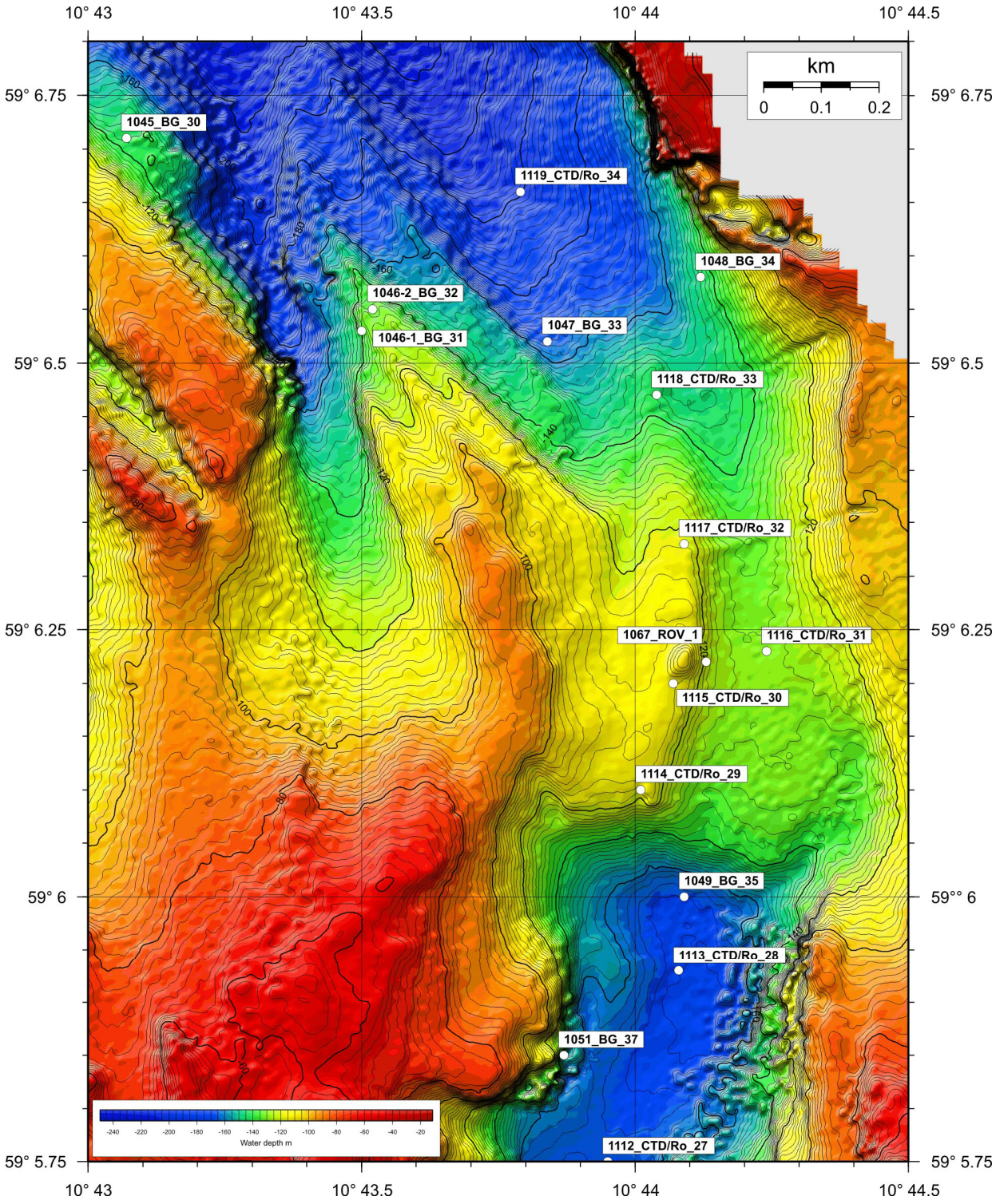


Fig. **8:** Multibeam map of the central part of the WOI, due west of North Soester Island with the pronounced ridge at ROV-station 1067 marking the about 400m-long *Lophelia* reef. Other stations yielding coral deposits are: 1049 (dead, 166m), 1050 (dead, 105m (not shown here)) and 1051 (dead, 120m).

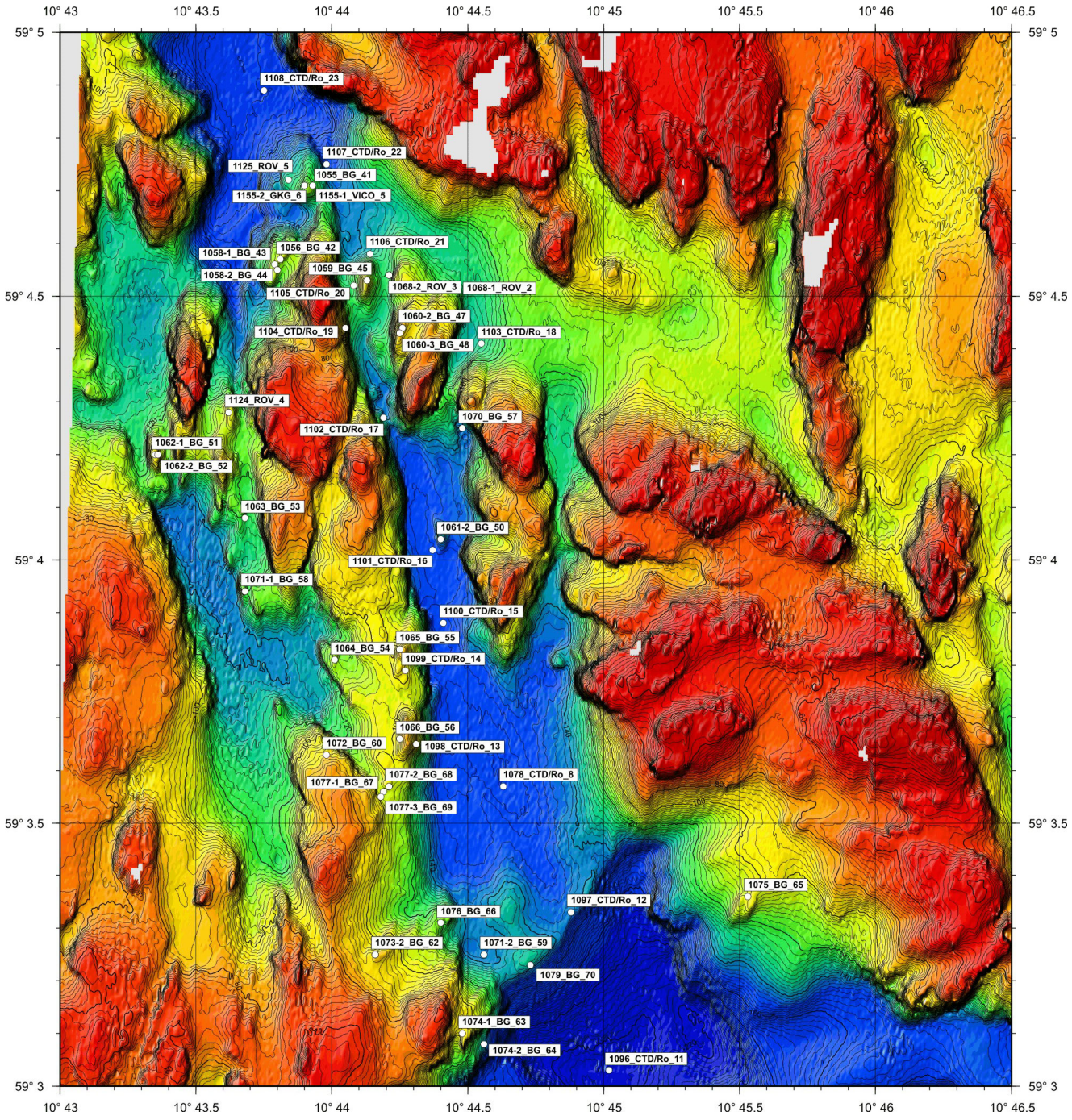


Fig. 9: Multibeam map of the southern section of the WOI with all stations marked. A large reef was found at Station 1059 (94m) and confirmed by ROV-dive 1068-2 at 59°04.53N and 10°44.13E. Dead corals were found at stations 1055 (117m), 1058-2 (110m), 1065 (92m), 1066 (88m), 1070 (143m), 1077-1 (105m) and 1077-2 (105m). More live reefs are known in this area by Tomas Lundälv (pers. comm.).

