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Hebbeln, D., C. Wienberg, L. Beuck, A. Freiwald, P. Wintersteller
and cruise participants

REPORT AND PRELIMINARY RESULTS OF RV POSEIDON CRUISE POS 385 "COLD-WATER CORALS OF THE ALBORAN SEA (WESTERN MEDITERRANEAN SEA)", Faro - Toulon, May 29 - June 16, 2009.

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◇ Cruise Report ◇

RV POSEIDON Cruise POS 385

"Cold-Water Corals of the Alboran Sea (western Mediterranean Sea)"

Faro - Toulon

May 29 – June 16 2009

◇◇◇

by

Hebbeln D, Wienberg C, Beuck L, Freiwald A, Wintersteller P, Dehning K, Klann M, Nowald N, Ruhland G, Klaucke I

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Cover image ROV images clockwise from top left. Live *Madrepora oculata* colony. View on multi-generation stacks of live and dead deep-sea oysters, *Neopycnodonte zibrowii*. Abundant ophiuroids, *Ophiotrix fragilis*. *Acanthogorgia hirsuta*.

This expedition contributes to the HERMIONE project (Hotspot Ecosystem Research and Man's Impact on European Seas) (7th FRP of the EU).

1 ◇ Participants

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Fig. 1.1 *Scientific crew of* RV Poseidon *cruise* POS 385.

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Dietmar Klare	Electrician	Ralf Peters	SM Deckhand
Benjamin Groenbohm	Technician	Johann Ennenga	Cook
Frank Schrage	Bosun	Dieter Jordan	Steward

***Fig. 1.2** Ship's crew of* RV Poseidon *cruise* POS 385.

2 ◇ Research Program

(Dierk Hebbeln & Claudia Wienberg)

The focus of the *RV Poseidon* expedition *POS 385* was on the investigation of cold-water coral ecosystems in the Strait of Gibraltar and in the Alboran Sea (western Mediterranean Sea) (Fig. 2.1) with regard to their distribution, faunal composition and vitality under present and past glacial conditions. Whereas for the western Strait of Gibraltar already some data existed about the distribution of cold-water corals (Álvarez-Pérez et al. 2005), the knowledge about their occurrence in the Alboran Sea was relatively sparse, and thus, the investigations here were rather of discovering manner.

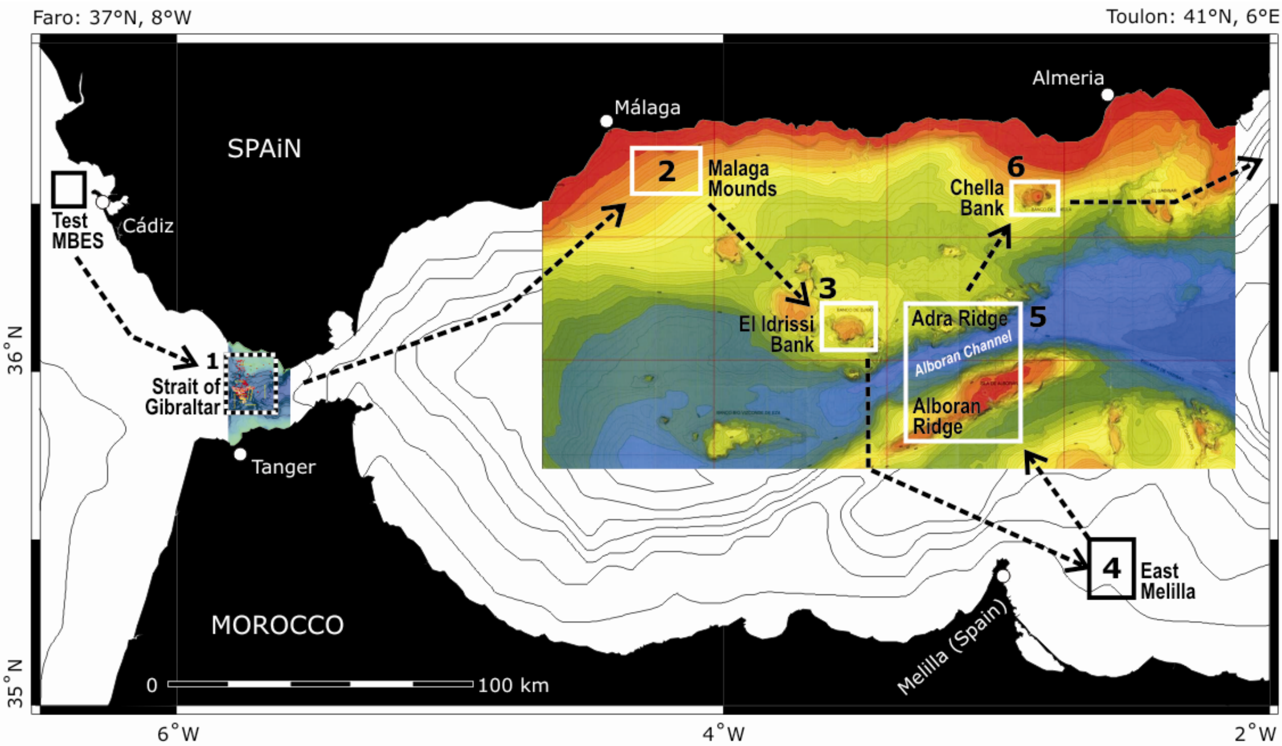


***Fig. 2.1** Bathymetric map of the Alboran Sea (western Mediterranean Sea) showing study sites and cruise track of* RV Poseidon *cruise* POS 385.

With the application of a 'remotely operated vehicle' (ROV), it was intended to conduct a detailed characterisation of the existing facies and biocoenoses. These video-based investigations were verified by fauna and sediment sampling by targeted ROV sampling as well as by standard sampling methods (gravity corer, box corer). In particular sediment cores enable to study the development of cold-water coral ecosystems under changing environmental conditions, e.g., over glacial-interglacial cycles. The overall aim is to reconstruct the development of the cold-water coral ecosystems in the western Strait of Gibraltar and in the Alboran Sea, and moreover, to identify and to evaluate those factors that control their distribution in this region.

This expedition contributes to the HERMIONE project (Hotspot Ecosystem Research and Man's Impact on European Seas), an integrated project funded within the 7th FRP of the European Union (Weaver et al. 2009). Part of this project is the investigation of cold-water coral ecosystems that are widely distributed along the NE Atlantic continental margin (Roberts et al. 2006). Over the past two decades, it has been discovered that they occur all along Europe from northern Norway (70°N) down to the Moroccan margin (36-35°N), and in the Mediterranean Sea. Whereas north of 50°N, namely off Norway and Ireland, thriving cold-water coral ecosystems are quite common (Freiwald et al. 2002; Fosså et al. 2005; Wheeler et al. 2007), in the lower latitudes (e.g., Bay of Biscay, along the Portuguese margin, Gulf of Cádiz) solely isolated patches of dead to fossil corals, so-called 'coral graveyards', exist (Reveillaud et al. 2008; Tyler et al. 2009; Wienberg et al. 2009). However, communities as vivid as the northern ones have recently been reported from the central Mediterranean Sea, where they especially occur within canyons and on escarpments (Freiwald et al. 2009; Orejas et al. accepted).

This expedition specifically focused on the distribution of cold-water coral ecosystems in the Alboran Sea under present-day as well as under glacial conditions and on the forcing factors driving the observed distribution patterns. Based on a similar strategy including (1) an initial hydro-acoustic characterisation of the selected structures with a multibeam echo-sounder (MBES), (2) video observations with the ROV 'Cherokee', (3) supplemental CTD casts, (4) sampling of sediments and fauna with box corer and gravity corer, with appropriate sediment sampling sites having been selected based on site-survey and visual information resulting from the video observations. Employing this combined technology the scientific work concentrated on 4 major scientific questions:

1. Do cold-water corals presently live in the transition zone between the Atlantic Ocean and the Mediterranean Sea?
2. If so, can living cold-water coral assemblages be correlated with the prevailing local environmental setting?
3. How are the cold-water coral ecosystems ecologically structured?
4. How have the cold-water coral ecosystems developed under changing environmental conditions and can migration pathways be deducted?

Six clearly defined working areas have been studied during *RV Poseidon* cruise *POS 385* (Fig. 2.1). Study area No. 1 was situated along the Spanish margin in the Strait of Gibraltar (Fig. 2.1). Within the Alboran Sea the first target area was a cluster of small-sized mounds discovered SE of Malaga (No. 2) along the Spanish margin. The cruise continued to the Djibouti Bank, where the seamount El Idrissi Bank (No. 3) was the target of sediment sampling and video observation. Afterwards, we sailed to the Moroccan margin, where small-sized mounds exist east off the Spanish enclave Melilla (No. 4) along the Moroccan margin, before *RV Poseidon* sailed again northwards to study the Alboran Ridge and the Adra Ridge (No. 5) that both border the Alboran Channel. The last target of the cruise was a seamount situated SW of Almeria: the Chella Bank (No. 6).

The evaluation of the data collected during this expedition will allow defining the distribution pattern of cold-water corals and associated fauna in the Alboran Sea in relation to various, regionally different forcing factors. In addition, the coverage of several target areas will allow to some degree to differentiate between typical (i.e. transferable) and site-specific distribution patterns helping to deduce principal insights on the dependence of cold-water corals from the prevailing environmental setting.

3 ◇ Narrative of *RV Poseidon* cruise *POS 385*

(Claudia Wienberg)

On **May 27th**, ten scientists of three German marine institutes (MARUM, GZN, IFM-GEOMAR) arrived in Faro (Portugal), where they directly started to unload the scientific equipment that was send from Bremen (MARUM) with two containers to *RV Poseidon* (Fig. 3.1). **May 28th** was spent with the installation of the equipment in the onboard laboratories. The ROV Cherokee work unit was installed as well as the MBES. It was planned to leave Faro in the early morning on **May 29th**, but due to stormy conditions at sea it was decided to postpone the departure to the next day.

Fig. 3.1 RV Poseidon *in the port of Faro.*

MBES test survey off Cádiz (May 30th)

RV Poseidon left the port of Faro at 07:00 on **May 30th** heading south-eastwards. Fair weather conditions and a continuously decreasing swell provided good conditions for the planned MBES test. We arrived at 14:30 at a **test site off Cádiz**, where the CTD was deployed for the first time (GeoB 13701-1). The frame was additionally equipped with a sound velocity sensor (Sea & Sun Technology) and a GAPS (global positioning system for subsea applications) transponder. A sound velocity profile was required to calibrate the MBES, and the GAPS was tested for an accurate positioning of the ROV. Afterwards, a test survey was conducted to calibrate and test the MBES (GeoB 13702-1).

Area 1: Strait of Gibraltar (May 31st)

On **May 31st** at 07:00, one of the scientists (Ingo Klaucke), who was responsible for the installation, calibration and testing of the MBES, disembarked. Then, *RV Poseidon* set sail to the first study area of expedition *POS 385*, the **Strait of Gibraltar**. Under very smooth wave conditions and with almost no wind the station work started with ROV Dive 1 (GeoB 13703-1), but unfortunately the deployment of the ROV had to be aborted. Due to very strong currents (probably related to the Mediterranean Outflow Water), the ROV could not dive deeper than 180 m, i.e. not closer than 40 m to the seafloor at this site. As a consequence, it was decided to completely cancel this study area, and to set sail to the Alboran Sea.

Area 2: Malaga Mounds (June 1st)

On **June 1st** at 06:00, we arrived at the **Malaga Mounds**, a cluster of small-sized mounds SE off the Spanish city Malaga. Station work started with a CTD cast (GeoB 13704-1). The CTD frame was again additionally equipped with a sound velocity sensor and a GAPS transponder. An MBES survey (GeoB 13705-1) was conducted across some of the mounds. During the following ROV Dive 2 (GeoB 13706-1), we crossed the flank of one of these mounds. This mound was dominated by bioturbated soft sediment with rare benthic fauna. After two hours, the dive was cancelled as no signs of cold-water corals were detected.

In the afternoon, the MBES survey (GeoB 13707-1) of the Malaga Mounds was continued and followed by ROV Dive 3 (GeoB 13708-1). The first part of the dive was a bit problematic as we got no reliable positioning data. But during the second part, a SW-NE elongated mound structure with ~20 m in height was surveyed. Few patches of *Dendrophyllia* sp. fragments were observed and some hard substrate debris was sampled with the ROV. On board, these samples could be identified as fossil rhodoliths, serpulids and *Lithophyllum* sp. that are most likely associated with the last Pleistocene sea level low-stand (Fig. 3.2).

Also the evening of June 1st was characterised by optimal weather conditions. It was intended to continue the mapping of the Malaga Mounds, but unfortunately, some technical problems with the MBES occurred that needed some time to fix them. Therefore, *RV Poseidon* set sail to the Djibouti Bank that is located south of the Malaga Mounds.

Fig. 3.2 *Fossil rhodoliths observed on the Malaga Mounds in 224 m water depth (ROV Dive 3).*

Area 3: El Idrissi Bank (June 2nd – 3rd)

In the early morning on **June 2nd**, *RV Poseidon* arrived at Djibouti Bank. Station work started with the mapping of a seamount called **El Idrissi Bank** (GeoB 13709-1). Under good weather conditions, the work was continued with ROV Dive 4 (GeoB 13710-1) starting at the lower southern flank of El Idrissi and going uphill. The seamount was dominated by outcropping hardground (of volcanic origin) partly covered by a thin veneer of soft sediments. Conspicuous are fields with large whitish sponges. Findings of cold-water corals comprised few living *Dendrophyllia cornigera*, a living colony of *Madrepora oculata* that colonised a lost fishing line (Fig. 3.3), and coral rubble. At 390 m, deep-sea oysters colonising outcropping hardgrounds were observed, of which one could be sampled. The top of the flank is dominated by extended fields with crinoids colonising soft sediment, partly surrounded by coral rubble.

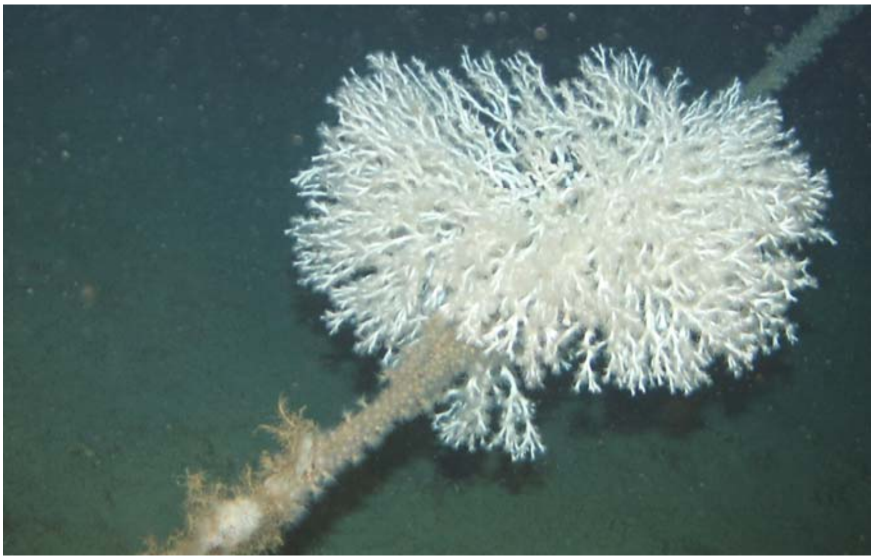


Fig. 3.3 Lophelia pertusa *colonising a fishing line observed on El Idrissi Bank (ROV Dive 4).*

Based on the ROV video observation, sampling sites for box coring were selected. Three of five coring attempts were successful (GeoB 13711-1, 13712-1, 13714-1) and revealed foraminifera sand with abundant coral fragments and shells. The day ended with a CTD cast (plus sound velocity sensor) (GeoB 13715-1) and an MBES survey (GeoB 13716-1) to continue the mapping that had been started in the early morning.

June 3rd started with ROV Dive 5 (GeoB 13717-1). The video survey started again at the base of the southern flank of **El Idrissi Bank**, slightly to the east of Dive 4 and continued uphill. Between 710 and 620 m water depth, bioturbated soft sediments dominated. Benthic organisms were relatively rare and comprised mainly holothurians, sea pens and crustaceans. First outcrops and coral rubble occurred at 620 m water depth, the coral rubble was made up of *Dendrophyllia* sp. The number of patches with coral rubble increased uphill together with an increase in hardground outcrops and sponges. At 535 m water depth, an extended area with massive *Dendrophyllia* framework was observed. The corals seemed to be *in situ*, which is quite surprisingly as *Dendrophyllia* reefs have never been observed before. Another sensational finding was the occurrence of some living deep-sea oysters (*Neopycnodonte zibrowii*) that colonised a steep cliff at 490 m water depth among abundant fossil oysters. The oysters could be sampled with the ROV (Fig. 3.4), and on board it was verified that two of the sampled oysters were still alive. This was the first time that live deep-sea oysters could be sampled in the Mediterranean Sea.

The ROV dive was followed by three attempts of box coring. Two box corer deployments were successful (GeoB 13718-2, 13718-3), although they were slightly tilted, and revealed foraminifera sand containing few coral fragments and some shells of molluscs and brachiopods. During the night, mapping of El Idrissi Bank was continued (GeoB 13719-1).

Fig. 3.4 *Sampling of live deep-sea oysters (*Neopycnodonte zibrowii*) on El Idrissi Bank (ROV Dive 5).*

Area 4: East Melilla Area (June 4th – 7th)

It was intended to start on **June 4th** with an ROV dive on the eastern flank of El Idrissi Bank. Due to a gale warning (8-9 Bft.), the ROV dive was cancelled. Instead, *RV Poseidon* set sail to the Moroccan margin and arrived there in the late afternoon. Sea conditions were just at the limit to allow for an ROV dive, however, the attempt to deploy the ROV had to be aborted as very strong surface currents made a safe deployment impossible. Instead, the CTD frame equipped with sound velocity profiler and GAPS transponder (GeoB 13720-1) was deployed. Afterwards, work was continued by an extended MBES survey (GeoB 13721-1) during the night. The target of the mapping was a cluster of small mounds that exist NE of the Spanish enclave Melilla (**Melilla Mounds**) (Comas and Pinheiro 2007).

On **June 5th**, it was planned to deploy the ROV for the 6th time, but the sea conditions were again too rough. Instead, an extensive box corer sampling was conducted in the East Melilla area. Two cores were collected from top of **Horse Mound**, an SW-NE elongated mound. One core contained only few silty sediment with some *Madrepora* fragments (GeoB 13722-2), whereas the other core comprised a 30-cm-long sequence of silty sediment with abundant *Madrepora* fragments and shells (GeoB 13722-3). One 'off-mound' core was collected in close vicinity to Horse Mound (GeoB 13722-1). This core revealed 50 cm of silt to clayey silt containing few shells and shell debris. A further sampling target was a so far unnamed small mound (**New Mound**) that was newly discovered during the MBES survey (GeoB 13721-1) to the west of Horse Mound. A box core of 20 cm in length was collected that was composed of sandy to clayey silt containing abundant *Madrepora* fragments (GeoB 13723-1). Three box cores were retrieved from **Elephant Mound**, which is an E-W elongated mound that is situated south of Horse Mound. The first core was completely filled with silt to clayey silt containing very few shells (GeoB 13724-1). The second core was empty (GeoB 13724-2), and the third one comprised very few silty sediment with some *Dendrophyllia* fragments (GeoB 13724-3).

During mapping in the East Melilla area, it was discovered that in the north of the mound cluster an extensive shallow platform exists (southern extension of the Banc de Provencaux that is indicated on the sea chart). Some sinusoidal elongated ridges are connected to this platform, arranged in a way giving the platform an ophiuroid-like appearance (Fig. 3.5). One of the southerly located ridges (**Brittlestar Ridge II**) was the last sampling target during this day. Unfortunately, the sampling was not very successful as the first core was empty (GeoB 13725-1) and the second one just contained some silty sediment with few coral fragments (GeoB 13725-2). During the night, mapping of the East Melilla area was continued (GeoB 13726-1).

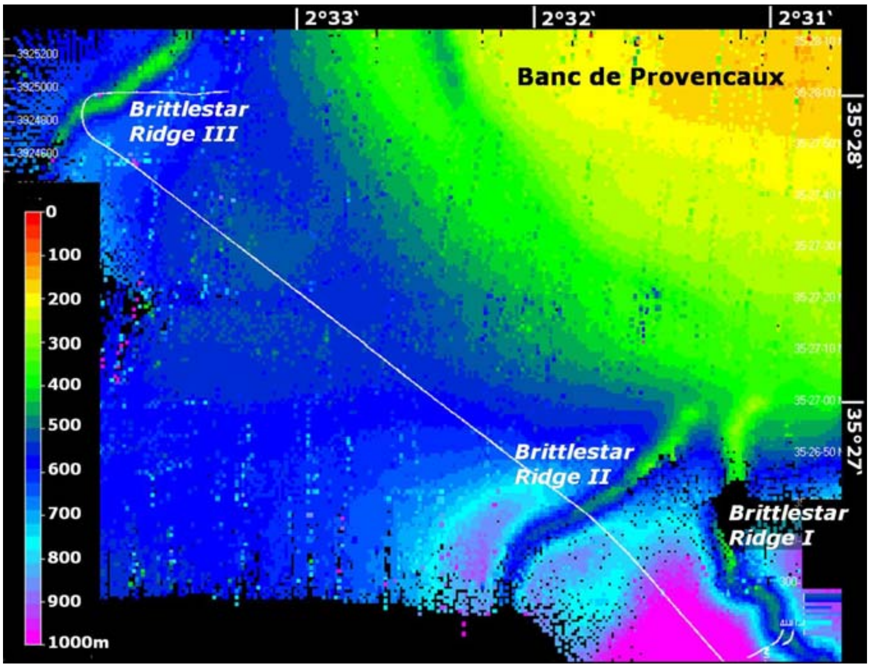


Fig. 3.5 *Map showing the Banc de Provencaux. Bended ridges (Brittlestar Ridges I- III) are connected to the platform.*

On **June 6th**, the weather has calmed down, therefore the cancelled ROV Dive 6 of the day before could be conducted (GeoB 13727-1). The dive started at the south-eastern end of one of the southern ridges (**Brittlestar Ridge I** formerly described as a coral mound and named "BigOne Mound"; Comas and Pinheiro 2007) connected to the Banc de Provencaux and continued uphill to the NW. During the dive, abundant dead coral framework mainly made up by *Dendrophyllia* was discovered that became more abundant uphill and even seemed to have an *in situ* position. Numerous individual live colonies of *Madrepora* and *Lophelia* were discovered to grow on the dead framework (Fig. 3.6), and were sampled by the ROV. Overall, benthic life was quite diverse comprising sponges, octocorals (abundant orange *Acanthogorgia hirsuta*), crustaceans, crinoids, echinoids and holothurians. After three hours, the dive had to be aborted due to problems with the ROV tether.

In the afternoon, sampling of the ridge structure (**Brittlestar Ridge I**) started. The positions of the sampling sites were selected based on the video observation during the ROV dive before. One box corer (GeoB 13728-1) of 10-20 cm in length was collected that was composed of foraminifera sand containing abundant coral fragments, followed by a gravity corer collected from the same site. This was the first time, the gravity corer was applied during cruise *POS 385*. The core had a length of 364 cm and contained abundant coral fragments (GeoB 13728-2). Two further coral-bearing cores (GeoB 13729-1: 447 cm, GeoB 13730-1: 434 cm) were collected from the ridge and one 'off-mound' core (GeoB 13731-1: 431 cm) was retrieved in close vicinity of the ridge. None of the cores were opened on-board, they were just labelled and stored; further descriptions and analyses will be done after the cruise in the home laboratories.

During the night, mapping of the East Melilla area was continued (GeoB 13732-1).

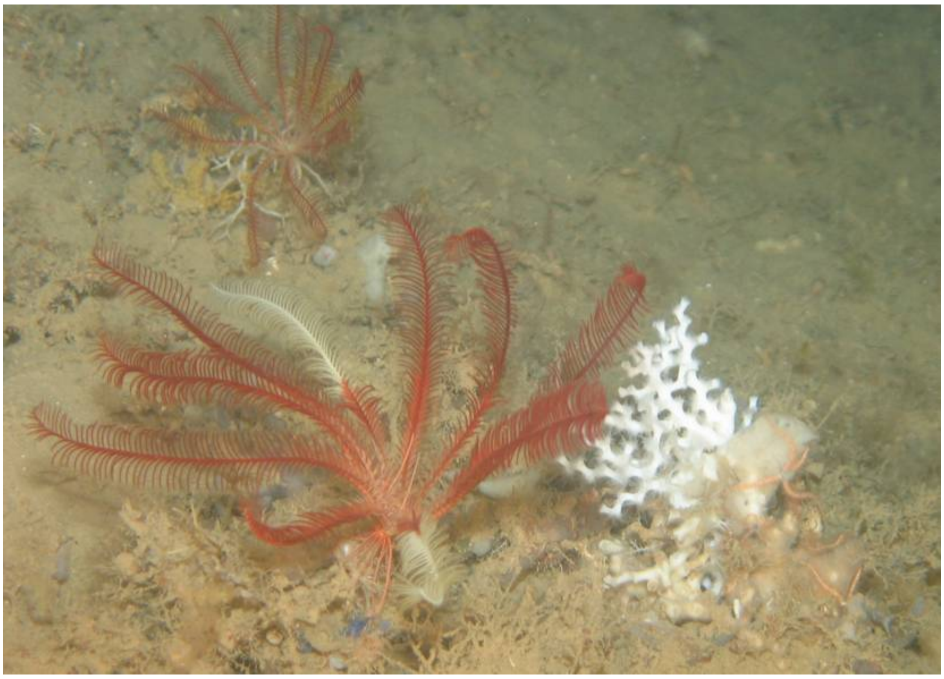


Fig. 3.6 *Crinoids and a live colony of* Madrepora oculata *observed on Brittlestar Ridge I (ROV Dive 6).*

On **June 7th**, the sampling in the East Melilla area was continued, starting with a box corer from the shallow (-200 m) top of the **Banc de Provencaux** (GeoB 13733-1). The box corer was empty pointing to that the platform is made up of hard substrate only covered by a thin veneer of soft sediment at its top. A further box core collected from the upper flank of the platform was more successful. A box corer of 30 cm in length (GeoB 13734-1) revealed sandy sediment composed of foraminifera and dark glauconitic(?) grains. The poor benthic fauna comprised mainly gastropods, bivalves, echinoids and crustaceans.

At the western side of the Banc de Provencaux, another ridge (**Brittelstar Ridge III**) exists that was a further target for sediment sampling. A box corer of 10-20 cm in length revealed foraminifera sand with abundant coral fragments and shells (GeoB 13735-1), followed by two gravity cores (GeoB 13735-2, GeoB 13736-1) which were 317 cm and 363 cm in length. Both cores contained abundant coral fragments. During the recovery of the second gravity core, the hook of the winch cable broke and the corer crashed on board. Fortunately, nobody was injured, but the core tube was bent resulting in a so-called 'banana' (Fig. 3.7).

***Fig. 3.7** Bent core tube, a so-called 'banana'.*

In the afternoon, ROV Dive 7 (GeoB 13737-1) was conducted on the western ridge (**Brittlestar Ridge III**). As for the southern ridge (Brittlestar Ridge I), again abundant dead coral framework was observed colonised by small individual live colonies of *Madrepora* and *Lophelia*, of which one live *Madrepora* colony was successfully sampled. Conspicuous was the large number of large (~30 cm in diameter) reddish ophiuroids that were sitting on top of and in between the coral framework (Fig. 3.8). Some very large trawling marks were detected as well. In contrast to Brittlestar Ridge I, crinoids and large sponges were rare and all material at the seafloor appeared to have a thin veneer of sediments, indicative of probably a weaker current regime on the western side of the bank. Interestingly, at all Moroccan sites fishes were rather abundant, whereas the amount of lost fishing gear observed during the ROV dives was much lower compared to the sites at the Spanish margin visited before.

***Fig. 3.8** Abundant ophiuroids (amongst* Ophiothrix fragilis*) observed on Brittlestar Ridge III (ROV Dive 7).*

After the ROV dive, *RV Poseidon* set sail back to Djibouti Bank were it was intended to conduct a video survey along the eastern flank of El Idrissi Bank that had to be cancelled on the June 4th. Station work started with mapping of the seamount (GeoB 13738-1). During the night the wind increased, and in the early morning on June 8th, the sea was too rough (up to 7 Bft.) to do any kind of station work. Therefore, the ROV dive was cancelled for the second time, and it was decided to set sail to our next study area in the east of Djibouti Bank.

Areas 5: Adra Ridge & Alboran Ridge (June 8th – 10th)

In the early afternoon on **June 8th**, mapping of the **Adra Ridge** that is situated at the NE end of the Alboran Channel started (GeoB 13739-1). It was intended to find some suitable sites for video observation and sampling. After two hours, the mapping had to be aborted as the wind speed further increased and precluded any further operations. *RV Poseidon* headed slowly to shore to go for shelter. On **June 9th**, the weather improved, and *RV Poseidon* transited to the **Alboran Ridge** that is situated in the south of Alboran Channel, where an MBES survey was started in the early afternoon (GeoB 13740-1). The MBES survey was followed by the 8th deployment of the ROV (GeoB 13741-1). The dive started at the northern base of the ridge (-750 m) running uphill in southeastern direction. We observed bioturbated soft sediments colonised by partly abundant cerianthids, large reddish ophiuroids (up to 80 cm in diameter) and holothurians (20 cm in diameter). After one hour, the dive had to be interrupted at a water depth of 650 m and was planned to be continued the next day. The night was used for mapping parts of the Alboran Ridge (GeoB 13742-1) and parts of the Adra Ridge (GeoB 13743-1).

On **June 10th**, the video survey on **Alboran Ridge** was continued by ROV Dive 9 (GeoB 13744-1). Above 547 m water depth, first coral rubble covering soft sediment was observed. The amount of rubble increased uphill, and even large frameworks of >1 m in diameter were observed. Partly, live *Dendrophyllia* as well as small live colonies of *Lophelia* colonise the dead coral framework. At 500 m water depth, a large outcrop of blackish hard substrate served as colonisation ground for deep-sea oysters; one of these dead oysters was successfully sampled by the ROV. At 400 m water depth, the coral rubble and hardgrounds disappeared, and are replaced by extensive plains of soft sediment showing scarce benthic life. At 270 water depth, the facies was changing to a fossil brachiopod facies, followed upslope by a corallinacea facies (-190 m) and a bryozoan-*Modiolus* facies (-130 m).

From the corallinacea and brachiopod facies, two box corer could be successfully collected (GeoB 13745-1, GeoB 13746-1). Two attempts to collect a box corer from a coral framework field failed (GeoB 13747-1, -2). At the end of the day the gravity corer (GeoB 13748-1) was deployed to sample a small coral rubble field. Although the core yielded only 30 cm, it was successful in bringing some coral rubble onboard. During the night, mapping of the Alboran Ridge was continued (GeoB 13749-1).

Area 3: El Idrissi Bank (June 11th – 12th)

Afterwards, *RV Poseidon* set sail back to Djibouti Bank to extend the mapping of **El Idrissi Bank** (GeoB 13750-1). On **June 11th**, we tried for the third time to conduct an ROV dive along the eastern flank of the seamount (Dive 10; GeoB 13751-1). With beautiful sunshine and absolutely calm sea, finally this survey has been carried out successfully. The dive started at the base of the flank. At a water depth of 675 m, first coral rubble occurred made up by *Dendrophyllia*, *Lophelia* and *Madrepora*. The rubble was getting more abundant uphill, merging into a dead reef at 530 m water depth. This dive revealed live *Dendrophyllia* and *Lophelia*, numerous whitish antipatharians forming forest-like accumulations, overall diverse benthic life with large whitish sponges, octocorals and crustaceans were observed. At 390 m, a 5-6-m-high cliff was detected that was colonised by live deep-sea oysters (*Neopycnodonte zibrowii*). Two living oysters could be successfully sampled by the ROV (Fig. 3.9). Shortly after sampling, the ROV got entangled with a fishing line resulting in a very serious situation. Therefore, the dive had to be aborted.

Fig. 3.9 *Live deep-sea oysters of the species* Neopycnodonte zibrowii *sampled during ROV Dive 10 from El Idrissi Bank.*

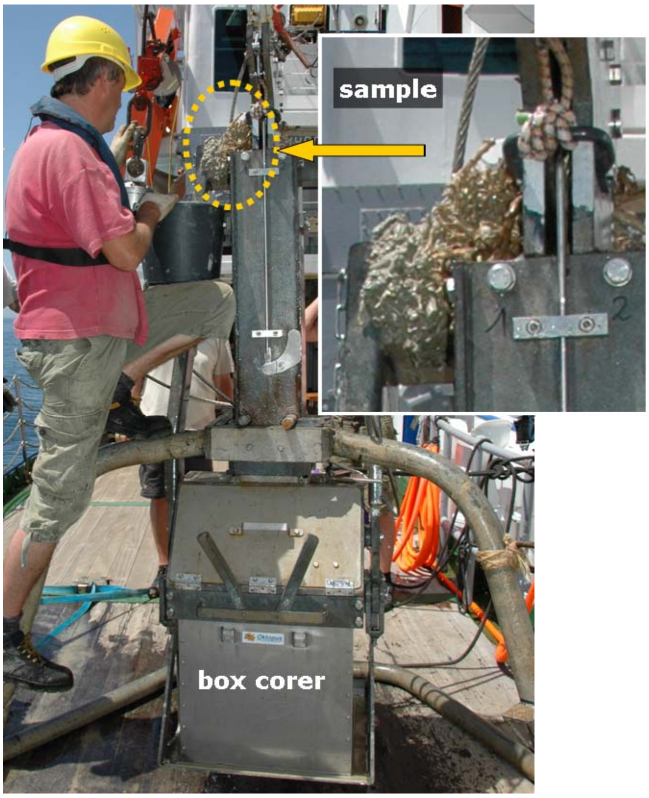


Fig. 3.10 *Sample entangled in box corer frame.*

When the ROV was safe back on board, the sampling at the eastern flank of El Idrissi Bank started with four box corers. The first box corer (GeoB 13752-1) was collected from the top of the seamount, but contained solely a live octocoral and no sediment. The second box corer (GeoB 13753-1) from the upper flank of El Idrissi Bank seemed to have been toppled over, therefore no sediment was left in the box, but some sediment and coral fragments were entangled in the frame of the box corer (Fig. 3.10). During analysing the coral content of this sample, it came out that finally the sample was quite successful as some fragments of the species *Pourtalosmilia anthophyllites* were identified. This species was so far only reported from a dredge sample collected in the early 20th century.

Four further attempts to collect box corer at two different sites failed as none of them were completely filled and solely very few coral fragments were recovered (GeoB 13754-1, -2; GeoB 13755-1, -2). Finally, a gravity corer (GeoB 13755-3) was taken from the lower slope of El Idrissi Bank. By yielding 25 cm of coral bearing sediment it was at least more successful than the box corer attempts in the coral rubble area. The night was spent with the final mapping of the northern part of the seamount (GeoB 13756-1).

On **June 12th**, we deployed the ROV for the fourth time on **El Idrissi Bank** (Dive 10; GeoB 13757-1), this time visiting its northeastern flank. The observation started in 660 m water depth where only bioturbated soft sediments were encountered. Coral rubble first occurred at 570 m water depth, thus, in much shallower water depths as at the eastern slope. Moreover, whereas at the eastern slope the coral rubble fields were often colonised by whitish antipatharians, during this dive huge amounts of the echinoid *Cidaris* were living on the coral rubble (and one entered by himself the ROV's sample basket). At 530 m water depth, basaltic outcrops were overgrown by fossil deep-sea oyster. Unfortunately, the attempt to sample a living *Lophelia* colony in 418 m was not successful. At ~400 m water depth, for the first time during this cruise the bamboo coral *Isidella elongata*, a soft bottom dweller, has been observed. The shallower upper part of the NE-flank (<375 m) was characterised by coarser sediment and some outcropping rocks.

Similar to the experience of the previous days, box corer sampling proved to be almost impossible at the steep slopes of the seamount. Whereas the first box corer (GeoB 13758-1) only yielded two coral fragments, the second one (GeoB 13759-1) was more successful. The core was filled with 24 cm of foraminifera sand with glauconitic grains (plus shells of gastropods, brachiopods, bivalves), underlain by greyish clayey sand with large *Lophelia* fragments. Finally, a gravity corer (GeoB 13760-1) taken at an off-mound position yielded a 424-cm-long record. After station work commenced at El Idrissi Bank, *RV Poseidon* set sail to our last study site, Chella Bank, a seamount located SW of Almeria.

Area 6: Chella Bank (June 13th)

During the night, *RV Poseidon* arrived at **Chella Bank** and we directly started mapping (GeoB 13761-1) the southeastern flank of this seamount that was proposed for the final ROV dive of this cruise. On **June 13th** at 06:00, we deployed the ROV for the 12th dive (GeoB 13762-1). Between 500 and 330 m, the predominating soft sediment was heavily disturbed by intensive trawling, and, probably as a consequence, benthic organisms and fish were rather scarce. The trawl marks had a height of up to several decimetres, and were easily to detect in the ROV's sonar. Above 330 m water depth, the texture of the sediment changed, it became coarser with some ripple marks indicating slope parallel transport. The number of benthic organisms (e.g. holothurians) and fishes increased. Close to the flat top of Chella Bank, some individual rocks were overgrown by a very diverse benthic community (i.a. live *Dendrophyllia*). Several parts of the flat top were marked by subaqueous dunes. Above 115 m water depth, a fossil rhodolith facies was encountered, and finally, above 100 m first living pink- to red-coloured rhodoliths occurred (coralligene facies). Huge amounts of gorgonians settled on the rhodoliths and on the outcropping hardgrounds.

After the dive, a very short MBES survey to finish the mapping of Chella Mound was conducted (GeoB 13763-1) and at noon on June 13th station work of cruise *POS 385* commenced and with light winds and a moderate easterly swell *RV Poseidon* set sail to Toulon. On the morning of **June 16th**, *RV Poseidon* arrived at the IFREMER pier in Toulon.

4 ◇ Equipment and Deployments

4.1 ◇ CTD

(Dierk Hebbeln)

For the measurement of sea water properties, a CTD system (Sea Bird Electronics) of the IFM-GEOMAR (Kiel) that is permanently installed on *RV Poseidon* was applied. In addition to the classical CTD data (conductivity, temperature and depth), the available CTD system also provided oxygen and fluorescence data. The electronic hardware was mounted inside a rosette frame that contained 12 niskin bottles á 10 liters (Fig. 4.1). However, water samples have not been taken. The CTD was mainly applied to get sound velocity profiles to calibrate the MBES, as well as to calibrate the GAPS antenna used for the positioning of the ROV (Fig. 4.1). In total, four CTD casts were conducted during cruise *POS 385* (Table 4.1).

