CORALFISH-HERMIONE CRUISE REPORT

Cruise 64PE345, Texel-Vigo,
28 Sept – 14 Oct 2011

Belgica Mound Province (CoralFISH & HERMIONE),
Whittard Canyon (HERMIONE)

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1. INTRODUCTION

Cruise 64PE345 is organized by NIOZ to collect additional observational data and seabed samples for two FP7 EU-funded programs: CoralFISH and HERMIONE. The HERMIONE project is focused on study of various hotspot ecosystems such as canyons (Whittard Canyon) and cold water coral mounds (Belgica Mounds) whereas CoralFISH aims to study relationships between cold water coral ecosystems and fish. Both projects are so-called integrated projects funded by the European Union and comprise partners belonging to the major European marine institutions. Coordinating institutions are National University Galway (Ireland) and NOC (Southampton, UK), respectively. The ship time for this cruise is provided by NIOZ.

During the CoralFISH leg of the cruise to the Belgica Mounds, we intend to make additional under water video surveys but now with our new fiber optic system. This system allows getting online data of a HD video camera until depths of 6000m. Further a comparison of landers baited with frozen mackerel and sardines on oil will be made to interpret our long-term baited video lander. This long-term lander with HD-video and bait dispenser with sardines on oil, which has been recovered after 6 month in June this year, will be deployed again for another year. Novel for this cruise will be the use of the fish finder to find schools of fish by echo sounding. Some boxcore samples (additional to those collected in 2009) will be collected for incubation experiments to get additional data on the respiratory activity of the bottom fauna. These data are necessary to construct a carbon flow model of coral and fish communities in cooperation with partners from NIOO (Yerseke, NL). In 2008 NIOZ organized a first CoralFISH cruise (Lavaleye et al. 2008) to the Belgica Mounds and Hatton Bank where baited videos were deployed to estimate fish abundance and samples were collected for food web analyses. Hatton Bank lies outside European EEZ's, and trawl fisheries here are largely unregulated especially in its deeper parts where the corals grow. The Hatton Bank is therefore considered as a threatened area. Belgica Mound Province, which lies within the Irish EEZ, is an SAC (Special Area of Conservation). Some of the mounds have a rich cold-water coral community. In this area research is only possible with a special permit. This area was briefly studied during the 2008 cruise with Pelagia (Lavaleye et al, 2008), and more thorough during the 2009 cruise with Pelagia (Duineveld et al, 2009) and the 2010 cruise also with the RV. Pelagia (Lavaleye et al. 2010). The 2011 cruise will continue the research started in 2008.

For the HERMIONE (Hotspot Ecosystem Research and Man's Impact on European Seas) project the NIOZ contribution covers two types of ecosystems: canyons and cold-water coral habitat. The topic concerned with cold water corals comprise the relation between physical habitat and functioning of coral communities. During research in a former EU project HERMES it was discovered that cold water coral habitats are associated with mechanisms that can bring fresh organic matter quickly to deeper water. First estimates from community respiration measurements in coral habitat show metabolic rates surpassing levels of the surrounding slope. This supports the contention that coral communities entrain elevated amounts of fresh organic matter. Most data have been collected during previous cruise, but some additional data will be gathered. The main thing will be however the long-term data from the long-term lander to be deployed during this cruise on Galway Mound and to be recovered in Oct. 2012.

During the second leg in the Whittard Canyon we plan to study relationships between seafloor morphology, particle transport near the canyon floor and the benthic fauna, all for the HERMIONE project. For this purpose we will use the new fiber optic hopper camera system and benthic landers. One of the BOBO bottom landers will be recovered from the canyon and deployed again in the canyon for another period of 1year to record near bed currents and particle fluxes. During the 2009 and 2010 Pelagia cruise we unfortunately couldn’t trawl in the deep canyon, as the first time there was not enough wire, while on the second cruise there was a problem with the winches. This time the winches are serviced and the wire should be long enough.

2. CRUISE PROGRAM and RESEARCH AREAS

Following sections contain a description of the program and the work areas. Some general information about the cruise, i.e. the participants, the cruise blog, and the logbook can be found in the Appendices-1, 5 and 6 at the end of this report.

2.1. Cruise Track

The track of cruise 64PE345 is shown in Fig. 1 starting with departure from Texel on the 28th September 2011 and arrival in Vigo at the 13th October. Three study areas were visited during the cruise: 1) North Sea, 2) Belgica Mounds and 3) Whittard Canyon. The sections below contain a map and the work program in each of the areas.

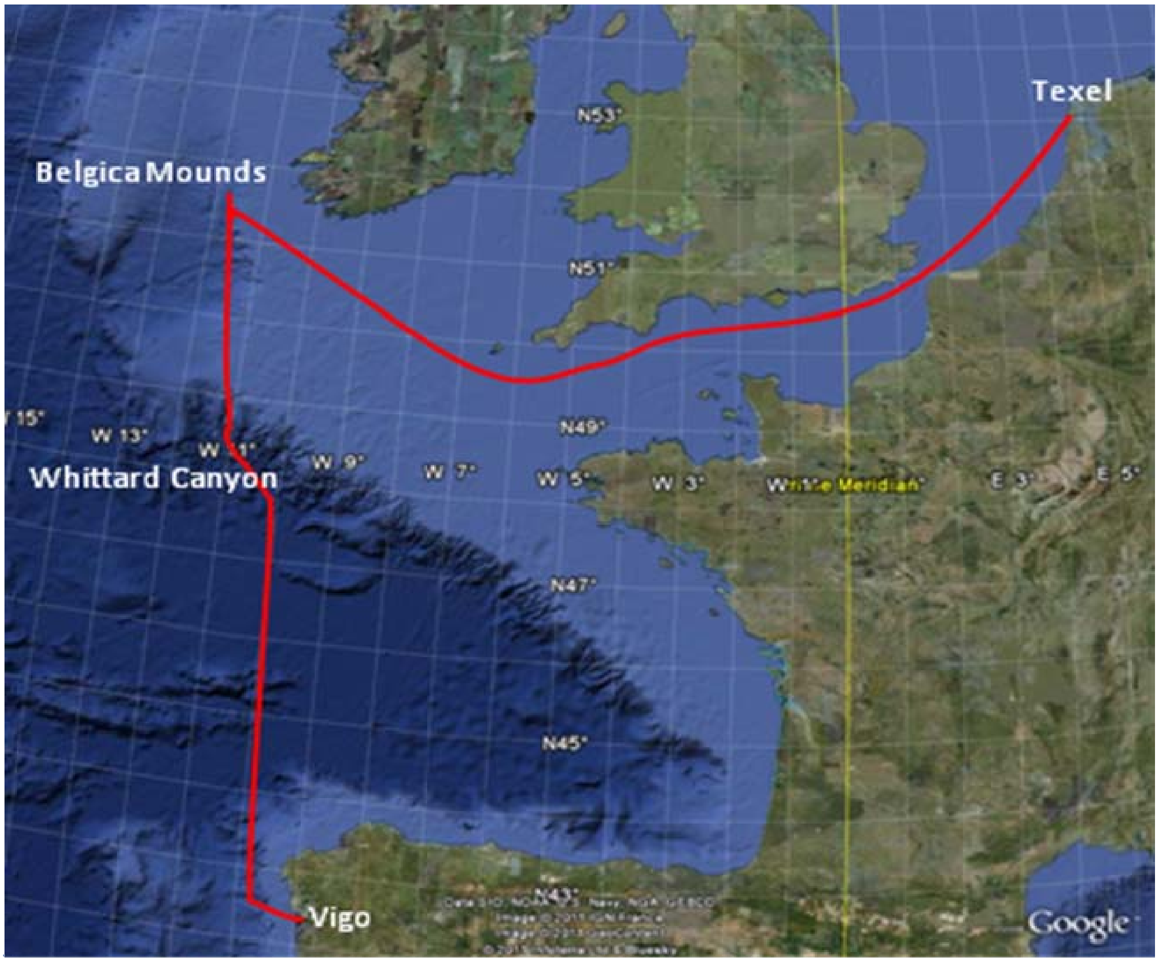

Fig. 1. Track of Cruise 64PE345 (28 Sept-14 Oct 2011).

2.2. North Sea

Though initially not a part of this expeditions program, the evening of the first day was used to do some research in the North Sea at 15m water depth off Egmond aan Zee. The main task was to redeploy our North Sea lander, which after a lot of difficulties was picked up yesterday by our group with another ship "Terschelling". Because of the delay caused by these difficulties there was no time left to service the lander for redeployment. Therefore we used the RV Pelagia to do that instead. The deployment of the lander with CTD, current meter, ADCP, OBS, Fluorometer and Ensis monitor was successful. The Ensis monitor contains 8 living razorshells (*Ensis directus*) (Fig. 2). Each shell is wired to an instrument that measures and logs the gape of the shell, and thus its activity. Next to the deployment also 8 boxcores samples were taken around the position of the lander to sample the very common

Ensis directus. As this shallow water program does not form part of the CoralFISH and HERMIONE project we will not elaborate any further on it in this cruise report.

Fig. 2. The Ensis monitor is put together within the frame of the North Sea lander (Top). Boxcores are being processed on board specifically for Ensis (Bottom).

2. 3. Belgica Mounds

The Belgica Mounds are situated on the eastern side of the Porcupine Bight (Fig. 3). The coral communities in the Belgica Mound Province have been a target of many programs and cruises in the past decade, a summary of which can be found in Foubert et al. (2005). NIOZ visited the area with RV Pelagia already in 2008, 2009 and 2010. The area is designated as a SAC (Special Area of Conservation) by the Irish authority for which a research permit is required.

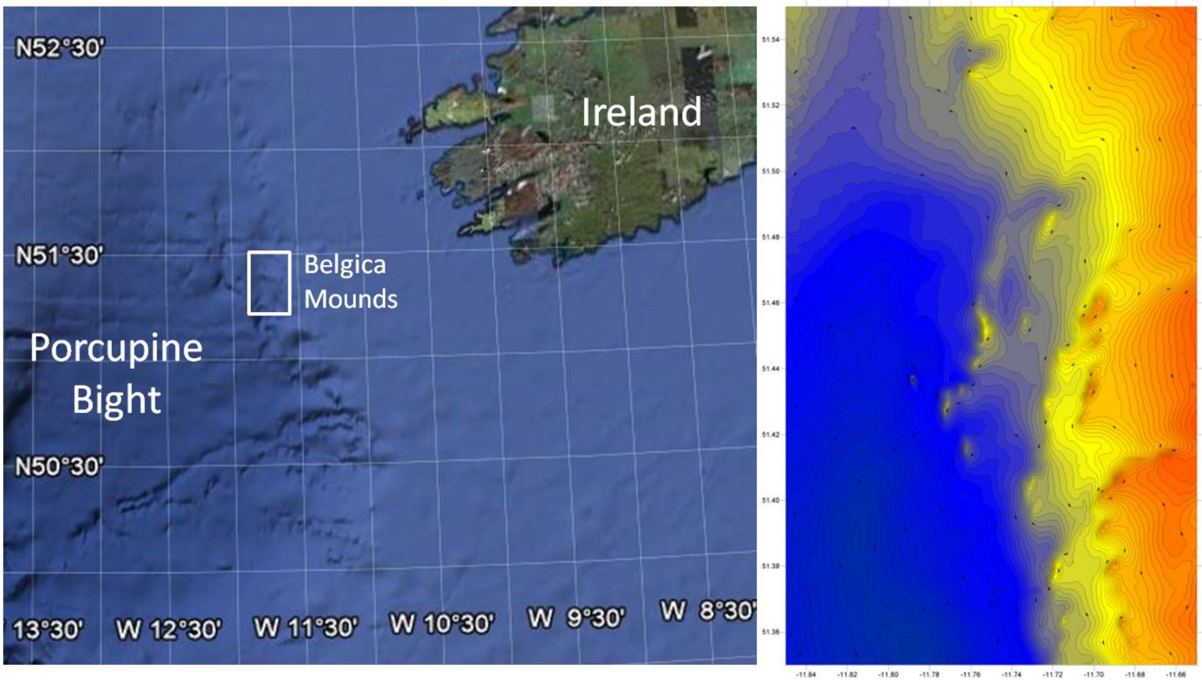

Fig. 3. Left-hand panel: overview of Irish continental margin with the Belgica Mound Province marked by a rectangle. Right-hand panel: bathymetric map of Belgica Mounds.

The combined objectives of cruise 64PE345 for Belgica Mounds were:

- conduct additional respiration measurements on sediment cores and selected biota collected on and off mound
- collect additional video records with a novel fiber optic HD Video system from the seafloor on and off mound in order to count fish and relate their distribution to the habitat type
- conduct and compare baited video experiments with different bait (frozen mackerel and sardines on oil) on and off mound to estimate fish abundance
- collect long-term records of physical parameters (current, temp, S) and particle fluxes in coral habitat
- collect long-term data on fish abundance in coral habitat by means of repeated baited experiments
- try to find evidence for schools of fish near coral mounds by means of echo sounding

2.4. Whittard Canyon

The Whittard Canyon, located 300 km south of Ireland, is a large branching canyon system intersecting the Celtic continental margin (Fig. 4). Following the HERMES studies of the Portuguese canyons (e.g. Tyler et al. 2009), the Whittard Canyon has become a focus of research by NIOZ in the framework of the HERMIONE project. Up to 2008 relatively few studies have been made of the Whittard Canyon i.e. a geochemistry study by Otto & Balzer (1998), a sedimentology study by Reid and Hamilton (1990), and benthic biology by Duineveld et al. (2001). In 2009 a geobiology cruise with the RRS James Cook was completely devoted to study the Whittard Canyon (Masson, 2009), and the Dutch had several cruises to this canyon in which they took samples with CTD, corers and deployed long-term landers (de Stigter et al., 2008, Duineveld et al., 2009; Lavaleye et al., 2010).

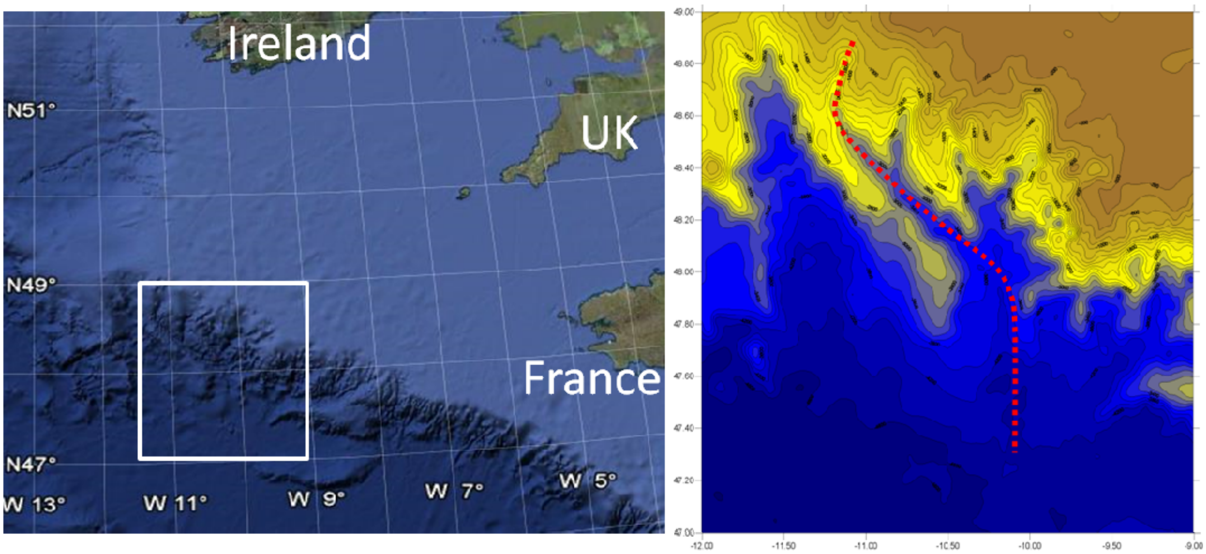

Fig. 4. Left-hand panel: overview of Irish continental margin with white lined rectangle marking the Whittard Canyon area enlarged in the right-hand picture. Right-hand panel: detail of Whittard Canyon. Dotted line marks the westernmost branch.

The objectives of cruise 64PE345 for the Whittard Canyon were to:

- collect long-term records on current speed and particle flux near the head and the mouth of the canyon by means of BOBO landers (1y deployment starting 2010).
- collect video records from the canyon floor for the analysis of benthic biodiversity with the novel fiber optic HD camera system
- collecting benthic animals with an Agassiz trawl for biodiversity and foodweb studies
- collect multicore samples for Foraminifera research, C/N and phytopigment analyses

3. METHODS

3.1. Multibeam

During the cruise a multibeam was mainly used for more precise location of some seafloor features. For this we used the hull mounted Kongsberg EM 300 multibeam echosounder on RV Pelagia. The system is a 30 kHz echo sounder with a 1^o opening angle for the transmitter and a 2^o angle for the receiver. The transducers consist of 135 beams covering max. 150^o. The transmit fan is split into maximum 9 individual sectors that can be steered independently to compensate for ships roll, pitch and yaw. The ships motion is registered by a Kongsberg MRU-5 reference unit and its position and heading by two GPS antennas. Motion and position is combined in a Seapath 200 ships attitude processing unit and sent to the transmitter and receiver unit (TRU). The system is synchronized by means of a 1 pulse per second signal produced by the Seapath 200 which is sent to the TRU. Data from the receiver transducer and the ships attitude are combined in an acquisition computer (Kongsberg HWS 10). The sound velocity profile is calculated on basis of a CTD profile obtained with a Seabird CTD system. The sound velocity near the transducers in the gondola is measured by a Reson SVP 70 sound velocity probe.