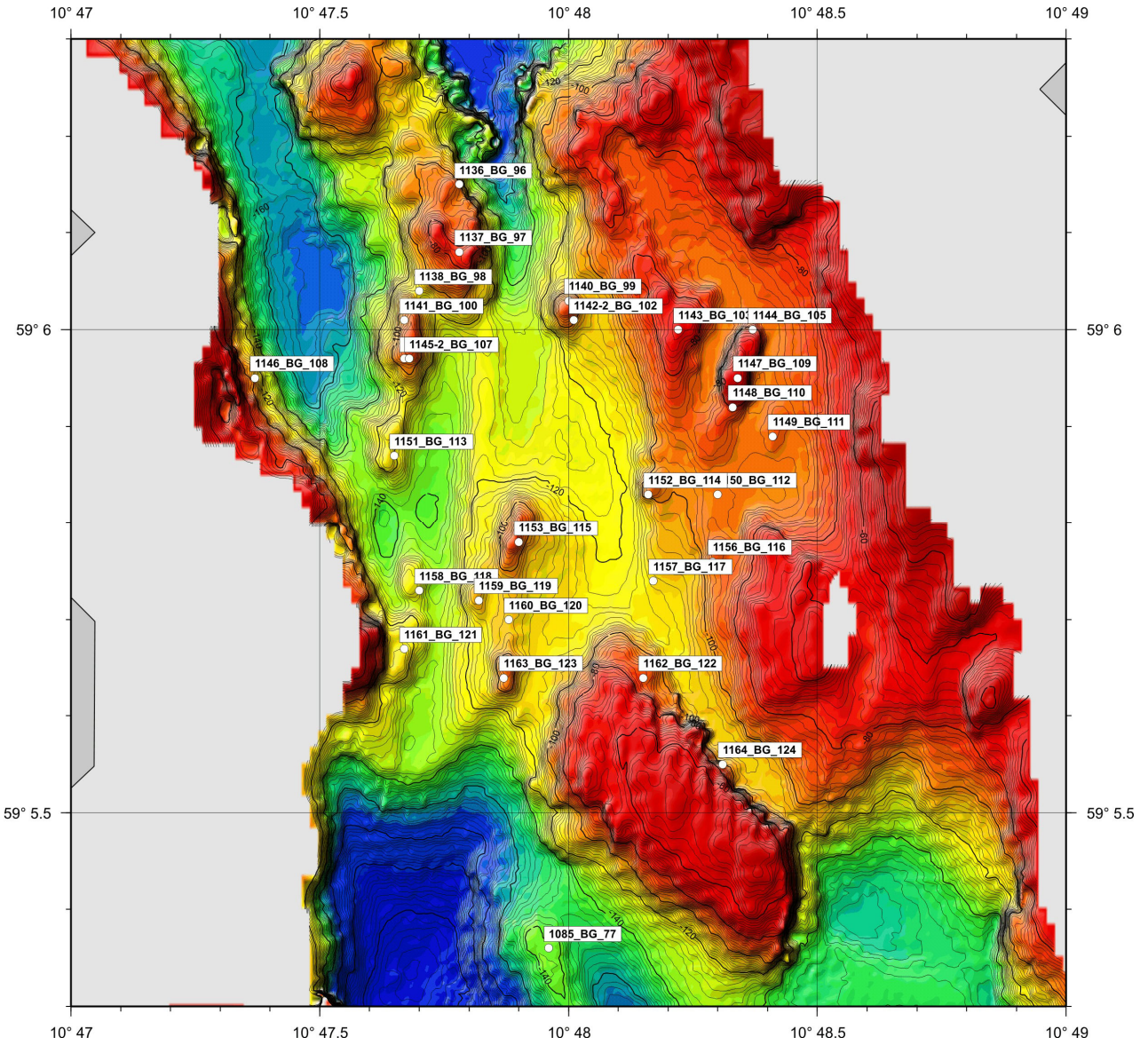


Fig. 10: Multibeam map showing the narrow southern part of the EOI, due east of South Soester Island. Nearly all of the ridges are covered by corals. At the following stations live coral reefs were located: station 1158 at 59°05.73N and 10°47.70 at 120m depth and at station 1161 at 59°05.67N and 10°47.67E at 110m depth and at station 1163 at 59°05.64N and 10°47.87E at 88m. Dead corals were found at station 1137 (74m), 1138 (99m), 1140 (87m), 1141 (87m), 1142-2 (86m), 1145-2 (86m), 1147 (64m), 1148 (76m), 1151 (109m), 1155-2 (106m) and 1159 (97m).

Selected aspects of the new *Lophelia* reef in the WOI groundtruthed during ROV dive 1067-1 are displayed in Fig. 11. In this reef open branched and strout and crowded branching types in Lophelia were observed. The living reef top colonies show the characteristic cauliflower growth habit and live in strong competition with *Mycale lingua*. Dead coral framework generally is inhabited by ascidians *(Polycarpa)* and *Geodia* sponges. A prominent feature were forests of healthy *Muricea* (gorgonians) and schools of medusa heads *(Gorgonocephalus).*

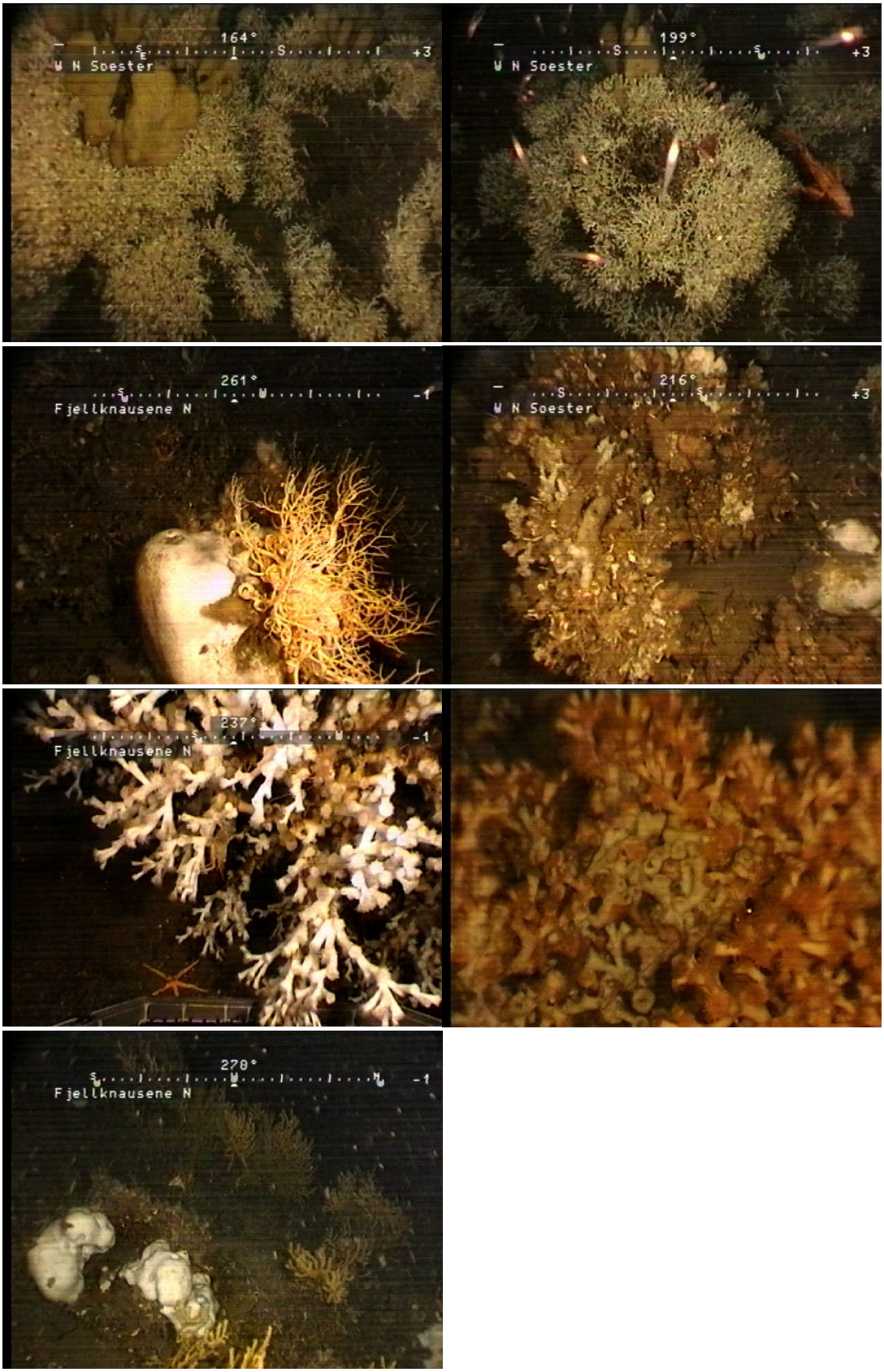


Fig. 11: Visual inspection of the new Lophelia reef in the WOI of the wider Fjellknausene area. These framegrabs were taken from ROV dive 1067, provided by Tomas Lundälv, TMBL.

The Djupekrak survey

The Djupekrak sill was only briefly surveyed with 2 Van Veen grabs (Fig. 12). The recovered sediments confirmed former data that corals cover the entire ridge on the sill but are not alive. Instead, the dead coral framework is colonized by huge *Geodia* sponges.

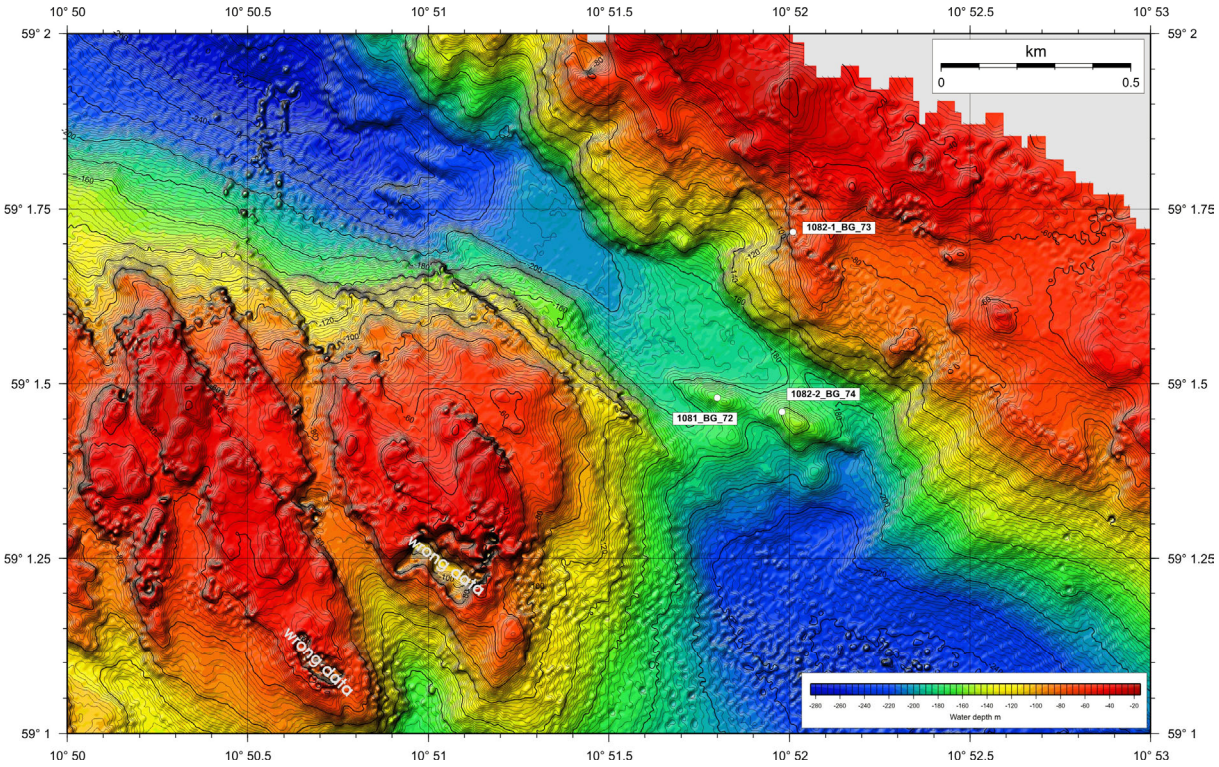


Fig. 12: Multibeam map showing the particular ridge on the Djupekrak sill is made of dead corals.

The Tisler survey

The known Tisler reef was only visited briefly in the dead coral mound area. Two vibro-corer stations failed but 3 box-corer stations successfully yielded fossil coral and a rich associated fauna (Fig. 13).