Fig. 4.1 ***A*** *CTD onboard* RV Poseidon. *The CTD frame was additionally equipped with* ***B*** *a GAPS transponder to calibrate the positioning of the ROV, and* ***C*** *a sound velocity sensor to get sound velocity profiles to calibrate the MBES.*

Table 4.1 *Metadata of CTD casts conducted during* RV Poseidon *cruise* POS 385 *(data are related to time of 10 to 20 m above seabed). WD: water depth.*

Cast	Station [GeoB]	Date [ddmmyy]	Time [UTC]	Longitude [N]	Latitude [W]	WD [m]	Description
test site off Cádiz							
#01	13701-1	30.05.09	14:30	36°36.89′	06°45.48′	99	• no reliable data • Test GAPS
Malaga Mounds							
#02	13704-1	01.06.09	04:26	36°35.05′	04°09.86′	358	• CTD max. depth: 330 m • Sound velocity profile for MBES mapping • Test GAPS
El Idrissi Bank							
#03	13715-1	02.06.09	16:36	36°05.01′	03°32.50′	727	• CTD max. depth: 700 m • Sound velocity profile for MBES mapping
East Melilla Area							
#04	13720-1	04.06.09	15:46	35°26.01'	02°30.92'	466	• no reliable data • Sound velocity profile for MBES mapping

4.2 ◇ Multibeam Echosounder

(Paul Wintersteller)

A SEA BEAM 1050 Multibeam Echosounder System (provided by the IFM-GEOMAR) was applied for bathymetric surveys during *RV Poseidon* cruise *POS 385*. These data were used to select targets for ROV surveys and subsequent sediment sampling. In total, 19 MBES surveys were conducted, of which three survey attempts failed (Table 4.2).

The operating frequency of SEA BEAM 1050 is 50 kHz. Two narrow beam width transducer arrays are pinging quasi-simultaneously into 14 directed sectors with a high acoustic transmission level. The receiving beamformer generates 3 narrow beams within each sector with a beam width of 1.5° and a spacing of 1.25°, called subfans. A complete fan comprises three subfans, i.e. there are 14 sectors x 3 beams x 3 subfans = 126 beams in total. The relatively high operating frequency of 50 kHz in conjunction with special small size transducers offers two advantages: high coverage and narrow beam width. The application of preformed beams guarantees extremely good side lobe suppression and a very low error rate. This has a positive influence on measuring accuracy and gives the system a big advantage over one way procedures, i.e. non-directed transmission and reception. Acquisition of data and system control is performed on a WINDOWS XP based high performance personal computer.

In the SEA BEAM 1050 system the influence of the sound velocity profile on the sound beam propagation in water is taken into account by using ray tracing algorithms based on the measured actual sound velocity profile. Thus, correct depth and position data are calculated.

Summary of system features

- Wide horizontal scan areas covered with 126 adjacent beams and 150° swath width. Due to the mounting on *RV Poseidon* one can reach a maximum swath width of 120° with 108 beams.
- Very high resolution, achieved by narrow beam width and efficient side-slobe suppression due to directional transmitting and receiving.
- High operating frequency giving clearly defined sea bed features.
- Two compact transducer arrays, for easy installation, with an acoustic source level of up to 234 dB/ uPascal/m at 50 kHz and a transmitter power output of 2 x 3500 W.
- Dynamic ships motion compensation for roll and correction for pitch and heave, yaw and ships speed.
- Online storage of raw and pre-processed data for post-processing using a proprietary or an external post-processing system.
- Operationally proven hardware and software.
- Interface to sound velocity profiling system.
- Analogue output selectable.
- Multiprocessor design.
- Interfaces for external system check.

Onboard *RV Poseidon* the SEA BEAM 1050 system consisted of the acoustic subsystem, the data acquisition subsystem and several ancillary sensors. The system consists of the following units:

- 2 x Ultrasonic Transducer Arrays (LSE 237)
- 1 x Transmit/Receive Unit (SEE 30)
- 1 x Roll, Pitch and Heave Sensor (Coda Octopus F180R+)
- 1 x Data Acquisition System (19” industry PC)
- 1 x GPS-System (implemented in the Coda-System)

- 1 x Sound Velocity Probe (SEA&SUN CTD48M)
- 1 x Postprocessing System (PC Dell 694)

Description of the components

Transducer arrays LSE 237 - The SEA BEAM 1050 system employs two transducer arrays of type LSE 237, port and starboard, both capable of transmitting and receiving. Their acoustic planes are tilted 30° to the horizontal. The arrays are normally installed fixed to the ship's hull. During the cruise with *RV POSEIDON* the transducers were mounted in the moon pool using a special construction. The ultrasonic transducer LSE 237 is used to transmit and receive ultrasonic impulses at a frequency of 50 kHz. It consists of 32 separate staves. By triggering the separate transducer staves with a phased transmit signal it is possible to point the direction of transmission to ±50° with respect to the normal 'untreated' array transmission angle. In the transmit path both transducer arrays operate in parallel with a common power stage. All 32 staves of each transducer array are used for transmit beam-forming. In the receive path port and starboard array signals are handled separately. Sixteen centre staves of each transducer are used to form narrow beams. The number of beams and fan width is selectable.

Control Unit SEE 30 - The Transmit/Receive Unit SEE 30 is accommodated within a transportable case. It consists of a number of plug-in components contained in a rack.

Motion Sensor Coda Octopus F180R+ - The motion (attitude) sensor F180R+ provides roll compensation signals to the system and pitch and heave correction signals to the processor. In addition, it also provides heading and GPS information to the data acquisition system. The IMU (Inertial Measurement Unit) has a waterproof housing and was mounted in the moon pool right above the transducers. Only a small lever arm correction had to be applied to the data. Two GPS antennas, as part of the F180R+ system where mounted on the rear monkey deck and connected to the F180 processor, housed in a rugged box, situated close to the SEE. These two GPS antennas were responsible to deliver a precise heading to the processor.

Problems during surveys - Due to the short GPS antenna-cables we could not get better positions for the antennas which caused some trouble to get the system initialised. As long as there is no heading and GPS information the system does not give any roll/pitch/heave information. The external use of GPS/heading is not provided meaning that partly data have been acquired without or with incorrect motion senor data due to heading loss or heading drift.

Data acquisition

Data acquisition station was a standard industry size 19" PC, operating system was Windows XP professional. Operator interface includes a 19" graphic monitor, keyboard and mouse. To enable input of several sensor data via serial lines a special 8-port serial interface was installed. Data storage is on a ruggedised hard disk. For backup purposes the recorded data has also been stored on external hard disks attached to the system via USB. L3 communications ELAC Nautik online software Hydrostar 3.5.3 was used for data acquisition.

Post-processing

A standard Dell 694 PC was used for calibrations of the multibeam data. The PC was set up as a dual-boot system with Linux (SuSE 10.1) as well as WinXP. An IBM ThinkPad W500 with WinVISTA as OS and a Linux Ubuntu/Poseidon in a VirtualBox was used to do post-processing.

For post-processing and calibration purposes, the ELAC Nautik software HDPedit and HDPpost were used. In addition, the open source software packages MB-System and GMT were applied. Regarding the post-processing with MB-System, it needs to be pointed out that problems partly occurred using 'mbprocess' to apply editing to the raw data (XSE-Files). We assume that zero values within the XSE-file recorded sound velocities are the reason.

Table 4.2 *Metadata of MBES surveys during* RV Poseidon *cruise* POS 385 *(position is related to time of survey start and survey end). WD: water depth.*

Cast	Station [GeoB]		Date [ddmmyy]	Time [UTC]	Longitude [N]	Latitude [W]	WD [m]	Description
test site off Cádiz								
#01	13702-1	Start	30.05.2009	18:52	36°38.09’	06°47.34’	106	calibration of MBES
		End	31.05.2009	03:02	36°35.24’	06°32.77’	99	
Malaga Mounds								
#02	13705-1	Start	01.06.2009	05:43	36°37.82’	04°12.84’	227	/
		End	01.06.2009	07:16	36°37.93'	04°11.02'	242	
#03	13707-1	Start	01.06.2009	11:48	36°37.75'	04°12.60’	229	continuation of #02
		End	01.06.2009	13:04	36°37.16'	04°13.25'	244	
El Idrissi Bank								
#04	13709-1	Start	02.06.2009	06:28	36°05.41’	03°33.28’	401	GAPS test
#05	13716-1	Start	02.06.2009	17:23	36°04.49’	03°31.99’	817	/
		End	03.06.2009	06:18	36°06.33'	03°35.03'	480	
#06	13719-1	Start	03.06.2009	16:40	36°06.49’	03°31.93’	395	continuation of #05
		End	04.06.2009	05:51	36°09.57'	03°31.33'	521	
#10	13738-1	Start	07.06.2009	23:00	36°04.52’	03°28.56’	642	continuation of #05, #06
		End	08.06.2009	09:45	36°07.48'	03°28.45'	538	
#16	13750-1	Start	10.06.2009	23:50	36°06.74’	03°30.06’	312	continuation of #05, #06, #10
		End	11.06.2009	20:48	36°09.22'	03°29.22'	656	
#17	13756-1	Start	11.06.2009	18:10	36°09.00’	03°28.02’	670	continuation of #05, #06, #10, #16
		End	12.06.2009	05:36	36°06.20'	03°33.04'	285	
East Melilla Area								
#07	13721-1	Start	04.06.2009	17:52	35°20.99’	02°35.94’	275	failed
#08	13726-1	Start	05.06.2009	16:08	35°26.67'	02°31.54’	312	failed
#09	13732-1	Start	06.06.2009	19:05	35°25.99’	02°33.84’	339	3rd attempt
		End	07.06.2009	05:55	35°29.87'	02°30.53'	202	
Adra Ridge								
#11	13739-1	Start	08.06.2009	13:56	36°13.53'	02°55.08'	870	failed
#14	13743-1	Start	09.06.2009	21:00	36°13.49'	02°55.02'	863	2nd attempt
		End	10.06.2009	05:04	36°11.26'	03°00.05'	805	
Alboran Ridge								
#12	13740-1	Start	09.06.2009	11:33	36°02.44'	02°55.08'	797	/
		End	09.06.2009	14:37	36°02.20'	02°56.25'	790	
#13	13742-1	Start	09.06.2009	18:29	36°01.04'	02°55.50'	273	continuation of #12
		End	09.06.2009	19:57	36°05.03'	02°55.36'	1524	
#15	13749-1	Start	10.06.2009	18:34	36°59.99'	02°56.16'	180	continuation of #12, #13
		End	10.06.2009	20:14	36°00.77'	02°54.71'	99	

Chella Bank								
#18	13761-1	Start	12.06.2009	22:00	36°30.05'	02°49.98'	462	/
		End	13.06.2009	03:05	36°31.50'	02°48.03'	398	
#19	13763-1	Start	13.06.2009	09:32	36°31.05'	02°50.88'	174	continuation of #18
		End	13.06.2009	10:15	36°30.21'	02°50.41'	124	

4.3 ◇ ROV Cherokee

(Nicolas Nowald & Götz Ruhland)

During *RV Poseidon* cruise *POS 385*, the midsize inspection class ROV Cherokee (manufactured by Sub-Atlantic, Aberdeen) was applied (Fig. 4.2). It is operated by MARUM since 2001 and was adapted and enhanced for scientific purposes. The ROV Cherokee is 1000 m depth rated, but due to several 'cut offs' and terminations of the umbilical supply cable, only a diving depth of 850 m is guaranteed.

Twelve dives were performed recording a total of 39.5 hours of video footage (Table 4.3). One ROV deployment in the Strait of Gibraltar had to be aborted due to strong currents. Two dives had to be aborted due to problems with the ROV tether and a fishing line, respectively. A total of 1200 still images were acquired with the photo camera, although during the last three dives (Dives 10, 11, 12) the camera had to be de-installed as some water was detected inside the camera. Finally, 36 samples comprising faunal material (e.g., live and fossil cold-water corals, deep-sea oysters and rhodoliths) and hard substrate were collected.

Finally, it needs to be mentioned that some software problems occurred concerning the positioning which could not be fixed during the cruise. Instead of the 'real' ROV position, a mixture of ship position and ROV position was stored. Unfortunately, this unfiltered dataset was used for the video description presented in this report. However, this problem was easily fixed back at home, moreover the 'real' depth values showed only slightly change.

ROV components

Vehicle - The vehicle dimensions are 120x80x100 cm (LxWxH) and weight in air is around 450kg. It has a payload for scientific equipment of approx. 20kg. It is electrically propelled by 4 axial thrusters and total power of the system is 12kW.

Winch - The spooling winch is an MPD, Aberdeen custom design winch, carrying approx. 1000 m umbilical. Overall weight of the winch, including the umbilical, is 1.5t. The supply cable (umbilical) contains 20 electrical conductors providing electrical power and basic telemetry. In addition, 4 optical multimode fibres provide 4 video and 4xRS232 channels. Control over the system is given by three 19” racks, equipped with several display and recording devices.

Surface Control Unit - The Surface Control Unit contains the remote control for the vehicle and the manipulator. It also contains the sonar PC and screen, two small 10” colour monitors for video camera display as well as an ampere- and voltmeter. The Pilot Rack’s PC monitor shows navigational data from the ship and the ROV, such as heading, position, depth etc. A large analogue monitor inside the rack displays the live video of the Tritech colour zoom camera. The Video Rack includes 2 DV recorders to record two cameras simultaneously. The rack also has a PC with software running to control the Konsberg still image camera, the IFREMER (Brest, France) framegrab utility Adelie and the USBL positioning system GAPS (IXSEA). The GAPS system consists of two components: an antenna with an acoustic array of four hydrophones, lowered on a ships pole below water surface and the corresponding transponder, mounted on the vehicle. The antenna interrogates the transponder, then calculating the relative distance from the vehicle to the ship in all three dimensions. Absolute position is achieved by a DGPS input, taking into account the relative distances, acquired by the acoustics. GAPS achieves an accuracy of 2 m. Navigational data (ship, ROV), video recordings, still images, Adelie frame grabs and sonar data are all time referenced for further scientific use.

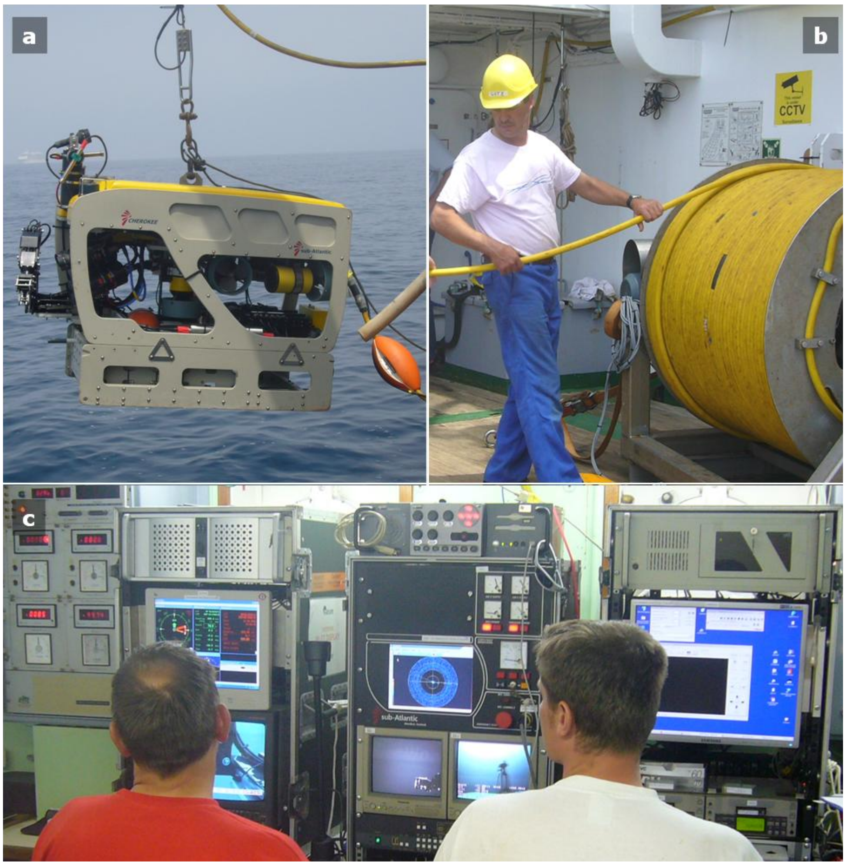


***Fig. 4.2 A** ROV Cherokee during deployment on board* RV Poseidon, ***B** winch, **C** control system consisting of three 19'' racks equipped with several display and recording devices.*

Video recording

Four video cameras are mounted on the ROV for observation and navigational purposes: a colour video zoom camera (720x576 lines), a modified digital Konsberg OE14 (5 Megapixel) with associated flash light and two mini video cameras for the overview to the front and back area of the vehicle. The video and the still image camera are mounted onto a Pan & Tilt unit, which enhances the observation capabilities of the vehicle. The Pan & Tilt unit also carries 3 lasers for object size measurements on the seafloor. Underwater light is provided by 3x230W DSPL dimmable spots. For long or close range obstacle detection and measurement, a Tritech Seaking dual frequency sonar is mounted on the port side of the vehicle. It displays an acoustical real time image on the topside sonar PC. The sonar operates at 325/675Hz with a maximum scanning range of 300 m. Navigational devices such as compass, altimeter and depth sensor are parts of the basic sensor package onboard the ROV.

Table 4.3 *Metadata of ROV Cherokee dives conducted during* RV Poseidon *cruise* POS 385 *(position is related to time of survey start and survey end). WD: water depth.*

Cast	Station [GeoB]		Date [ddmmyy]	Time [UTC]	Longitude [N]	Latitude [W]	WD [m]	Description
Strait of Gibraltar								
#01	13703-1	Start	31.05.2009	13:30	35°56.10′	05°46.39′	220	• Monte Tartesos • deployment was aborted due to too strong currents
		End	31.05.2009	14:30	/	/	/	
Malaga Mounds								
#02	13705-1	Start	01.06.2009	08:59	36°37.35′	04°13.16′	238	• SW-NE profile • no samples
		End	01.06.2009	11:04	36°37.72′	04°12.69′	233	
#03	13707-1	Start	01.06.2009	14:15	36°37.48′	04°13.10′	236	• SW-NE profile • 1 sample: rhodoliths
		End	01.06.2009	17:49	36°37.20′	04.12.91′	218	
El Idrissi Bank								
#04	13710-1	Start	02.06.2009	07:29	36°05.45′	03°33.17′	366	• uphill profile • 1 sample: fossil oyster
		End	02.06.2009	10:26	36°05.77′	03°33.18′	309	
#05	13717-1	Start	03.06.2009	07:45	36°05.30′	03°31.82′	710	• S-N profile, uphill • 6 samples • *Dendrophyllia* • live *Neopycnodonte*
		End	03.06.2009	12:37	36°06.00′	03°32.17′	284	
#10	13751-1	Start	11.06.2009	07:58	36°06.28′	03°29.28′	687	• SE-NW profile, uphill at the SE flank • 6 samples • *Dendrophyllia*, *Lophelia* • live *Neopycnodonte* • live *Madrepora*
		End	11.06.2009	~10:30	36°06.56′	03°29.70′	388	
#11	13757-1	Start	12.06.2009	07:45	36°09.37′	03°29.77′	622	• NE flank, NE-SW profile • 5 samples • two dead oysters • *Madrepora*, *Dendrophyllia* • live *Cidaris*
		End	12.06.2009	13:25	36°07.94′	03°30.45′	289	
East Melilla Area								
#06	13727-1	Start	06.06.2009	09:06	35°26.07′	02°30.83′	406	• S-N profile, uphill • 3 samples • dead corals • live *Madrepora* & *Lophelia*
		End	06.06.2009	~12:30	35°26.43′	02°31.03′	314	
#07	13737-1	Start	07.06.2009	12:05	35°27.98′	02°33.94′	356	• W-E profile, uphill • 2 samples • dead coral fragments • live *Neopycnodonte*
		End	07.06.2009	14:03	35°28.18′	03°33.39′	290	
Alboran Ridge								
#08	13741-1	Start	09.06.2009	16:29	36°02.02′	02°55.80′	747	• NW-SE profile, uphill • no sample
		End	09.06.2009	17:35	36°01.65′	02°55.41′	649	
#09	13744-1	Start	10.06.2009	07:30	36°01.71′	02°55.44′	664	• continuation of Dive 8 • 5 samples • *Dendrophyllia*, live *Lophelia* • deep-sea oyster
		End	10.06.2009	13:14	36°00.79′	02°55.01′	110	
Chella Bank								
#12	13762-1	Start	13.06.2009	04:52	36°29.97′	02°50.02′	497	• SE-NW profile, uphill • 7 samples • dead and live *Dendrophyllia* • dead and live rhodoliths • colonised bottle • hard substrate
		End	13.06.2009	09:04	36°31.13′	02°50.87′	76	

Sampling

For scientific sampling and experiments, a small hydraulical manipulator system is used. The Hydro-Lek HLK-EH-5 is a non-proportional, 5 function manipulator, powered and controlled by a combined pressure pump and 6 station valve pack. Operating pressure is 130bar and lifting capacity is 25kg. Part of the hydraulical system is the toolbox, which is used for storing samples and/or mounting sampling tools. It can be hydraulically opened and closed. Standard sampling tools during *RV Poseidon* cruise POS 385 were a 1 liter Niskin bottle and a sampling net with a diameter of 140 mm and a mesh size of 1 mm.

4.4 ◇ Box corer

(Claudia Wienberg & Lydia Beuck)

A box corer was the main sampling tool for undisturbed surface sediments during *RV Poseidon* cruise *POS 385* (Fig. 4.3). The box corer had a diameter of 50x50 cm and a height of 55 cm.

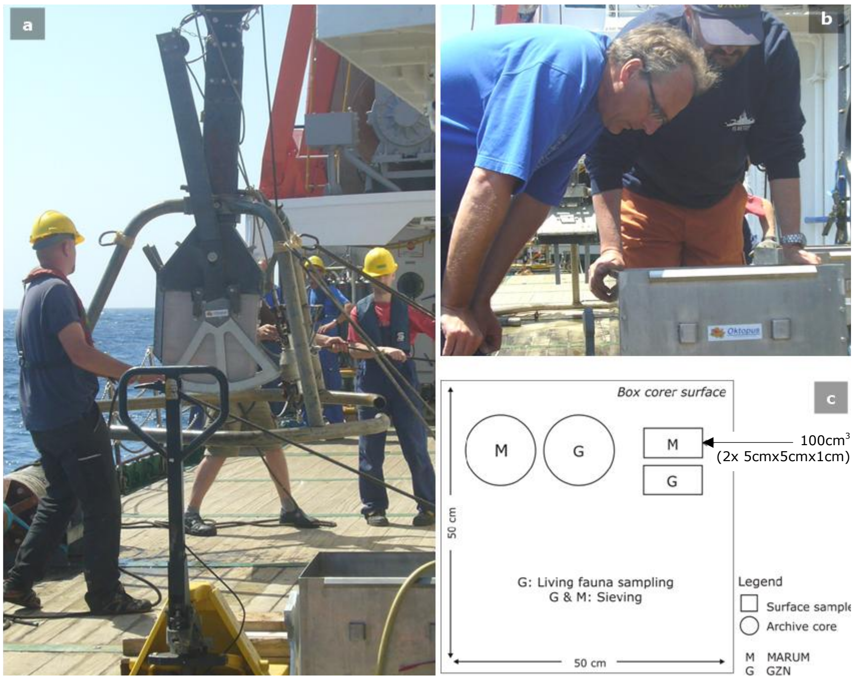


***Fig. 4.3 A** Recovery of a box corer during* RV Poseidon *cruise* POS 385*.* ***B** Description and **C** standards sub-sampling scheme of the box corers (see text for detailed description).*

Following standard sub-sampling scheme was conducted on each successfully deployed box core (Fig. 4.3c):

A) Rinsing of the super-standing water to sample the living fauna (GZN).
B) Photography and description of the sediment surface and column (MARUM).
C) Collecting of living fauna and fixation in 95% ethanol (GZN).

D) Surface sediment sampling (0-1 cm):
   1. 2 x 25 cm^2 (MARUM)
   2. 2 x 25 cm^2 (GZN)

E) Sampling of the sediment column by archive cores (12 cm in diameter):
   1. One core for scleractinian coral analyses (GZN).
   2. One core for scleractinian coral and sediment analyses (MARUM).

F) Sieving of the remaining sediment column over four sieves of 4, 2, 1 and 0.5 mm mesh size to collect corals fragments, shells and shell debris. Fragments were dried, living organisms fixed in 95% ethanol (GZN). MARUM collected individual coral fragments for dating.

Box cores were recovered from El Idrissi Bank, the East Melilla area and the Alboran Ridge. There, the box corer was deployed at a total of 33 stations (Table 4.4). 21 deployments were successful, although seven of them were disturbed or comprised very small samples, thus standard sampling was not possible. Twelve deployments did not release or the box was empty.

Table 4.4 *Metadata of box cores collected during* RV Poseidon *cruise* POS 385 *(data are related to time of bottom contact). WD: water depth, REC: recovery.*

Cast	Station [GeoB]	Date [ddmmyy]	Time [UTC]	Longitude [N]	Latitude [W]	WD* [m]	REC [cm]	Description
El Idrissi Bank								
#01	13711-1	02.06.2009	12:19	36°05.71′	03°33.18′	308	15	• foram sand with corals, oysters and other shells
#02	13712-1	02.06.2009	13:50	36°05.42′	03°33.27′	386 (450)	~5	• foram sand with corals, oysters and other shells
#03	13713-1	02.06.2009	14:31	36°05.48′	03°33.24′	327	/	• empty
#04	13713-2	02.06.2009	15:00	36°05.48′	03°33.24′	326	/	• not released
#05	13714-1	02.06.2009	15:39	36°05.71′	03°33.19′	303	17	• foram sand with corals and other shells
#06	13718-1	03.06.2009	13:45	36°05.67′	03°31.97′	475	/	• empty
#07	13718-2	03.06.2009	14:50	36°05.67′	03°31.95′	475 (534)	10-20	• tilted! • foram sand with corals
#08	13718-3	03.06.2009	15:35	36°05.67′	03°31.96′	472 (533)	23-38	• sligthly tilted! • foram sand with corals
#26	13752-1	11.06.2009	12:25	36°07.09′	03°30.78′	204 (207)	/	• no sediment • one live octocoral
#27	13753-1	11.06.2009	13:28	36°06.47′	03°29.55′	449 (498)	~5	• toppled over • small sample in the frame: corals i.a. *Pourtalosmilia anthophyllites*
#28	13754-1	11.06.2009	14:19	36°06.40′	03°29.45′	508 (560)	/	• not released
#29	13754-2	11.06.2009	14:50	36°06.39′	03°29.47′	512	~1	• not released • small sample in the frame
#30	13755-1	11.06.2009	15:38	36°06.28′	03°29.32′	621	<1	• small sample
#31	13755-2	11.06.2009	16:29	36°06.26′	03°29.32′	624	/	• empty
#32	13758-1	12.06.2009	15:20	36°08.45'	03°30.26'	353	/	• not released • two coral fragments
#33	13759-1	12.06.2009	16:00	36°08.82'	03°30.02'	423	24	• foram sand with *Lophelia*
East Melilla Area								
#09	13722-1	05.06.2009	07:01	35°20.98′	02°32.19′	318	46-51	• Horse Mound • silt to clayey silt with few shells
#10	13722-2	05.06.2009	07:57	35°21.05′	02°32.08′	280	<1	• Horse Mound • few *Madrepora*
#11	13722-3	05.06.2009	08:49	35°21.04′	02°32.11′	280	27-32	• Horse Mound • silt to clay with abundant *Madrepora*
#12	13723-1	05.06.2009	10:02	35°21.05′	02°34.82′	291	20	• New Mound • silt to clay with abundant *Madrepora*
#13	13724-1	05.06.2009	11:31	35°19.83′	02°33.19′	291	55	• Elephant Mound • silt to clay with few shells

#14	13724-2	05.06.2009	12:41	35°19.79′	02°33.05′	291	/	• Elephant Mound • empty
#15	13724-3	05.06.2009	13:39	35°19.80′	02°33.05′	259	<1	• Elephant Mound • few *Dendrophyllia*
#16	13725-1	05.06.2009	16:20	35°26.98′	02°31.62′	336	/	• Brittlestar Ridge II • empty
#17	13725-2	05.06.2009	17:00	35°26.71′	02°31.62′	355	<1	• Brittlestar Ridge II • few coral fragments
#18	13728-1	06.06.2009	14:04	35°26.28′	02°30.89′	343	10-20	• Brittlestar Ridge I • foram sand with abundant *Madrepora*, live antipatharian
#19	13733-1	07.06.2009	06:37	35°29.63′	02°29.65′	202	/	• Banc de Provencaux • empty
#20	13734-1	07.06.2009	07:23	35°28.50′	02°31.66′	235	23-31	• Banc de Provencaux • foram & glaukonitic sand with shells (abundant gastropods)
#21	13735-1	07.06.2009	08:04	35°28.08′	02°33.58′	313	10-21	• Brittlestar Ridge III • foram sand with corals
Alboran Ridge								
#22	13745-1	10.06.2009	14:30	36°00.97′	02°55.06′	127	16	• shell debris, bryozoans
#23	13746-1	10.06.2009	14:55	36°01.07′	02°55.23′	233	17	• brachiopods, corallinacea
#24	13747-1	10.06.2009	16:22	36°01.50′	02°55.32′	437	-	• one small coral fragment
#25	13747-2	10.06.2009	16:57	36°01.51′	02°55.32′	437	-	• empty

*note that the water depth indicated by the echosounder seemed to have been partly inaccurate, therefore at some stations also the rope length during box corer deployment was noted (given in brackets)

4.5 ◇ Gravity corer

(Claudia Wienberg)

A gravity corer with a pipe length of 6 m and a weight of 1.5 tons was applied to recover long sediment sequences during *RV Poseidon* cruise *POS 385* (Fig. 4.4). Before using the coring tools, the liners had been marked lengthwise with a straight line in order to retain the orientation of the core. Once on board, the sediment core was cut into 1-m sections, closed with caps on both ends and labelled according to a standard scheme (Fig. 4.5).

Fig. 4.4 *Deployment of a gravity corer with a 6 m long pipe on board* RV Poseidon.

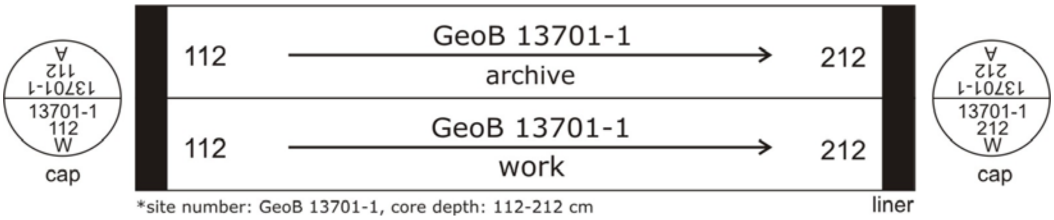


Fig. 4.5 *Scheme of the inscription of gravity core segments.*

During *RV Poseidon* cruise *POS 385*, the gravity corer was successfully used at 9 stations with sediment recoveries between 25 and 447 m (Table 4.5) resulting in total core recovery of 28.33 m. In the East Melilla area, six gravity cores were recovered (5 coral-containing cores, 1 off-mound core). One very short coral-containing core (recovery: 28 cm) was collected from the Alboran Ridge. Finally, one coral-containing core (recovery: 25 cm) and one off-mound core (recovery: 424 cm) were retrieved from the El Idrissi Bank (Table 4.5).

Table 4.5: Metadata of gravity cores collected during RV Poseidon *cruise* POS 385 *(data are related to time of bottom contact). WD: water depth, REC: recovery.*

Cast	Station [GeoB]	Date [ddmmyy]	Time [UTC]	Longitude [N]	Latitude [W]	WD [m]	REC [cm]	Remarks
East Melilla								
#01	13728-2	06.06.2009	14:42	35°26.28′	02°30.89′	343	364	• contains coral fragments
#02	13729-1	06.06.2009	15:27	35°26.07′	02°30.83′	442	447	• contains coral fragments
#03	13730-1	06.06.2009	16:29	35°26.20′	02°30.87′	338	434	• contains coral fragments
#04	13731-1	06.06.2009	17:25	35°24.80′	02°33.22′	362	431	• off-mound core
#05	13735-2	07.06.2009	08:34	35°28.08′	02°33.57′	315	317	• contains coral fragments
#06	13736-1	07.06.2009	09:08	35°27.98′	02°33.82′	327	363	• contains coral fragments • first 54 cm are slightly disturbed
Alboran Ridge								
#07	13748-1	10.06.09	17:26	36°01.53′	02°55.35′	456	28	• contains coral fragments
El Idrissi Bank								
#08	13755-3	11.06.2009	17:04	36°06.28′	03°29.32′	625	25	• contains coral fragments
#09	13760-1	12.06.2009	16:34	36°09.35′	03°29.74′	652	424	• off-mound core

None of the gravity cores were opened on board. All sediment cores collected during cruise *POS 385* were transported to Bremen and stored in the MARUM core repository at the University of Bremen. Further analysis of the sediment cores will be done after the cruise by MARUM in co-operation with GZN.

Find the description of following sediment cores in the Appendix:
East Melilla: GeoB 13728-2, GeoB 13729-1, GeoB 13730-1, GeoB 13735-2, GeoB 13736-1; *Alboran Ridge*: GeoB 13748-1; *El Idrissi Bank*: GeoB 13755-3, GeoB 13760-1.

5 ◇ Regional Results – Working Areas

5.1 ◇ Strait of Gibraltar

In 1994, an intensive sampling and MBES survey programme was conducted by the Spanish authorities in the Strait of Gibraltar. In an area of 65 km^2 along the Spanish shelf, numerous sites with cold-water corals were discovered and partly sampled by grab sampling (Álvarez-Pérez et al. 2005). During cruise *POS 385*, we selected a site, called Monte Tartesos, to conduct detailed ROV video mapping and sampling. A 3.5-km-long E-W-transect was selected, starting at the base of the structure at ~400 m water depth, crossing its crest, and terminating at its western base at ~300 m water depth. Unfortunately, the current conditions were too strong to reach the seafloor with the ROV, therefore the deployment was aborted after one hour.

5.2 ◇ Malaga Mounds

Along the Spanish margin SE of Malaga, clusters of mound-like structures were detected by multibeam echosounder and seismic surveys in a water depth of ~225-250 m (Muñoz et al. 2008) (Fig. 5.1). The individual mounds have heights of up to 10 m, and diameters between 90 and 130 m. Up to this cruise, no reliable information did exist about the sedimentology and faunal coverage of these mounds.

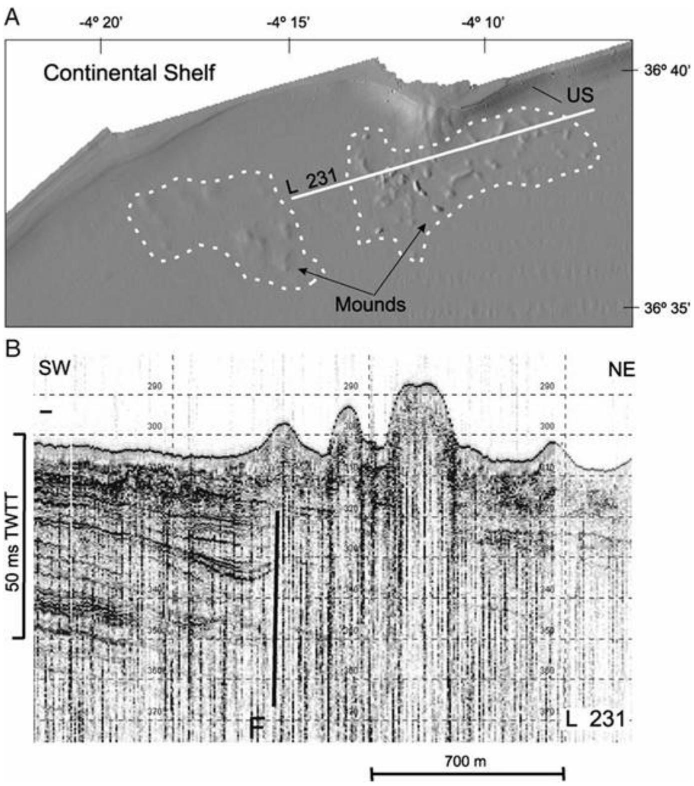


Fig. 5.1 A *Shaded relief map and* ***B*** *seismic reflection profile of mound clusters detected along the Spanish margin SE of Malaga in a water depth of ~225-250 m (Muñoz et al. 2008).*

Stations

During cruise *POS 385* mapping followed by two ROV dives were performed across some of the Malaga Mounds. One faunal sample containing few rhodoliths could be recovered during the second ROV dive. In addition, one CTD cast was performed.

CTD data (Dierk Hebbeln)

The most prominent feature at this 330 m deep CTD station was a strong thermocline that was accompanied by a remarkable maximum in the fluorescence record (Fig. 5.2). This fluorescence maximum had a sharp upper boundary followed by decreasing values further downward. At approximately 120 m, well below the thermocline, the fluorescence data reached minimum values.

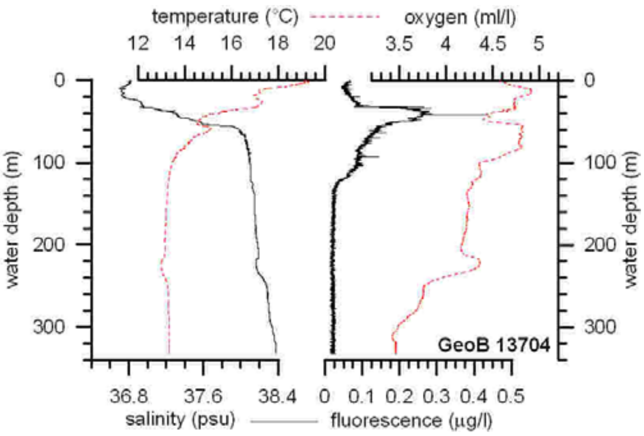


***Fig. 5.2** CTD-data from site GeoB 13704-1, Malaga Mounds.*

Video observation (Lydia Beuck & André Freiwald)

◇ ROV Dive 2 (GeoB 13706-1) ◇ Malaga Mounds

◇ start: 36°37.35'N, 04°13.16'W, 243 m water depth
◇ end: 36°37.72'N, 04°12.69'W, 233 m water depth
◇ heading: SW to NE; track length: 1,128 m

The sedimentary facies shows a highly bioturbated mud from 243 m to the lower base of the mound at 234 m depth. Upslope, the sediment becomes slightly coarser due to a larger amount of fossil debris made of mollusc shells and most likely coralline algal remains. This latter facies continues to the end of the dive at 237 m. Hardsubstrate is almost lacking, except few dispersed trunks of isidid octocorals and a single dendrophylliid coral.

The sessile benthic community is the same in both facies. Characteristic forms are alcyonarians, cerianthids and sabellid worms (*Sabella pavonina*), all were widely dispersed and do not form larger aggregations on the seabed surveyed (examples shown in Fig. 5.3C-G). The mobile organisms encountered were several species of pandalid shrimps, amongst them a large swarm of *Plesionika edwardsi* crowding in a trawl mark (Fig. 5.3A-B). Galatheid squat lobsters actively grasping for planktonic food, were occasionally observed on the open seabed, or sitting at the entrance of their burrows. In the upper part of the mound *Alcyonium corallioides* becomes common (Fig. 5.3G). In one particular case, a fossil trunk of a dendrophylliid coral served as settling substrate. The alcyonid colony was grazed by a majiid crab resembling *Macropodia linaresi* (Fig. 5.3G).