3.2. CTD

During the cruise the CTD was only used a few times at the Belgica Mounds and in the Whittard Canyon to calibrate the OBS and Fluorometer that were used on the landers (BOBO and ALBEX). The CTD system consists of a rosette sampler with 22 Noex bottles (12L) and a Seabird™ 911 CTD with auxiliary sensors for O_2, turbidity (Seapoint) sensor and fluorescence (Chelsea Aqua 3). During the calibrating casts, water was collected at the surface, at the chlorophyll maximum, and at the bottom and some additional depth levels. The water was filtered over pre-weighed GFF or CA filters for total SPM, C/N, and pigments.

3.3. Agassiz trawl, Triangular dredge

The special quantitative 3.5m wide Agassiz trawl with camera and odometers was only tried in the Whittard Canyon. Although the winches were completely serviced and indeed worked well, and the steel wire was long enough to fish at more than 4000m depth, the trawling had to be cancelled. This time the problem was that the new cable was not properly (not tight enough) spooled on to the drum of the winch. After we had paid out 1500m of cable during our first (and last) trial, the cable got stuck on the drum between the still remaining loops of the cable. With some luck we managed to get the trawl on board again. As there was no proper way of solving the problem on board, the trawl was not used during this cruise. The triangular dredge was also not used at all, as we did not need additional material from large animals of the non-coral area of Belgica Mounds.

3.4. Boxcorer, Multicorer

Boxcore samples were taken with NIOZ boxcorers which are equipped with a trip valve sealing the box. Cores were either 30 or 50 cm in diameter. The smaller sized cores (30 cm) were only used in the North Sea sampling in shallow depth. In the Belgica Mound coral area only 5 large boxcore samples were taken. These cores were mainly collected for incubation experiments for which acrylic cores of 10 cm were inserted in the core sample (Fig. 5). The multicorer equipped with 12 small acrylic incubation chambers (8 with diameter of 6 cm, 4 with diameter 10 cm) was only used in the Whittard Canyon area. From each multicore 3 cores ø10cm were cut on board for biochemical analysis in vertical slices of 0-1, 1-3, 3-5 and 5-10 cm. The slices were stored in -80^0C. The other cores were used for geological and Foraminifera research. A total number of 5 multicore casts were made.

Fig. 5: Boxcore sample with inserted incubation chambers.

3.5. Respiration experiments

Respiration rates of selected organisms and samples of the sediment community were measured in incubation vials. All incubations were carried out in a temperature-controlled laboratory at bottom water temperature (10°C). Cores were placed into a core holder (Fig. 6). The cores were sealed with a lid containing an o-ring. Each core lid contained a magnetic stirrer with a stirrer motor (stirring was continuous throughout the incubation) and a hole for insertion of a PRESENS™ optode and temperature probe sealed and held in place with bitumen sealant. Whilst the optode was not in place a rubber bung was used to seal the hole. As we had three sets of optodes three incubations could be continuously monitored and logged at the same time. The PRESENS™ Oxyview software logged every 5 seconds the temperature and oxygen concentration. At the end of the incubations the total volume of the overlying water was measured to be able to calculate the consumption per liter water. The incubated animals and coral rubble with epifauna were stored in -20°C, to be analyzed at home for their total organic carbon content. The sediment samples were not kept, but were discarded after the incubations.

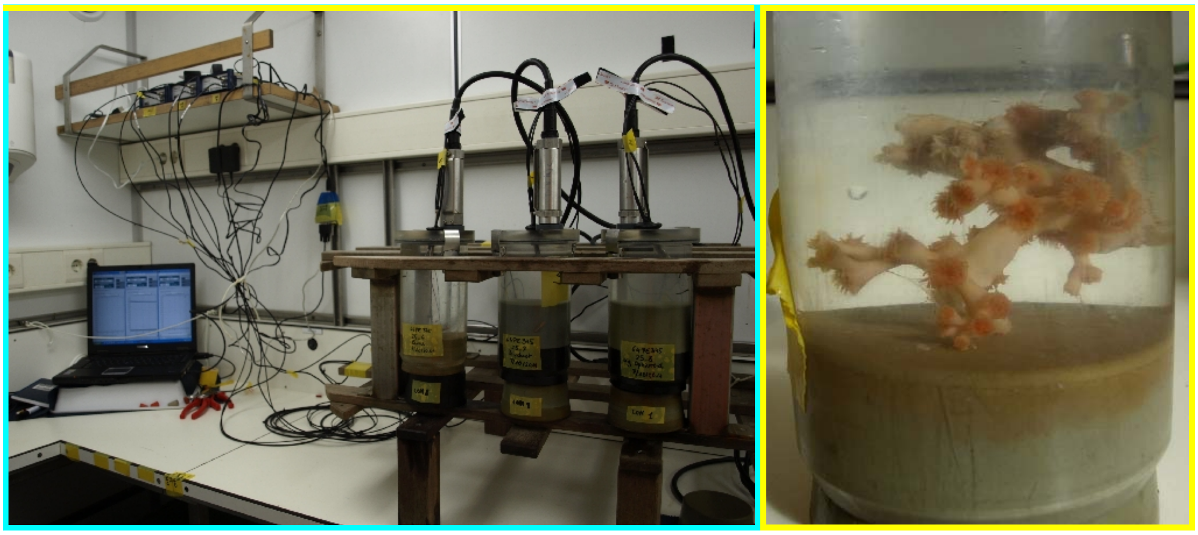

Fig. 6. Left: Incubation set-up in a cool container. Visible are the 3 incubation cores in a rack each with a stirrer on top. In the left corner the computer that logs the data every 5 seconds, and above it the 3 Presence modules with attached temperature and oxygen sensors (optodes). Right: Detail of an incubation core with a piece of living *Lophelia pertusa* coral.

3.6. Fish bait experiments

One of the objectives of CoralFISH is to compare methods to assess fish abundances. A common method to estimate fish abundance is by using the approach time of fish to bait which is usually attached to a camera set-up (photo/video) deployed onto the seafloor (see Priede & Merret 1998). In this cruise we used the NIOZ lander (ALBEX) equipped with an HD-video camera to do some additional (to our earlier cruises) baited experiments. The NIOZ lander (Fig. 7), consist of a triangular frame with floats and ballast holding a programmable HD video camera in a custom made titanium housing with 2 infra-red Led lights. Instead of the normal mackerel this time sardines on oil are used as bait. The bait is offered from a sediment trap vial. This is the same set-up as was and will be used for the long-term deployment; with the difference that carousel with baited vials will hold up to 24 pots. The NIOZ lander sits on the seafloor during the experiment. In total three short term deployments were carried out, two at Galway Mound and one on the plain without coral N. of Poseidon Mound.

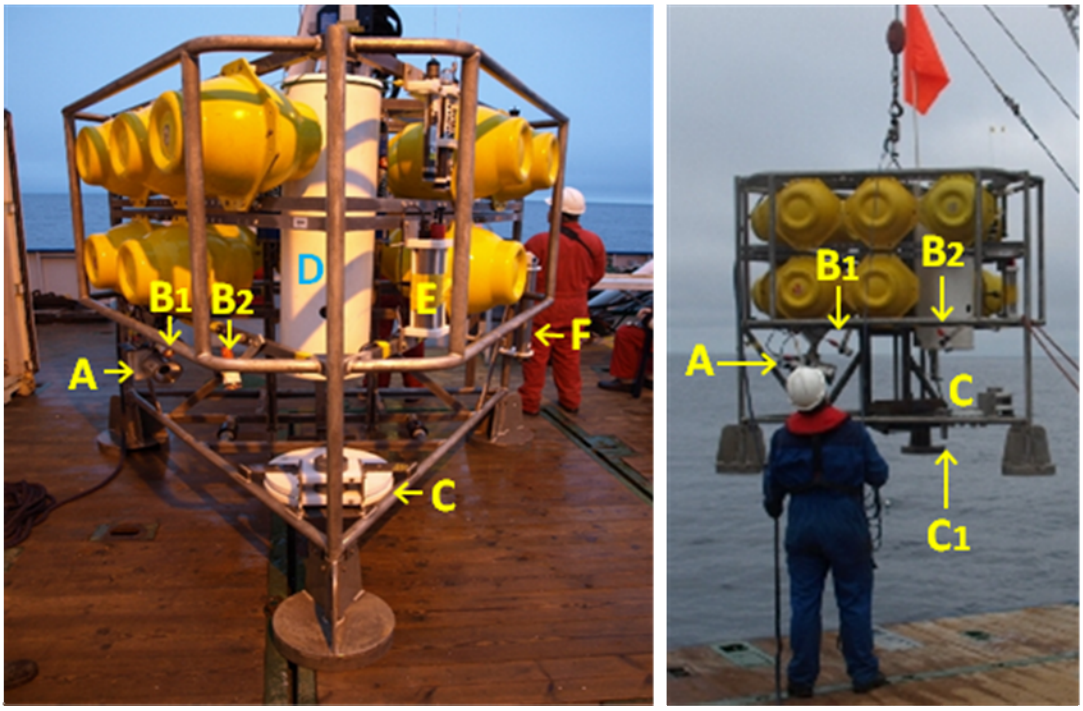

Fig. 7. Left: ALBEX1 lander used for baited experiment with HD-camera and baited carousel. 7b. Other view of the same lander. Explanation of letters. A. HD-video camera. B. Infrared lamps. C. 24 pots carousel with vial with bait. C1. Vial with sardines on oil. D. Sediment trap. E. Datalogger with OBS and Fluorometer. F. Aquadop currentmeter.

3.7. FishObs - longterm fish observations

At the start of the CoralFish project the MEE department of NIOZ developed a so-called fish observatory lander. The final version of the fish-observatory lander consists of a tripod similar as the one in Fig. 8 with 13 Benthos™ floats and double acoustic releasers, ballast etc. Two corners of the tripod accommodate a HighDef video camera (Sony HDR-CX6EK) with infrared illumination (LED). A Technicap carousel (24 pots) and sedimenttrap motor was used as a time lapse bait dispenser. Up to 24 sedimenttrap vials filled with sardines in oil can be attached. The vials open in sequence, but the exposure time of each baited pot can be programmed. This set-up is meant to do repetitive bait studies over 1 year in order to follow seasonal patterns in scavenger abundances. Next to the baited experiment other equipment, like a currentmeter, OBS, Fluorometer, and sedimenttrap, are attached to the lander.

During the cruise in 2008 a prototype of the lander was only used for short term deployments. In October 2009 it was deployed for the first time for a long-term deployment at 784 m depth on top of Galway Mound (51^o 27.0972'N 11^o 45.138'W) equipped with one HighDef camera and 3 Infrared lights. We recovered it successfully during the 2010 cruise. Unfortunately the battery sphere had leaked, which drained the energy for the camera system, so that no recordings took place. At the time we thought that the leaking was caused by a faulty seal of one of the electrical penetrating plugs, so we replaced the battery sphere with one with better

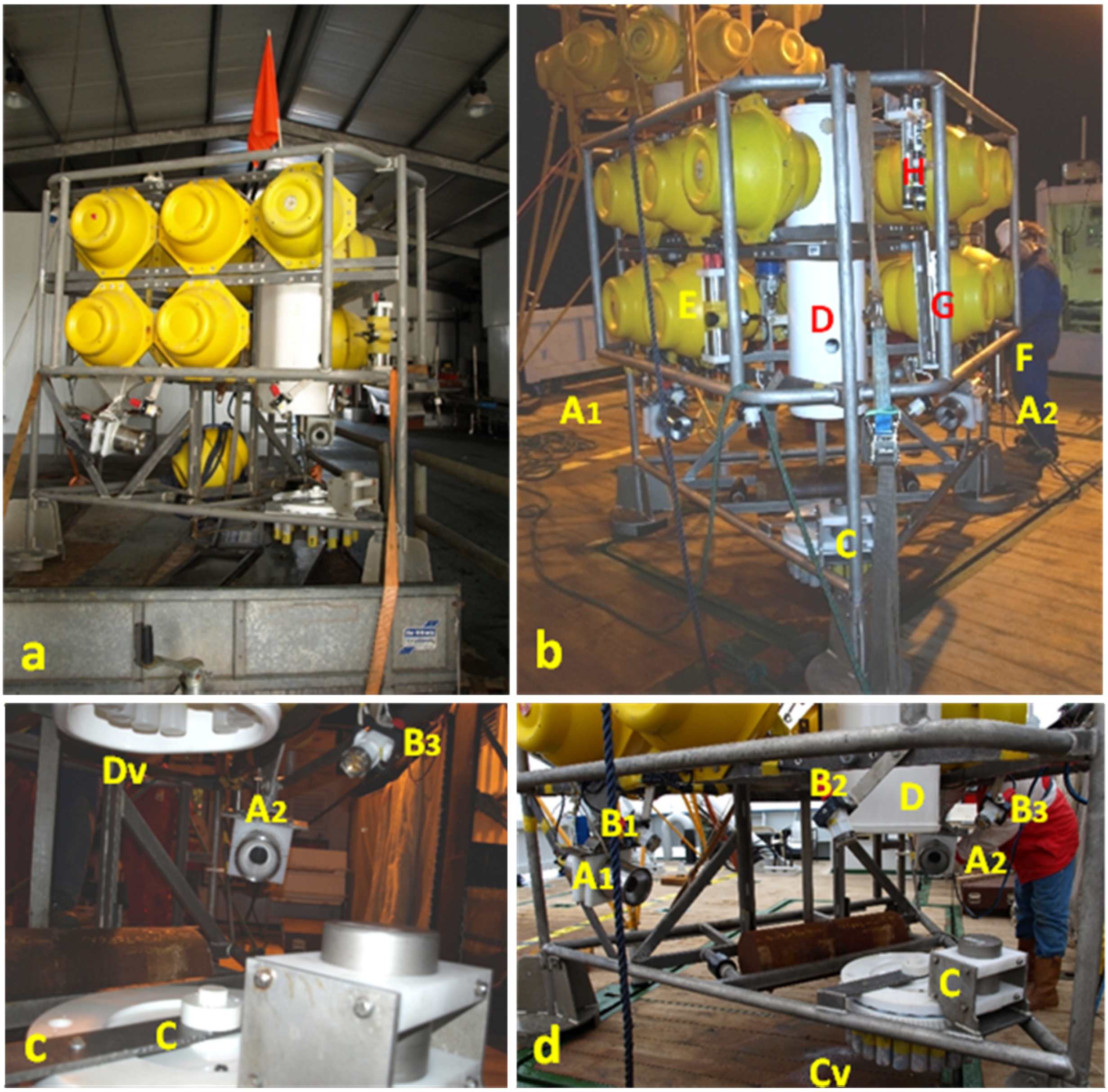

Fig. 8. The long-term fish-observatory lander. 8a.The salvaged lander in a fishery factory shed in Dingle. 8b. The lander just before deployment on Galway mound on 4 Oct 2011. 8c. Detail of one of the HD cameras directed to the baited carousel. The inside of the sediment trap with 12 vials is also visible. 8d. Overview of the position of the 2 HD cameras, 3 infrared lights and baited carousel with 24 vials visible. Explanation of letters. A1 and A2: HD-video cameras. B1, B2 and B3: Infraredlamps. C: 24 pots carousel with vial with bait. Cv: The baited vial with sardines on oil. D: Sedimenttrap. Dv: The sediment trap vials filled with filtered seawater and poisoned with HgCL. E: Datalogger with OBS and Fluorometer. F: Aquadop currentmeter. G. Wetlabs CTD. H: Set of beacons (Radio, flash and ARGOS).

penetrators. As the camera system itself had no damage, we were able to deploy the fish observatory again for another 1 year period at the same spot on 22 Sep 2010. As this was our last possibility to get a good result in the CORALFISH project period, we took a huge risk of attaching on another completely independent HD camera system directed at the same food dispenser, in the hope to increase the chance of getting a positive result, but also to get more frequent observations of the bait over time (if both camera systems do their job). However, on the 8th of July 2010 we received a satellite signal from our ARGOS beacon that our lander was floating on the surface, and was slowly drifting to the south. With help of the CoralFISH coordinator Anthony Grehan we quickly got in contact with the fisherman Tom Kennedy from Dingle (Ireland). This harbor is about 70 miles from the position of the lander. Thomas agreed to pick-up the lander with his fishing boat the Fiona K II as soon as possible. After some anxious waiting, we got the message on 10 July that the lander was brought safely on land. Marc Lavaleye subsequently went there, and discovered that this time one of the acoustic releasers was badly corroded and finally had leaked which caused the lander (as a safety procedure) to surface prematurely. However, all other equipment, including the two camera systems, had functioned perfectly.
During the 64PE345 cruise the fish-observatory lander was deployed again at the same spot (top of Galway Mound) in almost the same configuration on 4 Oct. 2011. Instead of the 12 pots of bait, we attached 24 pots baited with sardines on oil. A CTD (Wetlabs) was added to also get salinity data. During the hectic deployment in the night, just before our departure to the Whittard Canyon, one of the ropes to keep the swinging of the lander to a minimum ripped off at least 3 baited pots from the carousel. In the autumn of 2012 it will be picked-up again by us with a ship of opportunity.