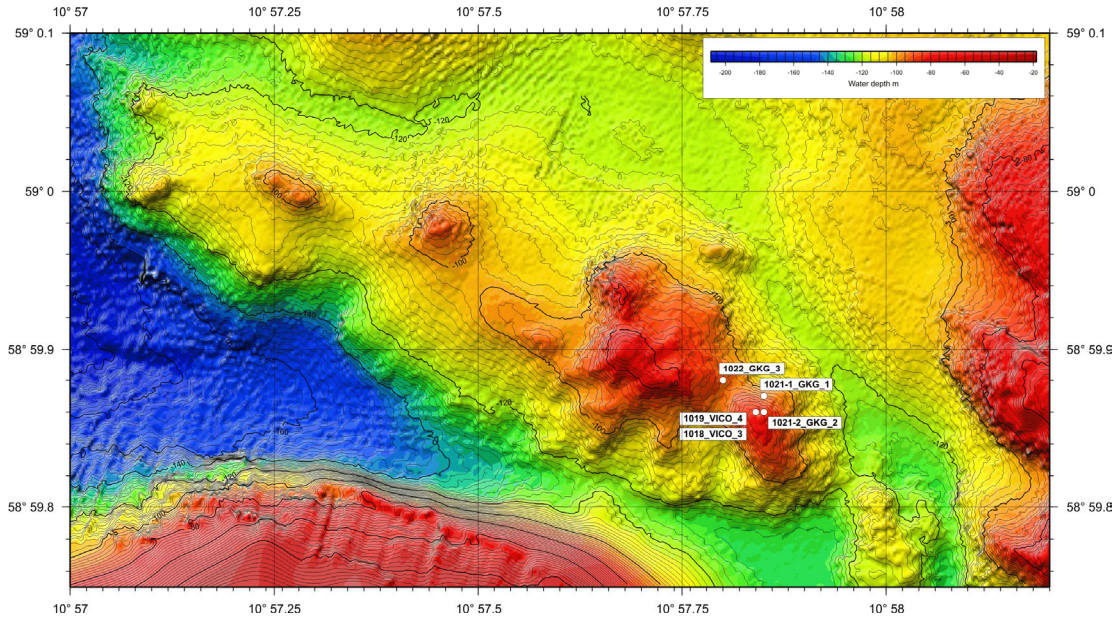


Fig. 13. Multibeam map of the Tisler reef with the stations concentrated on a fossil coral mound.

CTD measurements

Jens Greinert & Jasmin Floss

During the cruise we used a SeaBird 911 CTD to investigate the physical parameters of the water column to get sound velocity profiles for the swath bathymetry mapping and to investigate physical environmental conditions over reefs. For the later we run a CTD section along a N-S profile west of the Soester Islands (Figure 14). Preliminary data interpretation shows a well stratified water column with a warm water layer between 30 and 80 meters (Figure 15). The reefs itself occur in water with almost 35 ‰ salinity and temperatures of approx 8.5 °C. They were not formed related to a layer of higher turbidity that enters the reef region from the south in a water depth from 80 to 130m.

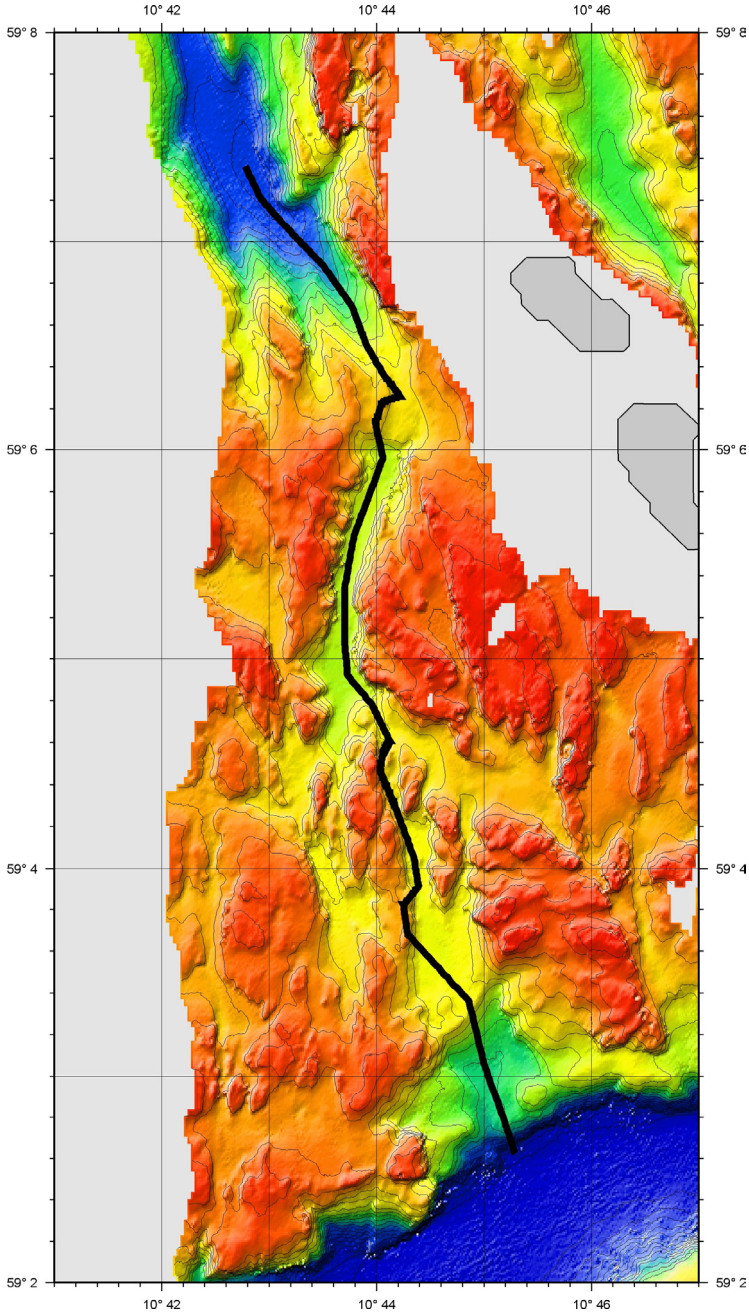


Figure 14: Map of the CTD profile west of the Soester Islands.

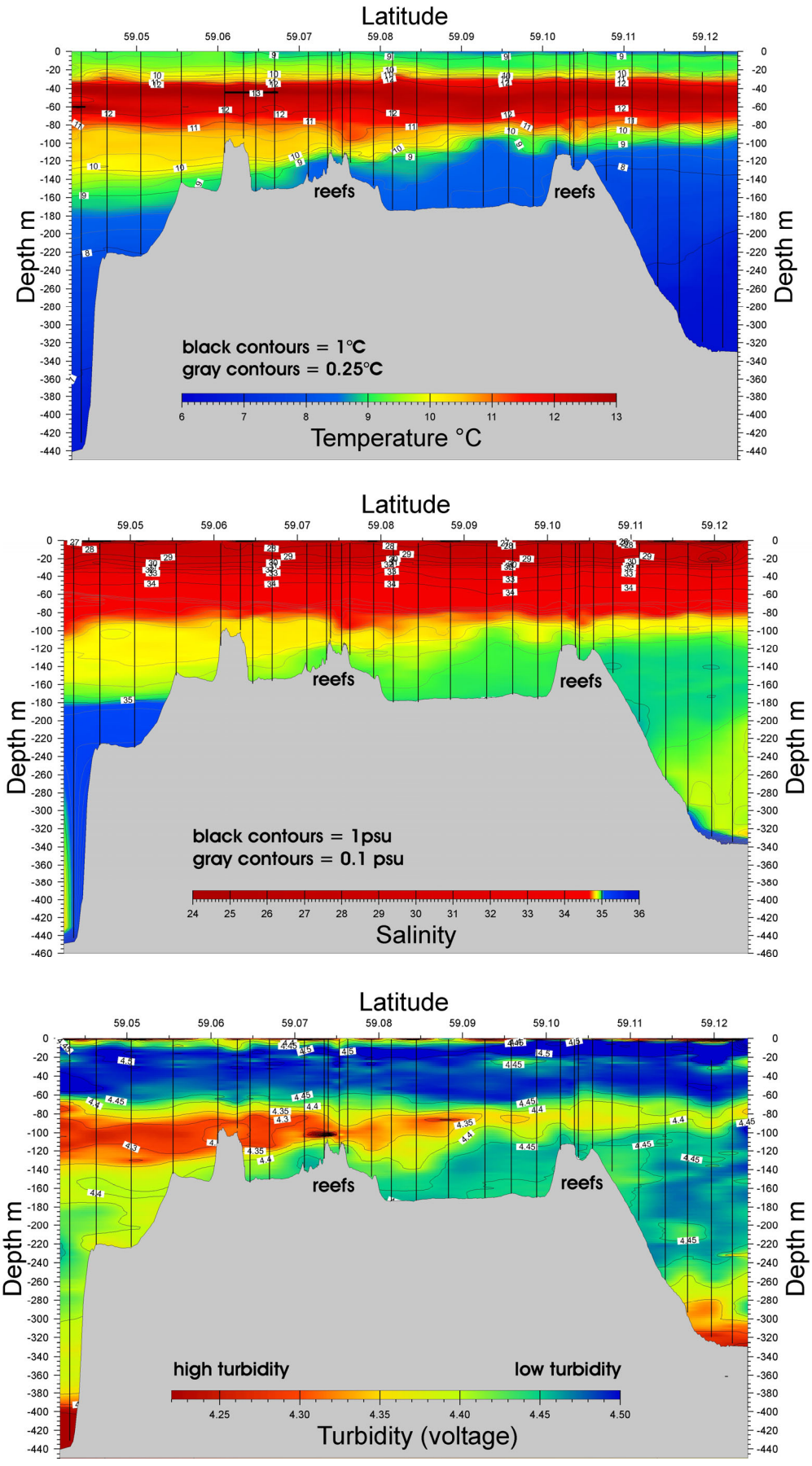


Figure 15: Temperature, salinity and turbidity sections along the N-S profile shown in Figure 13

Vibrocorer

A. Freiwald, A. Rüggeberg, W. Queisser

The VIBROCORER VK 300, is deployed on a conductive wire to take cores from more solid sediments. The aim for this cruise was to recover sediment cores from top of elevated structures, previously settled by cold-water coral *Lophelia pertusa*, and to penetrate the base of initial coral growth after the last deglaciation.