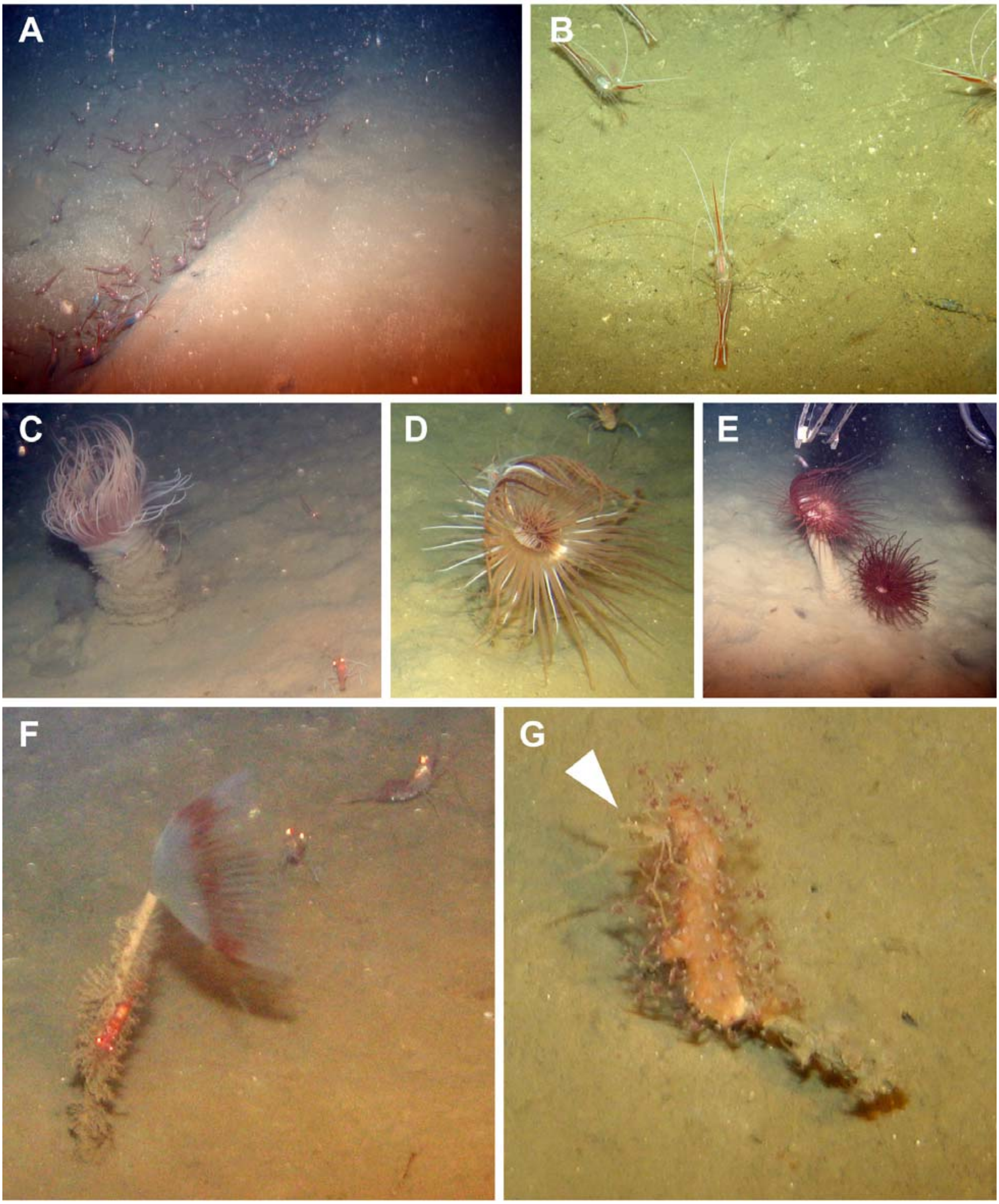


Fig. 5.3 *ROV images of Dive 2 (GeoB 13706-1).* ***A*** *Large swarm of* Plesionika edwardsi *aggregating in trawl mark (-235 m).* ***B*** *Close-up of* P. edwardsi *on carbonate debris-enriched sediment.* ***C-D*** *Cerianthids with white and orange coloured long marginal tentacles and orange coloured labial tentacles.* ***E*** *Cerianthid with inner and outer tentacle rings of dark red colour.* ***F*** *Filtering* Sabella pavonina *with tube colonised shrimp and hydrozoans.* ***G*** Alcyonium corallioides *colonised by a majiid crab resembling* Macropodia linaresi *(arrow) (-232 m).*

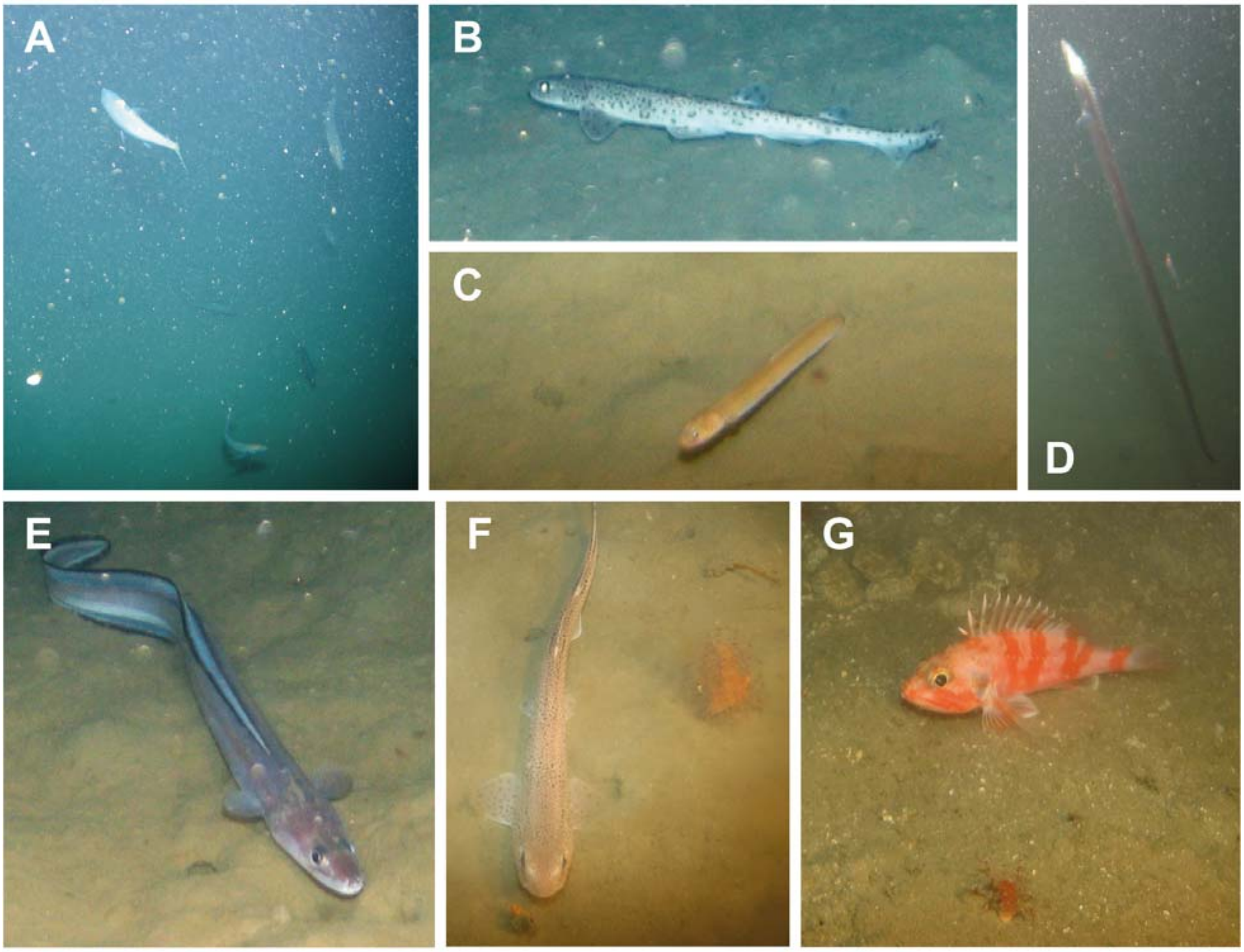


Fig. 5.4 *Fish and shark community of the Malaga Mound dives.* ***A*** *Swarm of* Trachurus *sp. seen in Dive 3.* ***B*** Scyliorhinus stellaris *(Dives 2, 3).* ***C*** Echiodon dentatus *still half buried in the sediment (Dive 2, -235 m).* ***D*** Lepidopus caudatus *(Dive 2, -240 m).* ***E*** Conger conger *(Dive 2, -242 m).* ***F*** Scyliorhinus canicula *(Dives 2, 3).* ***G*** Helicolenus dactylopterus *(Dive 3). The fish community encountered comprises two shark species,* Scyliorhinus canicula *(Fig. 5.4F) and S. stellaris (Fig. 5.4B).* Conger conger *was imaged moving close over the seabed (Fig. 5.4E). The trichurid* Lepidopus caudatus *was evidently attracted by the light of the ROV (Fig. 5.4D). Noteworthy is a single observation of the carapid pearlfish* Echiodon dentatus *that was photographed while half-hiding in the seabed (Fig. 5.4C). A swarm of* Trachurus sp. *was recorded (Fig. 5.4A). The anthropogenic impact along the surveyed ROV track is low, except for one trawl mark (Fig. 5.3A).*

◇ ROV Dive 3 (GeoB 13708-1) ◇ Malaga Mounds

◇ start: 36°37.48’N, 04°13.10’W, 236 m water depth
◇ end: 36°37.78’N, 04°12.91’W, 218 m water depth
◇ heading: SW to NE; track length: 1,931 m (close to the previous Dive 2)

As during Dive 2, two facies can be distinguished. A deeper highly bioturbated mud that changed into a mixed mud-fossil carbonate debris facies at 233 m water depth. From 226 m onwards, the fossil components are dominated by crustose rhodoliths, consisting of *Lithophyllum* sp., measuring up to 7 cm in diameter (Fig. 5.5A,D,E). At present the light regime is aphotic, hence the rhodoliths thrived under photic conditions, at times when sea level was lowered at the range of 100 m, i.e. during the last glacial maximum. Supposingly, the entire upper part of the mound hosted a Pleistocene rhodolith bed, admixed by muricid gastropods and glycymerid clams. At some localised spots, the modern muddy coverage seems to be removed to open the view on deeply exhumed rhodoliths, similar to a seepage site. Several rhodoliths were sampled at 36°37.76’N and 04°12.92’W in 225 m depth.

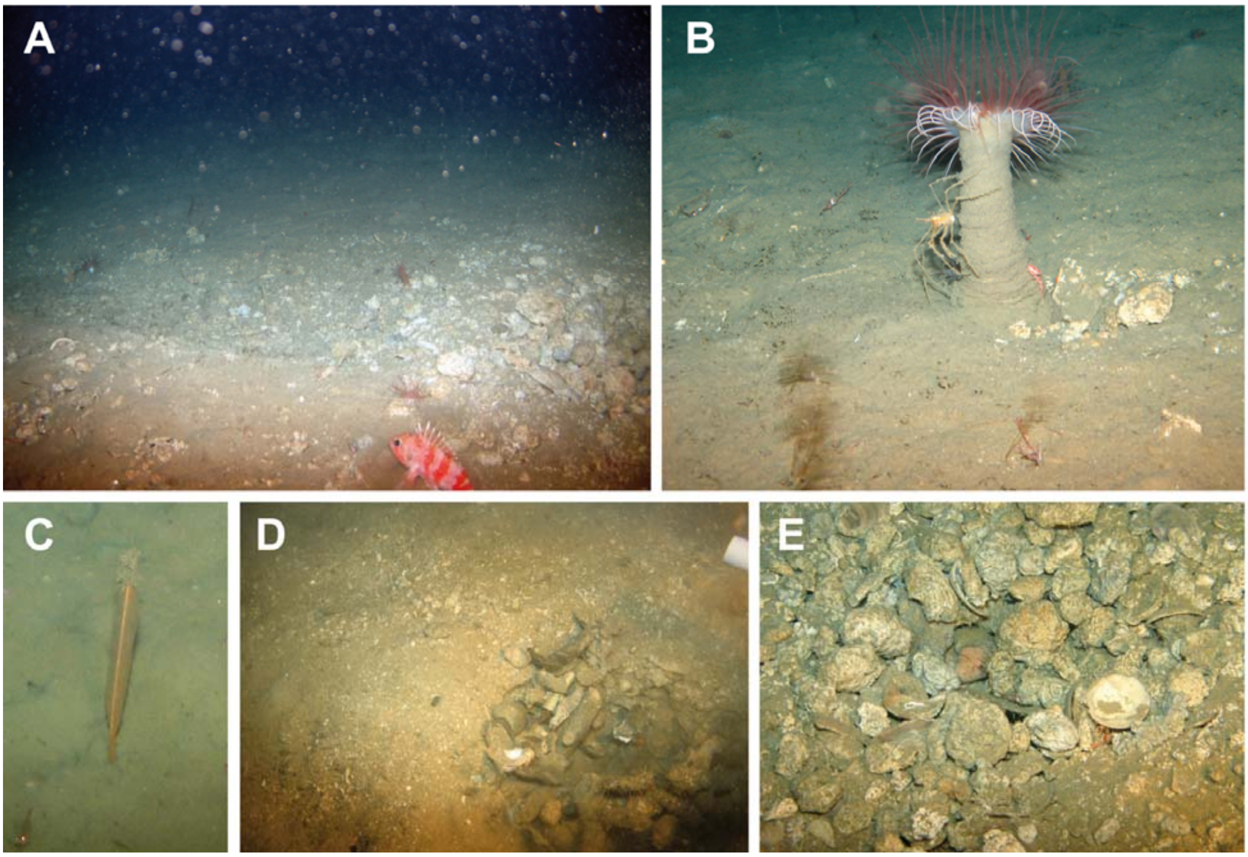


Fig. 5.5** ROV images of Dive 3 (GeoB 13708-1), Malaga Mounds. An exhumed accumulation of Pleistocene rhodoliths with the sebastid* Helicolenus dactylopterus *in the foreground (-223 m).* ***B *Large cerianthid next to exposed Pleistocene shells 'safeguarded' by a majiid crab and hydroid colonies in the foreground (-224 m).* ***C*** *A pennatulacean colony with shrimp (-234 m).* ***D*** *Localised outwashed depression filled with Pleistocene rhodoliths, shells and lithified burrows (-226 m).* ***E*** *Close up of another depression packed with Pleistocene rhodoliths and shells (-224 m).*

The sessile benthic community consists of pennatulaceans (rare) (Fig. 5.5C), cerianthids (common), *Sabella pavonina* (common) (Fig. 5.3F), alcyonarians with *Alcyonium corallioides*, hydroid colonies which are rooted on the fossil rhodoliths as hardsubstrate and some serpulids (*Protula* sp.). Despite the presence of hardsubstrates in the form of exhumed rhodoliths, a corresponding modern community is apparently poorly developed. The mobile community consists of galatheid squat lobsters and pandalid shrimps. Again a swarm of *Plesionika edwardsi* with gravid females was encountered. The association of *Macropodia* sp. sitting on the column of a cerianthid was documented (Fig. 5.5B). The fish community consists of sharks, *Scyliorhinus stellaris* (Fig. 5.4B) and *S. canicula* (Fig. 5.4F). The actinopterygians are represented by *Helicolenus dactylopterus* (Fig. 5.4G) and a triglid.

A swarm of mackerels, *Trachurus* sp., was attracted by the light of the ROV (Fig. 5.4A). The anthropogenic impact along the surveyed ROV track is low.

5.3 ◇ El Idrissi Bank

North of the Alboran Channel, a number of seamounts exist that belong to the main morphologic structure Djibouti Bank. The southernmost seamount is the El Idrissi Bank that was recently discovered to be covered by single live specimens of the cold-water coral *Dendrophyllia cornigera* and coral rubble (pers. communication Victor Diaz-del-Rio, IEO, Malaga, Spain), and was therefore selected as target of intensive video observation and sediment sampling during *POS 385*.

Bathymetric map and stations (Paul Wintersteller & Lydia Beuck)

Based on extensive mapping conducted along the southern and eastern flanks of El Idrissi Bank (Map 1), four ROV dives were conducted at its southern, eastern and northeastern flanks. The dives retrieved the first fully approved live specimens of the deep-sea oyster *Neopycnodonte zibrowii* and live scleractinian coral patches. The video observations were supplemented by five successfully deployed box corers stations, two gravity cores (recoveries: 25 and 424 cm) and one CTD cast.

CTD data (Dierk Hebbeln)

One CTD cast was performed south of El Idrissi Bank (Map 1). At this 700 m deep CTD station, a strong thermocline has been observed that again was accompanied by a remarkable maximum in the fluorescence record (Fig. 5.6). This fluorescence maximum had a sharp upper boundary followed by decreasing values further downward. At approximately 60 m, the fluorescence data reached minimum values that continue down to the seafloor. Below 100 m temperature (~13.2°C) and salinity (~38.1 psu) remained rather constant down to 700 m.

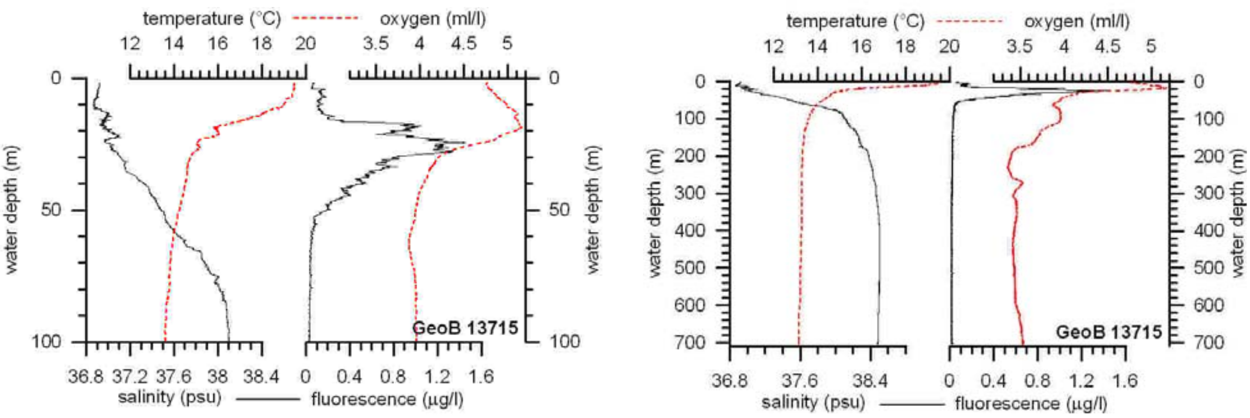
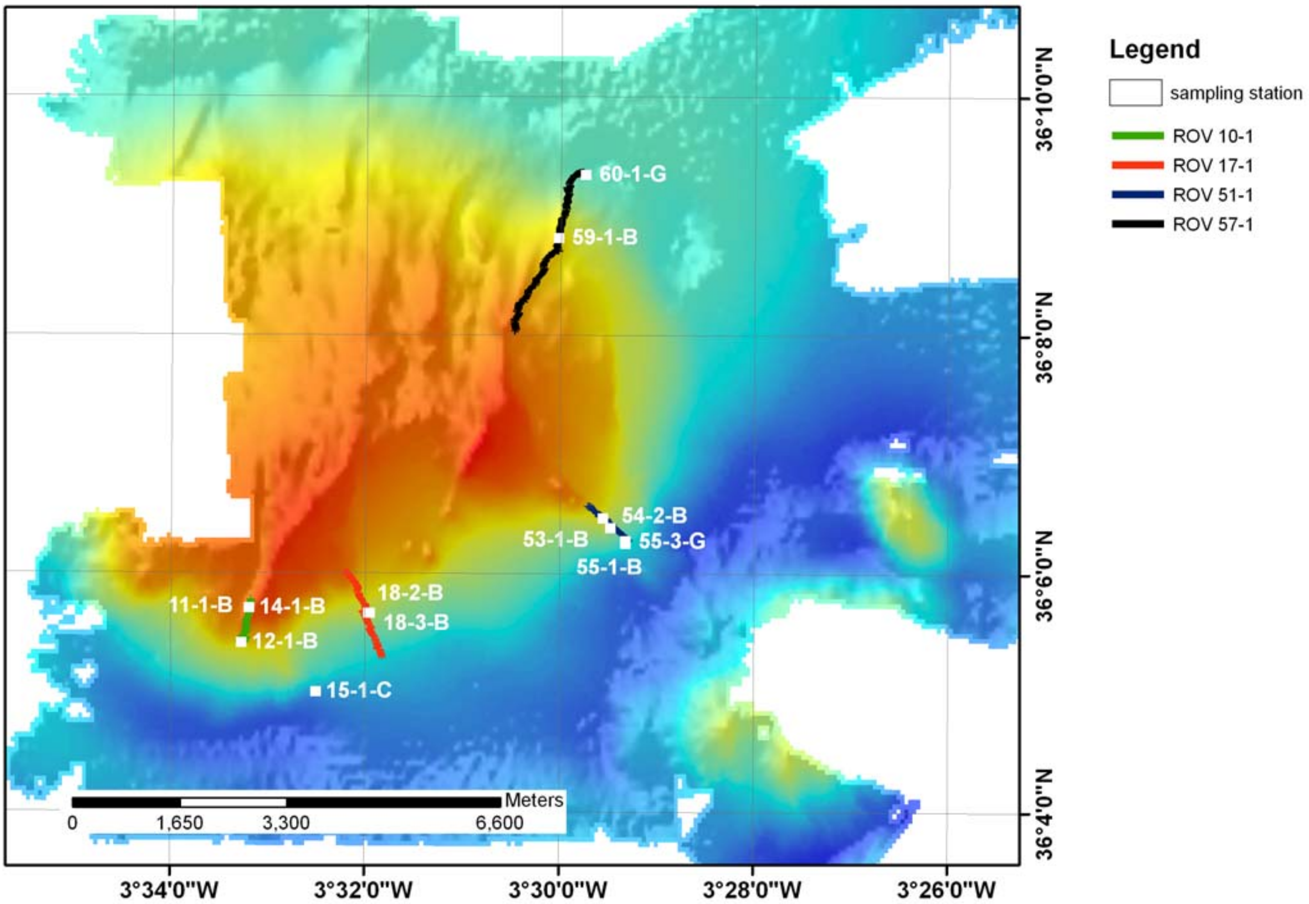


Fig. 5.6 *CTD-data from site GeoB 13715-1, El Idrissi Bank. Left panel: Record for the uppermost 100 m; right panel: full 700 m record.*



***Map 1** El Idrissi Bank. ROV track lines of dives GeoB 13710-1, 13717-1, 13751-1 and 13757-1 and the stations for gravity cores (G), box cores (B) and one CTD cast (C) are indicated.*

Video observation (Lydia Beuck & André Freiwald)

◇ ROV Dive 4 (GeoB 13710-1) ◇ El Idrissi Bank, S flank

◇ start: 36°05.45’N, 03°33.17’W, 366 m water depth
◇ end: 36°05.77’N, 03°33.18’W, 309 water depth
◇ heading: NNE; track length: 2,280 m

The objective of Dive 4 was to survey the southernmost and very steep slope of El Idrissi Bank, thereby crossing a prominent, narrow volcanic ridge on top of the shallow plateau. From 366 m to 434 m, the first part of Dive 4 has seen a slow descend over steeply inclined fields of rounded basaltic boulders and cobbles with sand and mud drapes in between (Fig. 5.7A). Interspersed are downfallen or in situ collapsed accumulations of fossil coral rubble.

There is evidence that the boulders are arranged stratiform, thus representing old, disintegrated volcanic rock ledges. At 416 m depth, the steep slope inclination levels out and sand sediment becomes the prominent aspect of the seabed, with only few volcanic boulders piercing out (Fig. 5.7B). The sand is mottled with different colours indicating high bioturbation activity. At 433 m depth, the seabed forms low-relief mounds with elevations up to about 30 cm. The surface of these low-relief mounds is packed with fossil *Lophelia* (Fig. 5.7C-D).

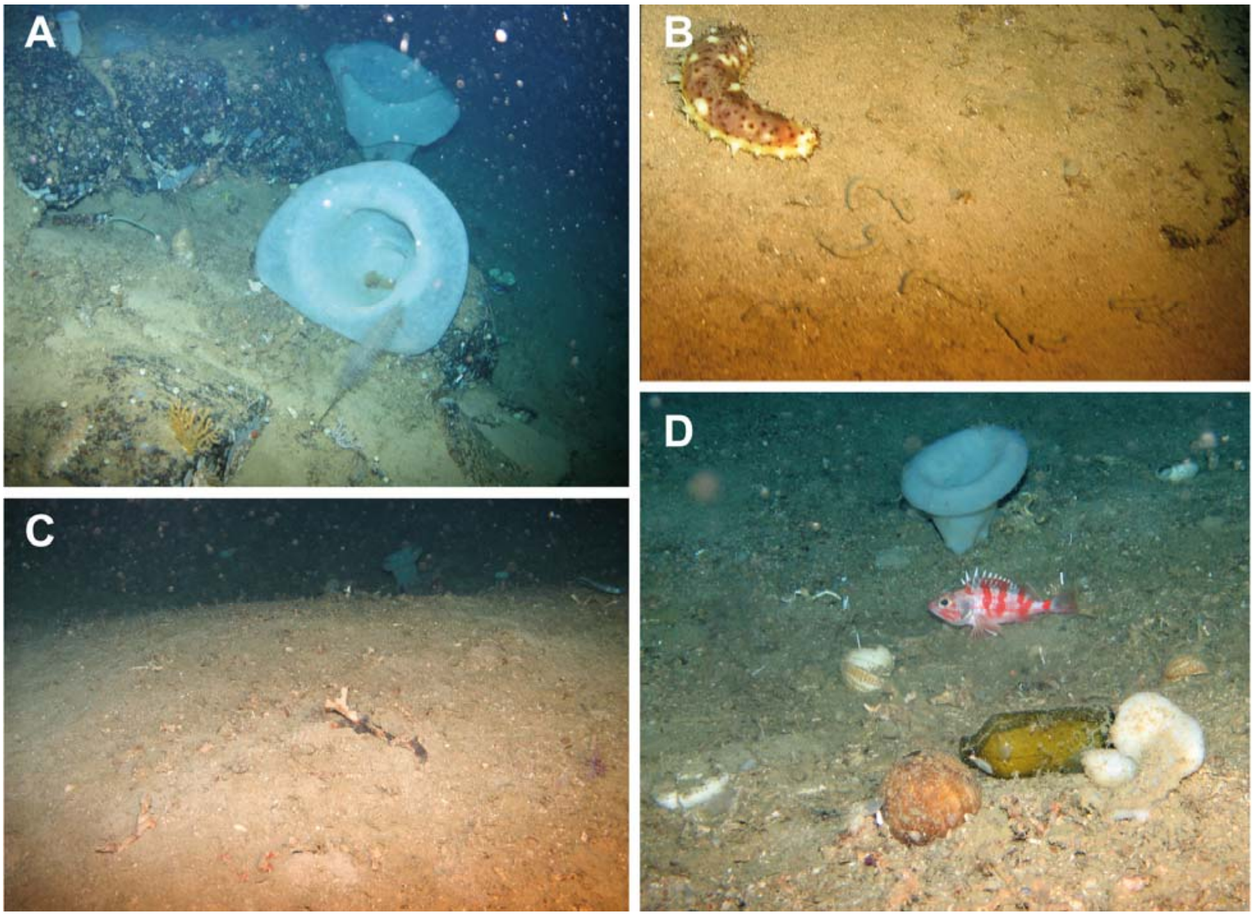


Fig. 5.7 *ROV images of Dive 4 (GeoB 13710-1) from 366 to 434 m depth.* ***A*** *Outcropping basalt with coral debris aprons with two large* Rossella nodastrella *sponges, one laying aside with the antipatharian* Parantipathes larix *and a white gorgonian colony in front. Also visible is a colony of* Acanthogorgia hirsuta*, a holothurian, several sponges, a galatheid crab and a small live* Dendrophyllia cornigera *(-374 m).* ***B*** *A defacating holothurian on sand bottom. Note the ophiuroids on the holothurian (-420 m).* ***C*** *Lateral view on low-relief coral rubble mounds rich in fossil* Lophelia *(-434 m).* ***D*** *Close up of a coral rubble mound with the sebastid* Helicolenus dactylopterus, R. nodastrella*, live serpulids, tests of* Echinus melo *(next to the bottle) and a spatangoid echinoid (-434 m).*

On the ascending part upslope, the ROV track led over near vertical basaltic walls of 7–15 m height probably representing individual basalt sheets. The lesser-inclined basalt surfaces are draped by lithified coral rubble and carbonate sand. Undersides of basalt ledges provided habitat for the deep-sea oyster *Neopycnodonte zibrowii* (Fig. 5.8A). The deepest occurrence of which was documented at 395 m during Dive 4. The levelled surface of the thick basalt sheets form small plateaus which act as localised depot centres for gravity-mass transported gravel and fine-grained sediment from higher upslope. Such a terrace was inspected at 387 m depth and shows a thick accumulation wedge of fossil *Dendrophyllia* admixed with plenty of detached right valves of *N. zibrowii*; one of which was sampled from this particular site (Fig. 5.8B). This arrangement of several metres-thick basalt sheets, bouldery layers and small-scaled accumulation terraces on top continues upslope until 344 m, when the general inclination of the entire flank levels out into the transition to the flat top plateau. Here, the rounded basalt boulders mimic a wave-impacted coast environment.

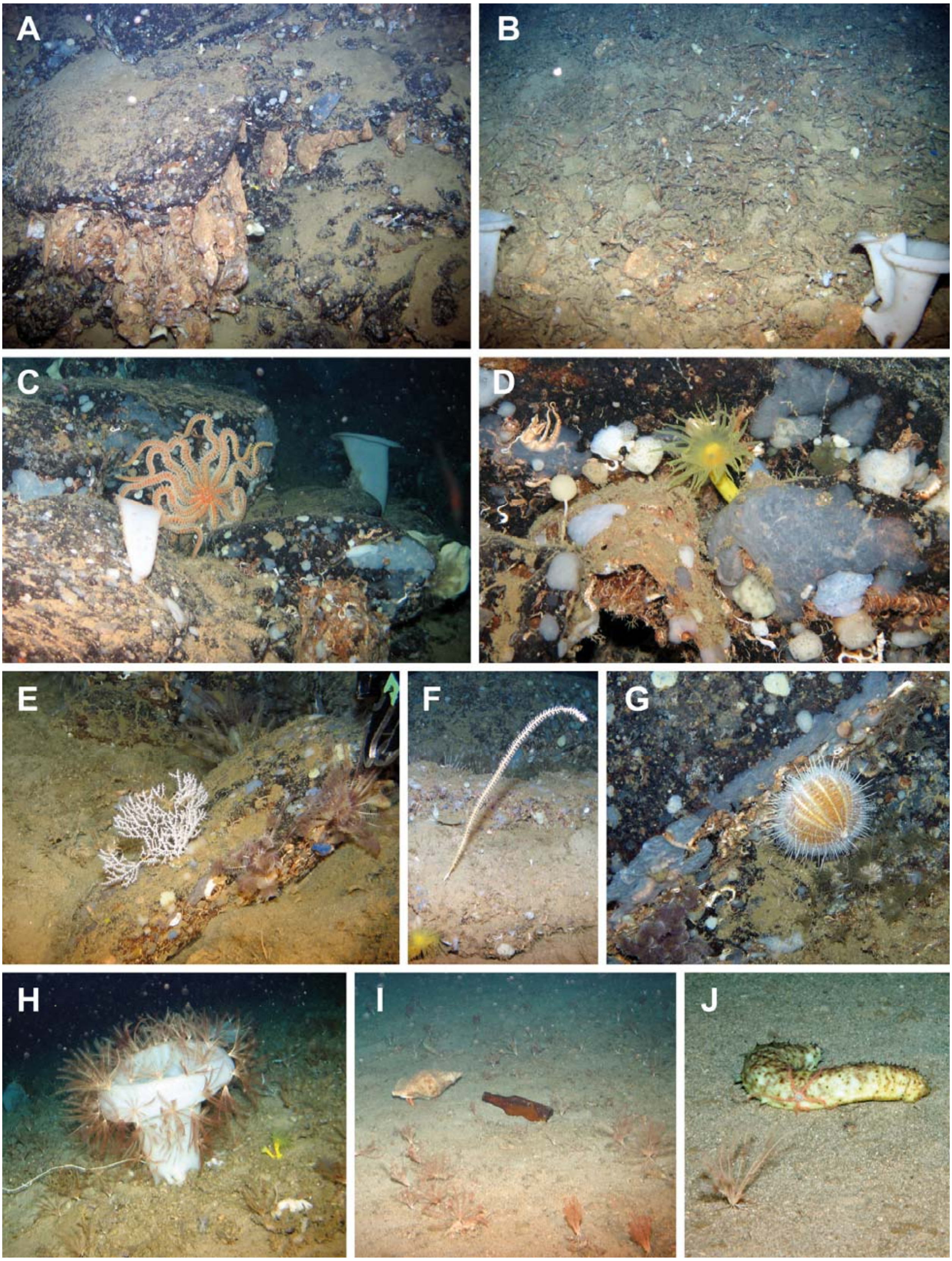


Fig. 5.8 *ROV images of Dive 4 (GeoB 13710-1) from 387 to 295 m depth.* ***A*** *Multi-generation stacks of fossil* Neopycnodonte zibrowii *underneath a basalt ledge (-365 m).* ***B*** Dendrophyllia *rubble apron admixed with detached right valves of* N. zibrowii *colonised by* Rossella nodastrella*. Note the small live* Lophelia pertusa *colony in the upper centre (-387 m).* ***C*** *The rare labiasterid* Coronaster *sp. in a rock habitat. Other fauna consists of*

rock-encrusting sponges, R. nodastrella*, serpulids and dead* N. zibrowii *(-365 m).* ***D*** *Rock-oyster habitat with a young* Dendrophyllia cornigera *and multiple encrustations of sponges. Note the stalked hadromerid* Stylocordyla *sp. in the central left and the diverse serpulid assemblage (-332 m).* ***E*** *Unidentified white gorgonian on a basalt boulder with crinoids clinged to the boulder edges (-326 m).* ***F*** *The gorgonian* Viminella flagellum*. Note the live* D. cornigera *in the lower left (-315 m).* ***G*** *Close up of* Echinus melo *grazing along the edge of an encrusted basalt. Note the two live* Megerlia truncata *brachiopods in the upper right (-295 m).* ***H*** *Mass occurrence of crinoids clinging on* R. nodastrella *and on the coral rubble. Note the two live* D. cornigera *and the translucient ascidians. The white string belongs to* V. flagellum *(-308 m).* ***I*** *Carbonate sand rich in coral rubble and* Gryphus vitreus *with masses of crinoids. The big conch is carried by a pagurid crab (-309 m).* ***J*** *A characteristic holothuroid-ophiuroid association (-307 m).*

From 344–326 m water depth the rounded boulder coverage becomes less dense, thus, giving way to coarse bioclastic sand patches (Fig. 5.8I). From 315 m depth onward, the sand areas dominate over basalt boulders in coverage. The levelled plateau is covered by bioclastic sand and gravel at 310–305 m depth. The marked ridge on the plateau is made of the basalt basement fringed by loose rounded boulders. The shallowest depth encountered was 295 m water depth. The dive went back to the plateau, due west of the ridge at 307 m depth. Here the bioclastic sand is enriched in coral rubble, the brachiopod *Gryphus vitreus* and detached right valves of fossil *N. zibrowii*.

The sessile benthos community is very diverse and utilises the provision of the volcanic hardsubstrate at any depth surveyed. Sponges are prominent as encrusting as well as upright growing forms. The most appealing sponge is the up to 40-cm-high, cup-shaped hexactinellid which we tentatively assume to be a *Rossella nodastrella* that was found attached to the basalt or directly on fossil coral rubble (Figs. 5.7A, 5.8B,C,H, 5.9A). This sponge is characteristic for the Atlantic Ocean. The other sponge of particular interest is the hadromerid *Stylocordyla* sp. (Fig. 5.8D), a stalked sponge attached to various sorts of hardsubstrate such as basalt, deep-sea oysters and fossil corals. The species *S. pellita* is known from the Mediterranean Sea. The cnidarian community is rich in gorgonian octocorals with *Acanthogorgia hirsuta* (Fig. 5.7A) as the most common species, followed by a yet not identified white gorgonian (Figs. 5.7A, 5.8E). Especially on the basalt ridge on top of the plateau *A. hirsuta* can form 'gardens'. At this shallow site, few specimens of *Viminella flagellum* were documented (Fig. 5.8F). Another common element is the antipatharian *Parantipathes larix* with its characteristic bottlebrush-shaped growth habit (Fig. 5.7A). Actinians were hardly visible on the ROV images but close ups show the presence of *Amphianthus dohrni*, i.e. on white gorgonians.

The most common live scleractinian is the yellow *Dendrophyllia cornigera*, but mostly represented by small if not recently settled colonies (Fig. 5.8D,F,H). The colonies occur widely distributed all over the slope. Live *Lophelia pertusa* were documented two times, small colonies attached to dead oysters and *Dendrophyllia* rubble (Fig. 5.8B). The other example was found attached to a lost long line, where *Lophelia* has developed into a spheroidal colony apparently without the presence of *Eunice*. This colony was the home territory of a bythitid (?) fish. Other sessile groups are represented by the ubiquitous serpulids, hydroids and ascidians.