3.8. Fish finder

During this cruise we used the Kongsberg Simrad EK 500 fishery research echo sounder (Fig. 9) for the first time since its repair, as it was disfunctional for years. We tried to locate fish concentrations at and around the coral reefs of the Belgica Mound province. New available software should make the analyses of the huge datasets less complicated. We are still in the process of selecting the proper Echoview software.

Fig. 9 The Simrad EK 500 fishery research echo sounder in operation.

3.9. Video surveys

The new HD-video hopper system (Fig. 10) with the new 9000m long Kevlar cable with glass fibers was tested in June 2011 in the shallow North Sea. For a prototype the whole system worked surprisingly smooth. With help of the Fiber-Optic Interface the camera and lamps can be adjusted on board during the survey operation. The HD-video images became immediately available online. The images of a second overview video camera (normal digital video) were also sent directly to the ship. During this cruise we used it for the first time in deep water. First at the Belgica Mound area up to more than 1000 m, and later also in the Whittard Canyon up to 4500m. It proved that the system indeed works at full Ocean depth. The only problem encountered was with the overview camera. For still unknown reason the signal of this camera was progressively scrambled deeper than 3000m.

We also learned that we had to pay out about 300 m of extra Kevlar cable at a depth of 4000m. This means that the actual video images were not taken straight below the position of the ship, but at least several 100 meters behind the ship (with a maximum of 1600m at 4000m depth). The exact position of the camera could not be calculated by us as this is depended on the curve of the cable in the water. We estimated that the distance will be about 500m behind the ship. This was probably the case for the hopper stations 37, 39, 40. For station 41 we had to pay out up to 600m extra cable, which to our estimations means that the camera was about 800m (absolute maximum 2300m) behind the ship.

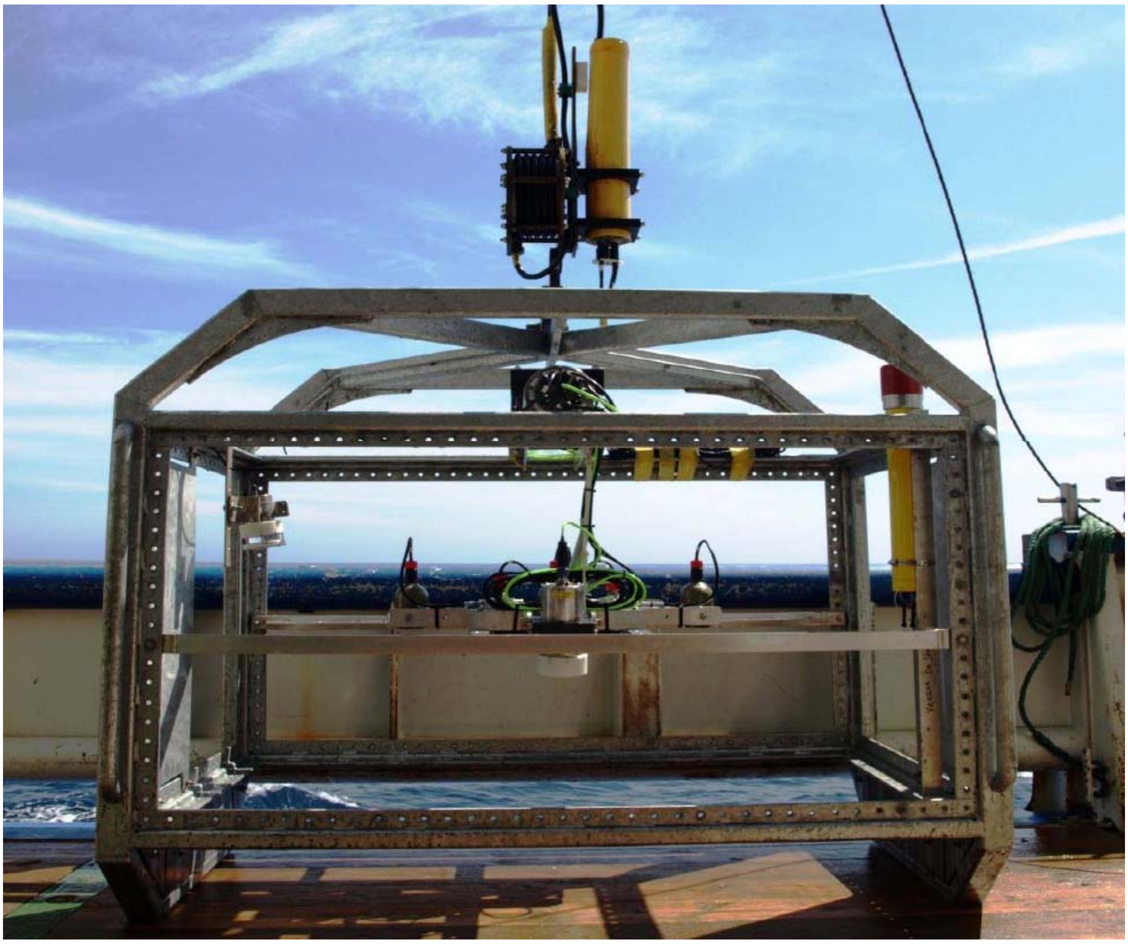

Fig. 10. The new hopper frame with HD-camera in the middle with lamps on each side, and an overview digital camera in the left upper corner of the frame. The images recorded by both cameras can be watched online at real time on board of the ship. This is made possible by the optic fibers (glass fiber) in the core of the 9000m Kevlar cable.

3.8. BOBO lander

BOBO is a tripod benthic lander of ca. 4 m height with on top a flotation body (Benthos™ glass spheres) and double acoustic releasers (Fig. 11). It is used for study of processes in the Benthic Boundary Layer (van Weering et al., 2000). Ballast weights (120 kg) are attached to the underside of each of the three legs. The BOBO carries a sediment trap (Technicap™ PPS4/3 with 12 vials), a downward looking ADCP (RDI 1200), a Seabird™ CT and Seapoint™ OBS at 2 heights. A central processing unit is connected to the different instruments to simplify programming and data downloading. The parameters collected by BOBO are temperature and salinity, a near-bottom profile of current velocity allowing calculation of shear velocity, SPM in the form of optical and acoustic backscatter units, and vertical particle flux.

It was planned to deploy the BOBO lander in the plain area between Galway Mound and the Poseidon Mound for one year to get data that could be compared with the long-term ALBEX lander that would measure simultaneously on top of Galway Mound. Unfortunately the ADCP of the BOBO-A had problems, and this planned deployment was cancelled. The BOBO-D lander was successfully recovered from the Whittard Canyon. The ADCP of the recovered BOBO-D had worked successfully, and after it was judged that this ADCP could still be deployed for another year, it was mounted on the BOBO-A lander. The complete BOBO-A was than deployed for 1 year in the Whittard Canyon at 3600m depth on 6 Oct 2011.

Fig. 11. BOBO-A lander just before it is being deployed for 1 year in the Whittard Canyon.

4. PRELIMINARY RESULTS

4.1. Belgica Mounds

4.1.1. Biodiversity, density and biomass of macrofauna

Only 6 boxcore samples (all 50 cm diameter) were collected mainly for incubations. See for photographs of the surface area Appendix 3A. Two were taken on top of Galway Mound (15-16), 3 on top of Therese Mound (24-26) and one in the plain area between Galway Mound and Poseidon Mound (31). The positions of the boxcores are shown in Fig.12. The top 10 centimeters of left-over's from the boxcore sediment were sieved over 0.5 mm, and stored wet for analyses of the thanatocoenosis (mainly Mollusca).

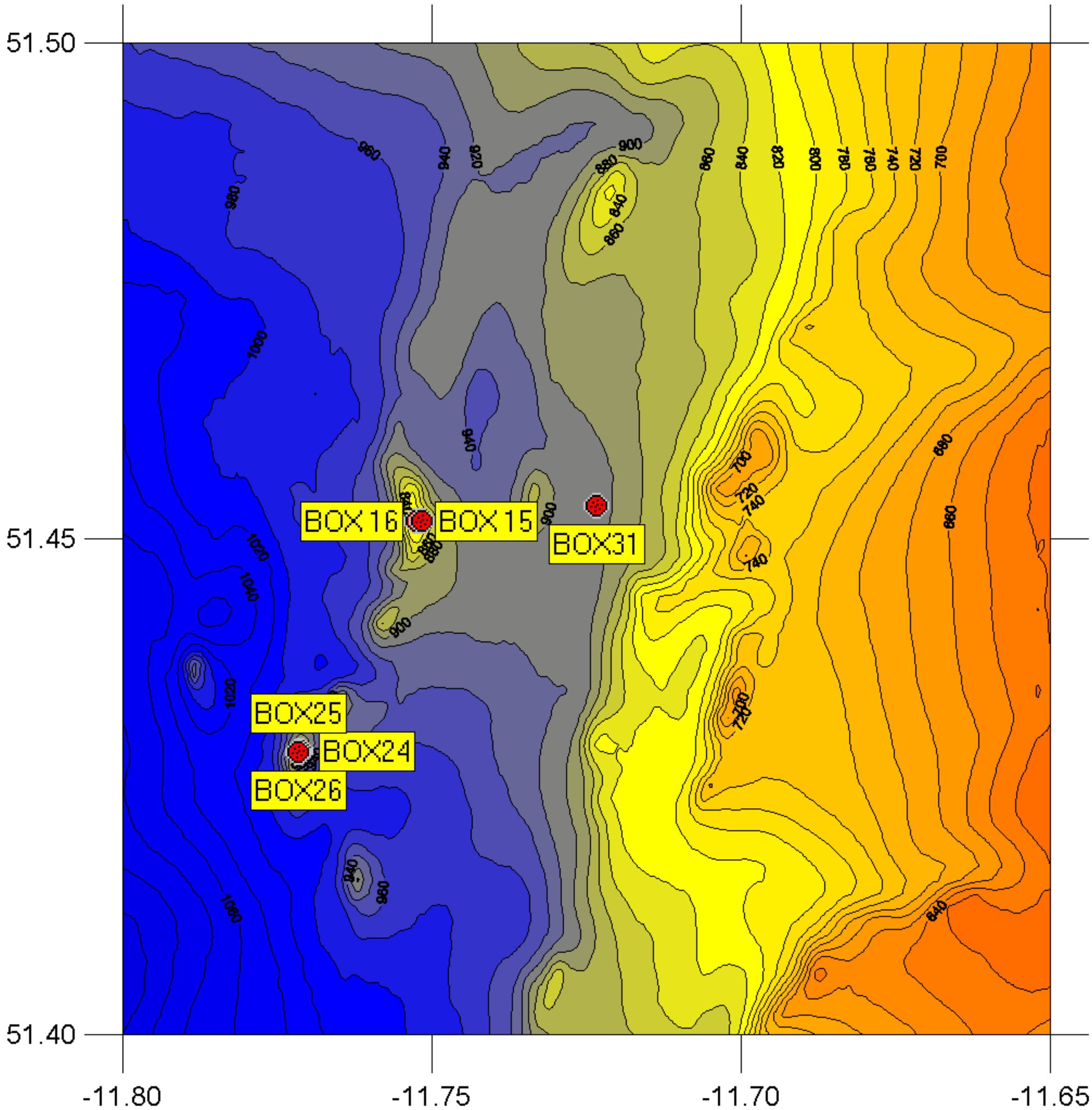

Fig. 12. Position of large boxcores taken in the Belgica Mound area.

4.1.2. Deck incubation of organisms and sediment (N. Langwald & G.Duineveld)

Subcores were obtained from boxcores for incubation experiments of sediments (Fig. 5). For the position of the boxcores see Fig. 11. These measurements form additions to the incubations done during the 2009 and 2010 cruises. The aim is to ascertain if there are differences in sediment oxygen uptake rates between coral mounds and areas without coral mounds. In addition to the sediment cores also live corals, dead corals and several larger animals were incubated (Fig. 6). The number of incubation experiments including blanco's is shown in Table 1.

Table 1. On board incubations with sediments, fauna and water (blanco's).

Station	Incubation no.	Area	Depth (m)	Material
15	15-1	Galway Mound	791	sediment
15	15-2	Galway Mound	791	blanco
15	15-3	Galway Mound	791	violet soft coral
15	15-4	Galway Mound	791	mixed gorgonian
16	16-1	Galway Mound	788	sediment
16	16-2	Galway Mound	788	orange gorgonian
16	16-3	Galway Mound	788	clubbed gorgonian
23	23-1	Therese Mound	870	blanco (bottom water)
23	23-2	Therese Mound	870	blanco (bottom water)
24	24-1	Therese Mound	877	Eunice norvegica
24	24-2	Therese Mound	877	Echinus sp.
24	24-3	Therese Mound	877	soft coral
24	24-4	Therese Mound	877	starfish
24	24-5	Therese Mound	877	Lophelia pertusa
24	24-6	Therese Mound	877	Lophelia pertusa
24	24-7	Therese Mound	877	gorgonian
24	24-8	Therese Mound	877	Eunice norvegica
25	25-1	Therese Mound	856	pale gorgonian
25	25-2	Therese Mound	856	coral
25	25-3	Therese Mound	856	starfish
25	25-4	Therese Mound	856	coral rubble
25	25-5	Therese Mound	856	coral rubble
25	25-6	Therese Mound	856	Eunice norvegica
25	25-7	Therese Mound	856	polychaete
25	25-8	Therese Mound	856	big ophiuroid
25	25-9	Therese Mound	856	striped ophiuroids
25	25-10	Therese Mound	856	ophiuroids
26	26-1	Therese Mound	857	Lophelia pertusa
26	26-2	Therese Mound	857	orange gorgonian
26	26-3	Therese Mound	857	orange gorgonian
26	26-4	Therese Mound	857	anemone
26	26-5	Therese Mound	857	community
26	26-6	Therese Mound	857	community
26	26-7	Therese Mound	857	community
26	26-8	Therese Mound	857	polychaete
26	26-9	Therese Mound	857	hydrozoa
31	31-1	Off coral area	903	sediment (large tube)
31	31-2	Off coral area	903	sediment (small tube)
31	31-3	Off coral area	903	yellow hydrozoan
32	32-1	Off coral area	904	blanco (bottom water)

4.1.3 Video surveys of the seafloor

A total of 4 video surveys were made with the new tethered video system in the Belgica Mound area (Fig. 13). Two extra tracks (in addition to our previous cruises) were made over Galway Mound (track 14 and 28). The two other tracks were made in a non-coral area north of Poseidon mound to investigate the deployment area for our ALBEX lander at station 18.