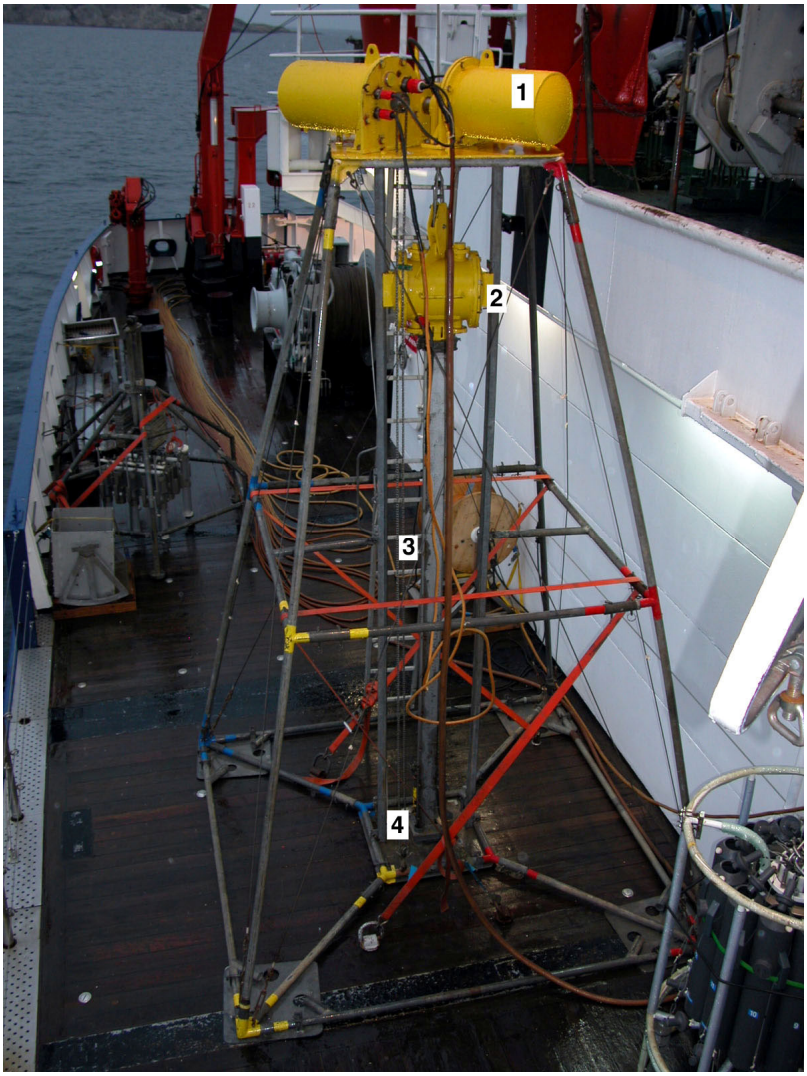


Fig. 16: The vibrocorer: (1) underwater winch, (2) vibrator, (3) diagonally screwed square-boxes (10 x 10 cm, 3 m length), (4) knife shutter.

The system

The vibro-system (Fig. 16) with its directed vibration attains the maximum striking power with a minimum of energy input by means of a portable power plant of at least 5 KW. The operation of the system and the indication of dip and penetration takes place from a switch- and controlboard with the aid of a security transformer (Fig. 17). After the vibrocorer has reached the greatest depth of penetration it switches off automatically and the underwater winch comes into action extracting the corebox. When the vibrator has reached its uppermost position the winch is again switched off automatically. It is possible to interrupt this automatic process at any time by means of the switch- and controlboard on deck. A knife shutter in the lower part of the support frame prevents the core from being washed out when hieved.

Fig. 17: Switch- and controlboard of the vibro-system. Determination of dip and penetration (top), as well as control of operation of vibrator and underwater winch (bottom).

The main characteristics of the instruments are:

- fast penetration,
- practically undisturbed cores of up to 3 m length in 10 x 10 cm diagonally screwed square boxes,
- extraction of cores by underwater winch,
- determination of dip and penetration at any time from indicator gage at the switchboard,
- maximum depth of operation 160 m (depending on cable length).

Limits of operation

- high seas and swells,
- strong winds,
- vibrocorer is positioned on the sea floor with an angle of > 20°,

The vibrocorer was provided with a transponder, which attains a highly precise positioning with the OLEX system provided by the Swedish group. Several attempts have been performed (see station list), but failed due to the highly variable morphology of the see floor, as can be seen from ROV dives in same areas. During the first attempt the gear turned over and all other attempts showed dip angles of ~ 24–26° which were too high to successfully penetrate the sea floor with the coring system. Therefore, unfortunately no sediment core could be recovered during the course of the cruise. However, little information of the sea floor sediment was received from the corners of the gear's base (comparable with Van Veen grab sampling), but unsatisfactory for the original intention to penetrate the base of initial coral growth.

5. Acknowledgements

The scientific party of cruise ALKOR 232 gratefully acknowledge the good co-operation and technical assistance of the captain and his crew who substantially contributed to the overall success of this expedition.
Work permissions for the NE-Skagerrak were granted by the coastal states Norway and Sweden which is gratefully appreciated.

APPENDIX 1

ALKOR CRUISE 232

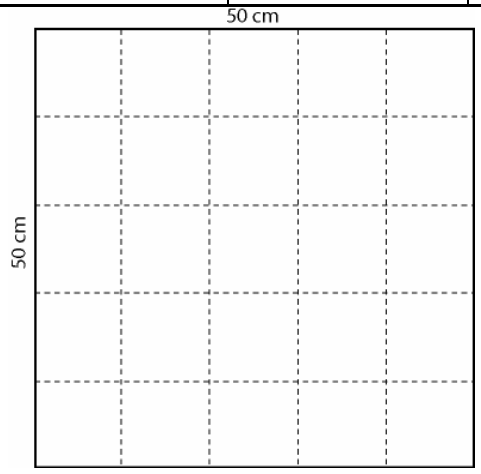
«SKAGERRAK»

Box Core Descriptions

ALK 232-1021-1
ALK 232-1021-2
ALK 232-1022-1
ALK 232-1025-1
ALK 232-1026-1
ALK 232-1155-1

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (1)

ALK 232-1021-1 (Tisler)	Date:	03.11.03	Time:	14:40
	Lat.:	58°59.87N	Long.:	10°57.85’E
	Water depth:	82 m	Recovery:	BC tipped over, 5cm *Lophelia*



Surface description:

Subfossil *Lophelia* rubble and colonies, muddy sand,
Buccinum undatum, *Ascidiella*, *Sabiella*

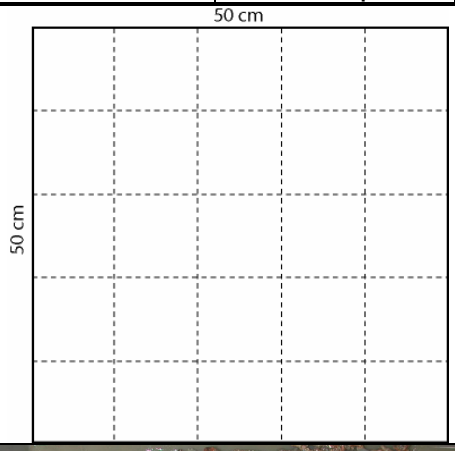
1 bulk sample, bulk sieved samples

Samples	Erlangen	Kiel	Tjärnö
Surface samples (0–1 cm, stained, 100 ccm)			
Bulk samples (bags)			
total bulk	X		
Archive box(es)	X		
Fixed fauna in ethanol	X		
Stratigraphic sieved fractions (bulk)			
0.5–1 mm	X		
1–2.5 mm	X		
2.5–5 mm	X		
> 5 mm	X		

Syringes	Erlangen	Kiel	Tjärnö

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (1)

ALK 232-1021-2 (Tisler)	Date:	03.11.03	Time:	15:12
	Lat.:	58°59.86’N	Long.:	10°57.85’E
	Water depth:	81 m	Recovery:	31 cm



Surface description:

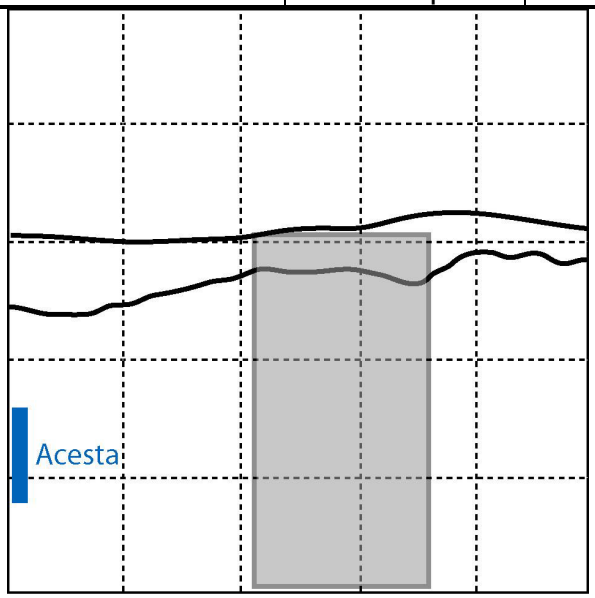
Lophelia rubble with muddy sediment (colour: 5Y 3/2)
Serpulids, brachiopods (*Terebratula*, *Macandrewia*), *Anomia*, ascidians, and *Acesta excavatum* in 13–23 cm depth interval

Samples	Erlangen	Kiel	Tjärnö
Surface samples (0–1 cm, stained, 100 ccm)			
Bulk samples (bags) 3–13, 13–23, 23–30 cm	X		
Archive box(es)	X		
Fixed fauna in ethanol	X		
Stratigraphic sieved fractions (0–3, 3–13, 13–23, 23–30 cm)			
0.5–1 mm	X		
1–2.5 mm	X		
2.5–5 mm	X		
> 5 mm	X		

Syringes	Erlangen	Kiel	Tjärnö

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (2)

ALK 232-1021-2 (Tisler)	Date:	03.11.03	Time:	15:12
	Lat.:	58°59.86’N	Long.:	10°57.85’E
	Water depth:	81 m	Recovery:	31 cm



Profile description:

0–3 cm:
Coral rubble and shell hash within coarser sediment (colour: 10Y R4/2)

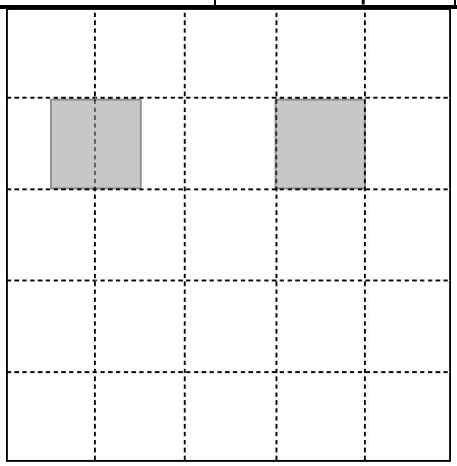
3–31 cm:
Mud (colour: 5Y 3/2) with corals and shells