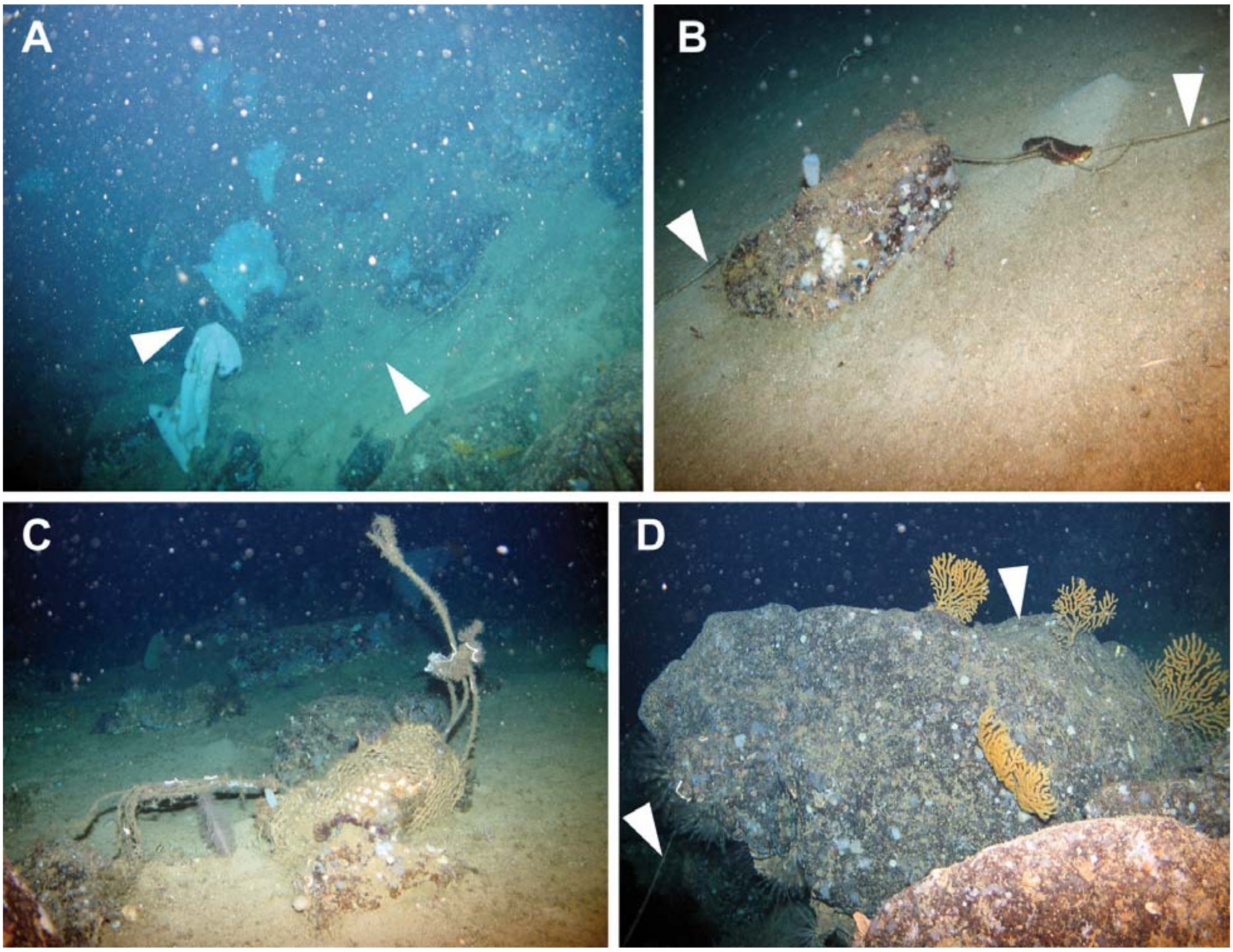


***Fig. 5.9** Evidence of anthropogenic impact from Dive 4 (GeoB 13710-1). **A** Lost long line (arrows) in between basalt boulders and a stock of partly damaged* Rossella nodastrella *(-300 m). **B** Another lost long line (arrows) grazed by a holothurian (-303 m). **C** Lost trap heavily colonised. Note* Parantipathes larix *left of the trap (-307 m). **D** Long line (arrows) entangled around a basalt nose colonised by* Acanthogorgia hirsuta *and crinoids (-295 m).*

Characteristic elements of the mobile fauna are holothurians that occurred on soft as well as on hard substrates. We took nice images of defacating holothurians (Fig. 5.7B). Especially on the plateau almost all holothurians carried one or more ophiuroids (Fig. 5.8J). Other common echinoderms are *Cidaris* and *Echinus* cf. *melo* (Fig. 5.8G). Crinoids are present with different species and can be found all over the slope. The flat sand plateau near the ridge was densely covered with crinoids thus forming a typical mass-occurrence (Fig. 5.8H-J). Noteworthy is the finding of a large deep-sea asteroid, *Coronaster* sp., known from the Atlantic and Pacific Oceans (Fig. 5.8C). Crustaceans are common with the galatheids and occasionally hermit crabs living in large gastropod conchs (Fig. 5.8I).

The fish community is relatively sparse over the steep slope except for grenadier-type macrourid fishes. On the plateau, *Helicolenus dactylopterus* (Figs. 5.7D, 5.12A), *Scorpaena scrofa* (see Fig. 5.12A) and some unidentified small myctphid fishes were recorded (Fig. 5.12L). The bythitid fish that lives in close association with the live *Lophelia* colony was already mentioned (Fig. 5.12J). Anthropogenic impact is higher (Fig. 5.9), especially in the upper slope and ridge section, were many lost long lines and a trap got entangled by the rough seabed topography. Litter content was sparse, except for two beer bottles (see Figs. 5.7D, 5.8I).

◇ ROV Dive 5 (GeoB 13717-1) ◇ El Idrissi Bank, SE flank

◇ start: 36°05.30'N, 03°31.82'W, 710 m water depth (1nm east of Dive 4)
◇ end: 36°06.00'N, 03°32.17'W, 284 water depth
◇ heading: SE-NW; track length: 3,671 m

From 710 to 627 m water depth the seabed consists of bioturbated mud followed by first basaltic outcrops, whose surfaces still are mud-covered (Fig. 5.10A-D). At 622 m, first *Dendrophyllia-Lophelia-Desmophyllum* coral rubble aprons became visible. Several coral pieces were sampled (Sample 1). After this first steeper inclined basaltic slope section, another bioturbated mud facies is present further upslope at about 590 m depth. At 585 m, a series of basaltic flows crop out to a depth, when fossil and in situ collapsed *Dendropyllia* framework characterise the seabed. This collapsed framework forms an extremely micro-habitat-rich environment for the modern fauna (see below) on top of the basalt basement. The highly porous coral skeletons were still quite complete indicating a relative young geological age of death. All coral skeletons are patinated with a Fe-Mn coating. One framework sample was collected at 536 m depth (Sample 2). Framework thickness is variable but can exceed 50 cm at places. This fossil framework habitat fades out in the form of thin rubble veneers at 500-491 m depth, when another steeply inclined basalt outcrop is developed. The coral rubble at the base of the basalt wall is littered with dead and complete deep-sea oysters (Sample 3). At 490 m, metre-sized stacked generations of live and dead *Neopycnodonte zibrowii* exist underneath the basalt ledges. The findings of live deep-sea oysters confirm the first evidence of this species in the Mediterranean Sea (Sample 4-5). On top of this basalt outcrop, the next collapsed *Dendrophyllia* framework was recorded at 488 m (Sample 6). At 483 m the slope becomes less steep so that sandy bioturbated mud can accumulate on the volcanic basement. At one site, several dead and Fe-Mn-patinated *Dendrophyllia cornigera* colonies were found in situ and provide habitat for large sponges. Within this facies only few volcanic boulders pierce through the loose sediment. Volcanic basement becomes prominent again at 437 m with rounded boulders and basalt outcrops. The larger of them contain galleries of live and dead deep-sea oysters, i.e. at 386 m depth, added by fringes of coral rubble around them. The plateau of the bank was reached at 307 m. Here, the sediments consist of a calcareous sand.

As in Dive 4, the sessile benthos community is very diverse. In the deep bioturbated mud facies some *Kophobelemnon* cf. *leuckarti* were recorded (Fig. 5.10B). The first basalt outcrop ridge at 627 m water depth provides substrate for solitary corals (Fig. 5.10G), encrusting and some larger sponges including *Rossella nodastrella*, brachiopods, serpulids and occasionally *Spondylus gussoni*. A very species-rich habitat is the fossil *Dendrophyllia* framework (Fig. 5.10E-F). The surfaces of the elongated skeletons are colonised by encrusting sponges (hexactinellids, *Hexadella* sp. and many others), byssate and cemented bivalves, larger benthic foraminifers, hydroids, bryozoans, fragile antipatharians with white soft tissue (Fig. 5.10F), the chasmolithic (or endolithic) actinian *Fagesia loveni*, serpulids and ascidians. The gorgonian *Acanthogorgia hirsuta* is present, although at lower quantities as in the previous dive. Very much the same community can be found on the valves of the dead deep-sea oysters, while live oysters showed only sparse epibenthic colonisation (Fig. 5.10H-I). We saw one aggregation of recently settled live *Lophelia* colonies attached to the underside of a dead oyster. The hadromerid sponge *Stylocordyla* sp., a characteristic species of this facies of Dive 4, is missing here. Higher upslope, at the transition to the plateau, live *D. cornigera* colonies become more abundant. The colonies found here are much larger compared to those of Dive 4 (Fig. 5.10K). Also the density of the common cup-shaped *R. nodastrella* as well as for the white gorgonian, increases considerably, compared to the deeper slope (Fig. 5.10J). The sand habitat of the plateau shows cerianthids with violet tentacle crowns (Fig. 5.10K). Larger basalt rocks near the plateau show again thick stacks of live and dead deep-sea oysters at 388 m.

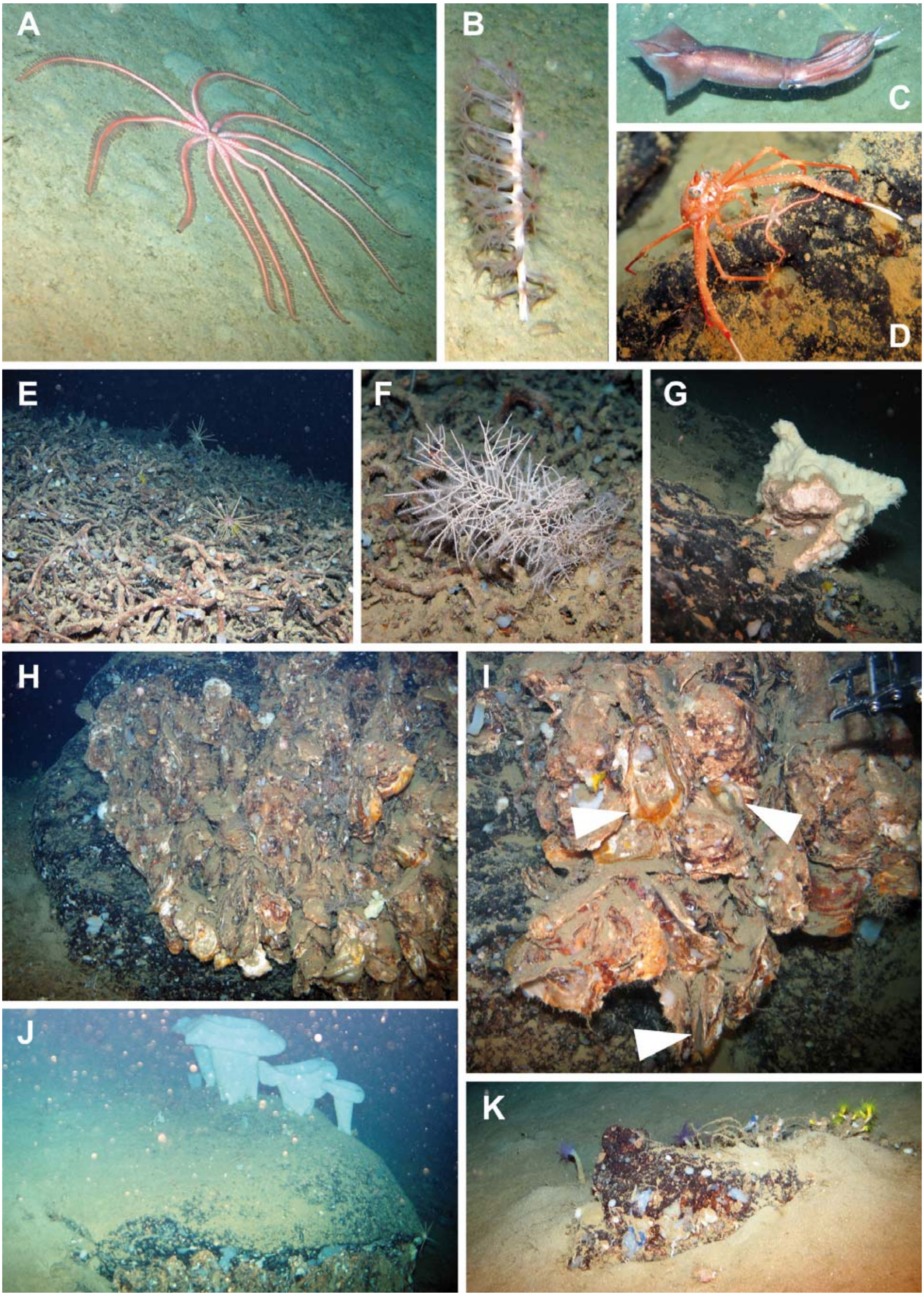


***Fig. 5.10** ROV images of Dive 4 (GeoB 13717-1). **A** The rare asteroid* Brisingella *sp. crawling over bioturbated mud (-618 m). **B** The pennatulacean* Kophobelemnon *cf.* leuckarti *from the mud facies (-629 m). **C** The squid* Todarodes sagittatus *(-692 m). **D** The galatheid* Munida *sp. next to an ophiuroid (-585 m). **E** Lateral view on the structure of the unique* Dendrophyllia *graveyards with grazing cidarids (-533 m). **F** A fragile antipatharian colony (-522 m). **G** Large sponge and small solitary corals on a basalt surface (-585 m). **H** View on multi-generation stacks of live and dead oysters,* Neopycnodonte zibrowii *(-388 m). **I** Another oyster stack with live (marked with arrows)* N. zibrowii *(-490 m). **J** The cup-shaped hexactinellid* Rossella nodastrella *on top of a sediment-laden basalt outcrop. The current-exposed face of the basalt is colonised by* N. zibrowii *(-400 m). **K** A basalt piecing through the carbonate sand facies on the plateau with soft-bottom cerianthids and larger live* Dendrophyllia cornigera *colonies (-450 m).*

The mobile benthic community is much sparser in the deep bioturbated mud facies compared to the previous dive. One exception is the large brisigid asteroid *Brisingella* sp. (Fig. 5.10A). Galatheid squat lobsters are facies independent and are common (Fig. 5.10D). Benthic shrimps were present but not abundant. Decapod crabs like *Bathynectes maravigna* occurred frequently in the dead *Dendrophyllia* framework. The same is true for sea urchins, *Echinus melo* and *Cidaris* sp. were frequent grazers in this special habitat (Fig. 5.10E). Close-up images of the dead coral framework show large numbers of tiny ophiuroids that live in the hollows and voids provided by the coral skeleton. Crinoids were common but again, at a much lesser proportion compared to Dive 4.

The fish community shows some new elements in the deep bioturbated mud with *Hoplostethus mediterraneus* (Fig. 5.12K), *Solea* sp. (Fig. 5.12I), *Trachyrincus scabrus* and other macrourid fishes which may belong to *Coelorinchus caelorhincus* and *Nezumia* sp. (Fig. 5.12C,D,F). Here, we encountered a *Galeus melanostomus* shark (Fig. 5.12H). The ROV light often attracted *Arctozenus risso* and one got throught the thrusters and was caught by a galatheid crab for further digestation (Fig. 5.12M). On the transition to the plateau, *Phycis blennoides* (Fig. 5.12B) and *Lophius* cf. *budegassa* (Fig. 5.12F) occurred for the first time on this cruise. We also recorded *Todarodes sagittatus* (Fig. 5.10B). Anthropogenic impact was evident in the higher slope area and on the plateau with lost long lines, nets and litter (Fig. 5.11).

***Fig. 5.11** Examples of anthropogenic impact observed during Dive 5. **A** Gauze sack (-690 m), **B** Long line thrown over board. Note the aggregation of crinoids on the basalt boulder (-308 m). **C** A highly corroded pot (-477 m).*

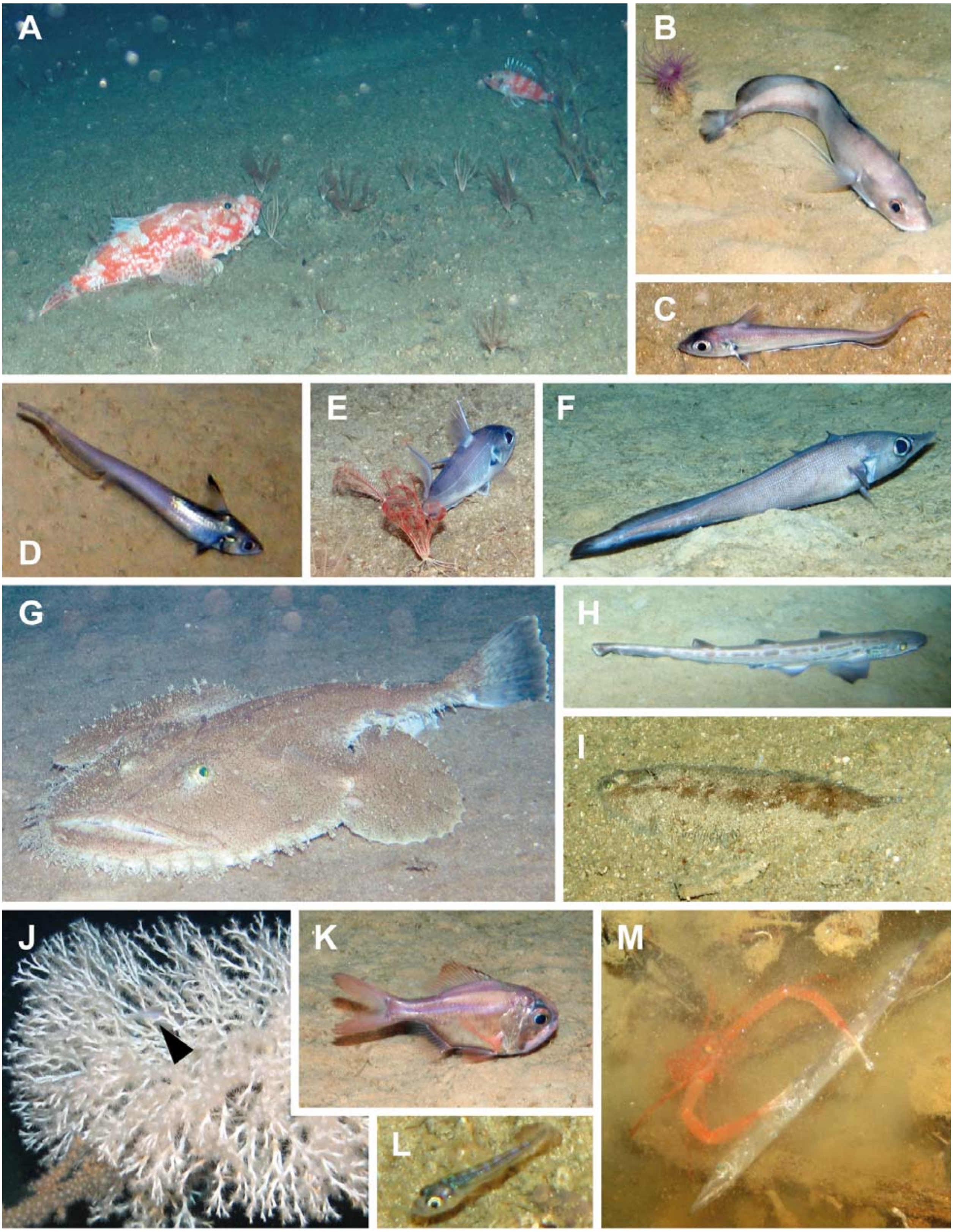


Fig. 5.12** The fish and shark community observed during Dives 4 & 5, El Idrissi Bank. **A Scorpaena scrofa *and* Helicolenus dactylopterus *(Dive 4, -308 m). **B*** Phycis blennoides *(Dive 5, -450 m). **C** Macrourid fish probably* Coelorinchus caelorhincus *(Dive 4, -431 m). **D** Grenadier-type macrourid most likely* Nezumia *sp. (Dive 5, -610 m). **E** Macrourid fish probably* Coelorinchus caelorhincus *(Dive 4, -309 m). **F*** Trachyrhincus scabrus *(Dive 5, -708 m). **G*** Lophius *cf.* budegassa *(Dive 5, -308 m). **H*** Galeus melanostomus *(Dive 5, -695 m). **I*** Solea *sp. (Dive 5, -434 m). **J** Presumably a bythid fish using a live* Lophelia

colony as habitat (Dive 4, -395 m). ***K*** Hoplostethus mediterraneus *(Dive 5, -691 m).* ***L*** *Unidentified fish (Dive 4, -309 m).* ***M*** Arctozenus risso *in the claws of a galatheid crab experiencing his last minutes (Dive 5, -491 m).*

◇ ROV Dive 10 (GeoB 13751-1) ◇ El Idrissi Bank, SE flank

◇ start: 36°06.28′N, 03°29.28′W, 687 m water depth
◇ end: 36°06.56′N, 03°29.70'W, 388 m water depth
◇ heading: SW-NE; track length: 1,459 m

The objective of Dive 10 was to survey the SE slope of the El Idrissi Bank, which is exposed to the west-flowing intermediate water masses in the upper bathyal zone. The dive had to be aborted due to severe problems with lost long lines. A technical problem with the digital still camera forced us to use the pilot video camera for reconnaissance on the seabed and post-dive image analysis.

The steep flank was a big surprise as it showed the largest fossil coral framework accumulations so far seen. The dive track started with bioturbated mud facies at 690 m water depth, when at 676 m thick coral framework took over. The most common megafauna species in the bioturbated mud here and repeatedly higher upslope were the pennatulacean *Kophobelemnon* cf. *leuckarti* (Fig. 5.14D-E), cerianthids (with violet tentacles, Fig. 5.13D) and holothurians. During the dive it became clear that the coral framework accumulations were in place and not transported downslope. The large portions of this slope were covered with smaller and larger individual coral reefs, which died and became degraded with time. The major framework constructing coral is the thick calcified variety of *Lophelia pertusa* (Sample 1, 676 m). Locally, we saw metre-sized framework chunks (Fig. 5.13A,E). Another sample with fossil corals was taken at 666 m depth (Sample 2). The overall impression is that the coral settled preferentially on volcanic basement rock ledges in the depth interval 676 m to at least 440 m with a dominance of *Lophelia* in the deeper and a dominance of *Dendrophyllia* in the shallower part of this interval (Fig. 5.13G-H). The live coral colonies were quite rare and always small in dimension. Live *Lophelia* colonies were again fragile, thin calcified with often extremely trumpet-shaped corallites, which indicate different environmental conditions compared to the fossil *Lophelia* variety (Sample 3, 647 m, Fig. 5.13F). Although dating of the fossil corals needs to be done, we assume a considerable time gap between the fossil coral growth pulse and the modern coral re-colonisation. From 458 m onward, live *Dendrophyllia cornigera* became more abundant (Fig. 5.14C). We documented peculiar coral skeleton-overgrowing sponges with yellow and translucient tissue (compare with Figs. 15H and 5.14F). At 387 m a 2-m-high volcanic rock outcrop with vertical walls provided habitat for large stacks of *Neopycnodonte zibrowii* both live and dead (Sample 6, Fig. 5.14J). This is the second sample of a live deep-sea oyster from the Mediterranean Sea.

The coral framework and the volcanic rocks were intensely colonised especially at depths above 566 m. Beyond this depth, colonisation is less dense and is dominated by smaller sponges, hydroids and only locally larger organisms. At 657 m depth, we recorded the first occurrence of the gorgonian *Callogorgia verticillata* (Fig. 5.13B) and at 647 m depth, the first occurrence of the antipatharian *Leiopathes glaberrima* (Figs. 5.13E, 5.14A) to which eggs of *Scycliorhinus* were attached (Fig. 5.14B). Another *Leiopathes* colony with shark eggs was documented in 452 m water depth.

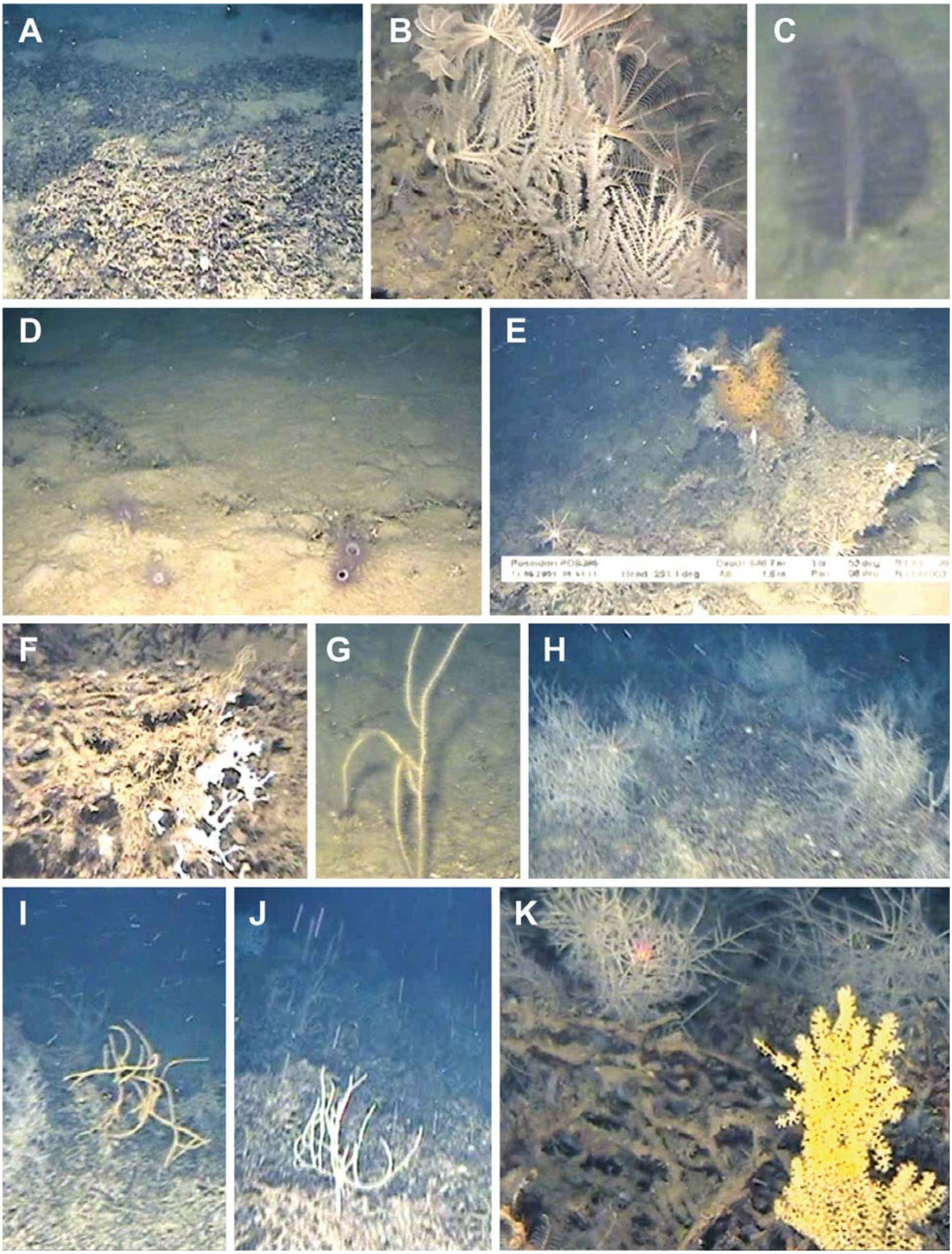


Fig. 5.13 *Fossil coral framework facies and faunal aspects of Dive 10 (GeoB 13751-1).* ***A*** *About half-a-metre-thick* Lophelia *framework (-666 m).* ***B*** *The gorgonian* Callogorgia verticillata *with resting crinoids (-657 m).* ***C*** Pennatula *sp. sea pen (-660 m).* ***D*** *Coral rubble embedded in bioturbated mud with a group of cerianthids (-663 m).* ***E*** *Large chunk of* Lophelia *framework being colonised by* Leiopathes glaberrima*. Note the many cidarids (-647 m).* ***F*** *Small and fragile live* Lophelia *colony (-647 m).* ***G*** *Yellow antipatharian colony,*

probably Antipathes *sp. (-630 m).* ***H*** *Fossil coral framework as substrate for white antipatharian colonies (-496 m). I White colour variety of presumably* Antipathes *sp. (-661 m).* ***J*** *White colour variety of presumably* Antipathes *sp. (-661 m).* ***K*** *One of the few* Acanthogorgia hirsuta *growing on coral framework. Note the dense colonies of antipatharians (-472 m).*

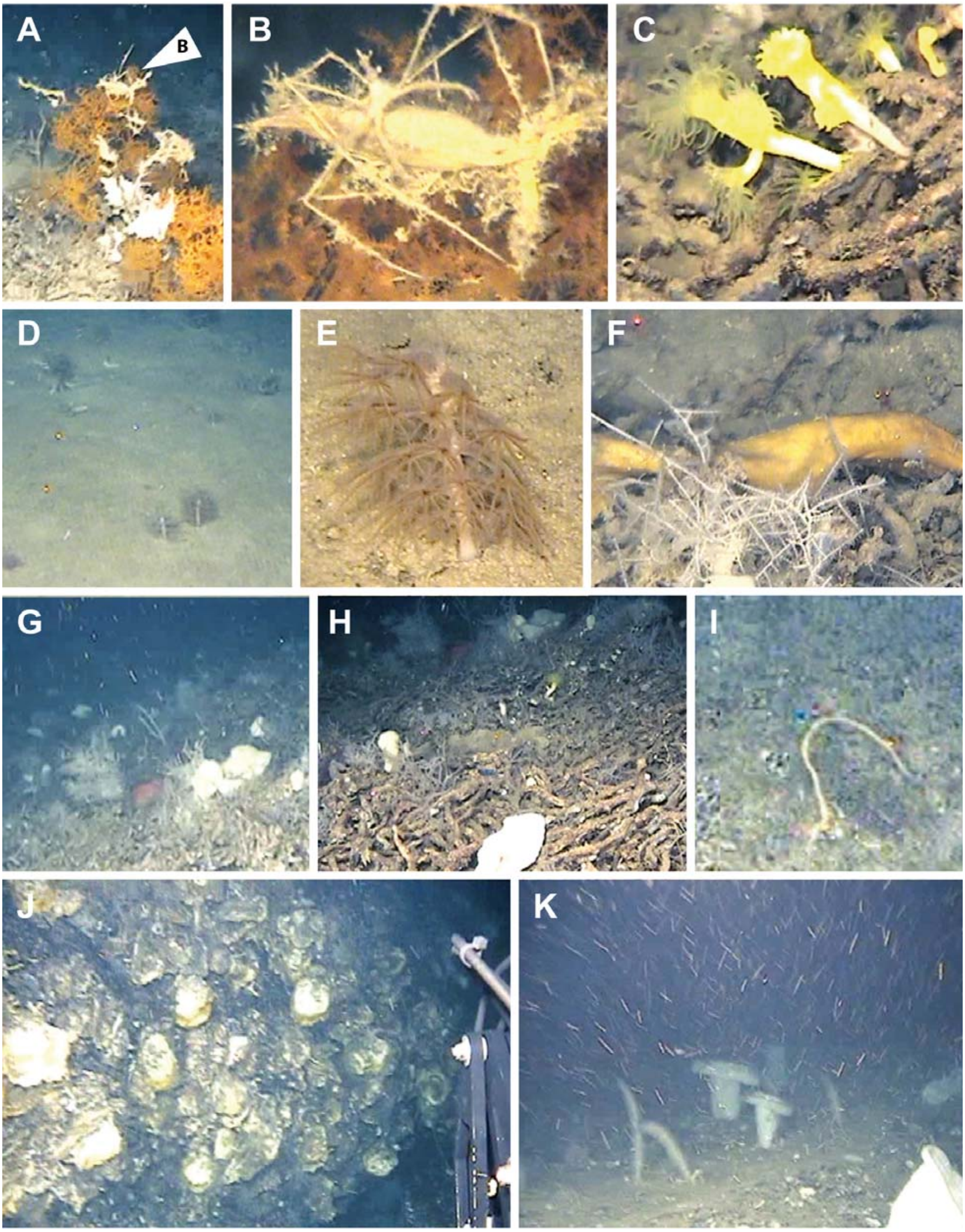


Fig. 5.14** Community aspects of Dive 10 (GeoB 13751-1). **A Leiopathes glaberrima *colony with eggs of* Scyliorhincus *sp. (arrow B see next image, -462 m). **B** Close-up of the shark fish egg capsule with a majiid crab on it (-462 m). **C** Group of live* Dendrophyllia cornigera *on* Dendrophyllia *framework (-465 m). **D** Bioturbated mud facies with several* Kophobelemnon *cf.* leuckarti *(-450 m). **E** Detail of* Kophobelemnon *cf.* leuckarti *(-450 m). **F** Yellow coral skeleton encrusting sponge with an antipatharian colony in the foreground (-441 m). **G** White sponges became more abundant in the shallower* Dendrophyllia *framework facies (-413 m). **H** Closer view on the* Dendrophyllia *facies with sponges and antipatharians (-413 m). **I** The gorgonian* Viminella flagellum *(-388 m). **J** Volcanic outcrop with many live* Neopycnodonte zibrowii *(-387 m). **K** Several* Rossella nodastrella *sponges and* Parantipathes larix *colonies (-382 m).*

The first occurrence of the cup-shaped hexactinellid *Rossella nodastrella* was noted at 644 m. The abundance of this sponge increases towards shallower depths. At 631 m depth antipatharians resembling *Antipathes fragilis* colonised coral framework (Fig. 5.13G-J). From 566 m onward the coral framework habitat yielded large aggregations of a smaller, finely branched type of antipatharian with whitish soft tissue (Sample 4, 495 m, Fig. 5.13H,K). From 458 m depth onward white encrusting and erect sponges suddenly became abundant (Fig. 5.14G). *Acanthogorgia hirsuta* (Fig. 5.13K), *Viminella flagellum* (Fig. 5.14I) and *Parantipathes larix* were present but never abundant, except for the shallowest part at 380 m, when *P. larix* occurred with many specimens associated with *R. nodastrella* (Fig. 5.14K). Crinoids were present on rocks, corals and elevated organisms.

The fish community consists of the usual suspects with *Arctozenus risso*, *Helicolenus dactylopterus*, macrourid fishes, *Hoplostethus mediterraneus* and *Lophius* cf. *budegassa*.

The anthropogenic impact was very high and the severe density of lost long lines that hung around under tension on the exposed rock noses in the shallower part from 380 m onward, forced us to abort the ROV dive for safety reasons.

◇ ROV Dive 11 (GeoB 13757-1) ◇ El Idrissi Bank, NE flank

◇ start: 36°09.37’N, 03°29.77’W, 662 m water depth
◇ end: 36°07.94’N, 03°30.45’W, 289 m water depth
◇ heading: NE-SW; track length: 6,219 m

Dive 11 surveyed the NE flank of El Idrissi Bank and the main objective again was to document the past and modern benthic colonisation patterns of the SMT flank under the influence of the intermediate water mass inflow.

The ROV reached the seabed in bioturbated mud which continues upslope to 570 m water depth. We noticed *Nephrops norvegicus* (Fig. 5.15D), the big crab *Chaceon affinis*, *Cidaris* sp., several holothurian species, cerianthids and few *Kophobelemnon* cf. *leuckarti* in this facies. The fishes recorded comprise of myctophids, macrourids, *Helicolenus dactylopterus*, *Hoplostethus mediterraneus* and *Merluccius merluccius* (Fig. 5.16A). All fishes occurred in low numbers. A rafted *Laminaria rodriguezi* was filmed at 662 m.