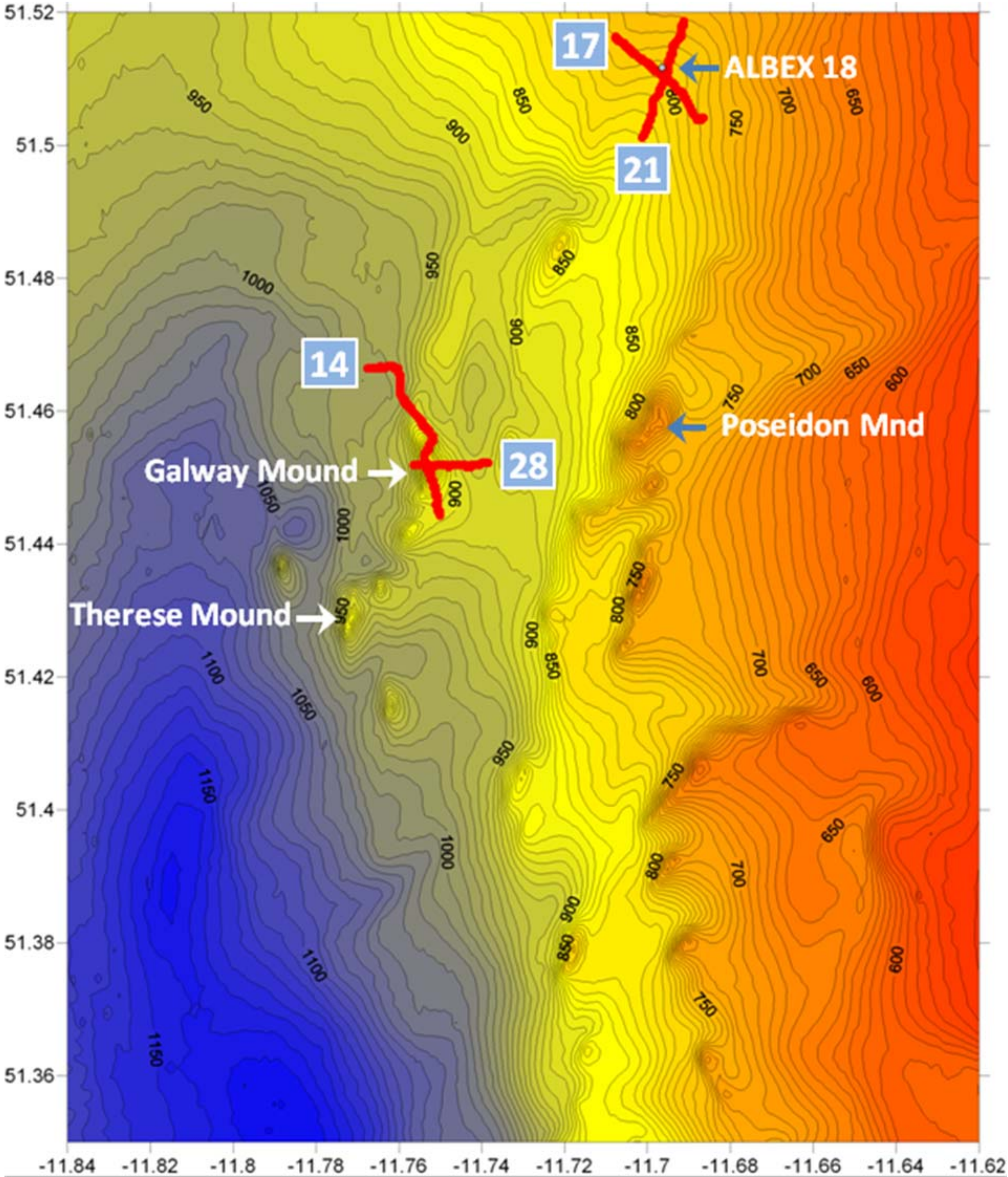

Fig. 13. Map of the Belgica Mound area with the 4 video survey tracks indicate by red lines with station numbers in rectangles. The position of the ALBEX lander (sta. 18) is also shown. The other lander position is shown on Fig.14.

4.1.4 NIOZ-landers

The ALBEX-4 lander, the same that was deployed for long-term on the Galway Mound, was deployed 4 times successfully for short periods. After the last short deployment it was redeployed for 1 year at the top of the Galway Mound. The BOBO-lander was deployed for 7 days in the plain area between Galway Mound and Poseidon Mound. The position of all deployments is shown on Fig. 14, except for station 18, which is shown on Fig. 13.

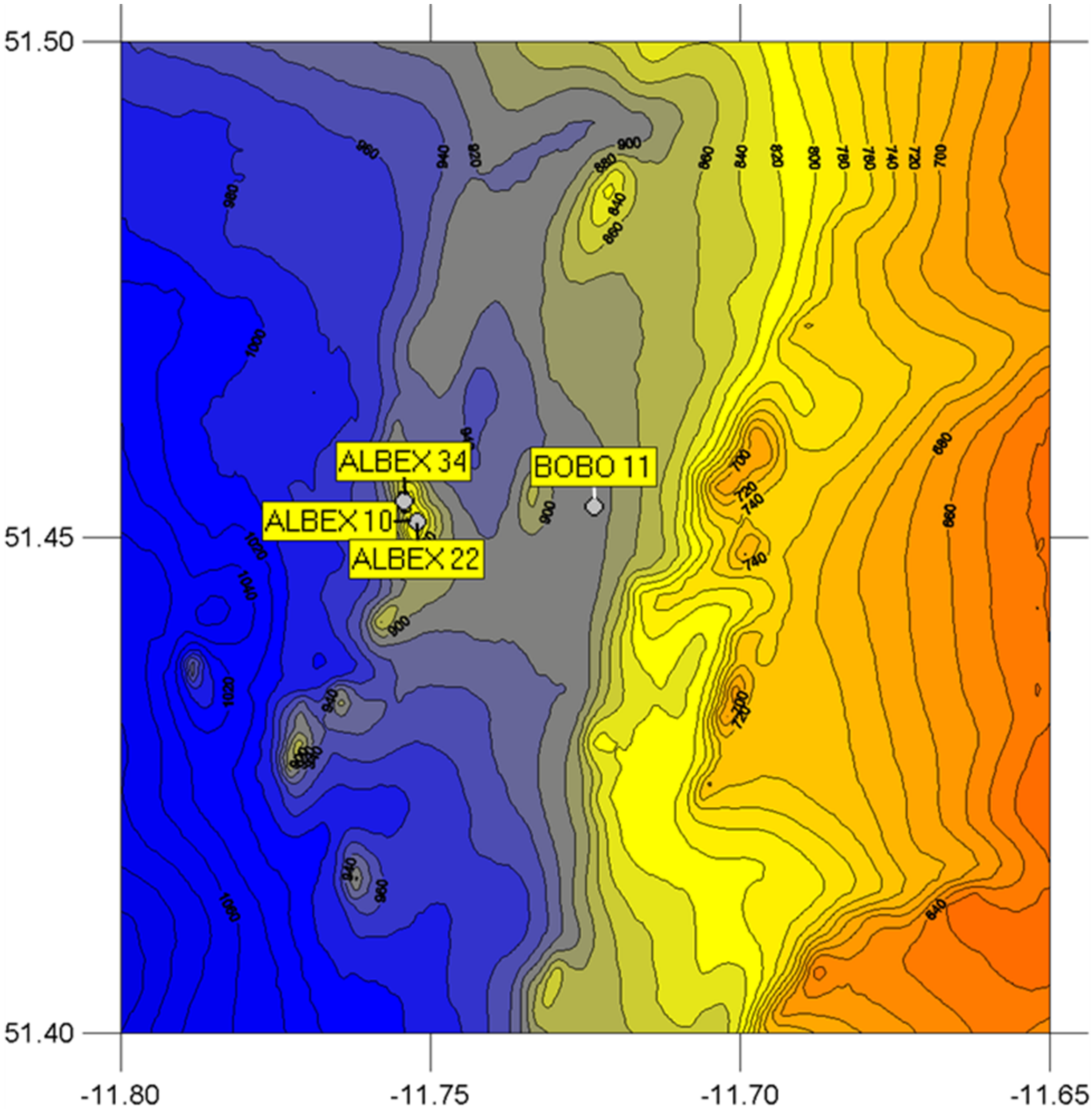

Fig. 14. Detailed map of the north part of Belgica Mounds around Galway and Poseidon Mound with the positions of the BOBO- and ALBEX landers shown. Station 34 is the position of the 1 year deployment that is scheduled to last until October 2012.

4.1.5 Fish finder

During the 3 subsequent nights 3 echo sounding tracks were done with the fish finder (Kongsberg Simrad EK 500 fishery research echo sounder). The first (station 12) was a zigzag track covering part of the north part of the Belgica Mounds including Galway Mound, Therese Mound and Poseidon Mound (Fig. 15). The two other tracks (sta. 19 and 29) were loops covering Galway Mound and Poseidon Mound (Fig. 15). During each of these two stations the loop was surveyed 4 times to see if there were any changes (migrations of fish) during the night. An example of the results of the fish-finding survey is shown in Fig. 16.

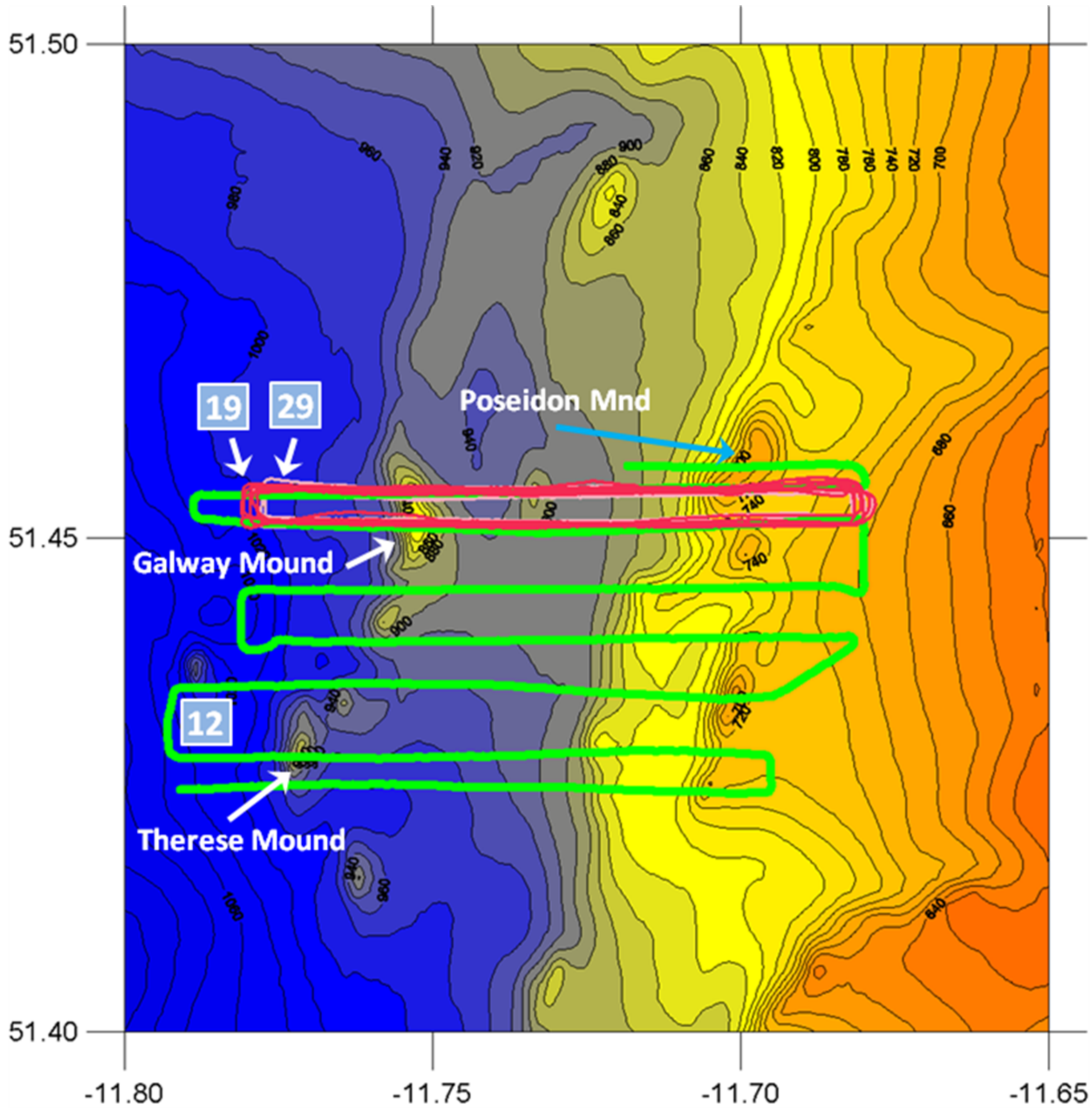

Fig. 15. Detailed map of the north part of Belgica Mounds around Galway and Poseidon Mound with the 3 fish-finder tracks. The green zigzag line is track 12, the red quadruple loop is station 19, while the rose quadruple loop is station 29.

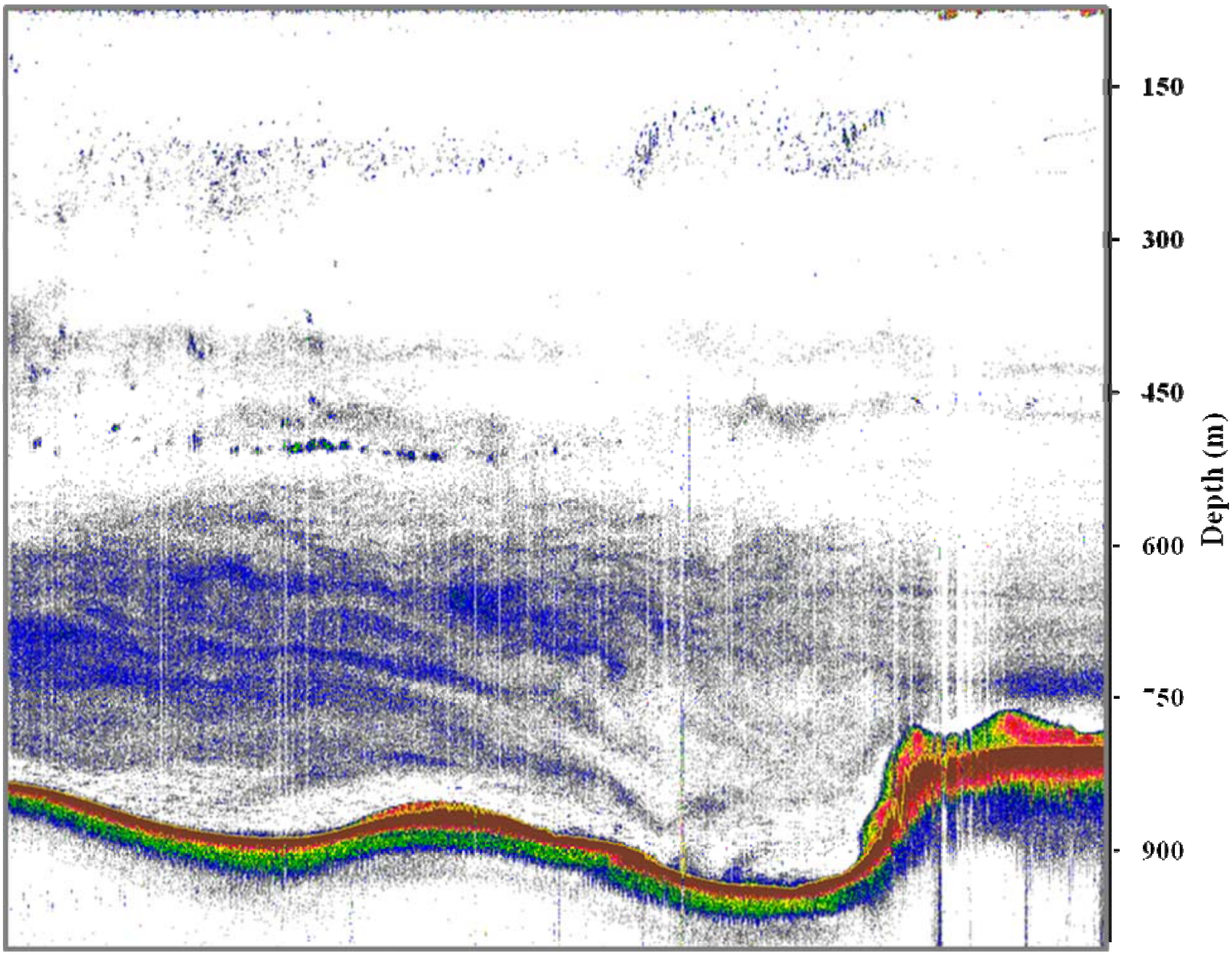

Fig. 16. Example (a small part) of the result of the fish finding survey over a mound structure (right). The pink patches on the mound close to the bottom are possible fish concentrations.

4.2. Whittard Canyon

4.2.1. BOBO-lander (H. de Stigter)

The long-term BOBO-D lander was recovered on 6 October from a depth of 4166 in the Whittard deep sea channel. It had been deployed there the year before on 29 September 2010. Read-out of the collected data showed distinct semi-diurnal tidal currents, with mean speed at 1 m above bottom of 2.9 cm s-1 and peak currents seldom exceeding 10 cm s-1. Turbidity was overall very low except for two events on 22 March and 1 July 2011 interpreted as the passage of sediment gravity flows through the channel. On these occasions turbidity increased sharply and then gradually decreased to normal levels in the course of a few days. Sediment trap samples corresponding to the time interval of these events showed a markedly elevated sediment deposition (Fig. 18).
After swapping the malfunctioning ADCP of the BOBO-A lander with the ADCP of the just recovered BOBO-D lander, BOBO-A was launched for a one-year deployment at 3569 m water depth in the lower part of the western branch of Whittard Canyon. Positions of the BOBO are indicated in Fig 18.