Archive box in grey (15 x 30 cm)

Single *Acesta excavatum* occurrence in sieve section 13–23 cm (in blue)

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (1)

ALK 232-1022-1 (Tisler)	Date:	03.11.03	Time:	15:45
	Lat.:	58°59.88’N	Long.:	10°57.80’E
	Water depth:	91 m	Recovery:	40 cm



Surface description:

Coral rubble, colonised by ascidians *(Polycarpa* sp.) and brachiopods (*Macandrewia, Terebratula*)

Shell hash and muddy sediment in between

Lithodes (decapod), ophiuroids, lichenoporid bryozoans

2 surface samples (in grey) stained with rose bengal

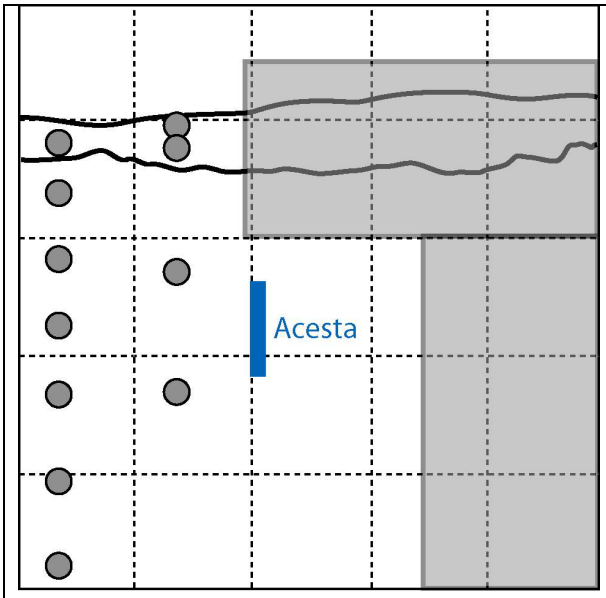
Lower right: big coral colony (30/10/15 cm) settled by ascidians

Samples	Erlangen	Kiel	Tjärnö
Surface samples (0–1 cm, stained, 100 ccm)	X	X	
Bulk samples (bags) 0–3, 3–13, 13–23, 23–33, 33–40 cm	X		
Archive box(es)	X		
Fixed fauna in ethanol	X		
Stratigraphic sieved fractions (same intervals as bulk samples) 0.5–1 mm 1–2.5 mm 2.5–5 mm > 5 mm	X X X X		

Syringes	Erlangen	Kiel	Tjärnö
1–2 cm		X	
3–4 cm	X	X	
6–7 cm	X		
12–13 cm	X	X	
13–14 cm	X	X	
17–18 cm	X		
23–24 cm	X		
30–31 cm			
38–39 cm			

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (2)

ALK 232-1022-1 (Tisler)	Date:	03.11.03	Time:	15:45
	Lat.:	58°59.88’N	Long.:	10°57.80’E
	Water depth:	91 m	Recovery:	40 cm



Profile description:

0–3 cm:
coral rubble and shell hash within coarser sediment (colour: 10Y R4/2)

3–31 cm:
reducing region, colour change to 5Y 3/2, clayey sediment packed with corals and bivalves

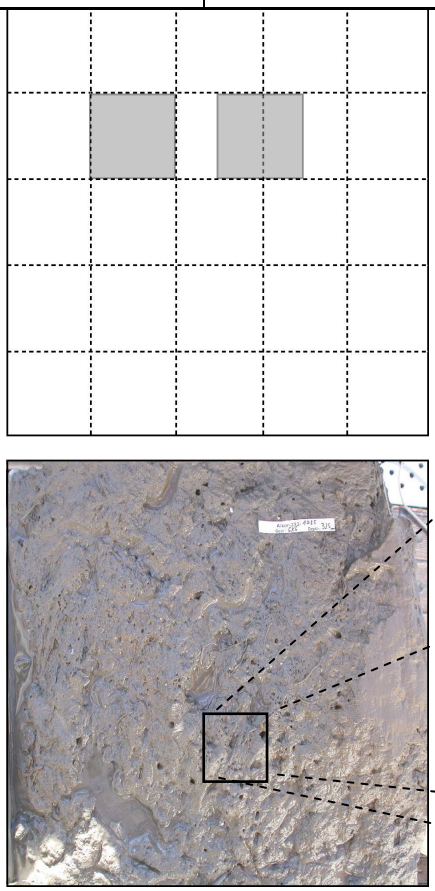
single *Acesta excavatum* occurrence in sieve section 13–23 cm (in blue)

Archive box in grey (15 x 30 cm)

Syringes (grey circles, 10 ml) for Erlangen (left) and Kiel (right)

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (1)

ALK 232-1025-1 (Bratten)	Date:	04.11.03	Time:	13:30
	Lat.:	58°25.88’N	Long.:	10°31.05’E
	Water depth:	326 m	Recovery:	54 cm described (total 60 cm)



Surface description:
mud, highly bioturbated by several types of worms,
clay tubes 3–5 cm long, Ø 2 mm,
≥ 10 cm clay tube worm-tubes *(Sabellaria),* Ø 4 mm,
few bivalve shells, few free living polychaets,
circular burrow fields with Ø 2 mm holes (see below)

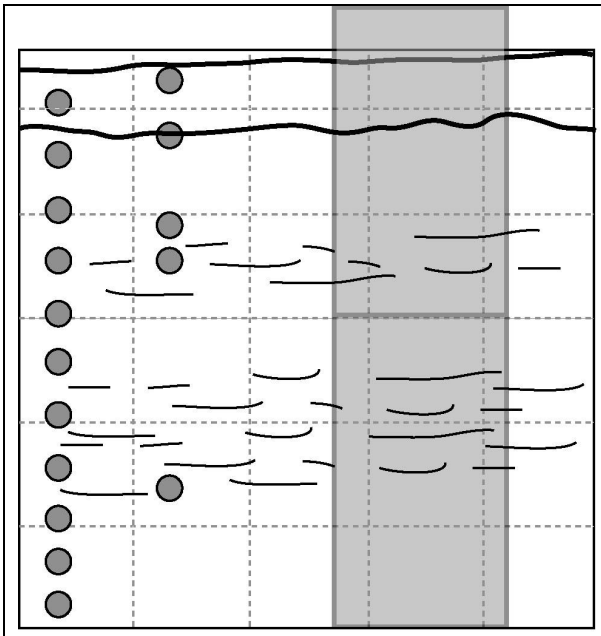
2 surface samples (in grey) stained with rose bengal

Samples	Erlangen	Kiel	Tjärnö
Surface samples (0–1 cm, stained, 100 ccm)	X	X	
Bulk samples (bags) 0–5, 5–12, 12–20, 20–30, 30–42, 42–54 cm	X		
Archive box(es)	X		
Fixed fauna in ethanol	X		
Stratigraphic sieved fractions (same intervals as bulk samples)			
0.5–1 mm	X		
1–2.5 mm	X		
2.5–5 mm	X		
> 5 mm			

Syringes	Erlangen	Kiel	Tjärnö
1–2 cm		X	
3–4 cm	X		
6–7 cm		X	
8–9 cm	X		
13–14 cm	X		
14–15 cm		X	
18–19 cm	X	X	
23–24 cm	X		
28–29 cm	X		
33–34 cm	X		
35–36 cm		X	
38–39 cm	X		
43–44 cm	X		
48–49 cm	X		

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (2)

ALK 232-1025-1 (Bratten)	Date:	04.11.03	Time:	13:30
	Lat.:	58°25.88’N	Long.:	10°31.05’E
	Water depth:	326 m	Recovery:	54 cm described (total 60 cm)



Profile description:

0–5 cm:
fine silty sediments (colour: 5Y 3/2), worm tubes, bivalves, high water content, highly bioturbated

5–54 cm:
dense muddy sediment (colour: 5Y 3/2)

some black bandings (hydrotroilite) between 5–12, 20–30, and 42–54 cm

intense black bandings in sections 12–20 and 30–42 cm

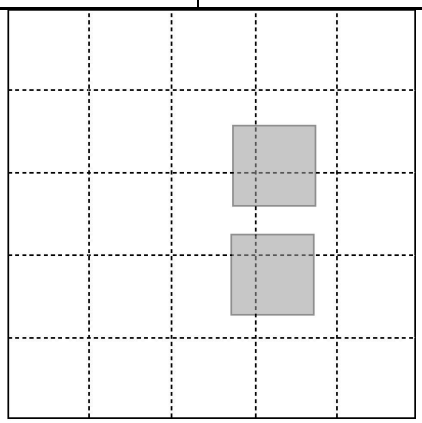
at 22 cm two specimens of *Abra*

Archive boxes in grey (15 x 30 cm)

Syringes (grey circles, 10 ml) for Erlangen (left) and Kiel (right)

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (1)

ALK 232-1026-1 (Bratten)	Date:	04.11.03	Time:	13:58
	Lat.:	58°27.75’N	Long.:	10°30.31’E
	Water depth:	287 m	Recovery:	45 cm described (total 50 cm)



Surface description:

bioturbated mud surface, dropstone pebbles occur occasionally

clay-tubes of polychaets (sabellid worms)

few *Astarte* shells

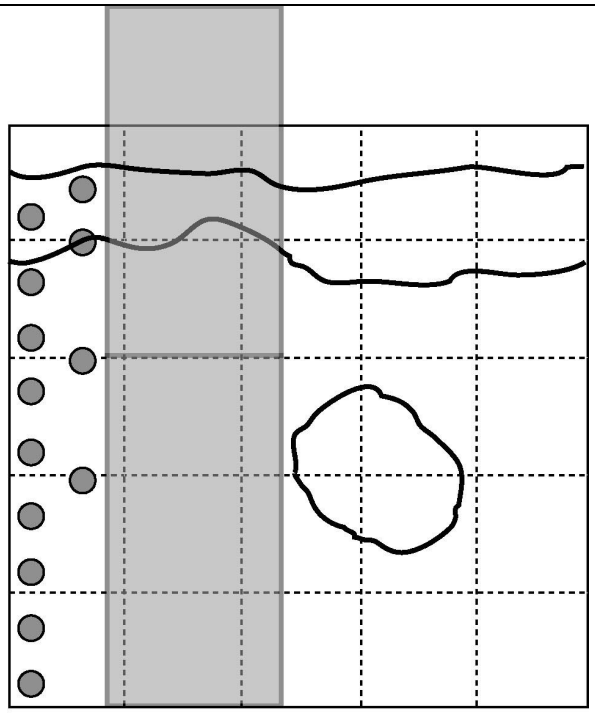
2 surface samples (in grey) stained with rose bengal