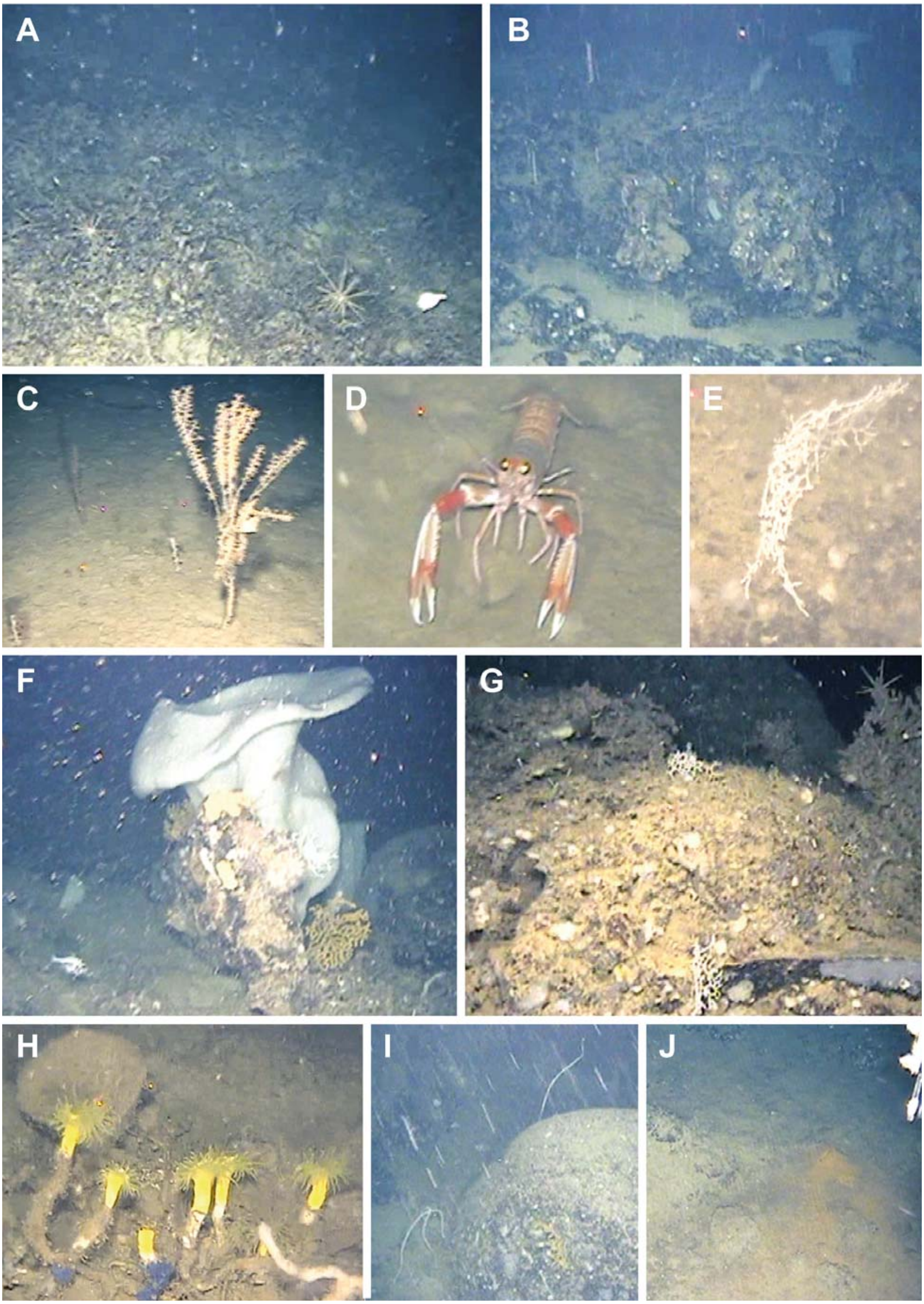


Fig. 5.15 *Community aspects of Dive 11 (GeoB 13757-1).* ***A*** *Coral rubble framework facies with* Hoplostethus mediterraneus *and* Cidaris *sp. (-664 m).* ***B*** *Volcanic basement with plasters of* Neopycnodonte zibrowii *and* Rossella nodastrella *on top of the outcrop (-632 m).*

C** Bioturbated mud facies is a worn* Isidella elongata *and* Kophobelemnon *cf.* leuckarti *(-434 m).* ***D Nephrops norvegicus *(-644 m).* ***E** Close-up of a white gorgonian colony (-412 m).* ***F** Large* R. nodastrella *with* Acanthogorgia hirsuta *and* H. mediterraneus *(-418 m).* ***G** Coral framework colonised with white gorgonian colonies (-412 m).* ***H** Larger* Dendrophyllia cornigera *colony with blue* Hymedesmia *sp. sponges (-415 m).* ***I** Volcanic boulder with* Viminella flagellum *(-432 m).* ***J** Small crater with rust-coloured emanations may be weak signs of hydrothermal activity (-294 m).*

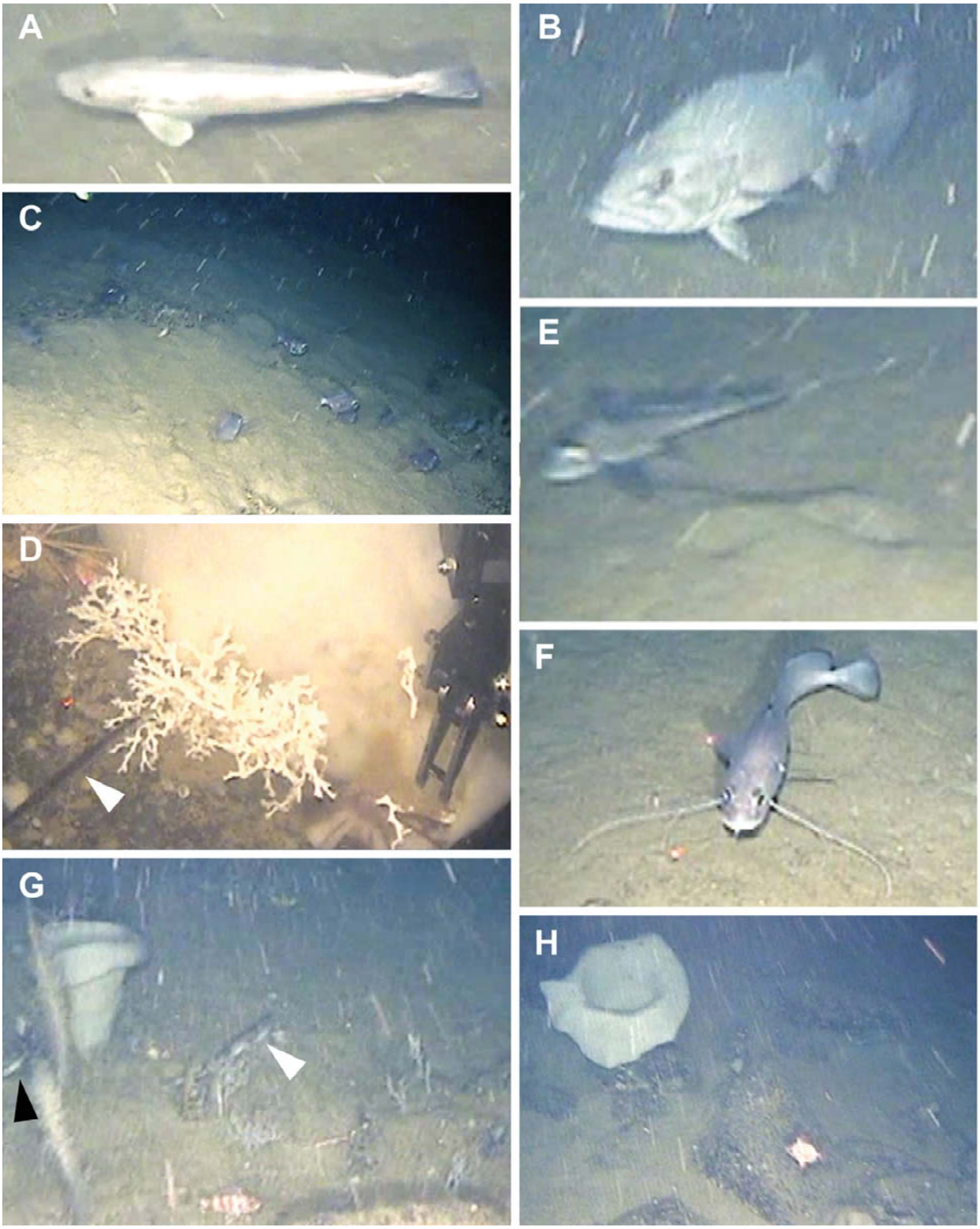


Fig. 5.16 *The fish community of Dive 11 (GeoB 13757-1).* ***A*** Merluccius merluccius *(-630 m).* ***B*** Polyprion americanus *(-437 m).* ***C*** Hoplostethus mediterraneus *swarm on coral rubble and bioturbated mud (-465 m).* ***D*** Arctozenus risso *next to a live* Lophelia *colony (-419 m).* ***E*** Chimaera monstrosa *(-390 m).* ***F*** Phycis blennoides *(-415 m).* ***G*** *A shark (white arrow) and a macrourid (black arrow) in the volcanic boulder field next to* Rossella nodastrella *and large* Parantipathes larix *(-327 m).* ***H*** Capros aper *above a volcanic boulder field next* to R. nodastrella *(-294 m).*

From 570 m upslope to about 467 m water depth, a series of volcanic hardsubstrates cropped out providing substrate for coral framework made by *Lophelia* and *Dendrophyllia* (Fig. 5.15A, Sample 1, -567 m). The framework is inhabited by *Rossella nodastrella* (Fig. 5.15F), while the steep rock faces are plastered by *Neopycnodonte zibrowii* (Fig. 5.15B, Sample 2, -530 m). The first occurrence of *Acanthogorgia hirsuta* was noted in 566 m water depth. A piece of a thickly calcified *Madrepora* was collected in 488 m water depth (Sample 3), close to a recently died *N. zibrowii* (Sample 4). Live oysters were encountered at 467 m water depth (Sample 5). Here, one antipatharian colony of the fragile type, which formed extended gardens in Dive 10, was recorded at this depth. The depth interval from 467 m to 425 m is dominated by bioturbated mud facies, interrupted by dispersed coral rubble and volcanic outcrops. Around 455 m to 439 m, a large swarm of *Hoplostethus mediterraneus* was present about a metre above the seabed with their heads facing into the residual current (Fig. 5.16C).

The mud facies was densely colonised by *Kophobelemnon* cf. *leuckarti* forming sea pen aggregations. We noted the big *Polyprion americanus* (Fig. 5.16B) next to a coral rubble field and *Palinurus mauritanicus*. At 432 m, we encountered first live *Dendrophyllia cornigera* (Fig. 5.15H) and isolated *Viminella flagellum* (Fig. 5.15I) in 432 m and 421 m, respectively. First *Isidella elongata*, although in a bad state, occurred at 432 m (Fig. 5.15C). The depth interval from 425 m to 410 m can be characterised by the presence of a volcanic boulder "stone park" with mud in between. Blocs with several colonies of an unidentified white gorgonian were present at 411 m depth. Here, we found more live *D. cornigera* and a 25-cm-large thin calcified *Lophelia* colony (Fig. 5.16D). Live *Lophelia* and *Madrepora* were very rare at all. Upslope of the stone park, bioturbated mud prevailed rich in *Isidella elongata*, especially around 380 m water depth. Fishes encountered in this depth interval were identified as *Chimaera monstrosa* (Fig. 5.16E), *Capros aper* (Fig. 5.16H), *Pagellus bogaraveo*, *H. dactylopterus*, *Phycis blennoides* (Fig. 5.16F), *Galeus melastomus* and more common *Hoplostethus mediterraneus*.

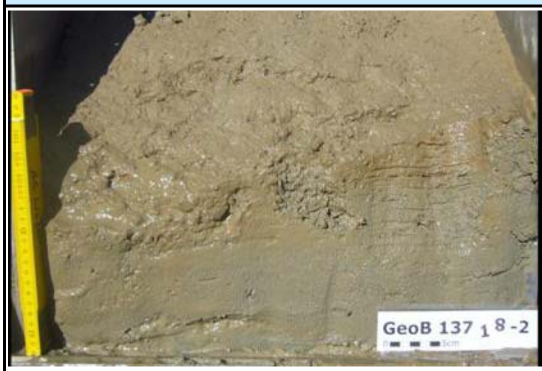
At 360 m, we reached the slope-to-plateau transition and therefore, volcanic basement was more prominent than mud facies. From here, *Rossella nodastrella* and *Acanthogorgia hirsuta* became the dominant megafauna element of the hardsubstrate community, added by some *Viminella flagellum* and *Parantipathes larix*, while *Kophobelemnon* cf. *leuckarti* and *Isidella elongata* were common elements of the mud facies as shallow as 303 m. We saw many rocks covered by dead deep-sea oysters up to 333 m water depth. At 294 m depth, the sediment patches showed conspicuous dark spots and in one occasion a small rust-brown coloured fluid-flow crater, few centimetres high, was recorded (Fig. 5.15J). These were the only hints of ongoing hydrothermal activities. The fish community in this last shallow depth interval consists of *H. dactylopterus*, *H. mediterraneus*, *P. bogaraveo*, *Capros aper*, *Scorpaena scrofa*, *Synchiropus phaeton* and flat fishes. On the plateau, we traversed a boulder ridge containing few live *Dendrophyllia cornigera* at 288 m water depth. The anthropogenic impact becomes higher in the shallower part of the dive. Many lost long lines were draped around the rocks. Litter pollution was evident by some bottles and tins.

Box corer sampling (Claudia Wienberg & Lydia Beuck)

GeoB 13711-1 (El Idrissi Bank, top)		Sample	
surface		MAR	GZN
	**sediment/colour**: olive (5Y4/4) foram sand with 5% volcanoclasts mottled by worm tubes **live fauna**: abundant polychaetes in agglutinated tubes, anemone **components**: crinoids, otoliths, bivalves, scaphopods, brachiopods **corals**: /	X	X
sediment column: 15 cm		MAR	GZN
	**sediment/colour**: <u>0-2 cm</u>: olive (5Y4/4) foram sand <u>2-15 cm</u>: olive grey (5Y5/2) silty foram sand **live fauna**: polychaetes in agglutinated tubes, cephalocarids, ophiuroids, agglutinating foraminifera, Caprellidea, *Ebalia nux* (male), glycerid polychaete **components**: cephalocarids, ophiuroids, agglutinating foraminifera, Caprellidea, *Ebalia nux* (male), glycerid polychaete **corals**: *Madrepora*, *Dendrophyllia*, solitary corals (*Caryophyllia*, *Stenocyathus*)	-	X

GeoB 13712-1 (El Idrissi Bank, S-flank)		Sample	
surface, sediment column: ~5cm		MAR	GZN
	**sediment/colour**: olive (5Y4/3) foram sand mottled by worm tubes **live fauna**: polychaetes in agglutinated tubes **components**: irregular echinoids, echinoid spines, carapax, oyster (*Neopycnodonte*?), bivalves, scaphopods, brachiopods, serpulids, gastropods, sponge spiculae, *Xenophora*, pteropods, foraminifera, bryozoans, otoliths, agglutinated polychaete tubes **corals**: *Madrepora*, *Dendrophyllia*, *Lophelia*, solitary corals (*Caryophyllia*)	-	-
Remarks: slightly tilted, surface disturbed			

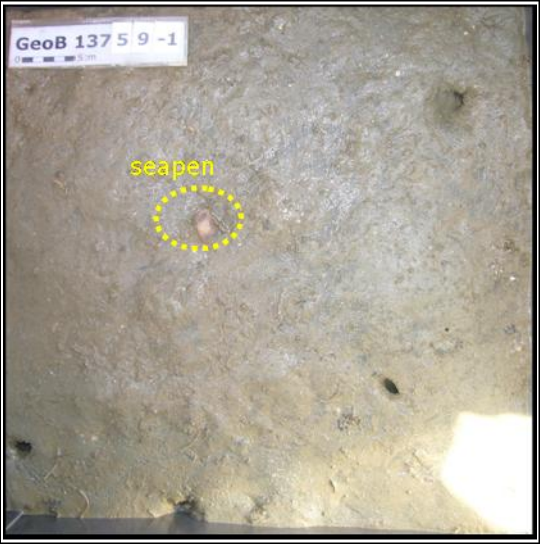
GeoB 13714-1 (El Idrissi Bank, SW-flank)		Sample	
surface		MAR	GZN
	**sediment/colour**: olive (5Y4/3) foram sand mottled by worm tubes **live fauna**: polychaetes, *Acanthogorgia*, ophiuroids, crustaceans (*Munida*), crinoids **components**: pteropods, oyster (*Neopcynodonte*?), bivalves, echinoid spines, brachiopods **corals**: *Madrepora*	X	X
sediment column: 17 cm		MAR	GZN
	**sediment/colour**: <u>0-2 cm</u>: olive (5Y4/3) foram sand <u>2-17 cm</u>: olive (5Y5/3) foram **components**: brachiopods, oyster (*Neopycnodonte*?), bivalves, gastropods, echinoid spines & plates, serpulids, otoliths, bryozoans, pteropods, irregular echinoids, agglutinated tubes, foraminifers, scaphopods, crustacean fragments (e.g., carapax) **corals**: *Madrepora*, *Lophelia*, *Dendrophyllia*, solitary corals (*Caryophyllia*, *Stenocyathus*)	X	X

GeoB 13718-2 (El Idrissi Bank, S-flank)		Sample	
surface		MAR	GZN
	**sediment/colour**: olive grey (5Y4/2) foram sand mottled by worm tubes **live fauna**: polychaetes, crustaceans (Gammaridea, *Homarus*?, *Paromola*?), agglutinating foraminifera **components**: shell debris **corals**: few small *Madrepora*	X	X
sediment column: 10-20 cm		MAR	GZN
	**sediment/colour**: <u>0-2 cm</u>: olive grey (5Y4/2) foram sand <u>2 cm-end</u>: olive grey (5Y5/2) foram sand **live fauna**: polychaetes **components**: *Acesta*, brachiopods, gastropods, echinoid spines and plates, bivalves, otoliths, bryozoans, oyster, scaphopods **corals**: *Madrepora*, *Dendrophyllia*, *Lophelia*, *Caryophyllia*	-	-
Remarks: tilted			

GeoB 13718-3 (El Idrissi Bank, S-flank)		Sample	
surface		MAR	GZN
	**sediment/colour**: olive (5Y4/3) foram sand mottled by worm tubes **live fauna**: polychaetes **components**: mm-sized shell debris **corals**: /	X	X
sediment column: 23-38 cm		MAR	GZN
	**sediment/colour**: <u>0-1 cm</u>: olive (5Y4/3) foram sand 1-23 cm: olive (5Y5/3) silty sand **live fauna**: Decapods, gammarids, pectinariids, polychaetes in agglutinated tubes, glycerid polychaete **components**: brachiopods (*Gryphus vitreus*), scaphopods, bivalves, gastropods, sea urchin spines and plates, pteropods, otoliths, sponge spicules **corals**: *Lophelia*, *Madrepora*, solitary corals (*Stenocyathus*, *Caryophyllia*), *Dendrophyllia*	X	X
Remarks: very slightly tilted			

GeoB 13753-1 (El Idrissi Bank, E-flank)		Sample	
bulk		MAR	GZN
	**sediment/colour**: olive grey silty sand **live fauna**: antipatharian **components**: gastropods, bivalves, pteropods, echinoid plates, crustacean fragments, foraminifera, sponge spicules, bryozoans, brachiopods **corals**: *Madrepora*, *Dendrophyllia*, *Pourtalosmilia anthophyllites*, *Stenocyathus*	-	-
Remarks: sample was entangled in the box corer frame			

GeoB 13754-2 (El Idrissi Bank, E-flank)		Sample	
bulk		MAR	GZN
	**sediment/colour**: silty sand **live fauna**: / **components**: bivalves, pteropods, gastropods, brachiopods, serpulids, foraminifera, crinoid ossicles **corals**: *Madrepora* and *Lophelia* with eunicid worm tubes, *Stenocyathus*	-	-
Remarks: very few sediment and shells			

GeoB 13759-1 (El Idrissi Bank, NE-flank)		Sample	
surface		MAR	GZN
	**sediment/colour/structure**: foram sand with dark glauconitic (?) grains 5Y4/3 olive bioturbation, burrows **live fauna**: sea pen, polychaetes, ophiuroid, worm tubes **components**: shell debris **corals**: /	X	X
sediment column: 24 cm		MAR	GZN
	**sediment/colour**: <u>0-16 cm</u>: silty foraminifera sand, 5Y4/3 olive <u>16 cm-end</u>: clayey sand, 5Y4/1 dark grey **live fauna**: polychates **components**: <u>0-16 cm</u>: gastropods, brachiopods, bivalves, coral debris, echinoderms, pteropods, volcanoclastics, otoliths **corals**: <u>16 cm-end</u>: corals amongst massive *Lophelia* fragments, echinoderms, molluscs, foraminifera, otoliths	X	X
Remarks: sieving from 0-16cm, 16cm-end			

5.4 ◇ East Melilla Area

The next survey area was devoted to the so-called Melilla Mounds which were discovered along the Moroccan margin in water depths between 200 and 300 m during a Spanish *RV Hesperides* cruise in 2006 (Comas and Pinheiro 2007) and followed up by the *RV Prof. Logachev* cruise *TTR-17* in 2008 (Fig. 5.17, map courtesy of M. Comas, Granada, Spain). During cruise *POS 385*, three of these mounds were targets for sediment sampling (box corer). Two of the mounds (Horse, Elephant) have already been discovered during the mentioned previous cruises, but one mound was newly discovered during cruise *POS 385* (called 'New Mound', situated west of Horse Mound). The sampling revealed that these mounds are largely covered or even composed of abundant coral fragments, whereby *Madrepora* is the dominant cold-water coral species.

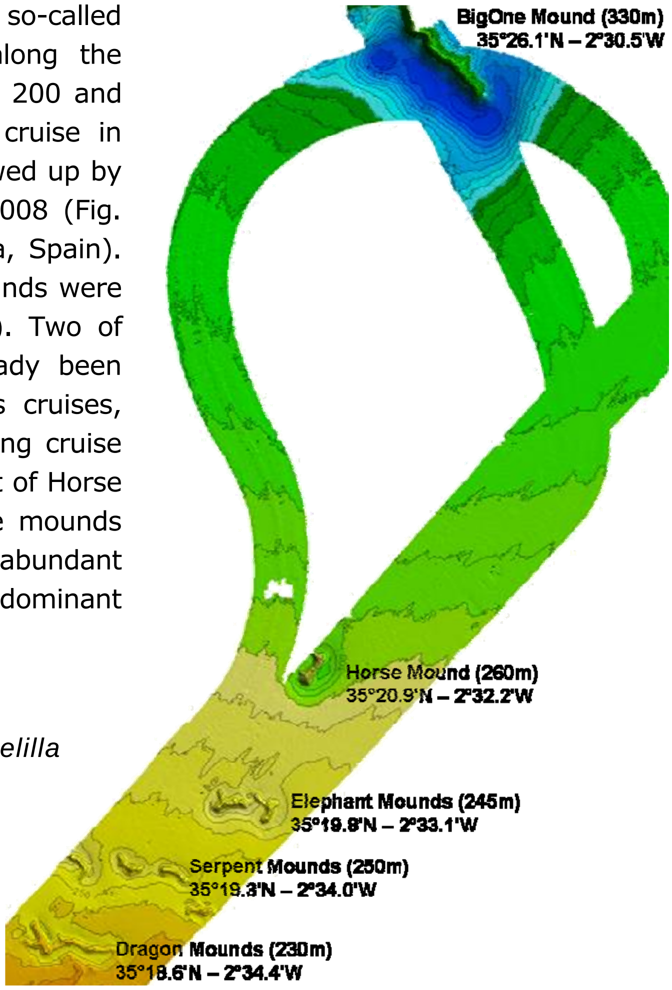


Fig. 5.17 *Bathymetric map showing the Melilla Mounds along the Moroccan margin of the Alboran Sea (map courtesy of M. Comas, Granada, Spain).*

5.4.1 ◇ Horse Mound

Box corer sampling ______________________ (Claudia Wienberg & Lydia Beuck)

GeoB 13722-1 (Horse Mound)		Sample	
surface		MAR	GZN
	**sediment/colour**: light olive brown (2.5Y5/4) silt with burrows and bioturbation **live fauna**: polychaetes, hydrozoans **components**: very few shells, echinoid **corals**: 1 coral fragment	X	X

sediment column: 46-51 cm		MAR	GZN
	**sediment/colour**: sediment changes gradually from light olive brown (2.5Y5/4) silt to olive (5Y5/3) clayey silt **live fauna**: abundant long black worm tubes, ?*Pseudoprotella phasma*, eunicids, polychaetes **components**: few shells (oyster, bivalves, scaphopds, pteropods, brachio-pods), agglutinated worm tubes, echinoid remains, foraminifera, sponge spicules, bryozoans, otoliths **corals**: few *Madrepora*, *Stenocyathus* 	X	X
Remarks: sieving 0-25 cm, 25 cm-end			

GeoB 13722-2 (Horse Mound)		Sample	
bulk		MAR	GZN
	**sediment/colour**: light olive brown (2.5Y5/4) silty foram sand **no live fauna** **components**: not observed **corals**: few *Madrepora*	-	-
Remarks: very few recovery			

GeoB 13722-3 (Horse Mound)		Sample	
surface		MAR	GZN
	**sediment/colour**: light olive brown (2.5Y5/4) silty foram sand mottled by worm tubes **live fauna**: ascidian, crustaceans (amongst *Munida*), hydrozoans, polychaetes **components**: bivalves, oyster, brachiopods **corals**: abundant small-sized *Madrepora*, few *Dendrophyllia*, solitary corals (amongst *Stenocyathus*)	X	X

<table>
<tr><td>sediment column: 27-32 cm</td><td></td><td>MAR</td><td>GZN</td></tr>
<tr><td>
</td><td>sediment/colour:
<u>0-15 cm</u>: light olive brown (2.5Y5/4) silty sand
<u>15 cm-end</u>: olive grey (5Y5/2) clayey sand

live fauna:
/

components:
bryozoans, serpulids, oysters, pteropods, sponge spicules, echinoid spines, coral fragments, gastropods

corals:
abundant Madrepora, Dendrophyllia</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">Remarks: sieving from 0-15 cm, 15 cm-end</td><td></td><td></td></tr>
</table>

5.4.2 ◇ New Mound

Box corer sampling (Claudia Wienberg & Lydia Beuck)

<table>
<tr><td colspan="2">GeoB 13723-1 (New Mound)</td><td colspan="2">Sample</td></tr>
<tr><td colspan="2">surface</td><td>MAR</td><td>GZN</td></tr>
<tr><td></td><td>sediment/colour:
olive (5Y5/4)silty sandy silt

live fauna:
crustaceans, 1 small fish, abundant hydrozoans

components:
/

corals:
few Madrepora</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">sediment column: 20 cm</td><td>MAR</td><td>GZN</td></tr>
<tr><td>
</td><td>sediment/colour:
<u>0-8 cm</u>: olive (5Y5/4) silty sandy silt
<u>8 cm-end</u>: olive grey (5Y5/2) clayey silt

live fauna:
/

components:
pteropods, gastropods, bryozoans, brachiopods, echinoid spines, bivalves, serpulids, otoliths, oyster

corals:
abundant Madrepora, Lophelia</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">Remarks: sieving from 0-8 cm, 8 cm-end</td><td></td><td></td></tr>
</table>

5.4.3 ◇ Elephant Mound

Box corer sampling (Claudia Wienberg & Lydia Beuck)

GeoB 13724-1 (Elephant Mound)		Sample	
surface		MAR	GZN
	**sediment/colour**: light olive brown (2.5Y5/4) silt mottled by worm tubes **live fauna**: polychaetes **components**: / **corals**: /	X	X
sediment column: 55 cm		MAR	GZN
	**sediment/colour**: <u>0-5 cm</u>: olive brown (2.5Y4/4) silt <u>5 cm-end</u>: olive grey (5Y4/2) clayey silt **live fauna**: polychaetes **components**: very few components **corals**: /	X	X

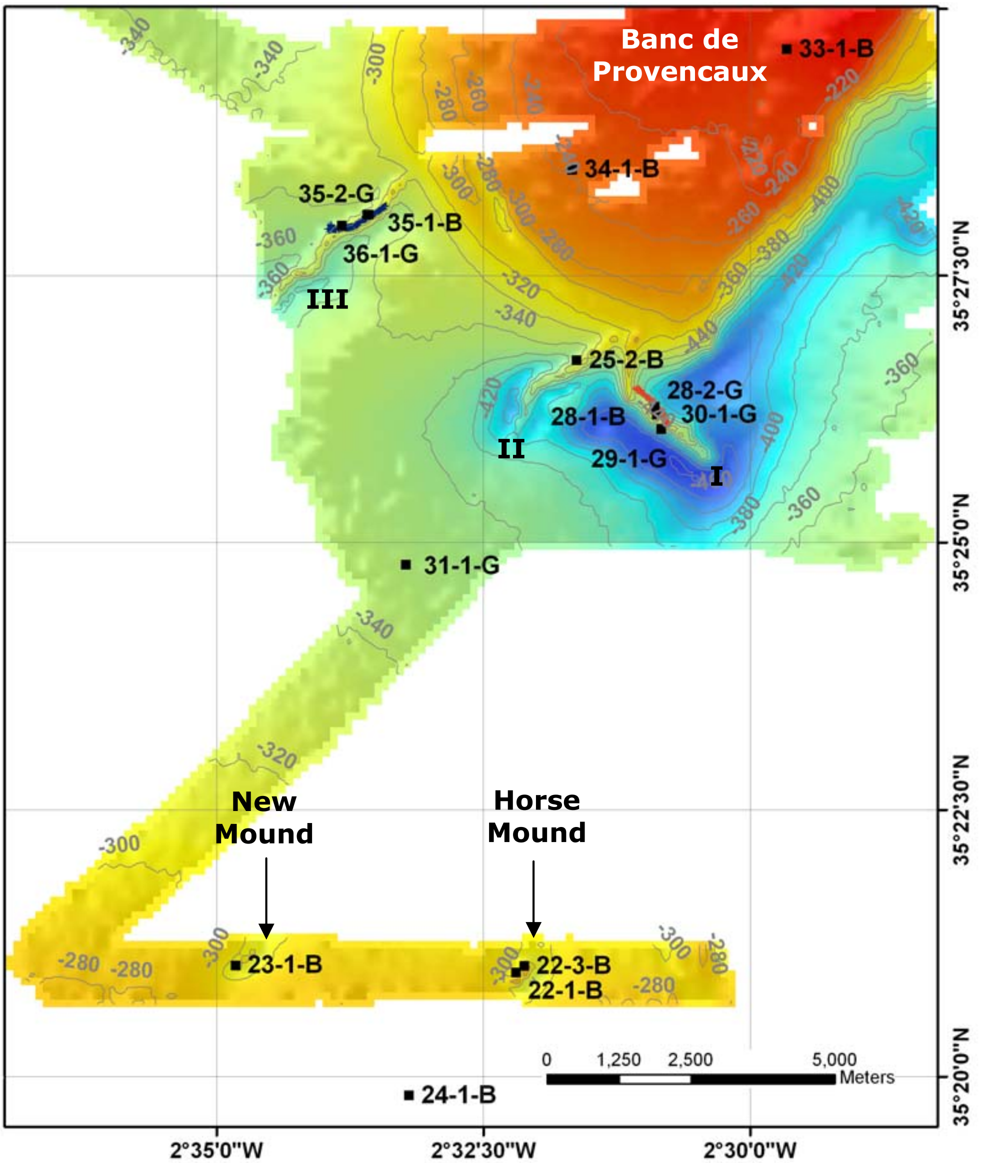
GeoB 13724-3 (Elephant Mound)		Sample	
bulk		MAR	GZN
	**sediment/colour**: brownish silt **live fauna**: / **components**: irregular sea urchins, echinoid spines, bivalves, gastropods, foraminifers, sponge spicules, pteropods, **corals**: *Dendrophyllia*, *Madrepora*	-	-
Remarks: very few sediment & corals			

5.4.4 ◇ Banc de Provencaux and Brittlestar Ridges

Our mapping (Map 2) clearly showed that some of the mounds (e.g., BigOne Mound, see Fig. 5.17) in the East Melilla area are narrow and bended outlier ridges, which are connected to the large shallow-water Banc de Provencaux (see Fig. 3.5). Because of the specific morphology of these outlier, the ridges were informally named as "Brittlestar Ridge I – III", whereby the bank represents the central disc of a brittle star.

Bathymetric map and stations ______________(Paul Wintersteller & Lydia Beuck)

Two ROV dives were carried out on Brittlestar Ridge I and Brittlestar Ridge III during which faunal samples comprising fossil coral framework, live specimens of *Madrepora oculata* and *Lophelia pertusa* and live ophiuroids were collected. The video observations were supplemented by intensive sediment sampling on all three ridges and the Banc de Provencaux. In total, four box cores and six gravity cores (recoveries: 317-447 cm) were successfully recovered (Map 2).



***Map 2** Banc de Provencaux with Brittlestar Ridges I to III. ROV track lines and positions of gravity cores (G) and box cores (B) are indicated.*

Video observation (Lydia Beuck & André Freiwald)

◇ ROV Dive 6 (GeoB 13727-1) ◇ Brittlestar Ridge I

◇ start: 35°26.07'N, 02°30.83'W, 426 m water depth
◇ end: 35°26.43'N, 02°31.03'W, 314 m water depth
◇ heading: SE-NW; track length: 1,890 m

The objective of Dive 6 was to explore the biotic and sedimentary environment of the central sector of the Brittlestar Ridge I. Underway, the ROV crossed the summit and adjacent flanks of the ridge several times, reaching the shallowest depth in 307 m at one of the summits.

The ROV reached the seabed at 426 m water depth at the southern sloping base of the ridge flank. Already here, the seabed is made of coral rubble and framework embedded in muddy sediment. Recognisable fossil corals are *Lophelia pertusa* and to a lesser degree *Dendrophyllia cornigera*. The soft mud matrix is densely colonised by infaunal polychaetes. Widely dispersed are still intact but dead chunks of coral framework acting as hardsubstrate islands for the benthic community (Fig. 5.18B). This general rubble-framework-mud facies continues upslope until 404 m water depth, when massive fossil coral framework dominates the seabed facies. The coral skeletons are clogged with mud and intensely loaded by an organic fluffy layer consisting of dendroid foraminifers, hydroids and other organisms. Underneath this fluffy layer, the skeletons are brownish due to the precipitation of a Fe-Mn coating. Close to the ridge crest at 360 m (and shallower) framework facies becomes very prominent and this is reflected in the increased colonisation density of cnidarians, including live *Lophelia pertusa*, *Madrepora oculata* and solitary corals, sponges and crinoids amongst others (see below). A framework sample (Sample 1) was collected at 353 m. The ROV track followed more or less the ridge crest in NW direction as general heading and thereby the depth progressively becomes shallower as to 307 m.

The benthic community of the deeper mud-rich coral rubble facies is very similar if not identical to the framework facies higher up on the ridge. Major differences are based on the lesser proportion of hardsubstrate provision to the fauna in the deeper part, which results in lesser settling densities of the corresponding fauna. Higher up, the hydrodynamic current regime diminishes sedimentation thus the coral frameworks become exposed thereby providing enormous niches for the modern community. Characteristic elements are gardens of *Acanthogorgia hirsuta* (Fig. 5.18A,C,E) that occurs in close association with white gorgonians and the antipatharian *Parantipathes larix* (Fig. 5.18A,B,G). The latter is present in two colour varieties, a dark red and a pale white one. We saw many examples of necrolysis in *A. hirsuta*. While parts of the colony remain intact and healthy other parts are devoid of polyps and soft tissue. Instead the actinian *Amphianthus dohrni* and hydroids settle on the hard and stick-like gorgonian central axes of the skeleton (Fig. 5.18C).

The scleractinian community is locally common but always confined to the crest or near-crest environment. We documented denser aggregations of *Lophelia* and *Madrepora* but very rare, live *Dendrophyllia cornigera* (Fig. 5.18D). Apparently, the live *Lophelia* and *Madrepora* colonies are hardly larger than 15-20 cm if not smaller in average (Fig. 5.18A,B,D). Based on our knowledge on growth rates of both corals, we can assume that the recent recolonisation of white corals is ongoing and probably peaked during the last decade. *Lophelia* occurs with two colour varieties, white (very abundant) and red (rare) (Fig. 5.18A,B). The deepest occurrence of live *Lophelia* was encountered at 365 m water depth and that of *Madrepora* at 353 m depth (Sample 2: live *Madrepora*). Sample 3 was a live *Lophelia* from 349 m water depth. Other common cnidarians are hydroids, which are difficult to identify on ROV images but this group is often colonising dead portions of scleractinians and gorgonians. One alcyonarid octocoral was recorded and few cerianthids and anemones.

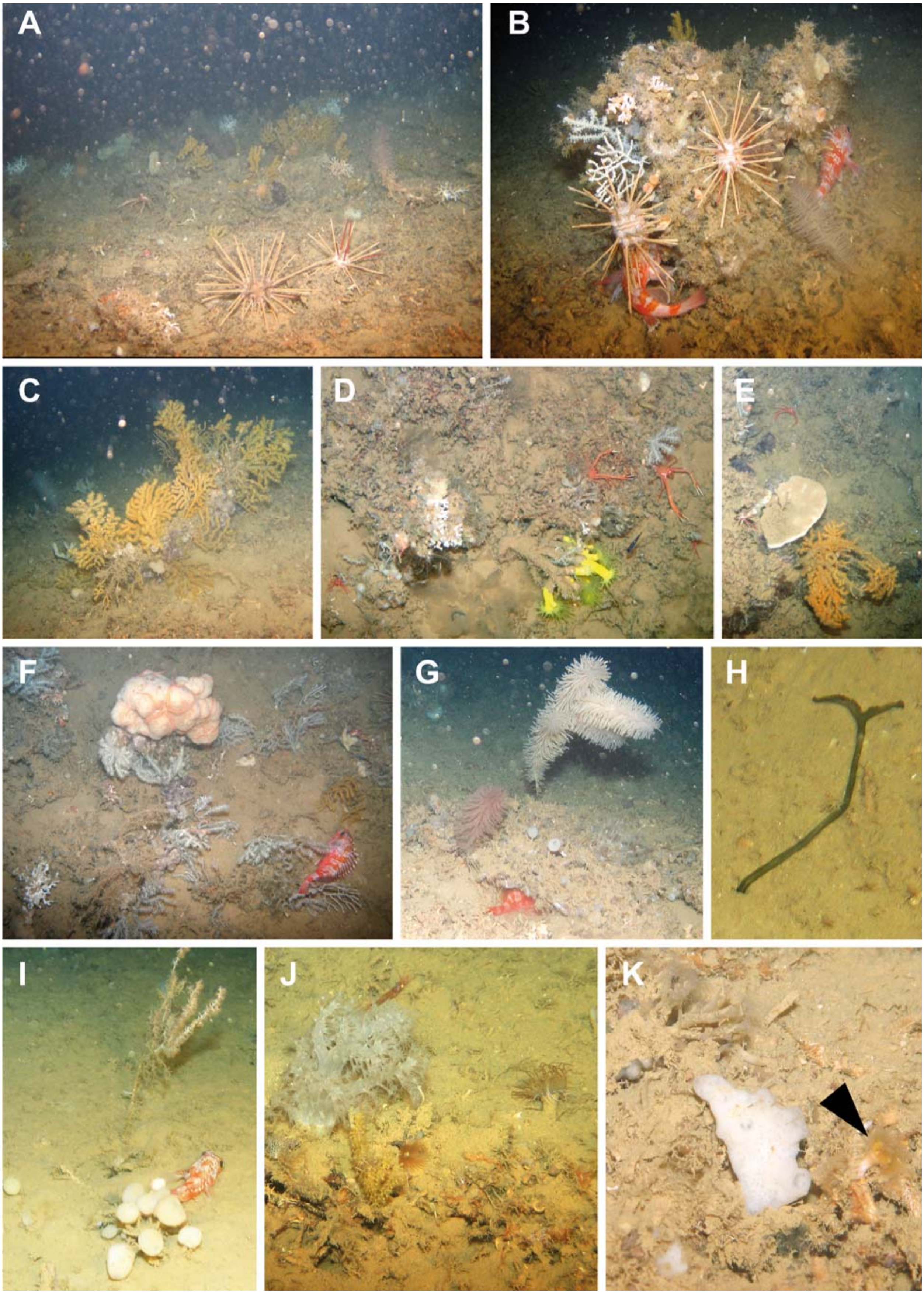


***Fig. 5.18** ROV images of Dive 6 (GeoB 13727-1). **A** Lateral view of the ridge crest framework habitat with many* Acanthogorgia hirsuta *(brown colonies) the bottle-brush-shaped* Parantipathes larix, *sponges, galatheid squat lobsters and grazing* Cidaris *sp. The speckled white colonies are live* Lophelia *with both colour varieties (-310 m). **B** Exposed coral framework representing a "biodiversity hotspot" with white gorgonians, red colour variety of* Lophelia pertusa, A. hirsuta, *masses of hydroids and several* Desmophyllum dianthus. *A* P. larix *colony lives right of this exposure. Two* Helicolenus dactylopterus *seek shelter while two* Cidaris *graze upon the framework (-326 m). **C** An* A. hirsuta *garden has established on exposed dead coral framework. Note that necrotic parts of some gorgonian colonies are colonised by* Amphianthus dohrni *and hydroids. Other organisms visible are crinoids and sponges (-315 m). **D** Live* L. pertusa *and* Dendrophyllia cornigera *colonies within dead framework rich in galatheid squat lobsters. Note the myctophid fish (-310 m). **E** Large lobate sponge next to* A. hirsuta. *Note that small morphological edges are preferred resting sites for crinoids (-316 m). **F** White gorgonian garden with live and dead colonies and a large massive sponge, providing habitat for ophiuroids. Other organisms visible,* H. dactylopterus, A. hirsuta, *shrimp, galatheid,* D. dianthus, L. pertusa, *sponges (-308 m). **G** Two colour varieties of* P. larix *colonies with stalked and encrusting sponges and a crinoid. Note* H. dactylopterus *hiding underneath the framework slab (-318 m). **H** Proboscis of the female echiurid* Bonellia viridis *often seen in the muddy coral rubble facies (-367 m). **I** Aggregation of another type of stalked sponges with* H. dactylopterus *and an almost dead gorgonian colony (-358 m). **J** Muddy coral rubble facies with an alcyonian colony, a small* A. hirsuta, *several cerianthids, bryozoans and a shrimp. Note the defacating ascidian near the right hand side of the alcyonarian (-312 m). **K** Probably a hexactinellid sponge next to* D. dianthus *with expanded polyps (arrow) (-316 m).*

Another important group are the sponges. *Rossella nodastrella* was very rare and if present, only immature (in the sense of small) specimens were imaged. *Rhizaxinella pyrifera* colonises the muddy matrix sediment in the framework facies, while another type of stalked sponges always forms groups, which are attached to exposed coral framework (Fig. 5.18I). Most of the sponges are small and often encrusting forms, which are difficult to discern on the images. A particular sponge seems to be successful in entirely overgrowing live *Lophelia*. Very important habitat is provided in the exposed coral framework, which resembles biodiversity hotspots. This habitat is attractive for a diverse group of all the before mentioned invertebrates, for crinoids and fish. The latter group was often found in little hollows and caves underneath these frameworks. Crinoids occur in different colours if not species but are confined to the crest environment. The most common echinoid is *Cidaris* sp. that locally forms mass occurrences. Ophiuroids are very common and were often found on sponges (Fig. 5.18F). Holothurians were present as some echiurids belonging to *Bonellia viridis* (Fig. 5.18H). Crustaceans occurred all over the dive track with galatheid crabs as the most abundant group, followed by pandalid shrimps and the crab *Bathynectes maravigna*. In one occasion, we documented the lobster *Palinurus mauritanicus* (see Fig. 5.19J). The fish community is quite diverse but sharks were not encountered. The most common species is *Helicolenus dactylopterus* which was recorded on the open coral rubble mud grounds but also hiding in the coral framework habitat (Figs. 5.18B, 5.20C,D). Macrourids were also common with *Nezumia* sp. and *Coelorinchus caelorhincus* (Fig. 5.20F). In the coral framework habitat *Capros aper* (Fig. 5.21E) and *Pagellus bogaraveo* (Fig. 5.20G) were photographed for the first time on this cruise. Most abundant were swarms of small myctophid fishes (Fig. 5.20A,B,F). Anthropogenic impact is very low and only one lost raincoat was recorded.