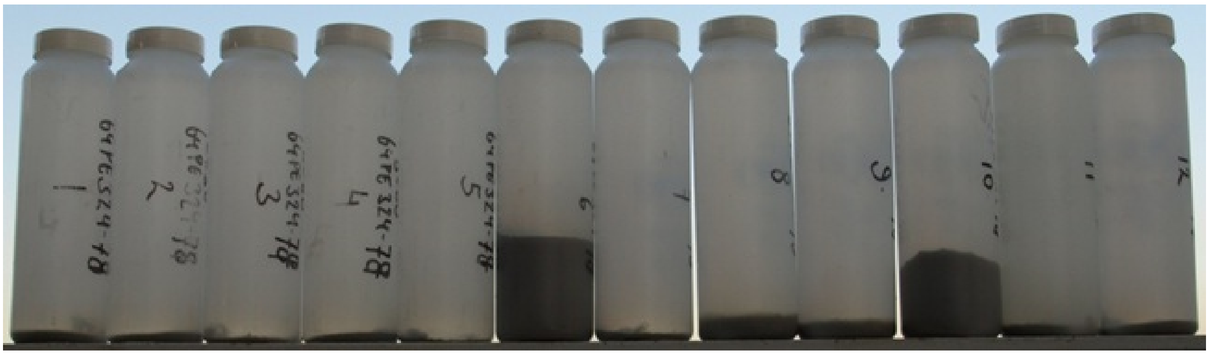

Fig. 17. Two sediment gravity flow events that occurred in the Whittard deep-sea channel are clearly reflected in a series of sediment trap samples collected with BOBO-D lander

4.2.2. Video surveys

In total 6 video-surveys each with a length of more than 1 hour were performed. All video tracks are plotted in Fig. 18. A preliminary check of the footage revealed that the sediment had a fluffy layer on top that was easily blown away by the movement of the video frame 2-3m above the bottom. Further lots of small cucumbers, probably *Peniagone*, were seen in the canyon, while outside the canyon hardly any were seen. Higher up in the canyon (sta. 49) we expected to find also high concentrations of these cucumbers, but they were to our surprise not present here.

4.2.3. Sediment sampling

A total of 5 multicore casts (all successful) were taken from the Whittard Canyon area. The position of the multicores is shown in Fig. 18. Sediment samples will be analysed for bulk composition, particle size, phytopigments, stable isotopes (C and N), N and organic C content, and aged on bases of ^{210}Pb.

4.2.4. CTD and calibration of OBS

Only one CTD was taken and this was done mainly to calibrate four OBS with the CTD instruments. Water was filtered to measure the dryweight of the suspended particles. This will be used to quantify the OBS signal.

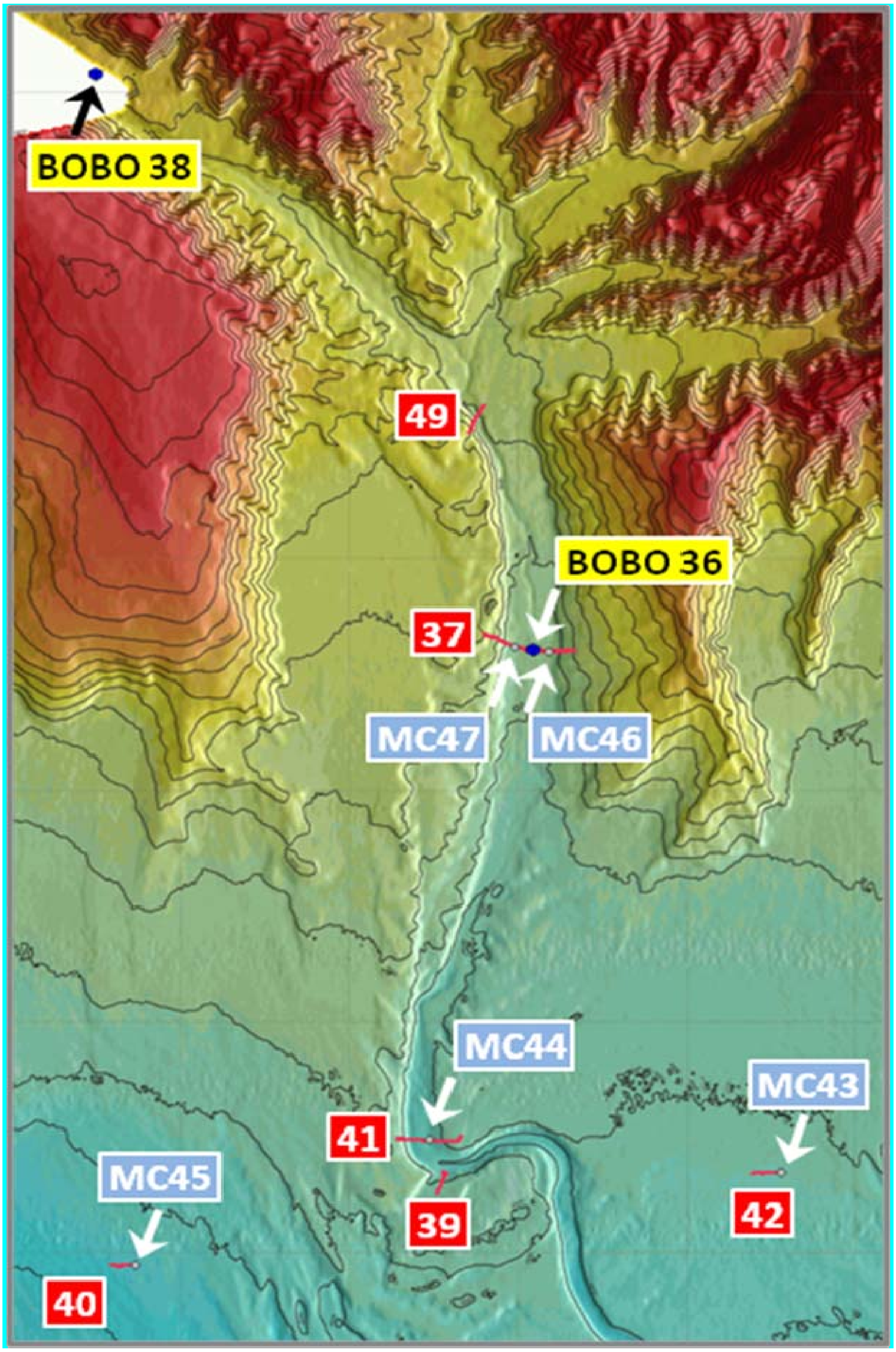

Fig. 18. The Whittard Canyon with indication of the 2 BOBO lander positions (blue dot with yellow labels), the multicore positions (small dot wit blue labels) and the videotracks (red lines with red labels). BOBO36 is the station were the long-term BOBO lander was recovered, and BOBO38 is the new position of the long-term BOBO lander. Underlying map: courtesy of V.Huvenne, NOC, Southhampton, UK, obtained with RRS Schott.

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APPENDIX 1

SCIENTIFIC PARTY AND CREW OF THE CRUISE 64PE345

Scientific Party

No	Name	Institute and profession
1	Marc Lavaleye	Chief scientist, NIOZ biologist
2	Gerard Duineveld	NIOZ -biologist
3	Magda Bergman	NIOZ -biologist
4	Henko de Stigter	NIOZ-geologist
5	Marcel Bakker	NIOZ-technician
6	Jan Dirk de Visser	NIOZ-technician
7	John Cluderay	NIOZ-electrotechnician
8	Evaline van Weerlee	NIOZ-analist
9	Matthias Biber	Master student Bangor University
10	Nina Langwald	Master student RUG
11	Gino Smeulders	Arcadis BV. Apeldoorn
12	Tanja Kouwenhoven	Katholieke Universiteit Leuven, Belgie
13	Teresa Amaro	University Aveiro, Portugal

List of the crew

No	Name	Rank
1	John Ellen	Captain
2	Joep van Haaren	First officer
3	David Verheyen	Second officer
4	Jaap Seepma	Chief engineer
5	Marco Frankfort	Second engineer
6	Fred Hiemstra	Able bodied
7	Sjaak Maas	Able bodied
8	Ger Vermeulen	Able bodied
9	Jose Vitoria	Able bodied
10	Arie Lont	Cook
11	Martins Zagars	Assistant cook

APPENDIX 2

SEDIMENT SAMPLES FOR BIOCHEMICAL ANALYSIS COLLECTED BY MULTICORE

All cores had a diameter of ø10cm and were sliced horizontally in the following way:
0-1, 1-3, 3-5 and 5-10 cm.

#ST 43
Core 1 - 5 samples
Core 2 - 5 samples
Core 3 - 6 samples

#ST.44
Core 1 - 4 samples
Core 2 - 7 samples
Core 3 - 8 samples

#ST 45
Core 1 - 8 samples
Core 2 - 6 samples
Core 3 - 7 samples

#ST 46
Core 1 - 6 samples + 1 filter
Core 2 - 7 samples + 1 filter
Core 3 - 7 samples + 1 filter

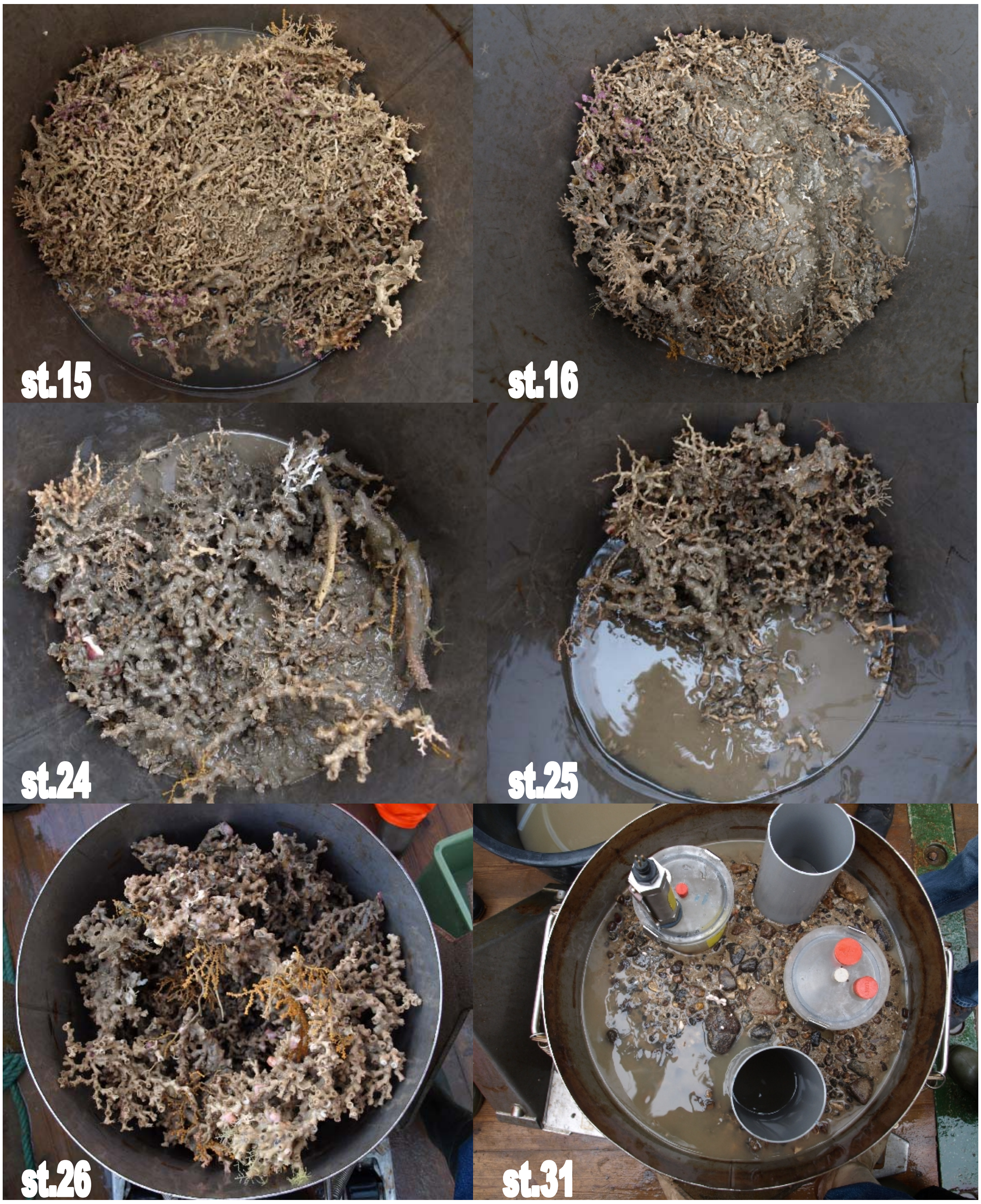
#ST 47
Core 1 - 7 samples + 1 filter
Core 2 - 6 samples + 1 filter
Core 3 - 6 samples + 1 filter

EXTRA SAMPLES

#FILTERS FROM EVALINE IN 3 PLASTIC BAGS AND A LITTLE VIAL WITH COPEPODS

APPENDIX 3A

PHOTOGRAPHS OF ALL BOXCORE SAMPLES FROM BELGICA MOUND AREA
All cores with diameter of 50cm.



APPENDIX 3B

PHOTOGRAPHS OF ALL MULTICORE SAMPLES FROM WHITTARD CANYON AREA

APPENDIX 4

CRUISE BLOG by Marc Lavaleye

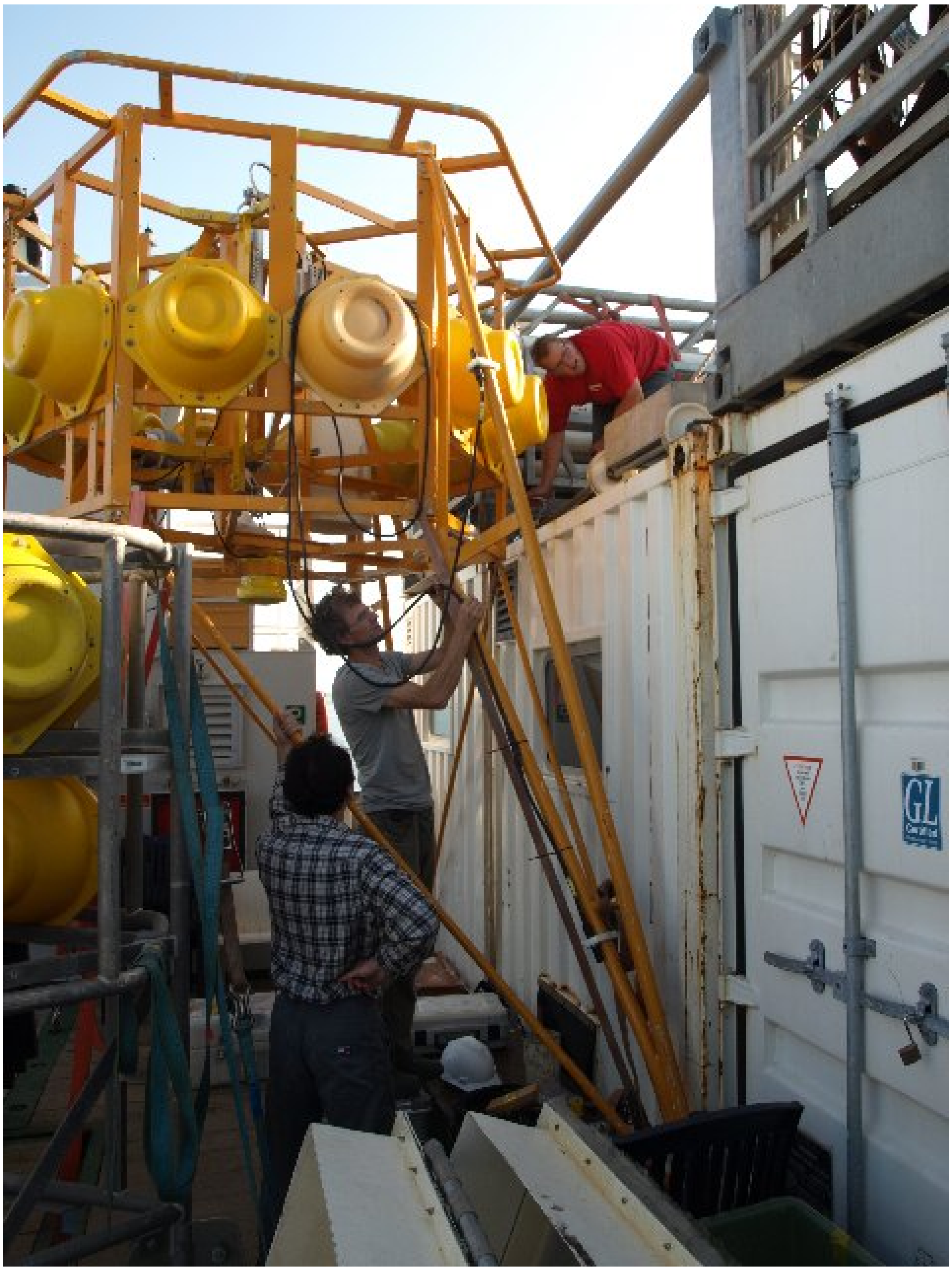
28 Sept 2011 Wednesday
Our cruise is a bit delayed because loading of all the equipment for several cruises on a row takes more time than expected. The RV. Pelagia will not come back at NIOZ the next 7 months, and will go as far as the Red Sea. For us it luckily will not take that long. We are scheduled to disembark in Vigo on 14 Oct. Yesterday 4 of the participant still had to do the one day "survival at sea" course, which is obligatory on the Pelagia. They all got their certificate after having jumped in the harbour of Den Helder to do some swimming, which was not so easy in the sturdy survival suite they had to wear. Three other participants, Gerard, Magda and Evaline, just came back from a one day cruise with the `Terschelling`. Their main task was to pick-up their North Sea lander from 15m water depth off Egmond aan Zee. However, the topfloat to pickup the lander was gone, and the release mechanism for the main pickup floats did not work as it was completely overgrown with a thick layer of barnacles. So they had to angle half day in the dark for that lander, but in the end were successful and recovered it, but had no time left to prepare the lander for another 3 week deployment. Therefore we will use this first day with the Pelagia to put that lander (serviced and the equipment reprogrammed) back at his position for another 3 week measurement. At lunch all the 13 participants are on board, and with beautiful weather we left Texel at 15:00. After a one hour test of the engines of the ship, the servicemen were satisfied and left the ship by means of the smaller NIOZ vessel the Stern steered by Ewout. All in all we only reach the lander position at 19:45, and drop it without difficulties. After having taken also 8 boxcores around the position of the lander to sample the very common razorshells (Ensis), we are off to the real targets of this expedition, the Porcupine Bight and the Whittard Canyon. During the day we are busy to spread our boxes with equipment over the different laboratories and discover that one container we thought we could use is completely packed with stuff for a next cruise. The funniest thing today was that Gerard had such problems with his laptop that in frustration he almost made it a tablet or iPad, by trying to split the screen from the keyboard. Luckily he was unsuccessful.