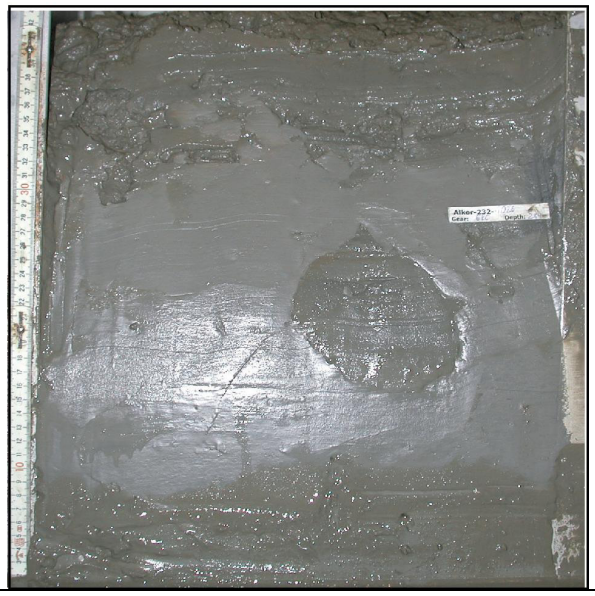
Samples	Erlangen	Kiel	Tjärnö
Surface samples (0–1 cm, stained, 100 ccm)	X	X	
Bulk samples (bags) 0–6, 6–45 cm	X		
Archive box(es)	X		
Fixed fauna in ethanol	X		
Stratigraphic sieved fractions (same intervals as bulk samples)			
0.5–1 mm	X		
1–2.5 mm	X		
2.5–5 mm	X		
> 5 mm	X		

Syringes	Erlangen	Kiel	Tjärnö
1–2 cm		X	
3–4 cm	X		
5–6 cm		X	
8–9 cm	X		
13–14 cm	X	X	
15–16 cm	X		
18–19 cm	X	X	
23–24 cm	X	X	
25–26 cm	X		
28–29 cm			
33–34 cm			
38–39 cm			
43–44 cm			

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (2)

ALK 232-1026-1 (Bratten)	Date:	04.11.03	Time:	13:58
	Lat.:	58°27.75’N	Long.:	10°30.31’E
	Water depth:	287 m	Recovery:	45 cm described (total 50 cm)





Profile description:

0–6 cm:
silty mud (colour: 10YR 4/2), worm tubes, highly bioturbated

colour change to 5Y 3/2 at 6 cm

6–45 cm:
olive greyish mud, strongly compacted, no internal sediment structures, no biogenic or terrigenous components,

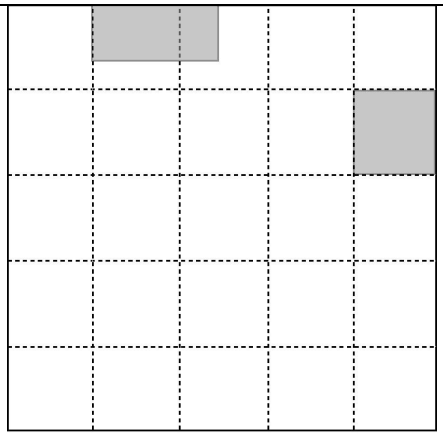
between 24 and 35 cm big burrow with coarse sediment comparable to surface layer

Archive boxes in grey (15 x 30 cm)

Syringes (grey circles, 10 ml) for Erlangen (left) and Kiel (right)

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (1)

ALK 232-1155-1 (Soester)	Date:	09.11.03	Time:	
	Lat.:	**59°04.71’N**	Long.:	**10°43.90’E**
	Water depth:	106 m	Recovery:	17 cm described (total 30 cm)



Surface description:

Dead coral rubble settled by different sponges, ascidians, serpulids, brachiopods, ophiuroids, crabs

Eggcase of Chondrichtyes

Sediment matrix between coral rubble consists of silty sand (colour: 10YR 4/2)

no live *Lophelia*

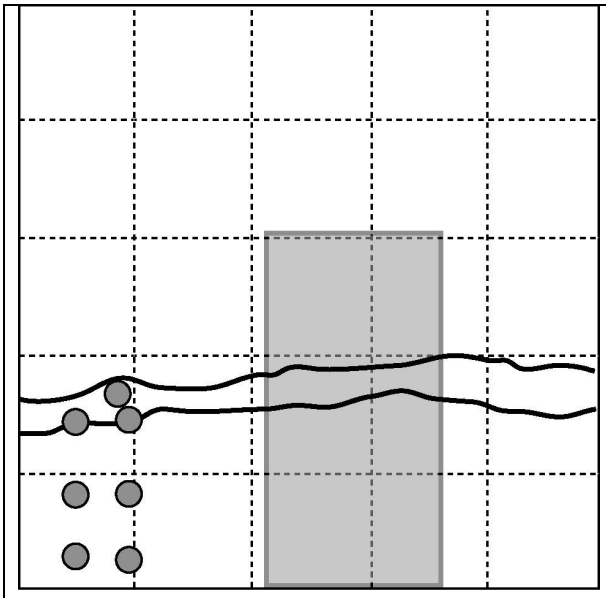
2 surface samples (in grey) stained with rose bengal

Samples	Erlangen	Kiel	Tjärnö
Surface samples (0–1 cm, stained, 100 ccm)	X	X	
Bulk samples (bags) 0–3, 3–17 cm	X		
Archive box(es)	X		
Fixed fauna in ethanol	X		
Stratigraphic sieved fractions (same intervals as bulk samples)			
0.5–1 mm	X		
1–2.5 mm	X		
2.5–5 mm	X		
> 5 mm	X		

Syringes	Erlangen	Kiel	Tjärnö
1–2 cm		X	
3–4 cm	X	X	
8–9 cm	X	X	
13–14 cm	X	X	

ALKOR cruise 232 „Skagerrak“, 30.10. – 11.11.2003
Box Corer (2)

ALK 232-1155-1 (Soester)	Date:	09.11.03	Time:	
	Lat.:	59°04.71’N	Long.:	10°43.90’E
	Water depth:	106 m	Recovery:	17 cm described (total 30 cm)



Profile description:

0–3 cm:
silty sand with subfossil coral rubble (*Lophelia pertusa*) and shells of bivalves (colour: 10YR 4/2), highly bioturbated

3–17 cm:
olive greyish mud (5Y 3/2), strongly compacted, coral fragments of *Lophelia pertusa*, molluscs, gastropods (*Neptunea*)

in between colour change from 5Y 3/2 to 5GY 3/2 in areas with high content of black organic remains, mainly decomposed eggcases of Chondrichtyes

Archive boxes in grey (15 x 30 cm)

Syringes (grey circles, 10 ml) for Erlangen (left) and Kiel (right)

APPENDIX II

Stationlist Cruise Alkor No.232 (Kiel-Kiel, 30. 0ct.- 11. Nov. 2003)

Station No.	Gear	No.	Area	Date	Start	Coordinates			at depth	Coordinates		End	Coordinates		Recovery Obs
					Time (MET)	Lat. °N	Long. °E	Depth (m)	Time (MET)	Lat. °N	Long. °E	Time (MET)	Lat. °N	Long. °E	
993	CTD/Ro	1	Sekken	01.11.03	10:50	58:58,21	11:05,37	64				10:57	58:58,22	11:05,37	ok
994	MB	1	Sekken	01.11.03	11:32	58:58,18	11:05,76					11:44	58:58,18	11:05,76	
995	CTD/Ro	2	Sekken	01.11.03	12:07	58:59,88	11:05,92	133				12:18	58:58,89	11:05,8	ok
996	MB	2	Sekken	01.11.03	12:37	59:00,76	11:06,85					13:50	59:03,88	11:09,61	
997	BG	1	Sekken	01.11.03				125	16:58	59:00,52	11:06,29				Mud
998	BG	2	Sekken	01.11.03				148	17:15	59:00,53	11:05,73				Mud
999	BG	3	Sekken	01.11.03				95	17:30	59:00,76	11:06,96				Mud
1000	BG	4	Sekken	01.11.03				91	17:40	59:00,84	11:06,87				Pebbly mud
1001	BG	5	Sekken	01.11.03				88	17:53	59:00,82	11:07,09				Pebbly mud
1002	BG	6	Sekken	01.11.03				100	18:05	59:00,91	11:06,95				Pebbly mud
1003	MB	3	Bratten	01. - 02.11.03	21:55	58:30,58	10:37,80					08:49	58:30,58	10:33,81	
1004	CTD/Ro	3	Bratten	02.11.03	09:14	58:28,39	10:34,78	193				09:26	58:28,35	10:34,74	ok
1005	BG	7	Bratten	02.11.03				217	09:36	58:28,33	10:35,10				Mud
1006	BG	8	Bratten	02.11.03				193	09:53	58:28,41	10:35,40				Mud
1007	BG	9	Bratten	02.11.03				168	10:13	58:28,74	10:36,56				Pebbly sand
1008	BG	10	Bratten	02.11.03				180	10:28	58:28,60	10:36,67				Mud
1009	BG	11	Bratten	02.11.03				323	11:11	58:25,85	10:30,96				Mud
1010	BG	12	Bratten	02.11.03				272	11:36	58:25,86	10:30,94				Mud
1011	BG	13	Bratten	02.11.03				271	11:48	58:25,86	10:30,88				Mud
1012	BG	14	Bratten	02.11.03				267	12:04	58:25,77	10:30,74				Sand
1013	VICO	1	Sekken	02.11.03				81	17:18	59:00,86	11:07,02				failure
1014	MB	4	Sekken	02.11.03	18:15	58:58,52	11:04,74					20:00	0,041	11:07,35	
1015	MB	5	Tisler	02.11.03	20:35	59:04,16	11:01,28					22:34	59:00,18	10:56,82	
1016	MB	6	Söster	02. - 03.11.03	23:25	59:04,16	10:47,85					05:48	58:59,70	10:58:00	
1017	VICO	2	Sekken	03.11.03				83	09:41	59:00,86	11:07,01				failure
1018	VICO	3	Tisler	03.11.03				90	11:24	58:59,86	10:57,85				failure
1019	VICO	4	Tisler	03.11.03				81	13:04	58:59,86	10:57,84				
1020	CTD/Ro	4	Tisler	03.11.03	13:41	58:59,99	10:56,53	220				13:55	59:00,00	10:57,84	ok
1021-1	GKG	1	Tisler	03.11.03				82	14:41	58:59,87	10:57,85				Coral rubble
1021-2	GKG	2	Tisler	03.11.03				81	15:11	58:59,86	10:57,85				Coral rubble
1022	GKG	3	Tisler	03.11.03				91	15:45	58:59,88	10:57,80				Coral rubble
1023	MB	7	Bratten	03. - 04.11.03	20:21	58:30,58	10:33,34					11:05	58:25,86	10:31,02	
1024	CTD/Ro	5	Bratten	04.11.03	11:06	58:25,88	10:31,05	326				11:24	58:25,87	10:31,01	ok
1025	GKG	4	Bratten	04.11.03				326	12:55	58:25,88	10:31,05				Mud
1026	GKG	5	Bratten	04.11.03				287	13:59	58:27,75	10:33,31				Mud
1027-1	CTD/Ro	6		04.11.03	16:17	58:45,23	10:46:07	83							ok
1027-2	MB-Calib			04.11.03	16:42	58:44:75	10:45,98	83							ok
1028	MB	8	W-OSLOFT	04. - 05.11.03	18:45	58:53,44	10:51,94					09:05	59:03,11	10:46,47	