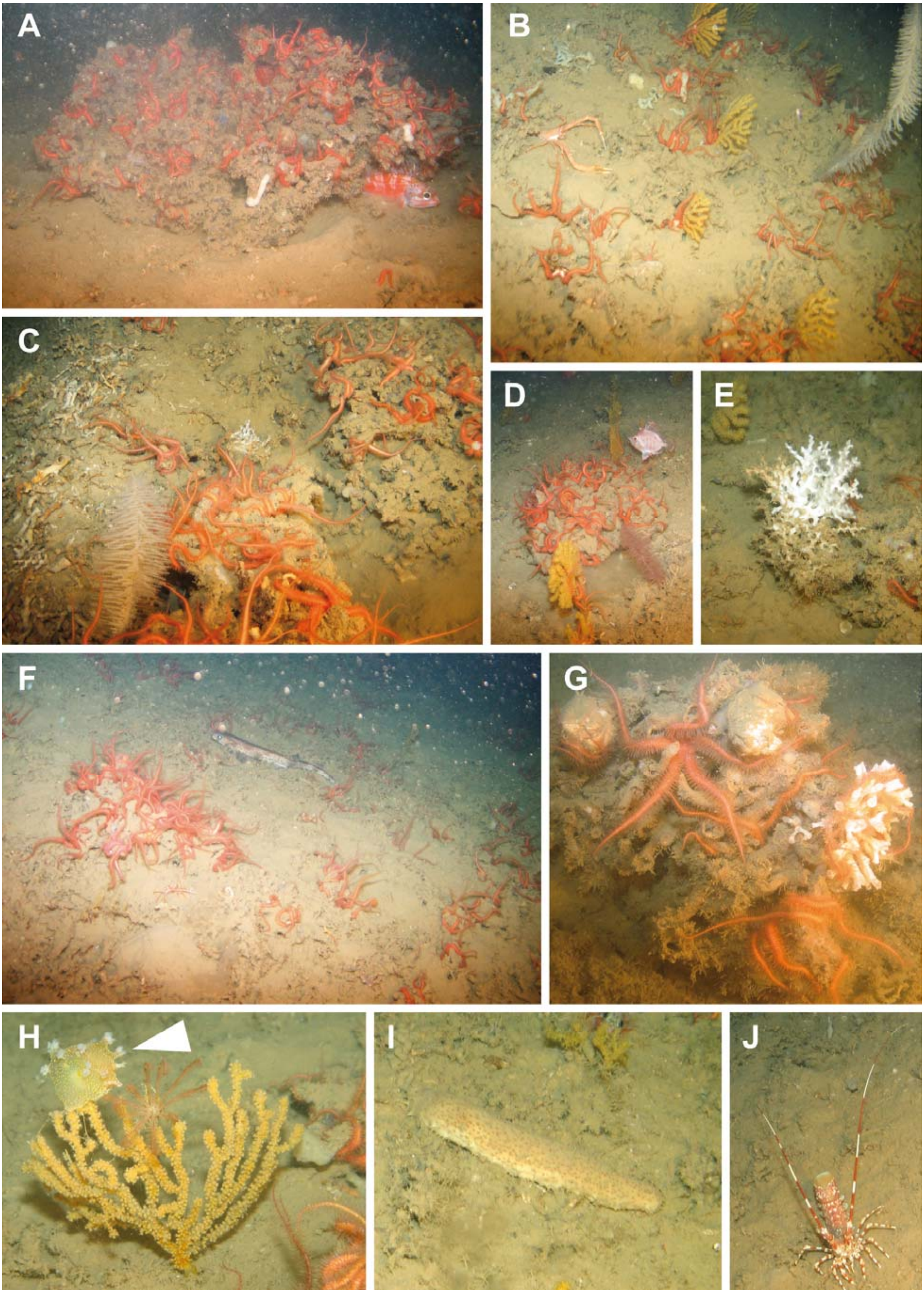


Fig. 5.19** ROV images of Dive 7 (GeoB 13737-1). **A** Large* Lophelia *framework slab with masses of* Ophiothrix fragilis *and a* Helicolenus dactylopterus *(-312 m). **B** Small colonies of* Acanthogorgia hirsuta *facing their fan-shaped colonies against the current. Other organisms visible are* Parantipathes larix, *a galatheid crab and* O. fragilis *(-300 m). **C** Trawl mark in the framework facies. Note the thick calcified fossil* Lophelia *skeletons, a dead but still white* Lophelia *colony and* P. larix *(-298 m). **D** Framework slab packed with hidden* O. fragilis *waving their arms*, A. hirsuta *and* P. larix. *Note the boarfish* Capros aper *(-296 m). **E** A live colony of* Madrepora oculata *(-297 m). **F** The shark* Scyliorhinus canicula *rests on the seabed surrounded by* O. fragilis *(-300 m). **G** Fossil* Lophelia *framework with a small freshly died* Lophelia *colony and two ascidians. Note the behaviour of the plankton feeding* O. fragilis *(-301 m). **H A. hirsuta *colony being grazed by a nudibranch (arrow). A crinoid rests on this colony (-299 m). **I** A common holothurian (-300 m). **J** The lobster* Palinurus mauritanicus *(-297 m).*

◇ ROV Dive 7 (GeoB 13737-1) ◇ Brittlestar Ridge III

◇ start: 35°27.98'N, 02°33.94'W, 356 m water depth
◇ end: 35°28.18'N, 02°33.39'W, 290 m water depth
◇ heading: SW-NE; track length: 2,760 m

The objective of Dive 7 was to compare another coral ridge belonging to the same system of ridges as of Dive 6. The target was Brittlestar Ridge III. The dive was carried out almost along the crest of the ridge.

The sedimentary facies are comparable to the previous dive, with muddy coral rubble in the deeper flank area which steadily merges into a dead coral framework facies upslope. In addition, exposed carbonate hardground slabs were occasionally encountered (Fig. 5.20C). By far the framework is dominated by *Lophelia pertusa*, whereas *Madrepora* or *Dendrophyllia* were hardly visible. We crossed several trawl marks, which deeply dug into the framework facies, thereby having upwarped fossil coral skeletons of *Lophelia* solely. As on the present surface environment, the *Lophelia* skeletons are thickly calcified, compared to small and thin calcified live colonies. Findings of deep-sea oyster were rare with one confirmed fossil valve in 300 m and a conspicuous finding still attached on a coral framework at 295 m water depth. The exposed fossil coral framework slabs reached greater dimensions compared to Dive 6. Some attained widths up to 150 cm and thicknesses up to 80 cm (Fig. 5.19A).

The benthic community found in Dive 7 matches well with those of Dive 6, except the apparent presence of a thickly spined red *Ophiothrix fragilis*. This ophiuroid forms a real mass occurrence in the coral framework facies. Generally their central discs are hidden underneath the corals or the sediment, while their arms stretched out into the water column (Fig. 5.19A-G). As mentioned before, the other key species are the same on both dives but the general impression is a much lesser colonisation density here, compared to Dive 6. The same holds true for the occurrence of live *Lophelia* and *Madrepora* colonies, which are less abundant on this ridge but also did not exceed sizes larger than 20 cm in height (Fig. 5.19E,G). The gorgonian *Acanthogorgia hirsuta* and the antipatharian *Parantipathes larix* do form larger aggregations on the crest only (Fig. 5.19B,C), while the size of *A. hirsuta* colonies is much smaller compared to Dive 6 in average. We documented a nudibranch gastropod grazing on an *A. hirsuta* colony (Fig. 5.19H). Other organisms found here were holothurians (Fig. 5.19I), ascidians (Fig. 5.19G) and the lobster *Palinurus mauritanicus* (Fig. 5.19J). We sampled dead coral framework with *Ophiothrix fragilis* at 299 m (Sample 1) and a live *Madrepora* colony at 297 m water depth (Sample 2).

The fish and shark community consist of *Scyliorhinus canicula* (Fig. 5.19F) and the macrourid *Coelorinchus caelorhincus* (Fig. 5.20F). Very abundant was *Helicolenus dactylopterus* in the framework facies. In one occasion, we saw seven individuals seeking shelter underneath a big hardground slab (Fig. 5.20C). At another site, two *H. dactylopterus* and one *Phycis blennoides* were found crowded together in a framework cave (Fig. 5.20D). *Capros aper* was more frequent here than in Dive 6 (Fig. 5.20E). All over the track, swarms of myctophids were swimming around the ROV, certainly attracted by the light (Fig. 5.20A). We saw a *Bathynectes maravigna* catching a myctophid and digesting it (Fig. 5.20B). Anthropogenic impact was evident through some deep trawl or dredge marks. Litter was not observed during this dive.

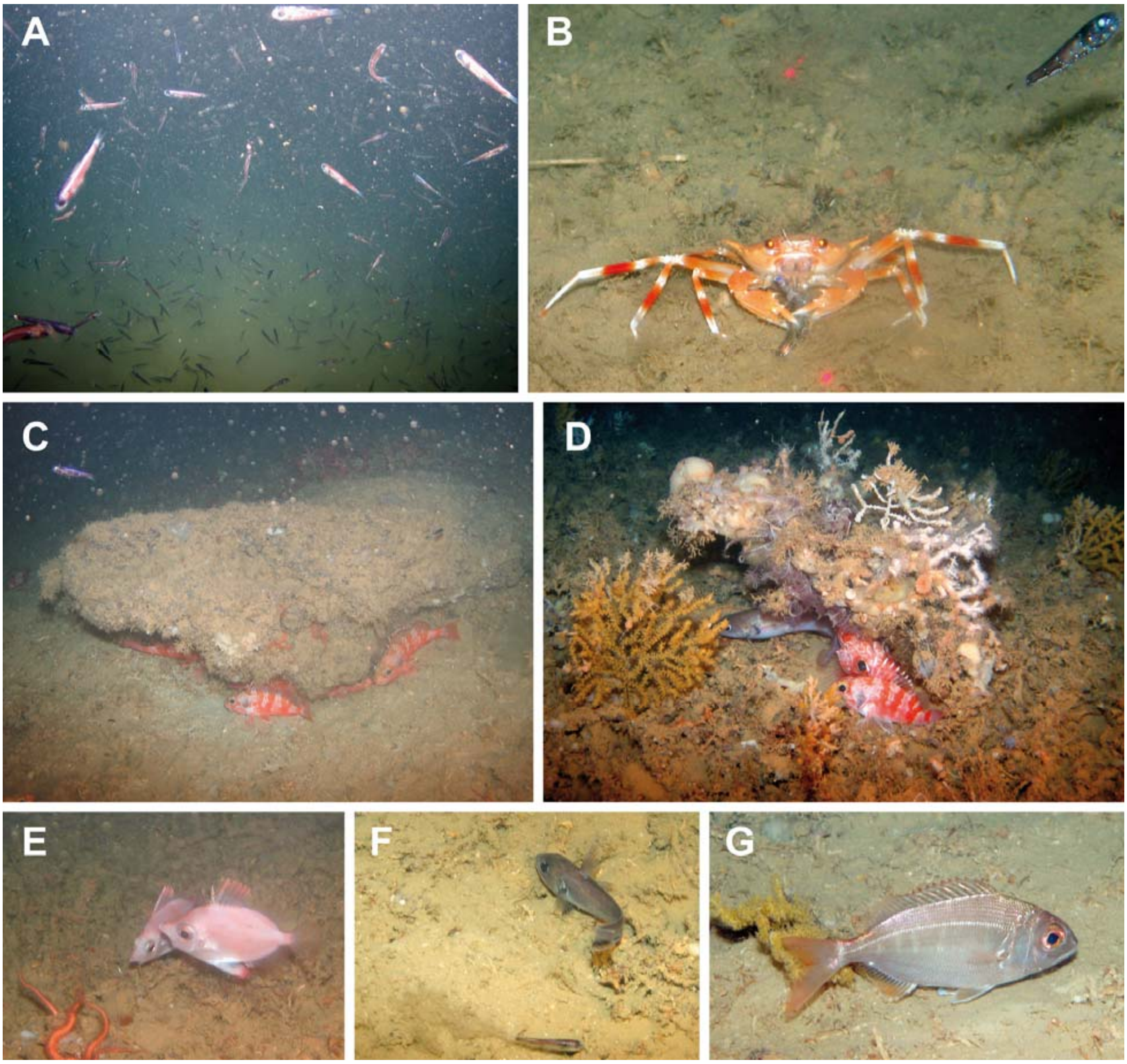


Fig. 5.20 *The fish community of Dive 6 (GeoB 13727-1) and Dive 7 (GeoB 13737-1).* ***A*** *Swarm of myctophid fishes (Dive 6, -426 m).* ***B*** Bathynectes maravigna *digesting a myctophid. Note another myctophid in the upper right (Dive 6, -424 m).* ***C*** *Seven* Helicolenus dactylopterus

hiding underneath and close to an exposed hardground slab (Dive 7, -297 m). ***D*** *Fossil coral framework acting as biodiversity hotspot with gorgonians,* Desmophyllum dianthus *and* Lophelia pertusa*. Note the aggregation of three fishes, one* Phycis blennoides *and two* H. dactylopterus *underneath the framework (Dive 6, -328 m).* ***E*** *Two* Capros aper *close to* Ophiothrix fragilis *(Dive 7, -297 m).* ***F*** *A macrourid, probably* Coelorinchus caelorhincus *and a myctophid fish (Dive 6, -316 m).* ***G*** *Nice photography of* Pagellus bogaraveo *(Dive 6, -315 m).*

Box corer sampling (Claudia Wienberg & Lydia Beuck)

<table>
<tr><td colspan="2">GeoB 13734-1 (Banc de Provencaux)</td><td colspan="2">Sample</td></tr>
<tr><td colspan="2">surface</td><td>MAR</td><td>GZN</td></tr>
<tr><td>
</td><td>sediment/colour:
olive grey (5Y4/2) foram sand with dark glauconitic (?) grains and shell debris, surface is mottled by worm tubes

live fauna:
/

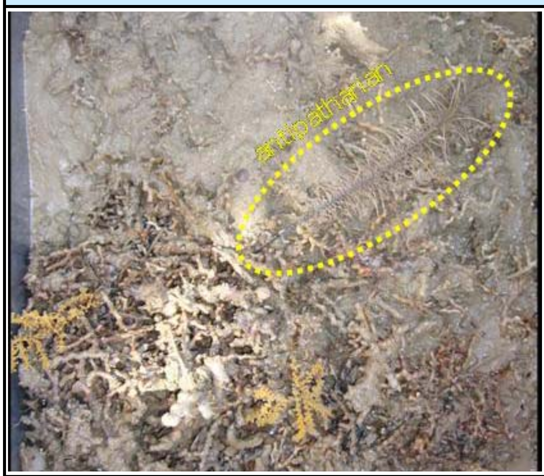
components:
large Nummulit, pteropods

corals:
/</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">sediment column: 23-31 cm</td><td>MAR</td><td>GZN</td></tr>
<tr><td>
</td><td>sediment/colour:
sediment is gradually changing from olive grey (5Y4/2) to dark grey (5Y4/1) foram sand

live fauna:
polychates

components:
abundant gastropods, otoliths, echinoid spines and plates, foraminifera, bivalves, sponge spicules, coral fragments, agglutinated worm tubes, pteropods

corals:
solitary corals (?Caryophyllia)</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">Remarks: slightly tilted</td><td></td><td></td></tr>
</table>

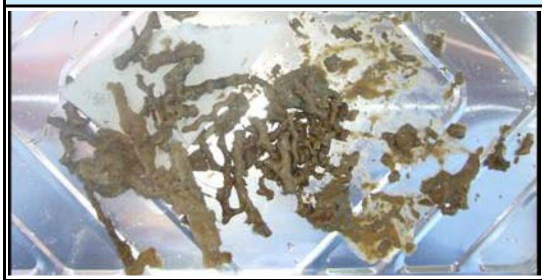
<table>
<tr><td colspan="2">GeoB 13728-1 (Brittlestar I)</td><td colspan="2">Sample</td></tr>
<tr><td colspan="2">surface</td><td>MAR</td><td>GZN</td></tr>
<tr><td>
</td><td>sediment/colour:
olive brown (2.5Y4/4) foram sand

live fauna:
antipatharian (Parantipathes), ophiuroids, sponges, Acanthogorgia hirsuta, crustaceans (amongst Monodaeus guinotae and Munida), serpulids, hydrozoans, bryozoans, Gnathiidae, Caryophyllia

components:
brachiopods, bivalves (Pecten), gastropods, pteropods

corals:
Madrepora</td><td>X</td><td>X</td></tr>
</table>

sediment column: 10-20 cm		MAR	GZN
	**sediment/colour**: sediment is gradually changing from olive brown (2.5Y4/4) foram sand to olive (5Y5/3) silty sand **live fauna**: / **components**: bivalves, coral fragments, bryozoans, gastropods, otoliths **corals**: abundant (!) *Madrepora* with eunicid worm tubes, some *Lophelia* and *Dendrophyllia*, *Desmophyllum*, *Caryophyllia*	-	-
Remarks: tilted			

GeoB 13725-2 (Brittlestar Ridge II)		Sample	
surface		MAR	GZN
	**sediment/colour:** silty sand **components:** / **corals:** *Madrepora*	-	-
Remarks: very few sediment, corals			

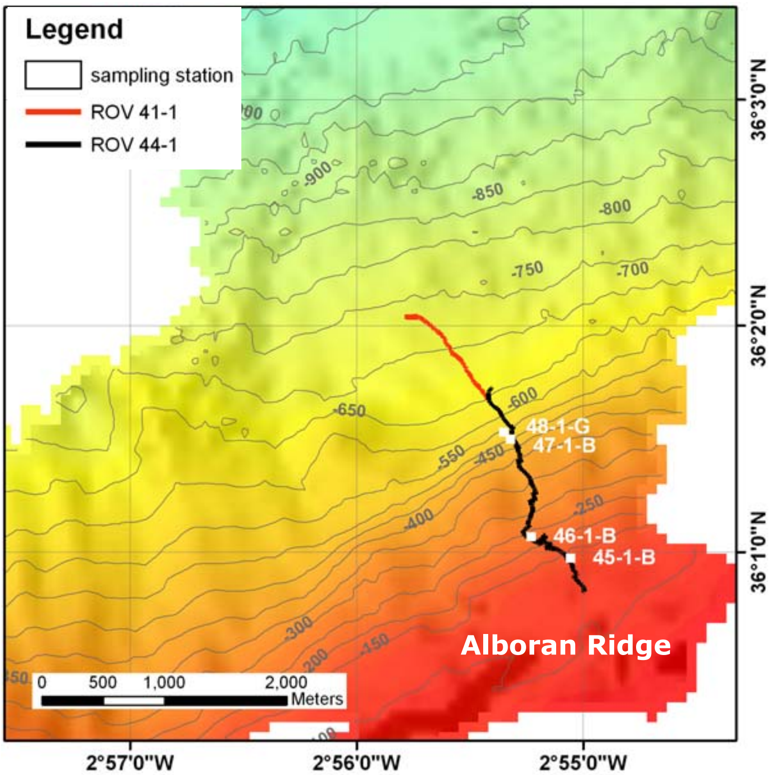
GeoB 13735-1 (Brittlestar Ridge III)		Sample	
surface		MAR	GZN
	**sediment/colour**: olive brown (2.5Y4/4) foram sand mottled by worm tubes **live fauna**: polychaetes, hydrozoans, crustaceans **components**: shell debris, gastropods, echinoid spines **corals**: very few *Madrepora*	X	X
sediment column: 10-21 cm		MAR	GZN
	**sediment/colour**: sediment gradually changes from olive brown (2.5Y4/4) foram sand to olive grey (5Y5/2) silty sand, large coral fragments are surrounded by grey (5Y5/2) clay **shells**: bryozoans, foraminifers, bivalves, otoliths, gastropods, pteropods, brachiopods, serpulids, echinoid spines, *Cidaris* **corals**: *Madrepora*, *Lophelia*	X	X

5.5 ◇ Alboran Ridge & Adra Ridge

The SW-NE trending Alboran Ridge is located in the southeast of the Alboran Channel. With a length of 150 km and a height of up to 1,700 m it is one of the most distinct topographic features in the Alboran Sea (Muñoz et al. 2008). The crest of the ridge is situated in ~100 m water depth. Mound-like features on top of the ridge were interpreted as coral mounds, although up to this cruise this assumption could not be proved by faunal or sediment samples (Muñoz et al. 2008). The much smaller Adra Ridge is situated in the northeast of the Alboran Channel.

Bathymetric map and stations (Paul Wintersteller & Lydia Beuck)

During cruise *POS 385*, we mapped parts of the Alboran and Adra Ridges. But solely the Alboran Ridge was target of further video observation and sediment sampling (Map 3). The northern slope of the Alboran Ridge was surveyed with two ROV dives both belonging to one track line. Two of four box coring attempts were successful and a gravity core of 28 cm length was recovered (Map 3).



***Map 3** Northern slope of the Alboran Ridge. ROV track lines and positions of gravity core (G) and box cores (B) are indicated.*

Video observation (Lydia Beuck & André Freiwald)

◇ ROV Dive 8 (GeoB 13741-1) ◇ Alboran Ridge

◇ start: 36°02.05'N, 02°55.80'W, 747 m water depth
◇ end: 36°01.65'N, 02°55.41'W, 649 m water depth
◇ heading: NW-SE; track length: 1,545 m

The sediment is a heavily bioturbated mud throughout the entire ROV track line. The benthic community is dominated by polychaetes, benthic foraminifers and cerianthids as major elements. Noteworthy is the frequent occurrence of the large asteroid *Brisingella* sp. (Fig. 5.21A). We recorded a holothurian sticked with shells and mud on its skin (Fig. 5.21B). As already observed from other dive locations, also this sea cucumber carries an ophiuroid. Near the end of the dive, we saw some well-cleaned bones on the seabed. *Phycis blennoides* was one of the few fishes observed.

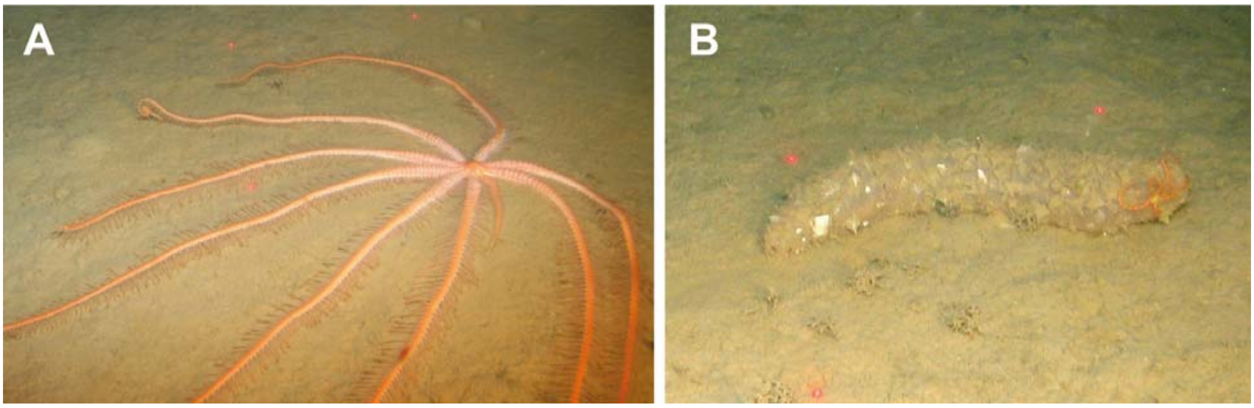


Fig. 5.21 *ROV images of Dive 8 (GeoB 13741-1).* ***A*** Brisingella sp. *(-691 m).* ***B*** *Armoured holothurian (-598 m).*

◇ ROV Dive 9 (GeoB 13744-1) ◇ Alboran Ridge

◇ start: 36°01.71'N, 02°55.44'W, 664 m water depth (continuation of Dive 8)
◇ end: 36°00.79'N, 02°55.01'W, 110 m water depth
◇ heading: NW-SE; track length: 8,992 m

The bioturbated mud facies of Dive 8 continued upslope until 548 m water depth (Fig. 5.22), when first *Lophelia* rubble and larger framework chunks became visible measuring up to 70 cm in length. These thick calcified fossil skeletons were Fe-Mn-coated. The background mud sediment is still accumulating on the fossil corals. At 542 m depth, the first fossil and dislocated deep-sea oysters appeared. Slightly higher up at 539 m, a metre-sized *Lophelia* framework lies on its side and provides substrate for live *Lophelia* and *Madrepora* colonies (Fig. 5.23B). This belt of fossil coral framework fades off at 538 m water depth and bioturbated mud is developed again until 502 m water depth. At this depth, volcanic basement in form of submarine effusive basalt crops out. This kind of hardsubstrate was colonised by *Spondylus gussoni* and at 497 m, by large stacks of *Neopycnodonte zibrowii* (Fig. 5.23C-D). A deep-sea oyster sample was taken at 495 m water depth (Sample 1). The preservation condition of the oysters indicates a fossil state but two specimens seem alive. In the depth interval 493 to 477 m the slope becomes less steep, thus allowing fine-grained sedimentary detritus to settle.

From 476 to 462 m water depth, another volcanic basement escarpment is developed, again packed with fossil deep-sea oysters. The nature of these volcanics is different from the deeper one as these seem to be much more friable and tend to loose contact with the basement, hence tumbling downslope at times. Upslope another belt of bioturbated mud continues to a depth of 452 m, when again volcanic boulders start piercing through the mud. From 452 m to 430 m, a belt of fossil *Dendrophyllia* rubble and framework is present

(Fig. 5.23A,E). The framework size culminates at 426 m, were we collected a larger chunk (Sample 2). At this depth, we noticed the deepest occurrence of *Dendrophyllia cornigera* (Fig. 5.23F). At 416 to 415 m depth a small terrace made of platy rocks (carbonates?) is developed, on top of which more *Dendrophyllia* rubble and framework had accumulated. Small live *Lophelia* colonies appeared at 404 m depth (Sample 3) attached to fossil corals (Sample 4) (Fig. 5.23G). In this depth live caryophyliids with dark red tentacles became more frequent (Fig. 5.23I). From 398 m upslope, muddy bioturbated sand plains dominate the scene, interrupted by small patches of coral rubble here and there. The amount of white skeletal grains steadily increases towards shallower depths. At latest at 322 m depth, the bioturbated sand facies is fully developed and larger tests and valves of clams, brachiopods and sea urchins increased in numbers. A sudden change occurred at 286 m when fossil valves of *Gryphus vitreus* form accentuated shell plasters on the seabed (Sample 5 at 269 m water depth) (Fig. 5.24E-G).

At 245 m depth, fossil maerl-type coralline algal pieces were admixed with the brachiopod shells (Fig. 5.24I). A change in dominance towards the fossil coralline facies with less amounts of *Gryphus* shells can be noted at 216 m water depth and at 193 m depth, the brachiopods fade off as sediment component. The fossil maerl and rhodolith facies is traceable until 142 m water depth and latest at 138 m, the maerl merges into a bryozoan-mollusc facies (Fig. 5.24K). This bryomol facies is well recognisable because of the rigid, branched bryozoan colonies. In a narrow depth interval from 138 to 133 m, the bryomol sediment is loaded with fossil *Modiolus* shells, almost in concave-up position (Fig. 5.24K). *Modiolus modiolus* does not occur in the present Mediterranean Sea but is known as 'boreal guest' during the late glacial maximum, about 15,000-18,000 years ago. At present, *M. modiolus* lives in the shallow subtidal northern North Atlantic. Interestingly, the depth of the fossil maerl matches with the depth of the fossil rhodoliths documented from the Malaga Mounds (Dive 3).

The benthic community is quite diverse along the entire ROV survey. The deeper bioturbated mud habitat is inhabited by infaunal polychaetes with filtering threads cerianthids, with a violet or dark red tentacle ring and by burrowing crustaceans. *Kophobelemnon* cf. *leuckarti* is a common element (Fig. 5.22B). Small translucient holothurians and shell-armoured holothurians were observed and in one case few crinoids and a *Cidaris* sp.

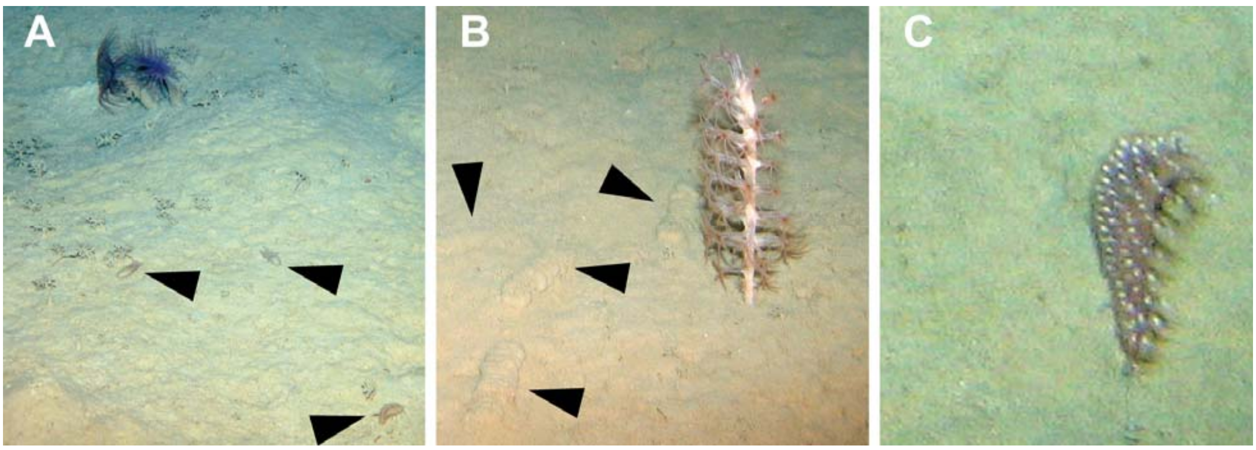


Fig. 5.22 *Bioturbated mud facies and faunal aspects of Dive 9 (GeoB 13744-1).* ***A*** *Two cerianthids and sediment-dwelling polychaetes with threads sticking out. Note numerous small holothurians (black arrows) (-575 m).* ***B*** Kophobelemnon *cf.* leuckarti*. Note the large holothurian fecal pellets (black arrows) (-602 m).* ***C*** *The sea pen* Pennatula phosphorea *(-570 m).*

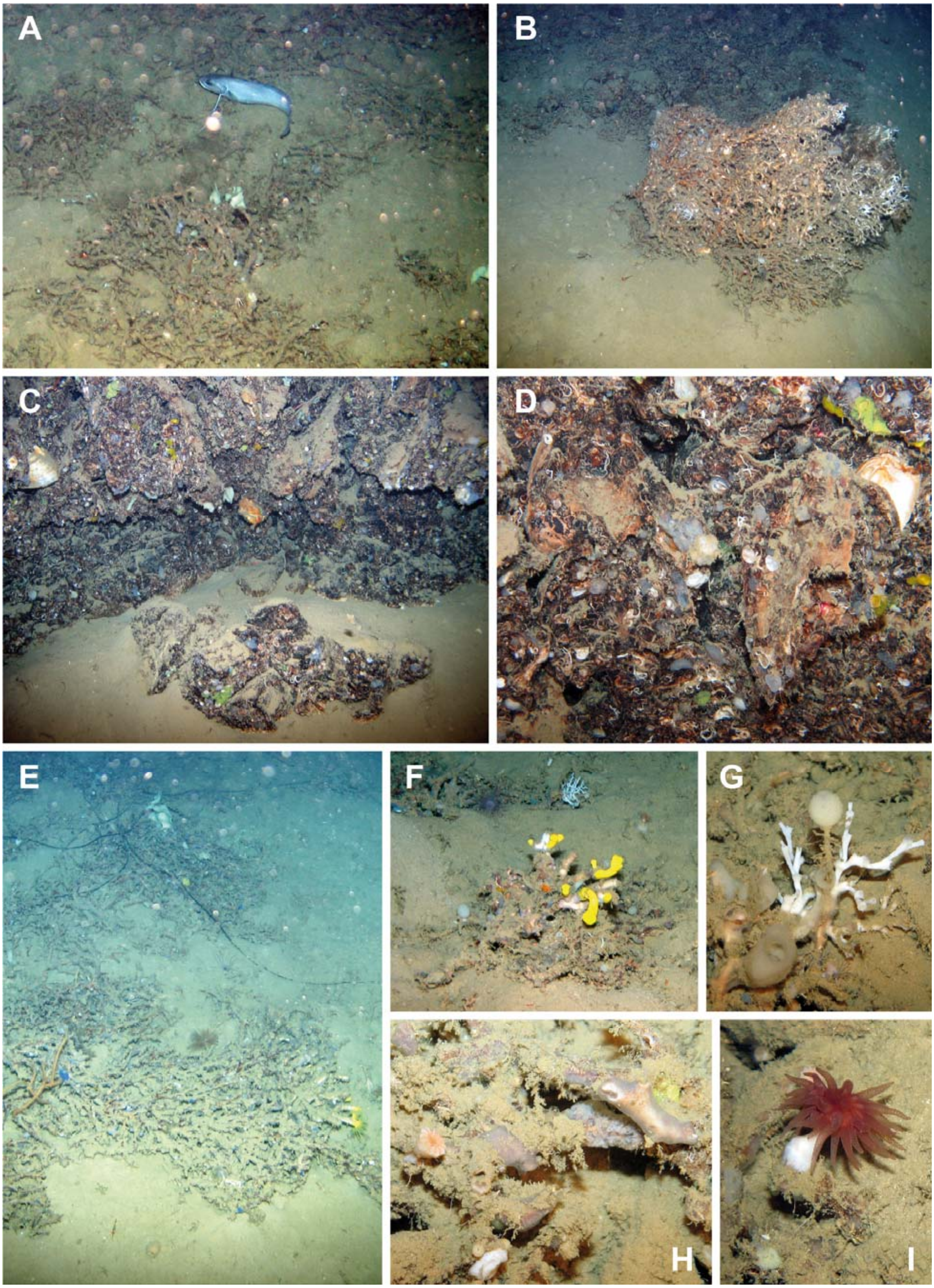


Fig. 5.23 *Coral framework and deep-sea oyster facies and faunal aspects of Dive 9 (GeoB 13744-1).* ***A*** *Fossil* Lophelia *framework and rubble with* Phycis blennoides *and small sponges (-436 m).* ***B*** *Large chunk of* Lophelia *framework with recolonisation of live* Madrepora oculata *and* Lophelia pertusa *(-539 m).* ***C*** *Volcanic outcrop with Fe-Mn-*

patinated stacks of live and dead (majority) Neopycnodonte zibrowii. *The coloured spots represent sponges (-497 m).* ***D*** *Close-up of several* N. zibrowii *with intense colonisation with* Spondylus gussoni, *sponges and serpulids (-497 m).* ***E*** *Fossil* Dendrophyllia *framework with sparse live* D. cornigera *polyps. Note the many blue and white sponges and the antipatharian colony, probably* Antipathes fragilis*. A lost long line has landed on the framework (-423 m).* ***F*** *Live* D. cornigera*. Also visible is a live* M. oculata, *a cerianthid and several sponges (-423 m).* ***G*** *A young* L. pertusa *colony with fragile trumpet-shaped corallites next to sponges including a stalked one (-404 m).* ***H*** *Close-up showing a coral skeleton encrusting sponge, a live caryophylliid coral and the organic fluffy layer draping the fossil coral framework (-404 m).* ***I*** *Live caryophylliid coral with expanded tentacles (-404 m).*

The bioturbated sand habitat shows several reddish, spiny holothurians. Higher up in the sand habitat, *Cidaris* sp. becomes more common. We noted a rafted kelp specimen, *Laminaria rodriguezi* in 330 m depth (Fig. 5.24C). A very nice encounter happened in the *Gryphus* shellbed habitat, were we found a specimen of the large and stunning nudibranch *Tethys fimbria* (Fig. 5.24D). From 278 m onward, pale blue cerianthids became steadily abundant (Fig. 5.24G-H). In the shallow part of the ROV track at 160 m, sea pens, *Veretillum cynomorium* (Fig. 5.24B,J) and *Pteroeides spinosum*, were the most common epibenthic organisms.

The hardsubstrate community is confined to the volcanic outcrops and to the fossil coral framework. The megafauna is sparsely developed on the fossil coral framework, except for few larger sponges and temporary guests, such as crinoids, cidaroid urchins and squat lobsters. In one particular case, a *Neopycnodonte zibrowii* was attached to a big *Lophelia* framework chunk. Biodiversity hotspots were not recorded from exposed coral framework. Most organisms are small and encrusting, thus hardly discernible from ROV images. At this scale, sponges, hydroids, serpulids and dendroid benthic foraminifers play a major role in the coral habitat. Triggered through microbial activity, the freshly died coral became coated with a brownish Fe-Mn layer (Fig. 5.23B). The same observations could be made in the dead *Dendrophyllia* framework and rubble habitat. It seems that a larger quantity of blue, encrusting *Hymedesmia* sp. is present. A single colony of *Antipathes* cf. *fragilis* was found attached to dead *Dendrophyllia* in 423 m water depth (Fig. 5.23E). Noteworthy, the few live *D. cornigera* colonies are confined to the dead *Dendrophyllia* facies (Fig. 5.23F). The coral framework facies faded off at 392 m, which is also the shallowest depth with live *Lophelia*. Further upslope, no volcanic basement crops out to provide a settling substrate for the corals.

The third hardsubstrate facies is the just mentioned volcanic basement. Close-up images show a remarkably dense and diverse macro- and micro fauna with sponges, solitary corals, hydroids, serpulids, bryozoans and bivalves (*S. gussoni*) as major groups (Fig. 5.23D).

The megafauna is characterised by some large sponges and few presumingly live *N. zibrowii* in 497 m water depth. Noteworthy, the common gorgonian *Acanthogorgia hirsuta* and the antipatharian *Parantipathes larix* were only found at one site in 404-407 m water depth during this survey. This site showed also highest abundances of crinoids and apparently rich life activity.