The ALTRAP lander deployment in the coastal zone of the Netherlands

29 Sept 2011 Thursday
A beautiful day of sailing towards the Channel. The sea is calm and the sun shines. We organize the labs and set up equipment. There are 24 people on board, 11 belong to the crew and 13 are participants of this CoralFISH/HERMIONE cruise. Most of the participants are from the Netherlands. Royal NIOZ represented by 4 scientist and 4 technicians/assistants. Next to 2 other Dutch scientists we have two German students and a Portuguese scientist. The biologists form just a majority (4 scientist), over the geologist (3 scientist), but we expect to have a good cooperation.

Unpacking the transport container

30 Sept 2011 Friday
We slowly come into the reach of the Atlantic Ocean and the long swell forces a few people to skip lunch. Fog sometimes obscures the sun. On the afterdeck we have 2 landers, the long-legged BOBO and the compact ALBEX. We are busy preparing both for their deployment tomorrow evening. So the different kinds of equipment are tested, and then attached to the landers. The ship goes ahead with a more or less constant speed of 10 knots, day and night.



Preparing the BOBO lander for deployment

1 Oct 2011 Saturday
The different apparatus's on the landers are being programmed for their first deployment scheduled for this evening. Among them are sediment traps, dataloggers for turbidity and fluorescence, current meters (Aquadop and ADCP), and a HD-camera. Normally there are always some problems to overcome, but this time the programming is going smoothly for all the equipment. It is rainy weather with fog. Probably because of that some birds lost track during migration, and land on our ship as a safe haven. We have a falcon, some wheatears (tapuit), and small singers. The last are checking the nets of the trawl for insects, as it is the only thing that looks a bit like vegetation. Because of the rain (drinking water) their life is prolonged a bit, but most of them will never see land again. Nina and Gerard set up the incubations in a cool container, as we expect the first sediment samples tomorrow. Evaline took the winkler set out of the box, and has built it up in the wetlab. This is to measure oxygen in watersamples. At 21:00 we arrive at Galway Mound, which is one of the richest underwater mounds with cold-water corals of the Belgica Mound Province. The area is protected, and we needed a special licence from Ireland to do research here. The landers are both ready to be deployed. The ALBEX lander is dropped on top of Galway Mound with a baited experiment. We want to see which species of scavengers are attracted by our bait (in this instance sardines on oil), and try to estimate their population by first approach times

(the quicker they arrive at the bait, the larger the population). We will be able to tell this, as it is all filmed by the underwater video camera. As a contrast the BOBO lander is dropped in the gully between Galway Mound and the continental slope. As the weather is calm both landers are deployed from the back of the ship without any problems. Henko tries to get an exact position by triangulation of the BOBO lander, as it could have been drifted during its 20 minutes descent to the 900m deep seafloor. After some calculation his outcome was that it had drifted about 200m. During the night the ship does a zigzag transect over the area including some coral mounds to search for fish with our so-called fishfinder, a kind of echo loading device with a frequency that is sensitive for fish. With the baited experiments (on the lander), the fishfinder (tonight) and the videourveys (starts tomorrow) we try to find out more about the relation between fish and cold-water corals. Our research forms part of an EU-project which is called (not surprisingly) “CoralFISH”.

Deployment of the ALBEX lander on Galway Mound

2 Oct 2011 Sunday
At 8 o’clock in the morning we beep up the ALBEX lander. On our special sound command the lander drops its heavy weight that keeps it at the bottom, and now steadily rises to the surface by way of its 13 glass floats. As it is 800m depth here, it takes about 20 minutes before it is at the surface. It is getting crowded on the bridge as everybody wants to be the first to locate it. Armed with binoculars we scan the horizon for the yellow floats and the orange flag on top of the lander. Henko wins the price and the crew picks it up quite easily in these calm weather conditions. We read out the instruments and we get our first data on currents, turbidity and fluorescence. The carousel has indeed turned to open the vial with sardines at the right time, but we notice a small mismatch between the openings of the vial and carousel. The HD-camera refuses to show if it has recorded anything. But after testing different options, and checking cables with our spare camera, it proves that the USB cable malfunctions. John Cluderay finds out that there is (rain) water in one of the extension plugs of this cable, and after some drying it works again. The video shows that there is not much interest for our bait, but we do not have the time to check all of the 5 hours of video at this time. As the lander is now safe on deck, we are able to do a video survey with the new HD video hopper system exactly over the top of the Galway Mound, and thus over the position of where the ALBEX lander has been. Last year at the same time of the year we had deployed this same lander also on this same spot, but in July of this year we got an unexpected message from the lander that is was floating on the surface. The satellite beacon gave us the exact position, and with our

directions a fisherman in Dingle picked it up for us. I went to Dingle to check it out, but luckily it proved that the lander was undamaged and that all equipment had worked fine inclusive the 2 HD video cameras (8000 movies of 17 seconds). The cause of its unscheduled ascent was that one of the acoustic releasers had leaked because of heavy corrosion around the O-ring sealing. Because of the flooding with seawater a safety protocol in the releaser had forced it to drop the ballast weight, otherwise we probably would have never got it back as the other releaser did not look good either. But now we have it on board, fixed up at NIOZ with fresh releasers. And it is important that we get some good video surveys over this area where we already got so many data. And right now we are doing that. Our new fibre-optic HDvideo system has never been to these depths before, but it gives amazing sharp and detailed images of the cold-water coral community down there. For the first time it is now much more easy to identify the animals, like the orange-white striped swimming crabs, the rose anemones, glass sponges, gorgonians (fan shaped soft corals), but also if the many coral branches we see are alive or dead. It is a delight to look at the images of this coral rich bottom passing by while the ship is moving slowly over it. We record about 3 hours of video on a transect over the mound and notice that it is not just the top of the mound that has corals but that it extends much further. The 2 boxcore samples we take on top of Galway are good enough to push some subcores in for incubations (will be explained later) and for the geologist. Tanja takes surface samples to study life Foraminifera, the unicellular organisms with a calcareous shell, while Nina takes some living animals to measure their activity. After another videosurvey over the gully between the Galway Mound and the continental slope, where there are lots of stones, we deploy the ALBEX lander in this gully for another baited experiment with sardines. We have noticed that it is a Sunday as Arie made special cake for coffee time and a steak for lunch.

The coral garden at the top of the Galway Mound

Everybody watching the beautiful video of the corals

3 Oct 2011 Monday

In the morning we pick up the ALBEX lander from the gully. It reacts well to our release command, but we can't see it coming up, as we don't see any changes in the distance between the ship and the lander. We try the other acoustic releaser but that does not react at all. So we are getting a bit nervous, till John the captain saves us by saying that the lander is on the surface. We had not realized that the captain had the ship at a larger distance from the lander than normally, for safety reasons. It is Murphy's Law that during the ascent of the lander the distance between the ship and the lander staid the same. While we thought that it was still on the bottom, it was in fact already rising to surface. The lander had worked well. The programming was tight; within a minute after the camera started running the lander lands on the seafloor stirring up a cloud of sediment. A minute later the vial with sardines opens, and we see the oil escaping. Matthias who is on board to analyse these videos is very vulnerable to the motions of the ship, so we get no detailed overview of the videos of the baited experiments yet. At the moment he is probably evaluating his wish to become a marine scientist, as he has a hard time on board coping with the sea-sickness. We do a video survey over the last lander station, perpendicular to the one we did yesterday in this stony area. It looks pretty much the same. In the mean time we have prepared the ALBEX for another deployment, but now with frozen mackerel instead of sardines as bait to see if this attracts more and different scavengers. It is dropped just before lunch on Galway Mound. Than we do our first CTD with Rosette sampler. It is for collecting bottom water for our incubation experiments, and for calibrating instruments that measure turbidity (number of particles in the water). There is a new version of the program steering the CTD that gives some problems, but more serious is that for an unknown reason the closing of the bottles is a bit ad random. Therefore we cannot use this CTD cast for calibrating, and only collect the bottomwater. On Therese Mound, another rich coral mound close to Galway Mound, we take two boxcore samples. We get lots of dead coral; one of the cores is even filled to the rim with it, but virtually no sediment, at least not enough to push in an incubation core. Luckily it contains some animals which we can use for incubations, like living Lophelia and Madrepora corals, a large green sea-urchin, 2 cushion starfishes, and different types of smaller epifauna. The bit of sediment is saved too, and sieved over 0.5mm for the research of the dead shells. In the past we described

Nina, Teresa and Gerard collecting corals for incubations from a boxcore sample from Therese Mound.

several new species from the coral areas. A ship passes us close by; it is the Pourquoy-pas of the French institute IFREMER. We more or less had planned this rendez-vous to do some simultaneous experiments with landers, but they fled for the bad weather in the north, and make it clear that they won't stay here either, so we see the ship disappearing over the horizon in the south. After dinner we cut of the mackerel experiment by picking up the ALBEX. On the surface the radio-beacon on the lander transmits an alarm, so that we know that the flag must be visible from the ship. As the direction finder does not work, we look in all directions but cannot find it. When a small cloud blocks part of the bright sunlight Evaline spots it not far from the ship. It happened (of course) to be surfaced exactly in the narrow very bright orange beam of the sun, in which direction you can't see anything without damaging your eyes. The mackerel is completely gone, a quick look at the video shows that big red crabs are the main cause for that. The swell in the area increases, so we do another videosurvey after dinner over Galway Mound as we fear that tomorrow it is getting even worse. With too much swell you get a video that makes people seasick, and besides it is difficult to keep the camera within a certain distance from the bottom. Too close and you damage the corals, and too far off and you cannot see anything. This time we still succeed to shoot a good video. When I bring the program for tomorrow to the captain, he tells me that we have to be in Vigo one day earlier. There are problems with the engines that have to be taken care of. Spanish specialists need a day in Vigo to test the engines and hopefully fix the problem. At the moment the engineers have found a temporary solution, so our cruise can go on as planned minus one day. Most of the flight tickets of those who fly back home from Vigo are set a day earlier.

4 Oct 2011 Tuesday

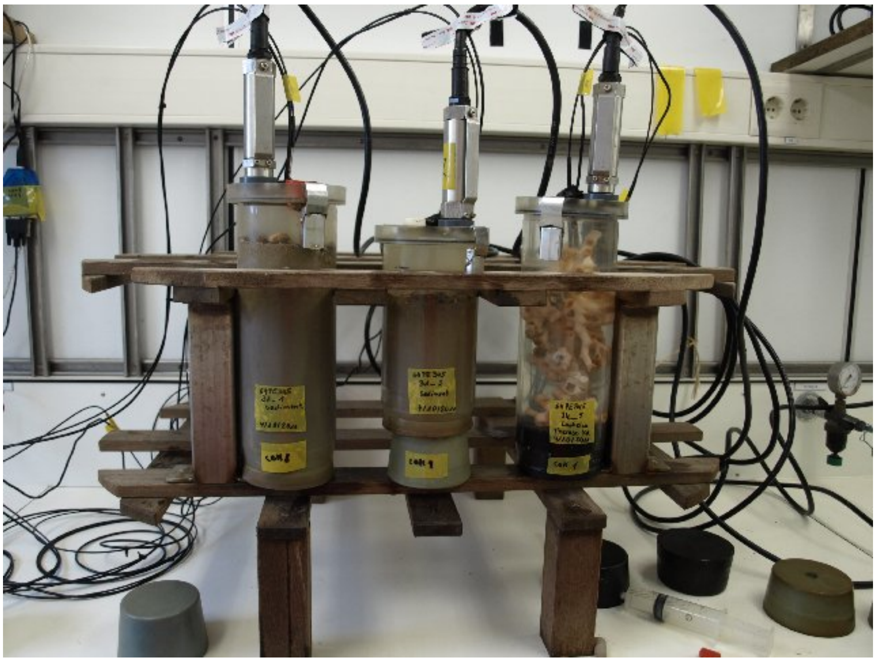
The swell has picked up, so bad weather is near. According to the predictions the wind will increase to over windforce 5. To be completely safe we cancel our last short deployment with the ALBEX, and prepare it for another 1 year stay on Galway Mound. So picking up the BOBO is the first thing to do, as that lander too is scheduled to stay here in the gully for 1 year. Henko and John are beeping it up, but they get not conclusive answers from both acoustic releasers. They try over and over again to send the release command, but without success. A one point Henko believes it must have been released, and we are all on the bridge to try to spot it. But there is nothing. As this lander does not have a radio-beacon we cannot expect an alarm to warn us that it is on the surface. However, it has an Argos beacon that sends a signal to a satellite, to give its position away. This signal is channelled through to NIOZ, and they inform us if they get an alarm. I remember that formerly we had a device, called the Goniometer, on board that could pick up the satellite signal from that beacon. John Cluderay confirms that is still on board, and we set it up on the bridge and fix the antenna even higher. But what we try no signal from the BOBO. I switch on the Argos beacon from the ALBEX that stands on the after deck, but the Goniometer does not pick this up either, even if we keep the beacon closer. We check that the beacon is working (it does), so the Goniometer does not function. In the end Henko starts again trying to communicate with the BOBO, and suddenly it answer crystal clear that it now finally has released its ballast weight. A big relieve, and indeed after 20 minutes it is first spotted by Nina, and then picked up safely by the ship.

Henko and John desperately trying to get contact with the BOBO.

Before dinner we get a nice boxcore from this stony place in the gully. The stones are all lying on the surface of the soft sediment. We call them drop stones, as they are transported from the north by icebergs. These icebergs melted during their trip to the south, shedding the stones that they contain. These stones are used by some deep-sea animals as a holdfast, in our instance these are small Foraminifera and very nice branched hydrocorals (*Pliobothrus*). Nina takes 2 incubation cores and Henko hammers in to long geocores. The incubation cores are kept in a cool container at bottom temperature of 9.5 °C, and are completely closed off from the air. With a special sensor (optode) the oxygen level in the water above the sediment is than measured every minute for a couple of hours. To keep the oxygen level homogeneous in the water it is slowly stirred with a small electrical fan. From the drop of the oxygen level over time we can measure the activity (= oxygen consumption) of the incubated sediment or enclosed animal. This is important knowledge if we want to calculate how much food is needed by this bottom and its faunal community. We have another try with the CTD. Now 2 dataloggers with the turbidity meters of the BOBO and the turbidity/fluorescence meter of the ALBEX are attached for calibration. This time the bottom alarm fails, and we have dragged the CTD over the bottom for a short while, but luckily there is no damage at all. We do another cast with the CTD without a bottom alarm, as the replacement does not work properly either, and a lot of bottles are filled with water at several different depths. This water is filtered to quantify the suspended particles, and with these figures it is possible to calibrate (check if they give proper data) of the instruments. In the mean time we work hard on both landers to prepare them for their long stay (1 year) on the bottom. Magda and Teresa fill up the 24 bottles of the carousel with sardines on oil. Gerard is busy with Evaline to set up the second camera system and to mount the heavy battery spheres. Marc is programming the motors that operate the sedimenttrap and baited carousel, and then programs with Teresa both HD-cameras. They are programmed to make a short video of 17 seconds every 2.2 hours over a period of 1 year, in all 4000 movies each. If they work both properly we have footage of the baited experiment every hour. After dinner Henko discovers a problem with his BOBO. The main apparatus, the downward looking ADCP, a kind of sophisticated currentmeter does not work properly. Without that the deployment is not very useful. This is a shame, but we cannot do much about it and we decide to not deploy the BOBO here. This means we will not have a salinity record of this area. But luckily by accident we have an own portable CTD with us that is suited for a long deployment at these depths. We even find new batteries, and after some difficulties (as he does not have the right cable) Gerard manages to program it. Jan Dirk quickly makes a socket for the small CTD out of a strip of aluminium so that we can attach it to the ALBEX lander. Finally we are ready late in the evening. It is pitch dark around us. Marcel takes over command to oversee the deployment of the lander, and sends all scientists away from the afterdeck for safety reasons. Taking over command means also taking over responsibility. While putting the lander in the water with a crane, one of the ropes to keep the lander steady slips underneath the lander and rips off at least 3 of the 24 pots of our important baited experiment. We hope that the rope did not do more damage. Marcel feels very sorry about it, and we feel bad too. As time is up we cannot do much about it, and we flea to the south to the Whittard Canyon for the bad weather that is coming tomorrow.