Station No.	Gear	No.	Area	Date	Start	Coordinates			at depth	Coordinates		End	Coordinates		Recovery Obs
					Time (MET)	Lat. °N	Long. °E	Depth (m)	Time (MET)	Lat. °N	Long. °E	Time (MET)	Lat. °N	Long. °E	
1029	MB	9	E-OSLOFT	05.11.03	09:45	59:03,11	10:46,49					11:08	59:08,71	10:43,84	
1030	BG	15	W-OSLOFT	05.11.03				35	11:24	59:08,97	10:42,51				Boulders
1031	BG	16	W-OSLOFT	05.11.03				125	11:39	59:08,80	10:43,22				Shelly sand
1032	BG	17	W-OSLOFT	05.11.03				124	11:55	59:08,75	10:42,94				Pebbly mud
1033	BG	18	W-OSLOFT	05.11.03				152	12:12	59:08,70	10:42,70				Mud
1034	BG	19	W-OSLOFT	05.11.03				128	12:31	59:08,68	10:43,41				Coral rubble
1035-1	BG	20	W-OSLOFT	05.11.03				134	13:10	59:08,62	10:42,09				Sand
1035-2	BG	21	W-OSLOFT	05.11.03				151	13:31	59:08,65	10:42,09				Sand
1036	BG	22	W-OSLOFT	05.11.03				153	13:53	59:08,65	10:41,48				Pebbly mud
1037	BG	23	W-OSLOFT	05.11.03				158	14:09	59:08,37	10:41,66				Pebbly mud
1038	BG	24	W-OSLOFT	05.11.03				178	14:32	59:08,35	10:41,81				Mud
1039	BG	25	W-OSLOFT	05.11.03				169	14:59	59:08,30	10:42,43				Mud
1040	BG	26	W-OSLOFT	05.11.03				159	15:22	59:08,00	10:42,61				Mud
1041	CTD/Ro	7	W-OSLOFT	05.11.03	15:39	59:07,44	10:42,81	326	15:55	59:07,51	10:42,63				ok
1042	BG	27	W-OSLOFT	05.11.03				191	16:07	59:07,51	10:43,26				Mud
1043	BG	28	W-OSLOFT	05.11.03				119	16:20	59:07,37	10:43,36				Pebbly mud
1044	BG	29	W-OSLOFT	05.11.03				165	16:37	59:07,27	10:43,29				Pebbly mud
1045	BG	30	W-OSLOFT	05.11.03				141	16:56	59:06,71	10:43,07				Mud
1046-1	BG	31	W-OSLOFT	05.11.03				137	17:14	59:06,53	10:43,50				failure
1046-2	BG	32	W-OSLOFT	05.11.03				140	17:20	59:06,55	10:43,52				Mud
1047	BG	33	W-OSLOFT	05.11.03				161	17:34	59:06,52	10:43,84				Coral rubble
1048	BG	34	W-OSLOFT	05.11.03				144	17:50	59:06,58	10:44,12				Sandy mud
1049	BG	35	W-OSLOFT	05.11.03				166	18:07	59:06,00	10:44,09				Coral rubble
1050	BG	36	W-OSLOFT	05.11.03				105	18:34	59:06,22	10:44,09				Alive corals
1051	BG	37	W-OSLOFT	05.11.03				120	18:55	59:05,85	10:43,87				Coral rubble
1052	BG	38	W-OSLOFT	05.11.03				163	19:17	59:05,65	10:43,80				Sand
1053	BG	39	W-OSLOFT	05.11.03				161	19:31	59:05,46	10:43,65				Coral rubble
1054	BG	40	W-OSLOFT	05.11.03				170	19:47	59:05,60	10:43,82				Coral rubble
1055	BG	41	W-OSLOFT	05.11.03				117	20:11	59:04,71	10:43,90				Coral rubble
1056	BG	42	W-OSLOFT	05.11.03				113	20:26	59:04,57	10:43,81				Sand
157	MB	10	W-OSLOFT	05. - 06.11.03	21.21	59:04,57	10:43,72					08:45	59:00,90	10:49,36	
1058-1	BG	43	W-OSLOFT	06.11.03				106	09:29	59:04,56	10:43,79				empty
1058-2	BG	44	W-OSLOFT	06.11.03				110	09:35	59:04,55	10:43,80				Coral rubble
1059	BG	45	W-OSLOFT	06.11.03				94	09:51	59:04,53	10:44,13				Alive corals
1060-1	BG	46	W-OSLOFT	06.11.03				84	10:03	59:04,44	10:44,26				failure
1060-2	BG	47	W-OSLOFT	06.11.03				84	10:07	59:04,44	10:44,26				failure
1060-3	BG	48	W-OSLOFT	06.11.03				94	10:12	59:04,43	10:44,25				failure
1061-1	BG	49	W-OSLOFT	06.11.03				139	10:31	59:04,04	10:44,40				failure
1061-2	BG	50	W-OSLOFT	06.11.03				140	10:38	59:04,04	10:44,40				Shelly sand
1062-1	BG	51	W-OSLOFT	06.11.03				93	11:00	59:04,20	10:43,35				Boulders
1062-2	BG	52	W-OSLOFT	06.11.03				90	11:06	59:04,20	10:43,36				Sand

Station No.	Gear	No.	Area	Date	Start	Coordinates			at depth	Coordinates		End	Coordinates		Recovery Obs
					Time (MET)	Lat. °N	Long. °E	Depth (m)	Time (MET)	Lat. °N	Long. °E	Time (MET)	Lat. °N	Long. °E	
1063	BG	53	W-OSLOFT	06.11.03				120	11:21	59:04,08	10:43,68				Boulders
1064	BG	54	W-OSLOFT	06.11.03				109	11:40	59:03,81	10:44,01				Pebbly sand
1065	BG	55	W-OSLOFT	06.11.03				92	11:53	59:03,83	10:44,25				Coral rubble
1066	BG	56	W-OSLOFT	06.11.03				88	12:11	59:03,66	10:44,25				Coral rubble
1067	ROV	1	W-OSLOFT	06.11.03	14:04	59:06,22	10:44,13	120-121				15:17	59:06,26	10:44,14	Lophelia reef
1068-1	ROV	2	W-OSLOFT	06.11.03	16:13	59:04,54	10:44,21								techn. Failure
1068-2	ROV	3	W-OSLOFT	06.11.03	16:56	59:04,54	10:44,21	123				18:11	59:04,52	10:44,18	Lophelia reef
1069	MB	11	W-OSLOFT	06. - 07.11.03	20:00	59:04,39	10:42,48					08:06	59:01,96	10:43,65	
1070	BG	57	W-OSLOFT	07.11.03				143	08:35	59:04,25	10:44,48				Coral rubble
1071-1	BG	58	W-OSLOFT	07.11.03				117	08:50	59:03,94	10:43,68				failure
1071-2	BG	59	W-OSLOFT	07.11.03				112	09:01	59:03,25	10:44,56				Pebbly sand
1072	BG	60	W-OSLOFT	07.11.03				84	09:16	59:03,63	10:43,98				Mud
1073-1	BG	61	W-OSLOFT	07.11.03				84	09:31	59:03,25	10:44,16				failure
1073-2	BG	62	W-OSLOFT	07.11.03				85	09:35	59:03,25	10:44,16				failure
1074-1	BG	63	W-OSLOFT	07.11.03				93	09:48	59:03,10	10:44,48				Pebbly mud
1074-2	BG	64	W-OSLOFT	07.11.03				137	10:39	59:03,08	10:44,56				Mud
1075	BG	65	W-OSLOFT	07.11.03				99	10:58	59:03,36	10:45,53				Mud
1076	BG	66	W-OSLOFT	07.11.03				110	11:18	59:03,31	10:44,40				Mud
1077-1	BG	67	W-OSLOFT	07.11.03				105	12:11	59:03,56	10:44,19				Coral rubble
1077-2	BG	68	W-OSLOFT	07.11.03				105	12:18	59:03,57	10:44,21				Coral rubble
1077-3	BG	69	W-OSLOFT	07.11.03				96	12:26	59:03,55	10:44,18				failure
1078	CTD/Ro	8	W-OSLOFT	07.11.03	13:15	59:03,57	10:44,63	152				13:23	59:03,57	10:44,64	ok
1079	BG	70	W-OSLOFT	07.11.03				131	13:51	59:03,23	10:44,73				Boulders
1080	BG	71	W-OSLOFT	07.11.03				106	14:17	59:02,39	10:44,39				Pebbly sand
1081	BG	72	Djupekrak	07.11.03				163	15:26	59:01,48	10:51,80				Coral rubble
1082-1	BG	73	Djupekrak	07.11.03				161	15:56	59:01:43	10:52,01				Coral rubble
1082-2	BG	74	Djupekrak	07.11.03				159	16:07	59:01,46	10:51,98				Coral rubble
1083	BG	75	Djupekrak	07.11.03				117	16:30	59:02,09	10:50,78				Sandy mud
1084	BG	76	Djupekrak	07.11.03				126	16:46	59:02,50	10:49,98				Mud
1085	BG	77	E-OSLOFT	07.11.03				136	18:32	59:05,36	10:47,96				Pebbly mud
1086	BG	78	E-OSLOFT	07.11.03				108	18:50	59:05,06	10:48,44				Mud
1087	BG	79	E-OSLOFT	07.11.03				130	19:15	59:05,02	10:48,39				Pebbly mud
1088	BG	80	E-OSLOFT	07.11.03				177	19:31	59:04,84	10:48,56				Pebbly mud
1089	BG	81	E-OSLOFT	07.11.03				128	15:54	59:04,75	10:48,21				Pebbly sand
1090	BG	82	E-OSLOFT	07.11.03				97	20:16	59:04,71	10:48,27				Pebbly sand
1091	BG	83	E-OSLOFT	07.11.03				104	20:34	59:04,71	10:48,61				Pebbly sand
1092	BG	84	E-OSLOFT	07.11.03				82	20:56	59:04,52	10:48,22				Mud
1093	MB	12	W-OSLOFT	07.11.03	21:50	59:05,06	10:48,89					22:08	59:03,64	10:49,16	
1094	CTD/Ro	9	W-OSLOFT	07.11.03				433	22:44	59:02,59	10:45,31				ok
1095	CTD/Ro	10	W-OSLOFT	07.11.03				219	23:07	59:02,78	10:45,19				ok