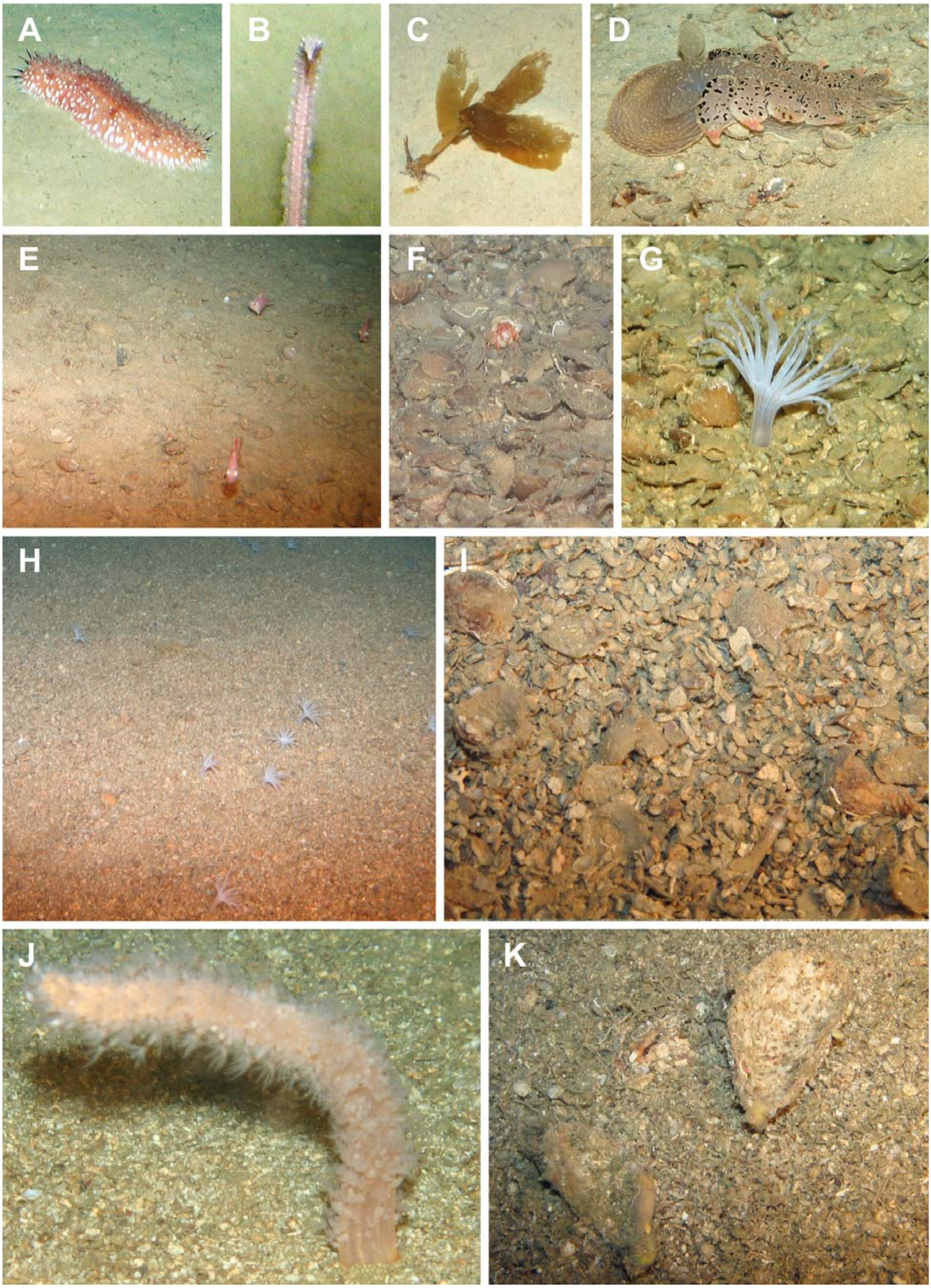


Fig. 5.24 *Bioclastic sand facies and faunal aspects of Dive 9 (GeoB 13744-1).* ***A*** *A common holothurian (-360 m).* ***B*** *A pennatulacean colony (-327 m).* ***C*** *Rafted kelp,* Laminaria rodriguezi *(-330 m).* ***D*** *The large nudibranch* Tethys fimbria *(-270 m).* ***E*** *A group of* Capros aper *over* Gryphus *sand (-264 m).* ***F*** *Close-up of the* Gryphus vitreus *facies. Note the small hermit crab*

(-241 m). ***G*** *Close-up of the common cerianthid in the* G. vitreus *facies (-241 m).* ***H*** *Overview of the common cerianthid density (-340 m).* ***I*** *Transition of* Gryphus *into relict coralline algal facies (-241 m).* ***J*** *Lateral view on* Veretillum cynomorium *in the relict coralline algal facies (-160 m).* ***K*** *Pleistocene valves of* Modiolus modiolus *and modern bryomol facies (-136 m).*

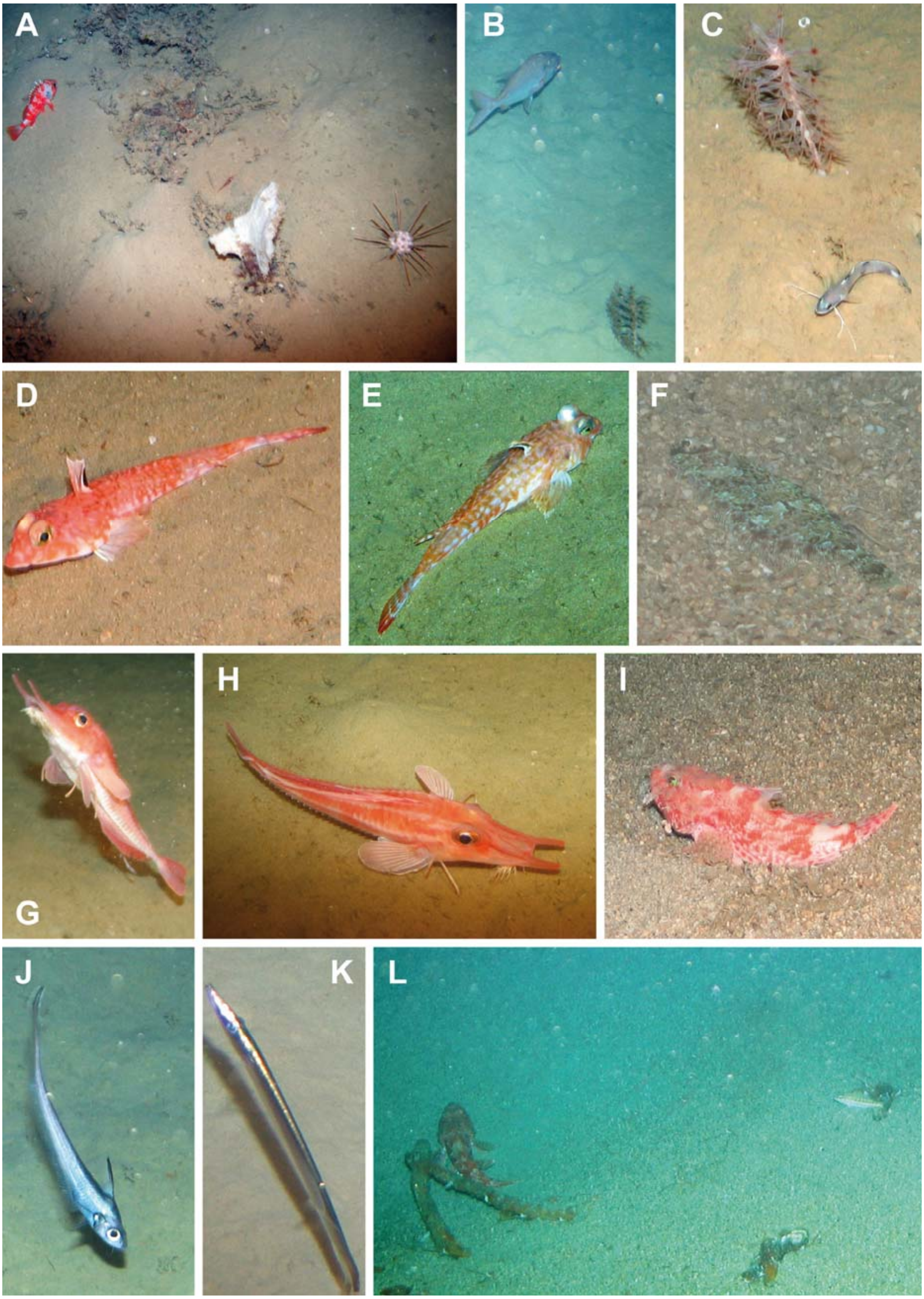


Fig. 5.25** The fish community of Dive 9 (GeoB 13744-1). **A Helicolenus dactylopterus *resting on the seabed next to coral framework. Visible also is a characteristic erect white sponge, shrimps and* Cidaris *sp. (-544 m). **B*** Pagellus bogaraveo *over bioturbated mud with* Kophobelemnon *cf.* leuckarti *(-572 m). **C*** Phycis blennoides *next to* Kophobelemnon *cf.* leuckarti *(-517 m). **D-E*** Synchiropus phaeton *on sand (D: -283 m, E: -328 m). **F*** Arnoglossus *sp. on sand (-217 m). **G-H*** Peristedion cataphractum *on sandy mud (-359 m). **I*** Scorpaena scrofa *on carbonate sand (-193 m). **J** Macrourid fish, probably* Nezumia *sp. (-585 m). **K*** Arctozenus risso *(-645 m). **L*** H. dactylopterus *(left) and* Serranus cabrilla *(right) on bioclastic sand (-18 m).*

The fish and shark community encountered here shows some species not seen before, especially in the shallower part of the dive. In water depths beyond 400 m the following species were recorded: *Arctozenus risso* (common) (Fig. 5.25K), *Helicolenus dactylopterus* (common) (Fig. 5.25A), *Nezumia* sp. (Fig. 5.25J), *Pagellus bogaraveo* (Fig. 5.25B), *Phycis blennoides* (Fig. 5.25C), *Trachyrincus scabrus* and the shark *Scyliorhinus canicula*. In depths shallower 400 m *Helicolenus dactylopterus* was present up to 182 m and *Scyliorhinus canicula* up to 120 m. New species were *Capros aper*, *Peristedion cataphractum* (Fig. 5.25G-H), *Serranus cabrilla* (Fig. 5.25L), *Synchiropus phaeton* (Fig. 5.25D-E), *Arnoglossus* sp. (Fig. 5.25F) and *Scorpaena scrofa* (Fig. 5.25I). Anthropogenic impact was noted in the form of lost long lines and bottles.

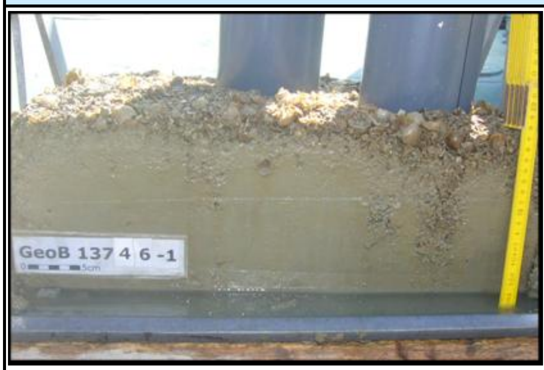
Box corer sampling (Claudia Wienberg & Lydia Beuck)

GeoB 13745-1 (Alboran Ridge, 130m)		Sample	
surface		MAR	GZN
	**sediment/colour**: olive brown (2.5Y4/4) foram sand with mm-sized shell debris **live fauna**: polychaetes, amphipods, bryozoans, scaphopods, gastropods **components**: benthic forams, pteropods, bivalves, gastropods, brachiopods, bryozoans, red algae **corals**: /	X	X
sediment column: 16 cm		MAR	GZN
	**sediment/colour**: <u>0-8 cm</u>: olive grey (5Y5/3) sand getting slightly finer downcore <u>8-16 cm</u>: light olive grey (5Y6/2) coarse sand **components**: <u>0-8 cm</u>: coarse shell debris, gastropods, brachiopods, bivalves, some red algae, bryozoans, rhodoliths, foraminifera, otoliths, sponge spicules, echinoid spines, coal? <u>8-16 cm</u>: abundant red algae, maerl-type corallines, molluscs (*Modiolus*), bryozoans, echinoderms, forams	-	-
Remarks: very slightly tilted; sieving from 0-8 cm and 8 cm-end			

<table>
<tr><td colspan="2">GeoB 13746-1 (Alboran Ridge, 230m)</td><td colspan="2">Sample</td></tr>
<tr><td colspan="2">surface</td><td>MAR</td><td>GZN</td></tr>
<tr><td>
</td><td>sediment/colour:
olive (5Y5/3) sand with shells and shell debris

live fauna:
crab, Miniacina miniacea, bryozoans, serpulids, sponges, small fish, Adamsia palliata on Pagurus prideaux

components:
abundant brachiopods (Gryphus vitreus) encrusted by bryozoans and serpulids, gastropods, bivalves, red algae, crustaceans

corals:
/</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">sediment column: 17 cm</td><td>MAR</td><td>GZN</td></tr>
<tr><td>
</td><td>sediment/colour:
<u>0- 6 cm</u>: olive (5Y5/3) foram sand with shells and shell debris
<u>6-17 cm</u>: olive (5Y4/4) foram sand with less shells than layer above

live fauna:
/

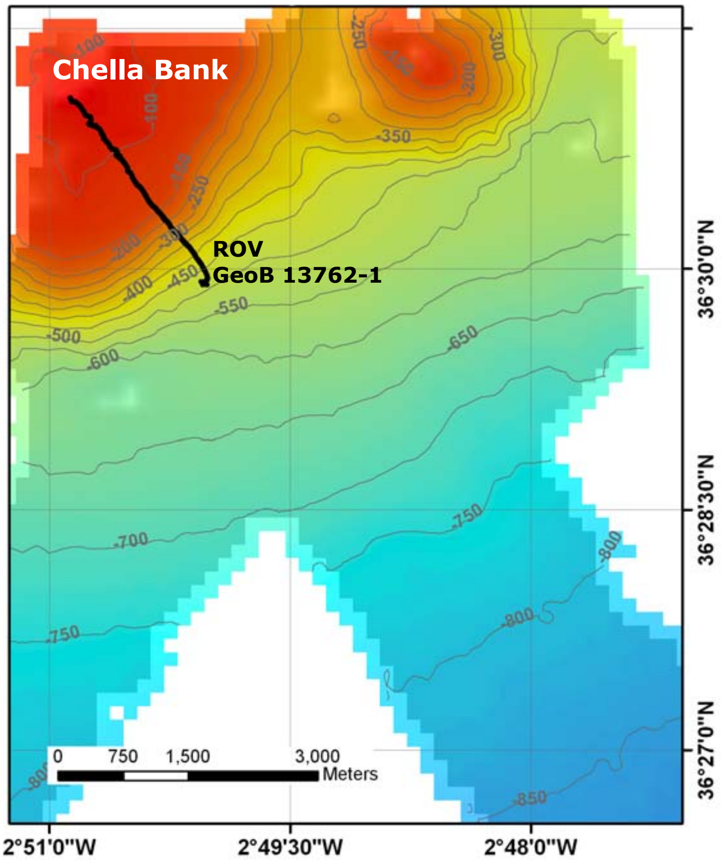
components:
abundant brachiopods (mainly Gryphus vitreus) having an in situ position, gastropods, irregular echinoids, rhodoliths, otoliths, foraminifera, bivalves, bryozoans</td><td>X</td><td>X</td></tr>
</table>

5.6 ◇ Chella Bank

Chella Bank is a seamount that is situated along the Spanish margin of the Alboran Sea, namely along the western slope of the Almería margin. The almost circular and flat-topped seamount is a Neogene volcanic edifice. The top of Chella Bank has a diameter of 2 km, reaches up to a water depth of <100 m and is characterised by a rocky seafloor. Based on acoustic data, it was supposed that patches composed of subfossil cold-water corals cover the seamount (Lo Iacono et al. 2008a). In fact, small fragments of *Madrepora oculata* and *Lophelia pertusa* have been already sampled during previous cruises in water depths between 200 and 400 m (Lo Iacono et al. 2008b).

Bathymetric map and stations ______________(Paul Wintersteller & Lydia Beuck)

On Chella Bank, only mapping (Map 4) and one ROV dive at its SE flank were conducted. During the dive, various faunal samples comprising dead and live rhodoliths, dead *Dendrophyllia* and hard substrate were sampled.



Map 4 *Southern slope of Chella Bank. ROV track line of dive GeoB 13762-1 is indicated.*

Video observation (Lydia Beuck & André Freiwald)

◇ ROV Dive 12 (GeoB 13762-1) ◇ Chella Bank, SE flank

◇ start: 36°29.97′N, 02°50.02′W, 497 m water depth
◇ end: 36°31.13′N, 02°50.87′W, 76 m water depth
◇ heading: SE-NW; track length: 16,456 m

The dive began in bioturbated mud facies in 497 m water depth, which continued upslope until about 320 m depth, when the sediment became apparently coarser. The deeper mud facies was intensely trawled. Characteristic sessile fauna consists of cerianthids and few *Kophobelemnon* cf. *leuckarti* but it was quite impoverished in terms of density compared to the previous dives. The benthic mobile fauna consisted of some *Nephrops norvegicus* solely. The fish community was dominated by macrourids and *Helicolenus dactylopterus*. Occasionally, sharks, *Arctozenus risso*, *Phycis blennoides*, *Synchiropus phaeton* and an octopus were recorded.

The sand facies shallower than 320 m water depth begun with a rippled area in 308 m depth. The ripples seemed to be older and were flattened already. Going upslope, the sand nature of the sediment became steadily coarser and bioclastic components were admixed with dark components, probably of basement origin. We sampled dead chunks of *Dendrophyllia* at 218 (Sample 1) and at 189 m (Sample 2) water depth. We have not noted a mature coral framework facies. Sample 3 was a colonised bottle sampled in 143 m water depth. From 137 m water depth onward, dead coralline algal constructions became more and more prominent. A small piece of coralligene-type algal nodule was collected from this depth (Sample 4). Larger, about 0.5-m-high, in situ blocs of coralligene were surveyed in 125 m water depth (Fig. 5.26A-B). These blocs provide substrate for a very diverse hardsubstrate community consisting of live *Dendrophyllia cornigera* (Sample 5), many caryophylliid solitary corals, several serpulid species, bryozoans, hydroids, ascidians, gorgonians and alcyonarians (Fig. 5.27A-B,D). In the adjacent soft bottom, a *Bonellia viridis* was present. Two fish species, *Serranus cabrilla* (Fig. 5.26A) and a yet not identified second one (Fig. 5.26B) evidently used the coralligene as a habitat.

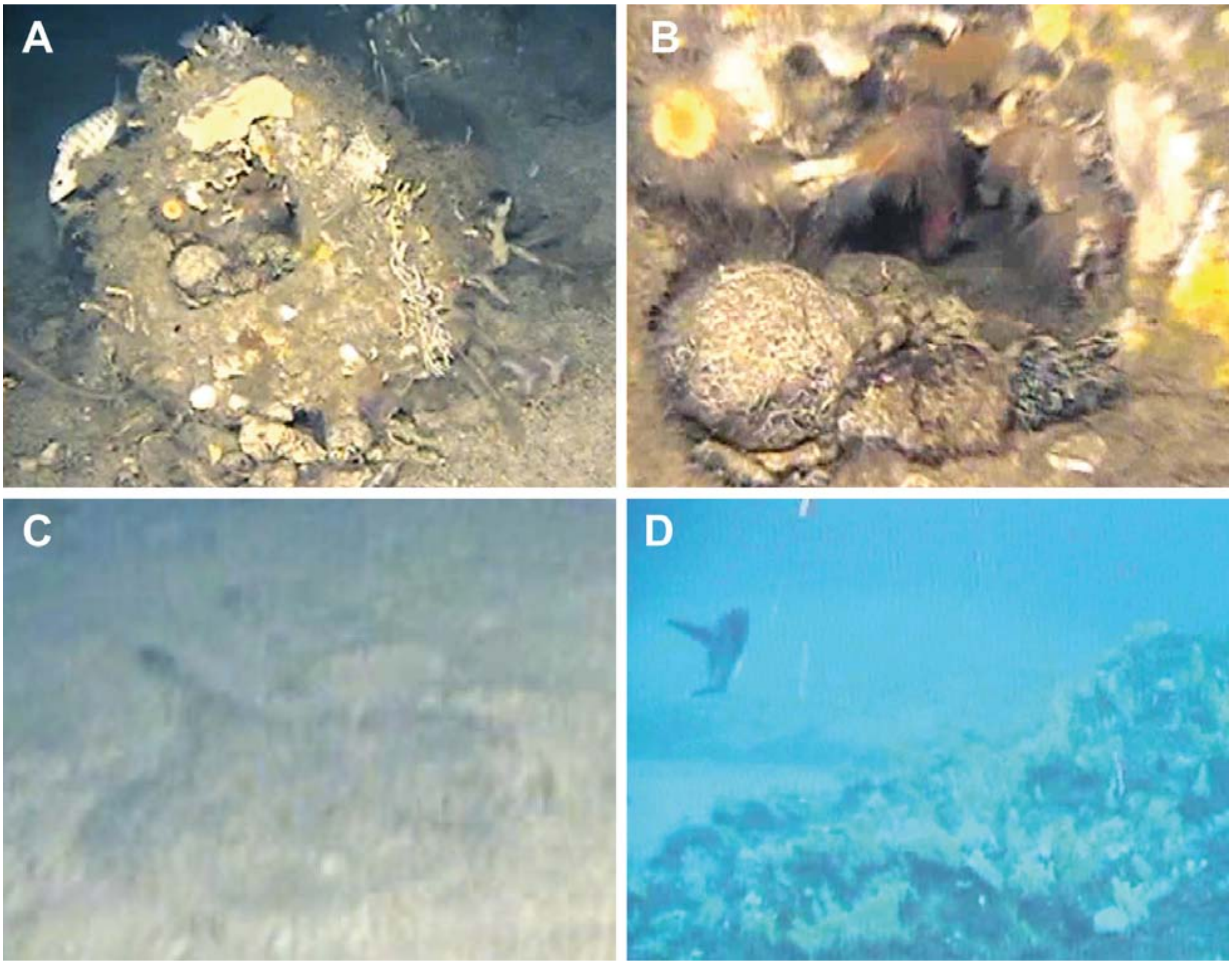


Fig. 5.26 *Fish community of Dive 12 (GeoB 13762-1).* ***A*** Serranus cabrilla *on coralligene bloc (-125 m).* ***B*** *Unidentified fish hiding inside the hollow coralligene bloc (-125 m).* ***C*** Raja *sp. (-105 m).* ***D*** *The fascinating moonfish* Mola mola *(-80 m).*

First dead rhodoliths occurred at 116 m depth (Sample 5) in an area, were moribund sand wave systems were developed. The coarse sand plain was inhabited by *Synchiropus phaeton*, *Raja* sp. (Fig. 5.26C), *Lophius* cf. *budegassa* and *Echinaster sepositus*. Occasionally, ascidian aggregations of *Diazona violacea* lived on these sandy areas (Fig. 5.27C). A huge sponge-rich coralligene framework, several metres high was developed in 103 m water depth (Fig. 5.27G). From 96 m onward, the seabed turned into a series of slight depressions and elevated coarse sand areas. The morphological depressions were filled with overwhelmingly dead rhodoliths (Fig. 5.27F) but with increasing water depth, the amount of live ones increased as well. We found a metal box with the medusahead *Astrospartus mediterraneus* (Fig. 5.27E).

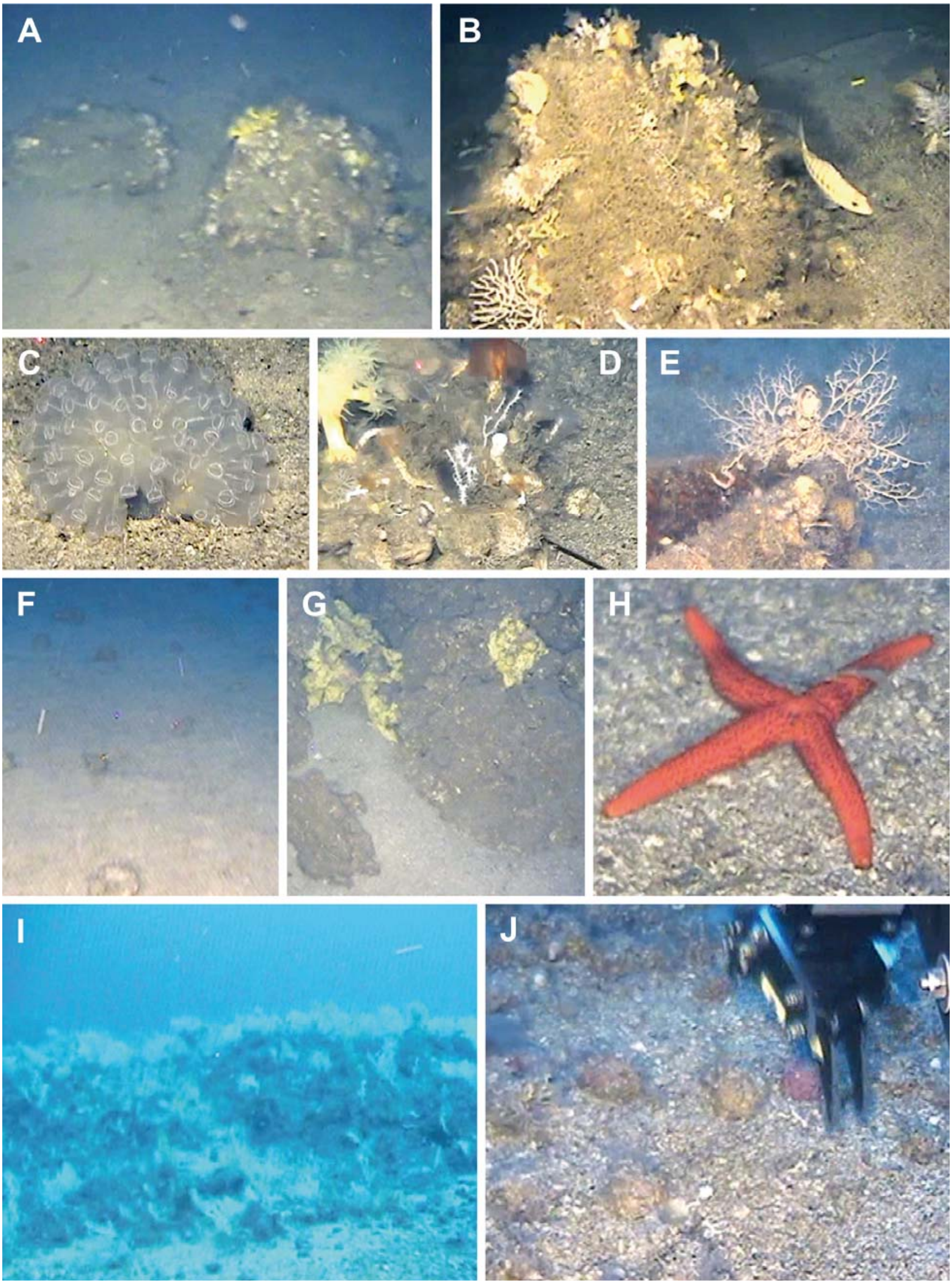


Fig. 5.27 *Community aspects of Dive 12 (GeoB 13762-1).* ***A*** *Two half-metre-sized Coralligene framework freely exposed on the seabed with live* Dendrophyllia cornigera *(-125 m).* ***B*** *Close-up of the larger coralligene bloc with bryozoan and hydroid colonies in the central part, white gorgonians and sponges. Note* Serranus cabrilla *(-125 m).* ***C*** *The ascidian* Diazona violacea *(-96 m).* ***D*** *Live* D. cornigera, *gorgonians, sponges and ascidians (-125 m).* ***E*** Astrospartus

mediterraneus *in an exposed position (-88 m).* ***F*** *Dead rhodoliths (-96 m).* ***G*** *Large coralligene with yellow sponges (-103 m).* ***H*** Echinaster sepositus *(-96 m).* ***I*** *View on the palaeo-shoreline with live gorgonian gardens on top and live rhodoliths in front (-80 m).* ***J*** *Live rhodoliths (-76 m).*

A sharp change in seabed topography was encountered at 85-80 m water depth, when aligned basement rocks cropped out, interspersed by flat seabed. The overall impression of this seascape was an old shoreline with a palaeo-foreshore and channels between the subsequently drowned rocky islands. The foreshore and the channel systems are now the production centres of the present-day rhodolith factory (Sample 6, 76 m depth, Fig. 5.27J). The rocky substrate was the home of gorgonian forests (Fig. 5.27I), while the rhodolith-associated megafauna was dominated by alcyonarians with *Alcyonium palmatum*, hydroids and sponges. Here, we were lucky to see the mind-blowing moonfish *Mola mola* in action, just before we stopped our ROV mission of this cruise (Fig. 5.26D).

Acknowledgements

The Scientific Shipboard Party aboard *RV Poseidon* cruise *POS 385* gratefully acknowledges the friendly and professional cooperation and very efficient technical assistance of Captain Michael Schneider, his officers and crew who substantially contributed to the overall scientific success of this cruise. We also appreciate the most valuable support of the Leitstelle in Kiel (IFM-Geomar), namely Thomas J. Müller, in planning and realisation of this cruise.

Literature

Álvarez-Pérez G, Busquets P, De Mol B, Sandoval NG, Canals M, Casomar JL (2005) Deep-water coral occurrences in the Strait of Gibraltar. In: Freiwald A, Roberts JM (eds) Cold-Water Corals and Ecosystems. Springer, Berlin, Heidelberg, pp 207-221

Comas M, Pinheiro LM (2007) Discovery of carbonate mounds in the Alboran Sea: The Melilla Mound field. Abstract for the First MAPG International Convention, Conference & Exhibition Marrakech Convention Center, October 28 - 31 2007

Fosså JH, Lindberg B, Christensen O, Lundälv T, Svellingen I, Mortensen PB, Alsvag J (2005) Mapping of *Lophelia* reefs in Norway: experiences and survey methods. In: Freiwald A, Roberts JM (eds) Cold-water Corals and Ecosystems. Springer, Heidelberg, pp 359-391

Freiwald A, Beuck L, Rüggeberg A, Taviani M, Hebbeln D (2009) The white coral community in the central Mediterranean Sea revealed by ROV surveys. Oceanography 22:58-74

Freiwald A, Hühnerbach V, Lindberg B, Wilson JB, Campbell J (2002) The Sula Reef Complex, Norwegian Shelf. Facies 47:179-200

Lo Iacono C, Eulàlia G, Diez S, Bozzano G, Moreno X, Dañobeitia J, Alonso B (2008a) Seafloor characterization and backscatter variability of the Almería Margin (Alboran Sea, SW Mediterranean) based on high-resolution acoustic data. Marine Geology 250:1-18

Lo Iacono C, Gracia E, Danobeitia JJ (2008b) Acoustic detection of deep coral mounds. Sea Technology August 2008:35-37

Muñoz A, Ballesteros M, Montoya I, Rivera J, Acosta J, Uchupi E (2008) Alborán Basin, southern Spain - Part I: Geomorphology. Marine and Petroleum Geology 25:59-73

Orejas C, Gori A, Lo Iacono C, Puig P, Gili JM, Dale MRT (accepted) Cold-water corals in the Cap de Creus canyon (north-western Mediterranean): spatial distribution, density and anthropogenic impact. Marine Ecology Progress Series accepted

Reveillaud J, Freiwald A, Van Rooij D, Le Guilloux E, Altuna A, Foubert A, Vanreusel A, Olu-Le Roy K, Henriet J-P (2008) The distribution of scleractinian corals in the Bay of Biscay, NE Atlantic. Facies 54(3):317-331

Roberts JM, Wheeler AJ, Freiwald A (2006) Reefs of the deep: The biology and geology of cold-water coral ecosystems. Science 312:543-547

Tyler B, Amaro T, Arzola R, Cunha MR, De Stigter H, Gooday A, Huvenne V, Ingels J, Kiriakoulakis K, Lastras G, Masson DG, Oliveira A, Pattenden A, Vanreusel A, Van Weering TCE, Vitorino J, Witte U, Wolff G (2009) Europe's Grand Canyon: Nazaré Submarine Canyon. Oceanography 22:46-57

Weaver PPE, Boetius A, Danovaro R, Freiwald A, Gunn V, Heussner S, Morato T, Schewe I, van den Hove S (2009) The future of integrated deep-sea research in Europe: The HERMIONE project. Oceanography 22(1):179-191

Wheeler AJ, Beyer A, Freiwald A, de Haas H, Huvenne V, Kozachenko M, Olu-Le Roy K, Opderbecke J (2007) Morphology and environment of cold-water coral carbonate mounds on the NW European margin. Int. J. Earth Sci. 96:37-56

Wienberg C, Hebbeln D, Fink HG, Mienis F, Dorschel B, Vertino A, López Correa M, Freiwald A (2009) Scleractinian cold-water corals in the Gulf of Cádiz - first clues about their spatial and temporal distribution. Deep-Sea Research I 56:1873-1893

Station List *RV Poseidon* cruise *POS 385*

Gears		Deployments/Surveys
CTD	Conductivity-Temperature-Depth	2/4*
MBES	Multibeam Echosounder System (SEA BEAM 1050)	16/19*
ROV	Remotely Operated Vehicle ('Cherokee', MARUM)	11/12*
BC	Box Corer	20/33*
GC	Gravity Corer	9/9*

* No. of successful deployments or surveys / No. of deployments or surveys in total

Study areas

Test site off Cádiz		CTD: 0/1	MBES: 1/1			
1	Strait of Gibraltar	CTD: /	MBES: /	ROV: 0/1	BC: /	GC: 0
2	Malaga Mounds	CTD: 1/1	MBES: 2/2	ROV: 2/2	BC: /	GC: 0
3	El Idrissi Bank	CTD: 1/1	MBES: 6/6	ROV: 4/4	BC: 8/16	GC: 2/2
4	East Melilla Area	CTD: 0/1	MBES: 1/3	ROV: 2/2	BC: 10/13	GC: 6/6
5	Alboran & Adra Ridges	CTD: /	MBES: 4/5	ROV: 2/2	BC: 2/4	GC: 1/1
6	Chella Bank	CTD: /	MBES: 2/2	ROV: 1/1	BC: /	GC: /

Abbreviations

Lat	Latitude
Lon	Longitude
REC	Recovery
WD	Water depth

			Gear at bottom / Start of survey					End of survey							
Station [GeoB]	**Gear**	**Cast** [No.]	**Date** [ddmmyy]	**Time** [UTC]	**Lat** [N]	**Lon** [W]	**WD** [m]	**Date** [ddmmyy]	**Time** [UTC]	**Lat** [N]	**Lon** [W]	**WD** [m]	**REC** [cm]	**Remarks**	**Area**
Test area off Cádiz															
13701-1	CTD	1	30.05.09	14:30	36°36.89'	06°45.48'	99	30.05.09	15:27	/	/	/		no reliable data, but sound velocity profile for MBES and test of GAPS	off Cádiz
13702-1	MBES	1	30.05.09	18:52	36°38.09'	06°47.34'	106	31.05.09	03:02	36°35.24'	06°32.77'	99		calibration of MBES	off Cádiz
Strait of Gibraltar															
13703-1	ROV	1	31.05.09	13:30	35°56.10'	05°46.39'	220	31.05.09	14:30	/	/	/		deployment was cancelled after 1 hour trying to reach the sea floor, current conditions were too strong	Strait of Gibraltar *Monte Tartesos*
Malaga Mounds															
13704-1	CTD	2	01.06.09	04:26	36°35.05'	04°09.86'	358							CTD max. depth: 330 m plus sound velocity profile for MBES and test of GAPS	Malaga Mounds
13705-1	MBES	2	01.06.09	05:43	36°37.82'	04°12.84'	227	01.06.09	07:16	36°37.93'	04°11.02'	242			Malaga Mounds
13706-1	ROV	2	01.06.09	08:59	36°37.35'	04°13.16'	238	01.06.09	11:04	36°37.72'	04°12.69'	233		SW-NE profile	Malaga Mounds
13707-1	MBES	3	01.06.09	11:48	36°37.75'	04°12.60'	229	01.06.09	13:04	36°37.16'	04°13.25'	244		continuation of GeoB 13705-1	Malaga Mounds
13708-1	ROV	3	01.06.09	14:15	36°37.48'	04°13.10'	236	01.06.09		no data	no data			SW-NE profile (north of dive #02) no reliable positioning data	Malaga Mounds
			01.06.09	16:05	36°37.71'	04°12.94'	228	01.06.09	17:49	36°37.78'	04°12.91	218		restart of GAPS	
	Sample 1		01.06.09	17:27	36°37.76'	04°12.92'	225							"coralligene": *Lithophyllum*, serpulids, rhodoliths, all fossil (last low-stand!)	
El Idrissi Bank															
13709-1	MBES	4	02.06.09	06:28	36°05.41'	03°33.28'	401							test of GAPS	El Idrissi Bank
13710-1	ROV	4	02.06.09	07:29	36°05.45'	03°33.17'	366	02.06.09	10:26	36°05.77'	03°33.18'	309		start at the base of the southern flank, uphill course	El Idrissi Bank (S-flank)
	Sample 1		02.06.09	08:24	36°05.48'	03°33.25'	388							fossil oyster	
13711-1	BC	1	02.06.09	12:19	36°05.71'	03°33.18'	308						15	foram sand with oysters, corals, brachiopods, gastropods, echinoids	El Idrissi Bank (top S-flank)
13712-1	BC	2	02.06.09	13:50	36°05.42'	03°33.27'	386 (450)						~5	slightly tilted, disturbed surface foram sand with corals, shells, oyster etc. *ROV depth 427m, BoKo: 450 m (!)*	El Idrissi Bank (S-flank)
13713-1	BC	3	02.06.09	14:31	36°05.48'	03°33.24'	327						/	security rope unclear, empty *ROV depth 395m, BoKo: 375 m (!)*	El Idrissi Bank (SW-flank)
13713-2	BC	4	02.06.09	15:00	36°05.48'	03°33.24'	326						/	not fully released, empty *ROV depth 395m, BoKo: 377 m (!)*	El Idrissi Bank (SW-flank)
13714-1	BC	5	02.06.09	15:39	36°05.71'	03°33.19'	303						17	foram sand with corals and other shells ROV depth 308m, BoKo: 318 m (!)	El Idrissi Bank (SW-flank)