The boxcore sample full of dropstones with 2 incubation cores and the 2 geocores

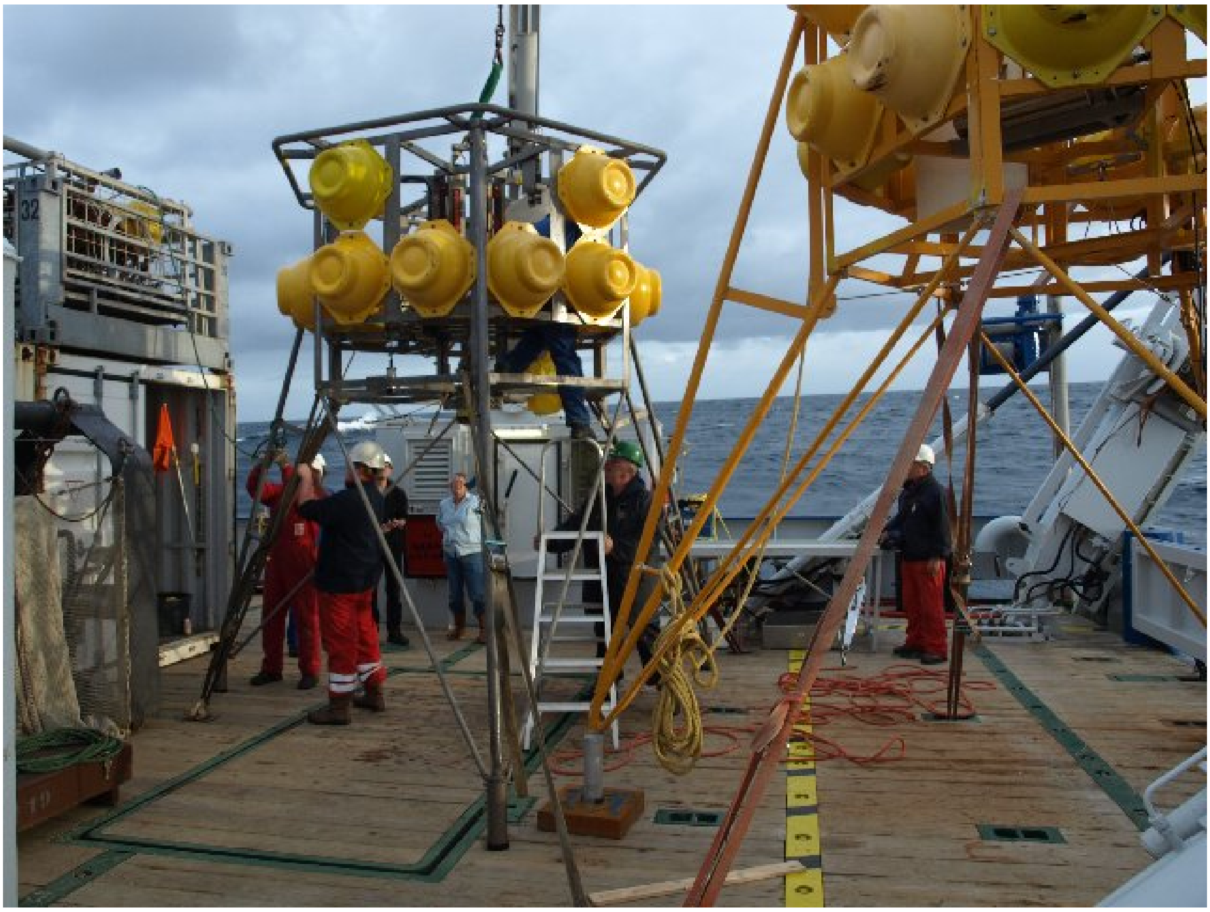
5 Oct 2011 Wednesday
It will take a whole day of steaming towards the position of the other BOBO lander that already stands there for 1 year in the Canyon at 3600m depth. The wind and swell are more than we expected, so the ship is moving quite a bit. On deck seawater sprays over the workdeck, so you have to be careful not to get wet. As there is not much to prepare it is not very busy at breakfast. We catch up with the paper work, e.g. the diary. Nina has still animals to incubate, and Evaline sieves the leftover of a boxcore. A large flock of birds follow us for several hours. A few are gannets, but most of them are Greater Shearwaters, beautiful birds with a dark grey hat, a white neck, somewhat grey-brownish wings, and a white streak at the start of the tail. It is a fascinating view how they take advantage of the wind and the waves. The gannets look quite clumsy next to them as they have to flap their wings quite often to keep up. Late in the afternoon we take a CTD cast half way the Canyon at 1500m depth to calibrate the turbidity meters of the BOBO even better as we expect here higher concentrations of particles. It is also useful to compare the data with measurements Henko did here with the BOBO some time ago. This takes 2.5 hours, a warning for us that the real deep-sea work will cost a lot of time. Henko is busy till late to filter all the water collected with the CTD. It is estimated that we arrive at the BOBO position very early in the morning.


The incubation set-up in the cool container with 2 sedimentcores and one with coral.


A flock of Greater Shearwaters following the ship.

6 Oct 2011 Thursday

Before breakfast Henko and John are ready to beep up the BOBO lander, and we hope it is still on the same place almost 4000m down there where we have put it last year. After sending the releasing code through the hydrophone a couple of times, to our joy the lander answers that it is coming up. We follow its ascent for a while, and calculate that its upward speed is 50m/minute. As expected it pops up at 9:30. The afterdeck becomes quite full. It now has the two large BOBO's and an Agassiz trawl. It seems the longterm BOBO has done well. The sediment trap pots all contain some sediment. Most of them only have caught a thin layer over a month period, but one pot has a couple of centimetres of sediment, a clear indication for a special event that suspended a lot of particles in the canyon. The old BOBO is dismantled, while the new one is completed by replacing the malfunctioning ADCP with the one from the BOBO we just picked-up. I urge Henko to prepare his BOBO-lander for another 1 year deployment as quickly as possible, as we need the space on the afterdeck if we are going to trawl. The next action is a very long one. We are going to video survey across the canyon at the position where the BOBO has been for a year. Lowering the camera frame to the bottom costs more than an hour. The video system has never been tested in these depths. In the coral area it went for the first time to 900 m, during which action some bars of the frame got squeezed by the great pressure as they contained trapped air. So we and especially John wonders if it will cope with 4000m of water above it. But the video operates fine, though at 3700m we cannot communicate with the lamps and cannot set the focus anymore. As the lights are still working the first is not a problem, the focus is more difficult. The camera is on autofocus now, and as the soft bottom looks a bit fuzzy the camera has problems to focus. The clouds we stir up now and then because of the swell do not help in this process. But we do not have other options and go on with the survey. At first the deep-sea floor looks quite boring, not much to see and monotonous. But the longer we look the more we see. In tandem Teresa and Nina record all features on sheets. While the camera is slowly hovering over the bottom we detect long stalked seapens with a few large polyps on top (*Umbellula*), large seacucumbers that look like grey faecal pellets of humans (Synallactidae), several anemones, few fishes, a crab, and only one large red pancake sea-urchin (Echinothuridae). On a closer look the small darker objects we see prove to be small seacucumbers (*Peniagone*). There are a few of them on the gentle slope of the canyon but in the canyon itself they become very numerous, and at some places there are more than 10 per square meter. As the surveys is prolonged to the



Both BOBO landers on the afterdeck.

other side of the canyon the numbers decrease rapidly. Next to living animals there are many tracks and features, like “fairy rings”, holes in a zigzag pattern, and “spoke-wheels”. A beer bottle, ribbed plastic and a piece of netting shows that mankind pollution reaches down to these depths. After more than 5 hours of video we have reached the other side of the canyon, and winch in the hopperframe, which takes another hour. After dinner the frame is safe back on deck. During its ascent we noticed that the overview camera shows a strange oblique fuzzy line over its images. On recovery it is clear that the glass is broken, but surprisingly the housing didn’t leak. The camera is still okay, but we replace it with a spare. Henko has selected a spot at 3600m to drop the BOBO-lander. It is still 28 miles steaming, which normally takes about 3 hours. This time wind and swell are against us, so the ship is rolling and pitching quite heavily and the average speed only around 7 knots. Therefore we arrive late at night at the station. The crew is ready to launch the BOBO, and after solving a problem with the crane, the BOBO is put in the water without too much problems. Henko carefully follows its descent to the bottom, as he had some bad experiences with former BOBO’s that lost ballast on the way down or after landing on the seafloor. This time everything is okay.

7 Oct 2011 Friday

We have moved to our most southern transect over the canyon. The canyon makes an S-turn here, and on the map it really looks like an underwater river. It is 4400m deep. The hopper frame with the HD-camera is put in the water to do another transect. We will compare the results with those of the video transect at 4000m. We hope to see large concentrations of the small seacucumbers again. Yesterday it was a big surprise for us to see so many seacucumbers in the canyon at this time of the year. It is known that the populations of these small deep-sea cucumbers can change dramatically over time (years). If they aggregate it is logical to assume that they do so because there is something to eat. Virtually all deep-sea organisms are dependent on food that rains down from the photic zone, the zone where sunlight still penetrates and where algae can grow. Normally you get a bloom of algae in spring till the nutrients are all used up, and sometimes another peak after summer after the top layer is mixed again because of early autumn storms. A small part of the algae bloom at the surface sinks out to the seafloor to form the food for deep-sea animals. So the concentrations of cucumbers we detect now, seems to be quite late. It is also possible that food from the much shallower and food richer continental shelf (0-200m) has been swept into the canyon and then was transported directly to the deep-sea to depths over 4000m deep, which

The camera frame ready to be launched for another video transect.

would explain the many cucumbers in the canyon itself. In the coming days we will concentrate to try to solve if this last hypothesis is true. Today we try to prove with the video transects that seacucumbers are especially abundant in the canyon, and not so much in other nearby deep-sea areas. In the mean time the camera has reached the seafloor. Large white tuskshells that could be used as cigarette pipes show up. Besides a few orange anemones sitting on clinkers thrown overboard by steamships in the two previous centuries, also a few seacucumbers are noted. But before we really reach the canyon itself the captain has problems to keep our vulnerable synthetic cable with fibre optics (the glass fibre through which our video signal is send to the surface) away from the ship and at the same time keep the right course. As we like to cross the canyon with the camera, we do not have the option to change course. If we ruin the glass fibre cable the videoing is over. Trying to start again from the other end of the transect will cost extra time, and furthermore the captain cannot guarantee that this will go much better with this kind of windforce and winddirection. It is clear that a ship is not so easy to steer as a car, especially during such slow speeds (1 knot). We decide to stop this transect, haul in the camera, and move to another abyssal plain station in the west. On that plain the direction is unimportant, and the bridge has a free choice to pick the best course for the camera transect. The depth here is the same as the canyon station, about 4300m. The bottom is pretty monotonous, and besides a few cucumbers, anemones, spokewheels and fairy rings there is not much to see, very different from our first canyon station. Teresa and Nina still enthusiastically write down the different features that pass by. Matthias shows some improvement as he eats dinner with us. The cook Arie may have overheard us talking about the small cucumber *Peniagone*, as he serves Italian “penne”. Just before dinner we finish the transect, and as there is no time to steam to another station and then still do something else, we have a free evening. Those who like to watch soccer do not mind, as tonight the Dutch national team plays against Moldavia. Satellite television now makes it possible to receive multiple channels on board.

8 Oct 2011 Saturday

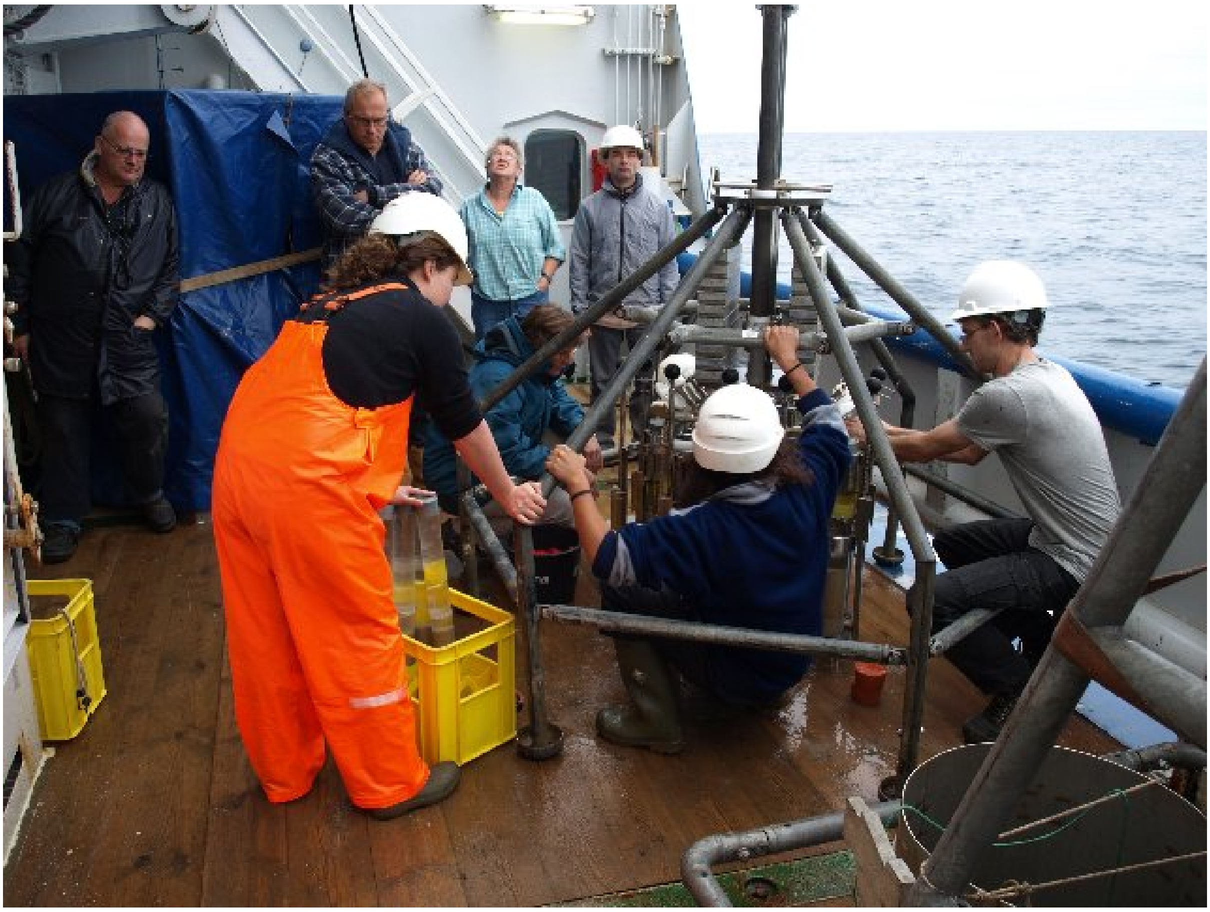
This morning we hope the wind is turned to a favourable direction to be able to finish the video transect over the canyon, which we had to break off yesterday. Alas this is not the case. The captain wants to try it anyway, but this time with a start at the north end of the transect. At first this looks okay, but then another problem makes itself clear. The swell comes from a westerly direction and hits the ship on the side, and because of that it rolls a lot along its axis. This is not just unpleasant, but also ruins our video down there as the movement is passed through the cable to our camera frame. The frame reacts as a kind of yo-yo, and one moment it is too far off from the bottom to see anything, while the next moment it lands on the soft sediment stirring up clouds of mud

Sjaak, Ger, Jose en Jan Dirk putting the HD-video hopperframe on deck.

with the same result. We cannot go on like that, as the video footage is worthless. Luckily the canyon makes a 90 degrees turn here, so we change the direction of the transect completely from North-South to East-West. As we luckily started in the inner corner of the canyon curve, we only have to change the course 90 degrees and do not lose too much time. This works out quite well, and we get a very good video. At first we do not see a lot of Peniagone, but when reaching the middle of the canyon bed these cucumbers become abundant, though not as numerous as at 4000m. So our hypothesis that the cucumbers mainly sit in the canyon and not so much outside still holds. In the afternoon we put it to the test by doing another video on the abyssal plain at 4400m, but this time 10 miles east of the canyon. This looks very much like the other station on the abyssal plain in the west. So hardly any small cucumbers to be seen. Marcel tries on our request to get a very close look at the few cucumbers at the seafloor by trying to lower the camera frame till it lands on the bottom, and a few times he succeeds in getting a nice image. Matthias looks very well recovered, and enthusiastically helps with watching the videos. David the Belgian 2nd officer makes us laugh when in typical Flemish he informs us after a change of course that we are going “terug vooruit”.