Station No.	Gear	No.	Area	Date	Start	Coordinates			at depth	Coordinates		End	Coordinates		Recovery Obs
					Time (MET)	Lat. °N	Long. °E	Depth (m)	Time (MET)	Lat. °N	Long. °E	Time (MET)	Lat. °N	Long. °E	
1096	CTD/Ro	11	W-OSLOFT	07.11.03				223	23:30	59:03,03	10:45,02				ok
1097	CTD/Ro	12	W-OSLOFT	07.11.03				141	23:51	59:03,33	10:44,88				ok
1098	CTD/Ro	13	W-OSLOFT	08.11.03				97	00:15	59:03,65	10:44,31				ok
1099	CTD/Ro	14	W-OSLOFT	08.11.03				94	00:31	59:03,79	10:44,27				ok
1100	CTD/Ro	15	W-OSLOFT	08.11.03				152	00:49	59:03,88	10:44,41				ok
1101	CTD/Ro	16	W-OSLOFT	08.11.03				148	01:11	59:04,02	10:44,37				ok
1102	CTD/Ro	17	W-OSLOFT	08.11.03				139	01:29	59:04,27	10:44,19				ok
1103	CTD/Ro	18	W-OSLOFT	08.11.03				128	01:48	59:04,41	10:44,55				ok
1104	CTD/Ro	19	W-OSLOFT	08.11.03				106	02:07	59:04,44	10:44,05				ok
1105	CTD/Ro	20	W-OSLOFT	08.11.03				117	02:21	59:04,52	10:44,08				ok
1106	CTD/Ro	21	W-OSLOFT	08.11.03				134	02:45	59:04,58	10:44,14				ok
1107	CTD/Ro	22	W-OSLOFT	08.11.03				148	03:13	59:04,75	10:43,98				ok
1108	CTD/Ro	23	W-OSLOFT	08.11.03				173	03:33	59:04,89	10:43,75				ok
1109	CTD/Ro	24	W-OSLOFT	08.11.03				173	03:52	59:05,07	10:43,72				ok
1110	CTD/Ro	25	W-OSLOFT	08.11.03				170	04:10	59:05,30	10:43,72				ok
1111	CTD/Ro	26	W-OSLOFT	08.11.03				171	04:30	59:05,56	10:43,81				ok
1112	CTD/Ro	27	W-OSLOFT	08.11.03				165	04:48	59:05,75	10:43,95				ok
1113	CTD/Ro	28	W-OSLOFT	08.11.03				169	05:06	59:05,93	10:44,08				ok
1114	CTD/Ro	29	W-OSLOFT	08.11.03				113	05:21	59:06,10	10:44,01				ok
1115	CTD/Ro	30	W-OSLOFT	08.11.03				110	05:37	59:06,20	10:44,07				ok
1116	CTD/Ro	31	W-OSLOFT	08.11.03				128	05:53	59:06,23	10:44,24				ok
1117	CTD/Ro	32	W-OSLOFT	08.11.03				117	06:11	59:06,33	10:44,09				ok
1118	CTD/Ro	33	W-OSLOFT	08.11.03				141	06:26	59:06,47	10:44,04				ok
1119	CTD/Ro	34	W-OSLOFT	08.11.03				196	06:43	59:06,66	10:43,79				ok
1120	CTD/Ro	35	W-OSLOFT	08.11.03				253	07:06	59:06,85	10:43,53				ok
1121	CTD/Ro	36	W-OSLOFT	08.11.03				287	07:28	59:07,01	10:43,23				ok
1122	CTD/Ro	37	W-OSLOFT	08.11.03				321	07:54	59:07,18	10:42,94				ok
1123	CTD/Ro	**38**	W-OSLOFT	08.11.03				326	08:20	59:07,33	10:42,80				ok
1124	ROV	4	W-OSLOFT	08.11.03	09:19	59:04,28	10:43,62	112-114				09:51	59:04,30	10:43,57	Sponge reef
1125	ROV	**5**	W-OSLOFT	08.11.03	10:15	59:04,72	10:43,84	128-129				11:32	59:04,72	10:43,84	Sponge reef
1126	BG	85	E-OSLOFT	08.11.03				59	12:57	59:09,25	10:45,96				Pebbly sand
1127	BG	86	E-OSLOFT	08.11.03				67	13:29	59:08,82	10:45,75				Pebbly sand
1128	BG	87	E-OSLOFT	08.11.03				75	13:53	59:08,64	10:46,23				Pebbly sand
1129-1	BG	88	E-OSLOFT	08.11.03				117	14:34	59:08,35	10:45,70				Muddy sand
1129-2	BG	89	E-OSLOFT	08.11.03				121	00:00	59:08,37	10:45,72				Coral rubble
1130	BG	90	E-OSLOFT	08.11.03				94	15:31	59:08,37	10:46,21				Boulders
1131	BG	91	E-OSLOFT	08.11.03				68	15:49	59:08,20	10:46,56				Pebbly mud
1132	BG	92	E-OSLOFT	08.11.03				71	16:21	59:07,78	10:46,69				Pebbly mud
1133	BG	93	E-OSLOFT	08.11.03				97	16:42	59:07,14	10:46,93				Mud
1134	BG	94	E-OSLOFT	08.11.03				83	16:55	59:07,01	10:47,01				Stiff clay
1135	BG	95	E-OSLOFT	08.11.03				88	17:15	59:06,77	10:47,25				Coral rubble
1136	BG	96	E-OSLOFT	08.11.03				93	18:05	59:06,15	10:47,78				failure
1137	BG	97	E-OSLOFT	08.11.03				74	18:31	59:06,08	10:47,78				Coral rubble

Station No.	Gear	No.	Area	Date	Start	Coordinates			at depth	Coordinates		End	Coordinates		Recovery Obs
					Time (MET)	Lat. °N	Long. °E	Depth (m)	Time (MET)	Lat. °N	Long. °E	Time (MET)	Lat. °N	Long. °E	
1138	BG	98	E-OSLOFT	08.11.03				99	18:42	59:06,04	10:47,70				Coral rubble
1140	BG	99	E-OSLOFT	08.11.03				87	19:18	59:06,03	10:48,00				Coral rubble
1141	BG	100	E-OSLOFT	08.11.03				87	19:45	59:06,01	10:47,67				Coral rubble
1142-1	BG	101	E-OSLOFT	08.11.03				96	20:16	59:06,01	10:48,01				failure
1142-2	BG	102	E-OSLOFT	08.11.03				86	20:36	59:06,01	10:48,01				Coral rubble
1143	BG	103	E-OSLOFT	08.11.03				67	20:55	59:06,00	10:48,22				failure
1144	BG	105	E-OSLOFT	08.11.03				75	21:02	59:06,00	10:48,37				Mud
1145-1	BG	106	E-OSLOFT	08.11.03				96	21:28	59:05,97	10:47,67				failure
1145-2	BG	107	E-OSLOFT	08.11.03				88	21:38	59:05,97	10:47,68				Coral rubble
1146	BG	108	E-OSLOFT	08.11.03				102	21:56	59:05,95	10:47,37				Sand
1147	BG	109	E-OSLOFT	08.11.03				64	22:17	59:05,95	10:48,34				Coral rubble
1148	BG	110	E-OSLOFT	08.11.03				76	22:28	59:05,92	10:48,33				Coral rubble
1149	BG	111	E-OSLOFT	08.11.03				87	22:39	59:05,89	10:48,41				Boulders
1150	BG	112	E-OSLOFT	08.11.03				86	22:53	59:05,83	10:48,30				Muddy sand
1151	BG	113	E-OSLOFT	08.11.03				109	23:12	59:05,87	10:47,65				Coral rubble
1152	BG	114	E-OSLOFT	08.11.03				91	23:32	59:05,83	10:48,16				Boulders
1153	BG	115	E-OSLOFT	08.11.03				88	23:47	59:05,78	10:47,90				Coral rubble
1154	MB	13	W-OSLOFT	08.-09.11.03	00:50	59:06,85	10:46,49					09:45	58:59,84	10:58,16	
1155-1	VICO	5	E-OSLOFT	09.11.03				121	11:22	59:04,71	10:43,93				failure
1155-2	GKG	6	E-OSLOFT	09.11.03				106	12:27	59:04,71	10:43,90				Coral rubble
1156	BG	116	E-OSLOFT	09.11.03				88	13:23	59:05,76	10:48,29				Mud
1157	BG	117	E-OSLOFT	09.11.03				110	13:54	59:05,74	10:48,17				Pebbly sand
1158	BG	118	E-OSLOFT	09.11.03				120	14:21	59:05,73	10:47,70				Alive corals
1159	BG	119	E-OSLOFT	09.11.03				97	14:41	59:05,72	10:47,82				Coral rubble
1160	BG	120	E-OSLOFT	09.11.03				105	15:04	59:05,70	10:47,88				Pebbly sand
1161	BG	121	E-OSLOFT	09.11.03				110	15:23	59:05,67	10:47,67				Alive corals
1162	BG	122	E-OSLOFT	09.11.03				86	15:44	59:05,64	10:48,15				Coral rubble
1163	BG	123	E-OSLOFT	09.11.03				88	16:00	59:05,64	10:47,87				Alive corals
1164	BG	124	E-OSLOFT	09.11.03				85	16:21	59:05,55	10:48,31				failure
1165	MB	14	W-OSLOFT	09.-10.11.03	16:33	59:05,50	10:48,18					03:45	58:25,10	10:27,87	