			Gear at bottom / Start of survey					End of survey							
Station [GeoB]	**Gear**	**Cast** [No.]	**Date** [ddmmyy]	**Time** [UTC]	**Lat** [N]	**Lon** [W]	**WD** [m]	**Date** [ddmmyy]	**Time** [UTC]	**Lat** [N]	**Lon** [W]	**WD** [m]	**REC** [cm]	**Remarks**	**Area**
El Idrissi Bank															
13715-1	CTD	3	02.06.09	16:36	36°05.01'	03°32.50'	727							CTD max. depth: 700 m plus sound velocity profile for MBES	El Idrissi Bank
13716-1	MBES	5	02.06.09	17:23	36°04.49'	03°31.99'	817	03.06.09	06:18	36°06.33'	03°35.03'	480			El Idrissi Bank
13717-1	ROV	5	03.06.09	07:45	36°05.30'	03°31.82'	710	03.06.09	12:37	36°06.00'	03°32.17'	284		S-N profile, uphill	El Idrissi Bank (S-flank)
	Sample 1			08:48	36°05.54'	03°31.92'	622							*Dendrophyllia* fragments	
	Sample 2			09:33	36°05.60'	03°31.97'	536							*Dendrophyllia* fragments (from reef)	
	Sample 3			10:06	36°05.68'	03°32.00'	491							dead deep-sea oyster (*Neopycnodonte*)	
	Sample 4			10:21	36°05.67'	03°32.00'	490							live deep-sea oyster (*Neopycnodonte*)	
	Sample 5	Alias 4		10:37	36°05.66'	03°31.98'	496							live deep-sea oyster (*Neopycnodonte*)	
	Sample 5A			10:45	36°05.66'	03°31.98'	496							dead deep-sea oyster (*Neopycnodonte*)	
	Sample 6			11:00	36°05.67'	03°31.98'	488							*Dendrophyllia* fragments	
13718-1	BC	6	03.06.09	13:45	36°05.67'	03°31.97'	475						/	empty	El Idrissi Bank (S-flank)
13718-2	BC	7	03.06.09	14:50	36°05.67'	03°31.95'	475 (534)						10-20	tilted foram sand with coral fragments *ROV depth 534m, BoKo: 534 m (!)*	El Idrissi Bank (S-flank)
13718-3	BC	8	03.06.09	15:35	36°05.67'	03°31.96'	472 (533)						23-38	slightly tilted foram sand with coral fragments *ROV depth 534m, BoKo: 534 m (!)*	El Idrissi Bank (S-flank)
13719-1	MBES	6	03.06.09	16:40	36°06.49'	03°31.93'	395	04.06.09	05:51	36°09.57'	03°31.33'	521		continuation of GeoB 13716-1	El Idrissi Bank (E-flank)
East Melilla Area															
13720-1	CTD	4	04.06.09	15:46	35°26.01'	02°30.92'	466							no reliable data, but sound velocity profile for MBES	East Melilla Area
13721-1	MBES	7	04.06.09	17:52	35°20.99'	02°35.94'	275	/	/	/	/	/		failed, problem with motion sensor	East Melilla Area
13722-1	BC	9	05.06.09	07:01	35°20.98'	02°32.19'	318						46-51	bioturbated surface silt to clayey silt, very few organisms, no corals, long black worm tubes ?*Pseudoprotella phasma*	Horse Mound
13722-2	BC	10	05.06.09	07:57	35°21.05'	02°32.08'	280						<1	very few sediment and few *Madrepora* fragments (on-mound)	Horse Mound
13722-3	BC	11	05.06.09	08:49	35°21.04'	02°32.11'	280						27-32	silt to clay with abundant corals, mainly *Madrepora*	Horse Mound
13723-1	BC	12	05.06.09	10:02	35°21.05'	02°34.82'	291						20	silt to clay with abundant corals, mainly *Madrepora*	New Mound
13724-1	BC	13	05.06.09	11:31	35°19.83'	02°33.19'	291						55	silt to clayey silt, very few shells	Elephant Mound
13724-2	BC	14	05.06.09	12:41	35°19.79'	02°33.05'	271						/	empty	Elephant Mound

			Gear at bottom / Start of survey					End of survey							
Station [GeoB]	**Gear**	**Cast** [No.]	**Date** [ddmmyy]	**Time** [UTC]	**Lat** [N]	**Lon** [W]	**WD** [m]	**Date** [ddmmyy]	**Time** [UTC]	**Lat** [N]	**Lon** [W]	**WD** [m]	**REC** [cm]	**Remarks**	**Area**
East Melilla Area															
13724-3	BC	15	05.06.09	13:39	35°19.80'	02°33.05'	259						<1	very few sediment, some coral fragments (*Dendrophyllia*)	Elephant Mound
13725-1	BC	16	05.06.09	16:20	35°26.98'	02°31.62'	336						/	empty	Brittlestar Ridge II
13725-2	BC	17	05.06.09	17:00	35°26.71'	02°31.62'	355						<1	very few sediment, some coral fragments	Brittelstar Ridge II
13726-1	MBES	8	05.06.09	16:08	35°26.67'	02°31.54'	312	/	/	/	/	/		failed	East Melilla Area
13727-1	ROV	6	06.06.09	09:06	35°26.07'	02°30.83'	406	06.06.09	?	35°26.43'	02°31.03'	314		during dive wrong GAPS signal!! started at 35°26.20', 02°30.89', but depth is right!! aborted; problems with the ROV tether	Brittlestar Ridge I
	Sample 1			09:37	35°26.16'	02°30.84'	363							dead corals	
	Sample 2			09:59	35°26.16'	02°30.86'	353							live *Madrepora*	
	Sample 3			10:08	35°26.16'	02°30.87'	349							live *Lophelia*	
13728-1	BC	18	06.06.09	14:04	35°26.28'	02°30.89'	343						10-20	foram sand with abundant coral fragments (mainly *Madrepora*), live antipatharian	Brittlestar Ridge I
13728-2	GC	1	06.06.09	14:42	35°26.28'	02°30.89'	343						364	corals	Brittlestar Ridge I
13729-1	GC	2	06.06.09	15:27	35°26.07'	02°30.83'	442						447	corals	Brittlestar Ridge I
13730-1	GC	3	06.06.09	16:29	35°26.20'	02°30.87'	338						434	corals	Brittlestar Ridge I
13731-1	GC	4	06.06.09	17:25	35°24.80'	02°33.22'	362						431	off-mound core	Brittlestar Ridge I
13732-1	MBES	9	06.06.09	19:05	35°25.99'	02°33.84'	339	07.06.09	05:55	35°29.87'	02°30.53'	202			East Melilla area
13733-1	BC	19	07.06.09	06:37	35°29.63'	02°29.65'	202						/	empty	Banc de Provencaux
13734-1	BC	20	07.06.09	07:23	35°28.50'	02°31.66'	235						23-31	foram sand (plus glaukonitic grains) with gastropods, and other shells *wire length: 250 m*	Banc de Provencaux
13735-1	BC	21	07.06.09	08:04	35°28.08'	02°33.58'	313						10-21	foram sand with coral fragments *wire length: 327 m*	Brittlestar III
13735-2	GC	5	07.06.09	08:34	35°28.08'	02°33.57'	315						317	corals	Brittlestar III
13736-1	GC	6	07.06.09	09:08	35°27.98'	02°33.82'	327						363	bended tube, first 54 cm slightly disturbed	Brittlestar III
13737-1	ROV	7	07.06.09	12:05	35°27.98'	02°33.94'	356	07.06.09	14:03	35°28.18'	02°33.39'	290		W-E profile, uphill	Brittlestar III
	Sample 1		07.06.09	13:14	35°28.01'	02°33.63'	299							dead coral framework, asteroids	
	Sample 2		07.06.09	13:32	35°28.06'	02°33.56'	297							live *Madrepora* and ophiuroids	
El Idrissi Bank															
13738-1	MBES	10	0706.09	23:00	36°04.52'	03°28.56'	642	08.06.09	09:45	36°07.48'	03°28.45'	538		continuation of GeoB 13719-1	El Idrissi Bank

			Gear at bottom / Start of survey					End of survey							
Station [GeoB]	**Gear**	**Cast** [No.]	**Date** [ddmmyy]	**Time** [UTC]	**Lat** [N]	**Lon** [W]	**WD** [m]	**Date** [ddmmyy]	**Time** [UTC]	**Lat** [N]	**Lon** [W]	**WD** [m]	**REC** [cm]	**Remarks**	**Area**
Adra Ridge & Alboran Ridge															
13739-1	MBES	11	08.06.09	13:56	36°13.53'	02°55.08'	870	/	/	/	/	/		failed	Adra Ridge
13740-1	MBES	12	09.06.09	11:33	36°02.44'	02°55.08'	797	09.06.09	14:37	36°02.20'	02°56.25'	790			Alboran Ridge
13741-1	ROV	8	09.06.09	16:29	36°02.05'	02°55.80'	747	09.06.09	17:35	36°01.65'	02°55.41'	649		NW-SE profile, uphill	Alboran Ridge
13742-1	MBES	13	09.06.09	18:29	36°01.04'	02°55.50'	273	09.06.09	19:57	36°05.03'	02°55.36'	1542		continuation of GeoB 13740-1	Alboran Ridge
13743-1	MBES	14	09.06.09	21:00	36°13.49'	02°55.02'	863	10.06.09	05:04	36°11.26'	03°00.05'	805			Adra Ridge
13744-1	ROV	9	10.06.09	07:30	36°01.71'	02°55.44'	664	10.06.09	13:14	36°00.79'	02°55.01'	110		continuation of dive #8	Alboran Ridge
	Sample 1		10.06.09	08:29	36°01.52'	02°55.32'	495							deep-sea oyster	
	Sample 2		10.06.09	08:44	36°01.48'	02°55.31'	423							fossil *Dendrophyllia*	
	Sample 3		10.06.09	09:16	36°01.45'	02°55.32'	404							live *Lophelia*	
	Sample 4		10.06.09	09:21	36°01.45'	02°55.30'	404							fossil *Dendrophyllia*	
	Sample 5		10.06.09	11:32	36°01.07'	02°55.25'	269							brachiopods	
13745-1	BC	22	10.06.09	14:30	36°00.97'	02°55.06'	127						16	shell debris, bryozoans, corallinacea	Alboran Ridge
13746-1	BC	23	10.06.09	14:55	36°01.07'	02°55.23'	233						17	brachiopods, corallinacea	Alboran Ridge
13747-1	BC	24	10.06.09	16:22	36°01.50'	02°55.32'	437						/	1 small coral fragment	Alboran Ridge
13747-2	BC	25	10.06.09	16:57	36°01.51'	02°55.32'	437						/	leer	Alboran Ridge
13748-1	GC	7	10.06.09	17:26	36°01.53'	02°55.35'	456						28	plus 1 coral fragment	Alboran Ridge
13749-1	MBES	15	10.06.09	18:34	36°59.99'	02°56.16'	180	10.06.09	20:14	36°00.77'	02°54.71'	99		continuation of GeoB 13742-1	Alboran Ridge
El Idrissi Bank															
13750-1	MBES	16	10.06.09	23:50	36°06.74'	03°30.06'	312	11.06.09	20:48	36°09.22'	03°29.22'	656		continuation of GeoB 13738-1	El Idrissi Bank (E-flank)
13751-1	ROV	10	11.06.09	07:58	36°06.28'	03°29.28'	687	11.06.09	10:31	36°06.56'	03°29.70'	388		SE-NW uphill profile aborted, problems with fishing line	El Idrissi Bank (E-flank)
	Sample 1		11.06.09	08:16	36°06.28'	03°29.29'	676							sponge & crinoid on *Lophelia* fragment	
	Sample 2		11.06.09	08:35	36°06.30'	03°29.31'	658							dead coral fragment: *Madrepora* growing on *Dendrophyllia*	
	Sample 3		11.06.09	08:55	36°06.31'	03°29.33'	647							live coral	
	Sample 4		11.06.09	09:31	36°06.44'	03°29.52'	495							live antipatharian	
	Sample 5		11.06.09	09:48	36°06.45'	03°29.53'	472							dead *Lophelia* fragment	
	Sample 6		11.06.09	10:31	36°06.56'	03°29.70'	388							live deep-sea oysters	
13752-1	BC	26	11.06.09	12:25	36°07.09'	03°30.78'	204						/	no sediment, one live octocoral	El Idrissi Bank (top E-flank)
13753-1	BC	27	11.06.09	13:28	36°06.47'	03°29.55'	449 (498)						bulk	box corer toppled over, some sediment with coral was entangled in the frame; rare coral species: *Pourtalosmilia*!!!!	El Idrissi Bank (E-flank)
13754-1	BC	28	11.06.09	14:19	36°06.40'	03°29.45'	508						/	not released	El Idrissi Bank (E-flank)

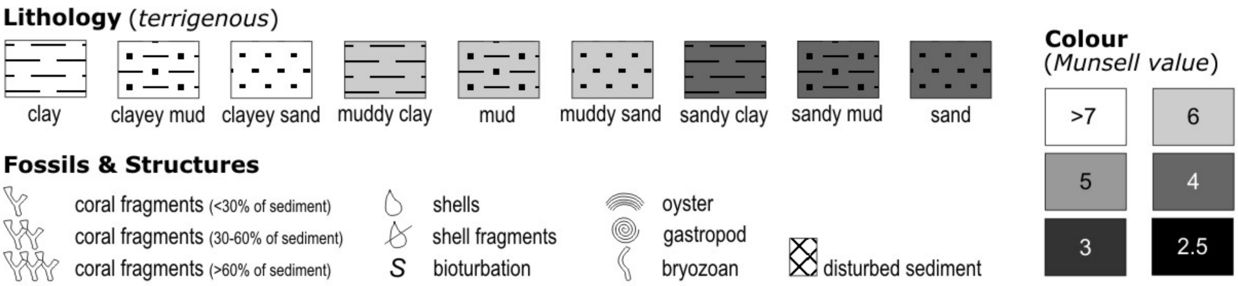
Station [GeoB]	Gear	Cast [No.]	Gear at bottom / Start of survey: Date [ddmmyy]	Time [UTC]	Lat [N]	Lon [W]	WD [m]	End of survey: Date [ddmmyy]	Time [UTC]	Lat [N]	Lon [W]	WD [m]	REC [cm]	Remarks	Area
El Idrissi Bank															
13754-2	BC	29	11.06.09	14:50	36°06.39'	03°29.47'	512						bulk	not released, small sample in the frame	El Idrissi Bank (E-flank)
13755-1	BC	30	11.06.09	15:38	36°06.28'	03°29.32'	621						<1	small sediment sample, few corals	El Idrissi Bank (E-flank)
13755-2	BC	31	11.06.09	16:29	36°06.26'	03°29.32'	624						/	empty	El Idrissi Bank (E-flank)
13755-3	GC	8	11.06.09	17:04	36°06.28'	03°29.32'	625						25	corals	El Idrissi Bank (E-flank)
13756-1	MBES	17	11.06.09	18:10	36°09.00'	03°28.02'	670	12.06.09	05:36	36°06.20'	03°33.04'	285		continuation of GeoB 13750-1	El Idrissi Bank
13757-1	ROV	11	12.06.09	07:45	36°09.37'	03°29.77'	622	12.06.09	13:25	36°07.94'	03°30.45'	289			El Idrissi Bank (NE-flank)
	Sample 1		12.06.09	08:38	36°09.15'	03°29.95'	567							coral fragments	
	Sample 2		12.06.09	09:00	36°09.11'	03°29.96'	531							dead deep-sea oyster	
	Sample 3		12.06.09	09:19	36°09.05'	03°29.94'	488							*Madrepora* fragments	
	Sample 4		12.06.09	09:28	36°09.05'	03°29.98'	488							large *Madrepora* fragment	
	Sample 5		12.06.09	09:50	36°09.00'	03°29.99'	467							recently died deep-sea oyster	
13758-1	BC	32	12.06.09	15:20	36°08.45'	03°30.26'	353						/	not released, two coral fragments	El Idrissi Bank (NE-flank)
13759-1	BC	33	12.06.09	16:00	36°08.82'	03°30.02'	423						24	foram sand with glauconitic grains, *Lophelia* layer underneath	El Idrissi Bank (NE-flank)
13760-1	GC	9	12.06.09	16:34	36°09.35'	03°29.74'	652						424	off-mound	El Idrissi Bank (NE-flank)
Chella Bank															
13761-1	MBES	18	12.06.09	22:00	36°30.05'	02°49.98'	462	13.06.09	03:05	36°31.50'	02°48.03'	398			Chella Bank
13762-1	ROV	12	13.06.09	04:52	36°29.97'	02°50.02'	497	13.06.09	09:04	36°31.13'	02°50.87'	76			Chella Bank
	Sample 1		13.06.09	06:00	36°30.35'	02°50.26'	218							dead *Dendrophyllia*	
	Sample 2		13.06.09	06:05	36°30.38'	02°50.28'	189							coral fragments	
	Sample 3		13.06.09	06:21	36°30.45'	02°50.36'	143							colonised bottle	
	Sample 4		13.06.09	06:30	36°30.44'	02°50.35'	138							hard substrate	
	Sample 5		13.06.09	06:51	36°30.47'	02°50.36'	124							live *Dendrophyllia*	
	Sample 6		13.06.09	07:31	36°30.61'	02°50.46'	116							dead rhodoliths, stones	
	Sample 7		13.06.09	08:57	36°31.12'	02°50.87'	76							live rhodoliths	
13763-1	MBES	19	13.06.09	09:32	36°31.05'	02°50.88'	174	13.06.09	10:15	36°30.21'	02°50.41'	124		continuation of GeoB 13761-1	Chella Bank

Appendix ◇ Description of sediment cores

Core List

Core-ID	*Longitude*	*Latitude*	*Water depth*	*Recovery*	*Remarks*
East Melilla					
GeoB 13728-2	35°26.28'N	02°30.89'W	343 m	364 cm	corals, oysters
GeoB 13729-1	35°26.07'N	02°30.83'W	442 m	447 cm	corals, oysters
GeoB 13730-1	35°26.20'N	02°30.87'W	338 m	434 cm	corals
GeoB 13735-2	35°28.08'N	02°33.57'W	315 m	317 cm	corals
GeoB 13736-1	35°27.98'N	02°33.82'W	327 m	363 cm	bryozoans, corals
GeoB 13731-1	35°24.80'N	02°33.22'W	362 m	431 cm	off-mound core *not described yet*
Alboran Ridge					
GeoB 13748-1	36°01.53'N	02°55.35'W	456 m	28 cm	corals, clast
El Idrissi Bank					
GeoB 13755-3	36°06.28'N	03°29.32'W	625 m	25 cm	corals
GeoB 13760-1	36°09.35'N	03°29.74'W	652 m	424 m	off-mound core

Legend



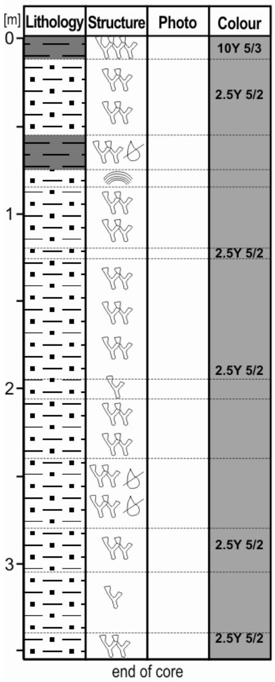
Lithologs

GeoB 13728-2

East Melilla-Brittlestar Ridge I

POS 385 • Date: 06.06.09
Position: 35°26.28'N 02°30.89'W
Water Depth: 343 m • Core Length: 356 cm

Lithology



Description

0-12 cm: sandy clay, gradual colour shift from brownish to grayish brown, abundant fragments of scleractinian corals (>60% of the sediment): e.g. *Lophelia pertusa*, *Madrepora oculata*, bivalve shell fragments

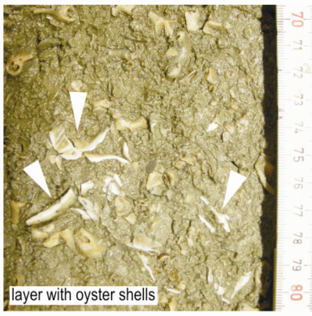
12-55 cm: clayey mud, fragments of corals (30-60% of the sediment): mainly *Lophelia pertusa*

55-75cm: sandy clay, coral fragments (30-60% of the sediment), abundant fragments of bivalves and brachiopods

75-80 cm: layer with oyster shells (see photo)

80-120; 126-194 cm: clayey mud, fragments of corals (30-60% of the sediment): mainly *Lophelia pertusa*

120-126 cm: clayey mud, no coral fragments visible


layer with oyster shells

194-206 cm: clayey mud, occassionaly coral fragments, <10% of the sediment

206-305 cm: clayey mud, coral fragments (30-60% of the sediment): mainly *Lophelia pertusa*

240-280 cm: abundant small fragments of bivalves and corals (1-2 mm in Ø)

305-340 cm: clayey mud, coral fragments (<30% of the sediment)

332-340 cm: abundant small fragments of corals (1-2 mm in Ø)

340-356 cm: clayey mud, coral fragments (30-60% of the sediment) with abundant small fragments of corals (1-2 mm in Ø)

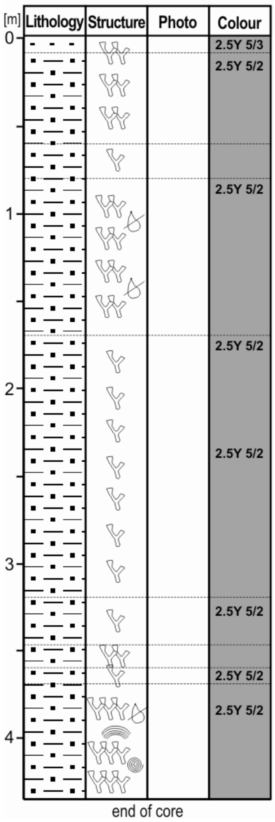
356 cm: end of core

GeoB 13729-1

East Melilla-Brittlestar Ridge I

POS 385 • Date: 06.06.09
Position: 35°26.07'N 02°30.83'W
Water Depth: 442 m • Core Length: 435 cm

Lithology



Description

0-9 cm: clayey sand (probably foraminifera), gradual colour change from olive brown to grayish brown; fragments of scleractinian corals (30-60% of the sediment): mainly *Lophelia pertusa*

9-60; 80-170 cm: clayey mud, fragments of scleractinian corals (30-60% of the sediment): mainly *Lophelia pertusa*; occasionally shell fragments

60-80 cm: less coral fragments (<30% of the sediment)

170-320 cm: clayey mud, less coral fragments than in the section above (<30% of the sediment): mainly thick-walled *Lophelia pertusa*

320-347 cm: clayey mud, only very few coral fragments (<10% of the sediment)

347-360 cm: clayey mud, fragments of scleractinian corals (30-60% of the sediment)

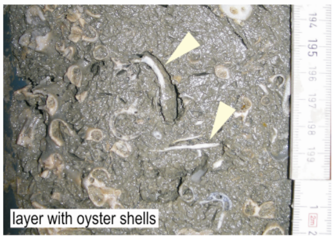
360-369 cm: clayey mud, only small fragments of corals (~ 1-2 mm in Ø, <30% of the sediment)

369-435 cm: clayey mud with abundant fragments of corals (>60% of the sediment), bivalve and gastropod shells

370-380 cm: large coral fragment

380; 395-401 cm: oyster shells (see photo)

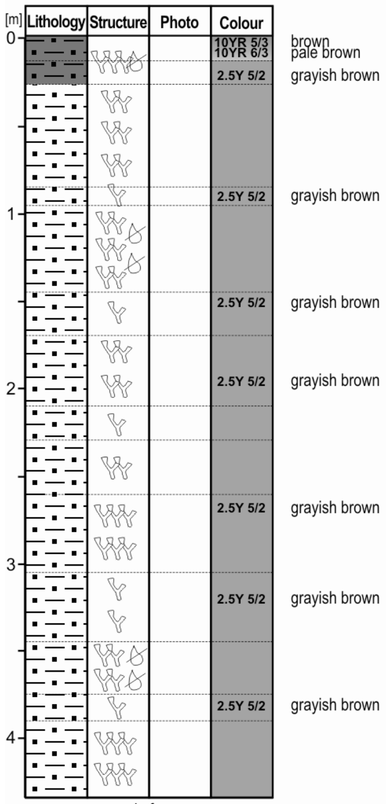
435 cm: end of core


layer with oyster shells

GeoB 13730-1

POS 385 • Date: 06.06.09
Position: 35°26.20'N 02°30.87'W
East Melilla-Brittlestar Ridge I
Water Depth: 338 m • Core Length: 434 cm

Lithology



Description

0-26 cm: sandy mud (grains probably foraminfera), in the upper 10 cm gradual colour shift from brown to pale brown, abundant fragments of scleractinan corals (>60% of the sediment): e.g. *Lophelia pertusa & Madrepora oculata*; bivalve and gastropod fragments

26- 260 cm: clayey mud, varying amount of coral fragments, mainly *L. pertusa*;
26-85; 95-145; 170-210; 230-260 cm: 30-60% of the sediment
85-95; 145-170; 210-230 cm: <305 of the sediment
95-145 cm: occasionally bivalve fragments
160 cm: sandy layer

260-305 cm: clayey mud, abundant fragments of corals (>60% of the sediment)
290 cm: large *Desmophyllum* sp. fragment (5 cm)

305-345 cm: clayey mud, coral fragments (<30% of the sediment); e.g *L.pertusa* & *Desmophyllum* sp.

345-375 cm: clayey mud, coral fragments (30-60% of the sediment); abundant small fragments of corals and bivalves (~ 1-2 mm in Ø); bivalve and brachipod shells

375-390 cm: clayey mud, sparse coral fragments (<10% of the sediment)

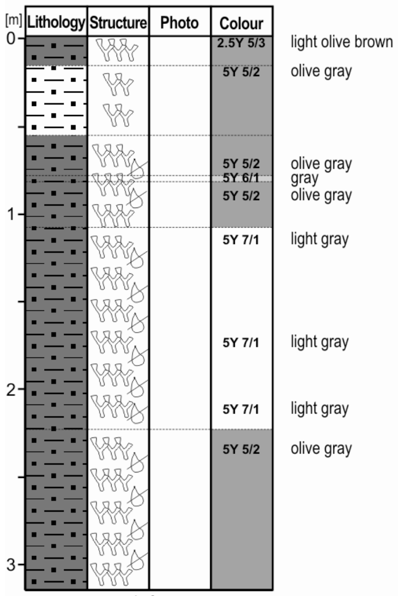
390-434 cm: clayey mud, abundant fragments of corals (>60% of the sediment): e.g. *L.pertusa;* abundant small fragments of corals and bivalves (~ 1-2 mm in Ø);
395 cm: large *Dendrophyllia* sp. fragment (7-8 cm)

434 cm: end of core

GeoB 13735-2

POS 385 • Date: 07.06.09
Position: 35°28.08'N 02°33.57'W
East Melilla-Brittlestar Ridge III
Water Depth: 315 m • Core Length: 315 cm

Lithology



Description

0-16 cm: sandy mud (grains probably foraminifera), colour shift from brownish to gray, abundant fragments of scleractinian corals (>60% of the sediment): *Desmophyllum* sp., *Madrepora oculata, Lophelia pertusa*; coral fragments are affected by bioerosion

16-55 cm: clayey mud, coral fragments (30-60% of the sediment): e.g *L. pertusa* & *M. oculata*

55-108 cm: sandy mud (grains probably foraminifera), coral fragments (>60% of the sediment); abundant small fragments of corals and bivalves (~ 1-2 mm in Ø); bivalve shells, echinoid spines
78-81 cm: layer with lighter sediment

108- 223 cm: distinct colour shift to light gray (see photo), sandy mud (grains probably foraminifera), abundant coral fragments (>60% of the sediment): e.g *L. pertusa* & *M. oculata*, bivalve shell fragments and brachiopods;
138 cm: shell layer
~165 cm: large *L.pertusa* fragments (10 cm)
174-182: some *Dendrophyllia* sp. fragments

223-315 cm: distinct colour shift to olive gray (see photo), sandy mud (grains probably foraminifera), abundant coral fragments (>60% of the sediment): e.g *M. oculata* & *L. pertusa*, bivalve shell fragments and brachiopods;
243 cm: shell layer

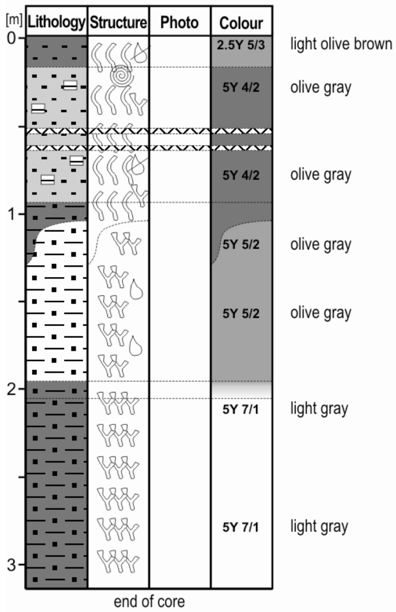
315 cm: end of core

GeoB 13736-1

East Melilla-Brittlestar Ridge III

POS 385 • Date: 07.06.09
Position: 35°27.98'N 02°33.82'W
Water Depth: 327 m • Core Length: 315 cm

Lithology



Description

0-17 cm: sand, abundant bryozoans, scleractinian coral, bivalve and gastropod shell fragments

17-118 cm: muddy sand, abundant bryozoans, ~ 70% of the sediment (see photo, partly more than 70%), few coral fragments (~10% of the sediment), shells of bivalves, brachipods and gastropods, echinoid spines, crustacean chelae, few clayey lenses

52-54; 61-63 cm: lost during coring

93-118cm: more coral fragments than above (*Lophelia pertusa*), affected by bioerosion

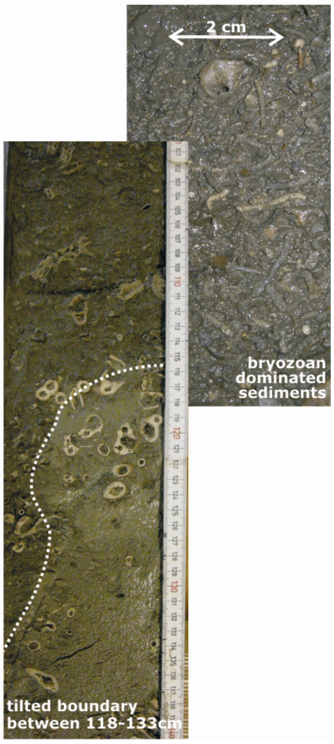
118-133 cm: sharp, tilted boundary between both sediment types (see photo)

118-195 cm: stiff clayey mud, fragments of scleractinian corals (30-60% of the sediment), mainly thick walled *Lophelia pertusa,* occasionally bivalve shells

195-315 cm: sandy mud, abundant fragments of coral fragments (>60% of the sediment): e.g *Lophelia pertusa* & *Madrepora oculata*

195-205 cm: gradual colour shift from gray to light gray

315 cm: end of core

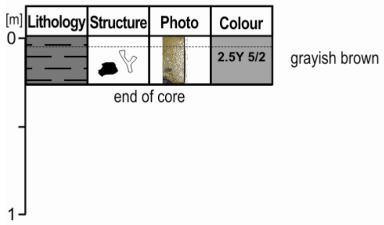


GeoB 13748-1

Alboran Ridge

POS 385 • Date: 10.06.09
Position: 36°01.53'N 02°55.35'W
Water Depth: 456 m • Core Length: 25 cm

Lithology



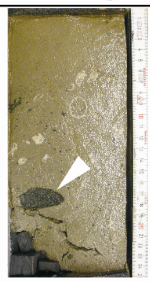
Description

0-5 cm: sandy clay without coral fragments

5-25 cm: sandy clay, occasional fragments of scleractinian corals (<30 % of the sediment): e.g. *Lophelia pertusa*, *Desmophyllum* sp.; small shell fragments and klasts (1-2 mm in Ø)

17-19cm: big klast (2x4 cm)

25 cm: end of core

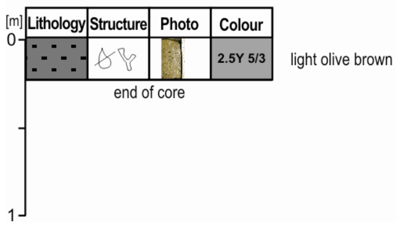


GeoB 13755-3

El Idrissi Bank

POS 385 • Date: 11.06.09
Position: 36°06.28'N 03°29.32'W
Water Depth: 625 m • Core Length: 22 cm

Lithology



Description

0-22 cm: sand, abundant small (mm-scale) fragments of scleratinian corals, bivalves and gastropods; no structures visible

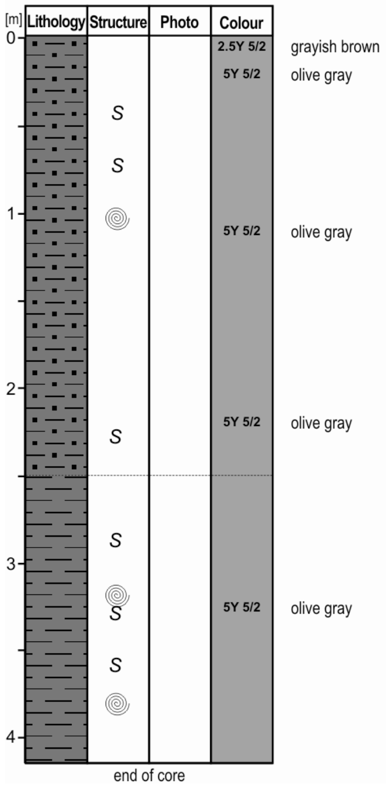
17cm: large bivalve shell (1cm in Ø)

22 cm: end of core

GeoB 13760-1

POS 385 • Date: 12.06.09
Position: 36°09.35'N 03°29.74'W
El Idrissi Bank
Water Depth: 652 m • Core Length: 415 cm

Lithology



Description

0-250 cm: sandy mud, occasionally small shell fragments (<1 mm in Ø)

40 cm: burrows, filled with mud (1 cm in Ø)

70 cm: burrows, filled with sand (1 cm in Ø)

110 cm: gastropod

230-240 cm: burrows, filled with black sand

250-415 cm: sandy clay, stiffer than in the upper core section, occasionally small shell fragments (<1 mm in Ø)

280-290; 325, 365 cm: burrows, filled with black sand

320; 390-393 cm: gastropod

360-370; 405-415 cm: black spots

415 cm: end of core

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Report and preliminary results of RV SONNE Cruise SO-184, PABESIA, Durban (South Africa) – Cilacap (Indonesia) – Darwin (Australia), July 08th - September 13th, 2005. 142 pages, Bremen 2006.

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Report and preliminary results of RV METEOR Cruise M61/3. Development of Carbonate Mounds on the Celtic Continental Margin, Northeast Atlantic. Cork (Ireland) – Ponta Delgada (Portugal), 04.06. – 21.06.2004. 64 pages, Bremen 2006.

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Element Stratigraphy and Age Models for Pelagites and Gravity Mass Flow Deposits based on Shipboard XRF Analysis. 100 pages, Bremen 2006.

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Report and preliminary results of RV METEOR Cruise M65/2, Dakar - Las Palmas, 04.07. – 26.07.2005. 185 pages, Bremen 2006.

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Report and preliminary results of POSEIDON Cruise 330, Las Palmas – Las Palmas, November 21th – December 03rd, 2005. 48 pages, Bremen 2006.

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Report and preliminary results of METEOR Cruise M65/1, Dakar – Dakar, 11.06.- 1.07.2005. 149 pages, Bremen 2006.

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Report and preliminary results of POSEIDON Cruise P336, Heraklion - Heraklion, 28.04. – 17.05.2006. 127 pages, Bremen, 2006.

No. 254 **Wefer, G. and cruise participants**
Report and preliminary results of R/V METEOR Cruise M65/3, Las Palmas - Las Palmas (Spain), July 31st - August 10th, 2005. 24 pages, Bremen 2006.

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Report and first results of the POSEIDON Cruise P342 GALIOMAR, Vigo – Lisboa (Portugal), August 19th – September 06th, 2006. Distribution Pattern, Residence Times and Export of Sediments on the Pleistocene/Holocene Galician Shelf (NW Iberian Peninsula). 203 pages, Bremen, 2007.

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Composition of molecular organic matter pools, pigments and proteins, in Benguela upwelling and Arctic Sediments. 192 pages, Bremen 2007.

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Report and preliminary results of Poseidon cruise 344, leg 1 and leg 2, Las Palmas (Spain) – Las Palmas (Spain),
Oct. 20th –Nov 2nd & Nov. 4th – Nov 13th, 2006. 46 pages, Bremen 2007.

No. 260 **Westphal, H. and cruise participants**
Report and preliminary results of Poseidon cruise 346, MACUMA. Las Palmas (Spain) – Las Palmas (Spain), 28.12.2006 – 15.1.2007. 49 pages, Bremen 2007.

No. 261 **Bohrmann, G., T. Pape, and cruise participants**
Report and preliminary results of R/V METEOR Cruise M72/3, Istanbul – Trabzon – Istanbul, March 17th – April 23rd, 2007. Marine gas hydrates of the Eastern Black Sea. 130 pages, Bremen 2007.

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Report and preliminary results of R/V METEOR Cruise M70/3, Iraklion – Iraklion, 21 November – 8 December 2006. Cold Seeps of the Anaximander Mountains / Eastern Mediterranean. 75 pages, Bremen 2008.

No. 263 **Bohrmann, G., Spiess, V., and cruise participants**
Report and preliminary results of R/V Meteor Cruise M67/2a and 2b, Balboa -- Tampico -- Bridgetown, 15 March -- 24 April, 2006. Fluid seepage in the Gulf of Mexico. Bremen 2008.

No. 264 **Kopf, A., and cruise participants**
Report and preliminary results of Meteor Cruise M73/1: LIMA-LAMO (Ligurian Margin Landslide Measurements & Observatory), Cadiz, 22.07.2007 – Genoa, 11.08.2007. 170 pages, Bremen 2008.

No. 265 **Hebbeln, D., and cruise participants**
Report and preliminary results of RV Pelagia Cruise 64PE284. Cold-water Corals in the Gulf of Cádiz and on Coral Patch Seamount (NE Atlantic). Portimão - Portimão, 18.02. - 09.03.2008. 90 pages, Bremen 2008.

No. 266 **Bohrmann, G. and cruise participants**
Report and preliminary results of R/V Meteor Cruise M74/3, Fujairah – Male, 30 October - 28 November, 2007. Cold Seeps of the Makran subduction zone (Continental margin of Pakistan). 161 pages, Bremen 2008.

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Benthic organic carbon fluxes in the Southern Ocean: Regional differences and links to surface primary production and carbon export. 143 pages, Bremen, 2008.

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Report and preliminary results of R/V POSEIDON Cruise P339, Piräus - Messina, 16 June - 2 July 2006. CAPPUCCINO - Calabrian and Adriatic palaeoproductivity and climatic variability in the last two millenia. 61 pages, Bremen, 2008.

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Report and preliminary results of R/V POSEIDON Cruise P360, Las Palmas (Spain) - Las Palmas (Spain), Oct. 29th - Nov. 6th, 2007. 27 pages, Bremen, 2008.

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Report and preliminary results of R/V POSEIDON Cruise 365 (Leg 1+2). Leg 1: Las Palmas - Las Palmas, 13.4. - 16.4.2008. Leg 2: Las Palmas - Las Palmas, 18.4. - 29.4.2008. 40 pages, Bremen, 2009.

No. 271 **Kopf, A. and cruise participants**
Report and preliminary results of R/V POSEIDON Cruise P386: NAIL (Nice Airport Landslide), La Seyne sur Mer, 20.06.2009 – La Seyne sur Mer, 06.07.2009. xx pages, Bremen, 2009.

No. 272 **Freudenthal, T., G. Fischer and cruise participants**
Report and preliminary results of Maria S. Merian Cruise MSM04/4 a & b, Las Palmas (Spain) – Las Palmas (Spain), Feb 27th – Mar 16th & Mar 19th – Apr 1st, 2007. 117 pages, Bremen 2009.

No. 273 **Hebbeln, D., C. Wienberg, L. Beuck, A. Freiwald, P. Wintersteller and cruise participants**
Report and preliminary results of RV POSEIDON Cruise POS 385 "Cold-Water Corals of the Alboran Sea (western Mediterranean Sea)", Faro - Toulon, May 29 - June 16, 2009. 79 pages, Bremen 2009.