9 Oct 2011 Sunday

Since we moved to the canyon we are very lucky with the weather. In this time of the year it can be quite bad, but now there is hardly any wind and the ocean swell is noticeable but very moderate. In the previous days we have videoed 4 transects, 2 across the canyon and 2 more than 10 miles away from the canyon. We have seen that the small cucumber Peniagone was common in the canyon and rare outside the canyon. Now we have to find out why these cucumbers made that choice. We think it has to do with food availability. Seacucumbers are the vacuum cleaners of the deep-sea. They suck up the thin layer of fresh food on the seafloor that rained down from above. We try to prove that there is indeed a difference between the foodcontents of the sediment in the canyon and outside. Thus we need bottom samples and preferable as undisturbed as possible, as it will be top millimetres that contain the “fresh” food mostly in the form of half digested algae. The multicorer is especially designed to take such samples in the deep-sea. It pushed quite gently 12 perspex cores with diameters of 6 to 10cm into the sediment. If we are lucky we will get 3 good samples today. That is how long it will take to lower and haul in the multicore three times. The start is not good, as the sensitive Kevlar cable get caught in one of the blocks even before the multicore is launched. Luckily the inner core with the glassfibre is not damaged, and

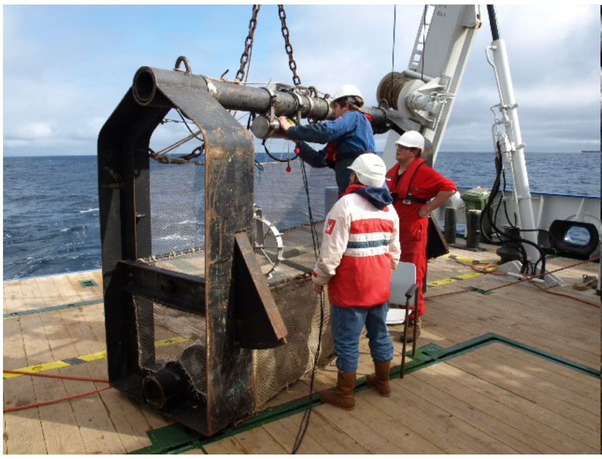


People crowding around the multicorer full of samples.

after a repair with sticky rubber and tape, we have another start at 10 o'clock, 2 hours later than planned. This delay is also used by Marcel and Jan-Dirk to make a steelcable of 10m length, which will be placed between the multicorer and the vulnerable and heavy termination of the Kevlar cable. Without this we are afraid that during touchdown the heavy termination will hit the multicorer, damaging itself and the multicorer. To everybody's content this works fine. The first multicorer 10 miles east of the canyon is perfect. All 12 tubes are filled with mud with crystal clear water above it. The tubes are taken out and immediately sliced in the coolcontainer. Teresa and Nina take care of the biological cores, and store the different slices into the -80 freezer to take care that labile components like chlorophyll (the green stuff in algae) will not break down during storage. In the lab at home we will measure the amount of chlorophyll in these samples, as it is a marker for the quality and quantity of the food in the sediment. Tanja, Gino and Henko take care of the other tubes and slice most of these to study the living Foraminifera fauna. They store it on alcohol with Rosebengal to colour the tissue of the living Forams. A part of it will already be sorted under the microscope by Tanja. The other 2 multicores, one in the canyon and one 10 miles west of the canyon, are very successful too. And though we only took 3 samples today, the last multicorer only arrives at 21:00 on board. Taking samples from 4400m depth clearly takes a lot of time!

10 Oct 2011 Monday

During the night we steamed from the 4400m station to the 4000m transect across the canyon, and continue with multicoring. The attempts to get a sample in the canyon are again successful. We take one sample on the eastern side where we saw large concentration of seacucumbers, and the other on the Westside where there were vertically none. In the mean time Evaline and I finished preparing the Agassiz trawl, the special bottom fishing net for the deep-sea. It is special as it has a closing door on the front that only opens when the trawl is on the bottom. This prevents the trawl from fishing in the water column itself. So in principal all animals caught come from the bottom. Further the trawl has 2 so-called odometers that measure the length of the fishing track, and also a digital camera system that monitors the bottom in front of the trawl during fishing. In our previous cruises catch and video matched quite good in respect of animals, which mean that despite the slow speed of the trawl (1.5 knots) not a lot of animals escape. Due to the engine problems we have to be earlier in Vigo, and this is our last day in the Whittard Canyon. So we only have one chance with the trawl. At 15:00 everything is ready, and after Magda starts the video with a kick-and-go command the trawl is launched in the water. We will have to pay out 5300m of steel cable to be able to fish in 4000m depth. We moved 10 miles up to the confluence of the 2 main branches of the canyon. It is a bit of a gamble, but as the Dutch say we want to kill two flies in one blow. We want a video of this new transect to see if and how abundant the Peniagone are, and secondly catch these animals to analyse their gut content which hopefully gives us a direct clue what they were doing (eating) here. The gamble is that we don't know if they are present at this new spot. After paying out 2500m the winch starts to make scary noises that become worse and worse. After checking it out Marcel warns me that it is very dangerous to go on because the cable sits to loose on the winch. In showing me what happens by paying out a few meters more, I notice that the cable wedges itself deep in between the bunch of cable still on the winch. This makes a terrible noise, and it can be expected that at a certain point it gets stuck. And indeed this is happening in front of our eyes right now, and just in time we can stop the winch. A few meters more and we could have lost everything. So without even being close to the bottom we start hauling in. Luckily this does not pose any problems, and the trawl gets back safe on deck again. Of course this is a big disappointment for us all. The crew, some with a fishery history, also would have liked to experience such a deep catch. Because the trawl is cut short, there is still time to do another action. Getting the winch in order is out of the question. So I warn John Cluderay that we like to do another video transect with the Hopper camera. As he had not expected this, and



Left: The Agassiz trawl just before it is launched. Right: The winch stopped just in time!

already partly had packed things, he needs some time to build everything up again. With help of Gino this goes quicker than expected and before evening dinner the camera is in the water. To our surprise there is no trace of *Peniagone* here. Only a few large seacucumbers (*Benthothuria*) as big as a rugby ball show up. Large fairy rings made by a mystery worm are very abundant here. These rings are perfect circles up to 1m in diameter, each indicated by about 40 evenly spread dark holes. A very peculiar sight. At 21:00 this last action of our expedition is finished, and the ship heads for Vigo with a speed of 10 knots.

11 Oct 2011 Tuesday
The closer we come to Spain the better the weather. The sea is almost flat, a rare phenomenon in the Gulf of Biscay. But we like it very much, and it makes packing and cleaning much easier. It is a perfect day to sea whales, but alas we do not see much. Yesterday we were more lucky. While preparing the trawl Arie our cook was watching us. As he made a very peculiar loud sneeze, we looked up. But he strongly denied that it was him. A second sneeze made clear that it came from a large finwhale just 10 m from the ship. After showing us its large back with a tiny fin a few times it vanished.

Participants relaxing on the deck.

12 Oct 2011 Wednesday
In the morning we stowed our containers with all our packed boxes and equipment. The dismantled BOBO lander also fits in one of the containers. The labs are now empty and clean, only a few computers are still there. The journey is going quick because of the ideal weather conditions. At 15:00 we are close to Vigo, and the pilot boards Pelagia to lead us to our place in the harbour. Safely we set foot on land again. This is the end of our relatively short deep-sea expedition, and within the given time I believe it was a quite successful one.

The pilot from Vigo boarding the Pelagia. Almost the end of the cruise.

CRUISE 64PE345 LOGBOOK - BELGICA MOUNDS

Station	Instrument	Action	Date	Latitude	Longitude	Depth	Remark
1	Small Boxcore	Bottom	28/09/2011 17:43	N 52° 38.28192'	E 4° 36.23256'	13	
2	Small Boxcore	Bottom	28/09/2011 17:53	N 52° 38.28672'	E 4° 36.22356'	13	
3	Lander ALTRAP	Deployment	28/09/2011 18:14	N 52° 38.26764'	E 4° 36.33588'	12	
4	Small Boxcore	Bottom	28/09/2011 18:26	N 52° 38.2638'	E 4° 36.36318'	12	
5	Small Boxcore	Bottom	28/09/2011 18:37	N 52° 38.25396'	E 4° 36.38904'	11	
6	Small Boxcore	Bottom	28/09/2011 18:46	N 52° 38.2284'	E 4° 36.37668'	11	
7	Small Boxcore	Bottom	28/09/2011 18:56	N 52° 38.20176'	E 4° 36.372'	12	
8	Small Boxcore	Bottom	28/09/2011 19:07	N 52° 38.21262'	E 4° 36.1962'	13	
9	Small Boxcore	Bottom	28/09/2011 19:18	N 52° 38.22006'	E 4° 36.2088'	13	
10	Lander ALBEX	Deployment	01/10/2011 19:10	N 51° 27.1008'	W 11° 45.13794'	789	Galway Mnd
11	Lander BOBO	Deployment	01/10/2011 19:36	N 51° 27.1914'	W 11° 43.4181'	904	
12	EK900 Track	Begin	01/10/2011 21:32	N 51° 27.44196'	W 11° 43.05276'	887	
12	EK900 Track	End	02/10/2011 03:52	N 51° 25.46628'	W 11° 47.41422'	1045	
13	Lander ALBEX	Recovery	02/10/2011 06:41	N 51° 27.2811'	W 11° 45.27114'	810	
14	Hopper Camera	Begin	02/10/2011 07:22	N 51° 26.66622'	W 11° 45.01398'	893	Galway Mnd;1.76 nm
14	Hopper Camera	End	02/10/2011 10:11	N 51° 27.98736'	W 11° 46.04868'	984	
15	Large Boxcore	Bottom	02/10/2011 11:51	N 51° 27.10194'	W 11° 45.15132'	791	incubation & forams
16	Large Boxcore	Bottom	02/10/2011 12:58	N 51° 27.10188'	W 11° 45.09888'	788	incubation & forams
17	Hopper Camera	Begin	02/10/2011 14:30	N 51° 30.24498'	W 11° 41.20992'	773	4'noord of POSEIDON; 1.14 nm
17	Hopper Camera	End	02/10/2011 15:43	N 51° 30.9666'	W 11° 42.45702'	780	
18	Lander ALBEX	Deployment	02/10/2011 17:11	N 51° 30.69456'	W 11° 41.79252'	793	4'noord of POSEIDON
19	EK900 Track	Begin	02/10/2011 17:49	N 51° 27.2652'	W 11° 40.9722'	723	every hour over depth gradient for vertical migration of fish
19	EK900 Track	End	03/10/2011 05:15	N 51° 27.31494'	W 11° 46.58214'	989	
20	Lander ALBEX	Recovery	03/10/2011 06:35	N 51° 30.91674'	W 11° 41.44092'	774	
21	Hopper Camera	Begin	03/10/2011 07:18	N 51° 31.10268'	W 11° 41.48448'	763	4'noord of POSEIDON; 1.13 nm
21	Hopper Camera	End	03/10/2011 08:28	N 51° 30.1059'	W 11° 42.03786'	827	
22	Lander ALBEX	Deployment	03/10/2011 09:43	N 51° 27.09876'	W 11° 45.13548'	786	Galway Mnd
23	CTD with samples	Begin	03/10/2011 11:40	N 51° 25.7406'	W 11° 46.24122'	860	
23	CTD with samples	Bottom	03/10/2011 12:02	N 51° 25.62168'	W 11° 46.43412'	870	bottom water
23	CTD with samples	End	03/10/2011 12:28	N 51° 25.59456'	W 11° 46.35528'	866	
24	Large Boxcore	Bottom	03/10/2011 13:35	N 51° 25.7154'	W 11° 46.26918'	877	incubation&forams
25	Large Boxcore	Bottom	03/10/2011 14:33	N 51° 25.7079'	W 11° 46.29246'	856	incubation&forams
26	Large Boxcore	Bottom	03/10/2011 15:21	N 51° 25.71156'	W 11° 46.29588'	857	incubation&forams
27	Lander ALBEX	Recovery	03/10/2011 17:11	N 51° 27.2859'	W 11° 45.23376'	805	
28	Hopper Camera	Begin	03/10/2011 18:51	N 51° 27.13008'	W 11° 44.3277'	917	Galway Mnd; 0.67 nm
28	Hopper Camera	End	03/10/2011 19:38	N 51° 27.10596'	W 11° 45.37818'	968	
29	EK900 Track	Begin	03/10/2011 21:06	N 51° 27.30168'	W 11° 46.49382'	986	every hour over depth gradient
29	EK900 Track	Course Change	04/10/2011 05:09	N 51° 27.28398'	W 11° 41.06322'	727	
29	EK900 Track	End	04/10/2011 05:09	N 51° 27.28302'	W 11° 41.055'	727	
30	Lander BOBO	Recovery	04/10/2011 09:01	N 51° 27.47904'	W 11° 43.41372'	902	
31	Large Boxcore	Bottom	04/10/2011 09:53	N 51° 27.20028'	W 11° 43.39818'	903	incubation&forams
32	CTD with samples	Begin	04/10/2011 11:46	N 51° 27.2196'	W 11° 43.42146'	903	
32	CTD with samples	Bottom	04/10/2011 12:06	N 51° 27.21072'	W 11° 43.46124'	904	failed for calibration
32	CTD with samples	End	04/10/2011 12:16	N 51° 27.2367'	W 11° 43.46472'	904	
33	CTD with samples	Begin	04/10/2011 12:55	N 51° 27.20718'	W 11° 43.16844'	894	
33	CTD with samples	Bottom	04/10/2011 13:09	N 51° 27.26382'	W 11° 43.3041'	900	calibration OBS en Fluor
33	CTD with samples	End	04/10/2011 15:07	N 51° 27.18912'	W 11° 43.37634'	901	
34	Lander ALBEX	Deployment	04/10/2011 19:42	N 51° 27.1116'	W 11° 45.14208'	784	trip position

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Station	Instrument	Action	Date	Latitude	Longitude	Depth	Remark
35	CTD with samples	Begin	05/10/2011 16:11	N 48° 54.9075'	W 11° 9.03366'	1477	
35	CTD with samples	Bottom	05/10/2011 16:37	N 48° 54.88332'	W 11° 8.988'	1476	for calibration OBS
35	CTD with samples	End	05/10/2011 18:37	N 48° 54.91068'	W 11° 9.00384'	1476	
36	Lander BOBO	Recovery	06/10/2011 07:30	N 47° 46.07568'	W 10° 9.5601'	3913	
37	Hopper Camera	Begin	06/10/2011 09:43	N 47° 45.85782'	W 10° 6.68244'	3965	transect canyon-M; 4 nm
37	Hopper Camera	End	06/10/2011 15:29	N 47° 46.65564'	W 10° 12.13968'	3892	
38	Lander BOBO	Deployment	06/10/2011 21:36	N 48° 10.5372'	W 10° 35.02284'	3573	1Y deployment
39	Hopper Camera	Begin	07/10/2011 07:32	N 47° 22.61742'	W 10° 14.81904'	4278	transect south-west part canyon-S; 1.2 nm
39	Hopper Camera	End	07/10/2011 08:59	N 47° 23.52546'	W 10° 14.39388'	4351	
40	Hopper Camera	Begin	07/10/2011 13:23	N 47° 19.43508'	W 10° 32.62308'	4449	transect W outside canyon;1.2 nm
40	Hopper Camera	End	07/10/2011 14:49	N 47° 19.5153'	W 10° 34.2111'	4462	
41	Hopper Camera	Begin	08/10/2011 07:14	N 47° 25.0785'	W 10° 13.42806'	4273	transect canyon-S; 2.6nm
41	Hopper Camera	End	08/10/2011 11:31	N 47° 24.98742'	W 10° 17.12874'	4229	
42	Hopper Camera	Begin	08/10/2011 15:31	N 47° 23.48808'	W 9° 54.37758'	4322	transect E outside canyon; 1.2nm
42	Hopper Camera	End	08/10/2011 17:04	N 47° 23.46876'	W 9° 56.1366'	4324	
43	Multi Corer	Bottom	09/10/2011 09:26	N 47° 23.49684'	W 9° 54.39588'	4321	station E plain
44	Multi Corer	Bottom	09/10/2011 13:28	N 47° 24.91536'	W 10° 15.2715'	4349	station canyon-S
45	Multi Corer	Bottom	09/10/2011 17:48	N 47° 19.50318'	W 10° 32.691'	4448	station W plain
46	Multi Corer	Bottom	10/10/2011 07:20	N 47° 45.87456'	W 10° 8.1741'	4138	in Peniagone field west part canyon-M
47	Multi Corer	Bottom	10/10/2011 09:55	N 47° 46.0647'	W 10° 10.21926'	4166	in east part canyon-M no Peniagone
48	Agassiz Trawl	Begin	10/10/2011 12:56	N 47° 57.26736'	W 10° 9.83466'	3928	
48	Agassiz Trawl	Bottom	10/10/2011 15:09	N 47° 56.205'	W 10° 12.01692'	3976	FAILED, winch failure
48	Agassiz Trawl	Start Heave	10/10/2011 15:09	N 47° 56.20134'	W 10° 12.02454'	3976	
49	Hopper Camera	Begin	10/10/2011 16:50	N 47° 56.43096'	W 10° 12.0906'	3973	across canyon-N; 1.4 nm
49	Hopper Camera	End	10/10/2011 18:49	N 47° 55.25214'	W 10° 12.9492'	3756	