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RRS *DISCOVERY* CRUISE D297
27 JUL - 16 AUG 2005

The geobiology of the Nazare and Setubal
Canyons, Portuguese Continental Margin

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ABSTRACT

The main objective of this cruise was to complete the geological survey of the Setubal and Nazare canyons including more sidescan sonar survey in the canyon mouths and on the lower continental rise north of the mouth of Setubal mouth. Other major objectives were to carry out sampling of the seabed for meio and macro fauna at 3 depth transects in each canyon; to run a series of SHRIMP video runs in the canyons at different depths to quantify the seabed organisms; to measure the amount and type of particulate matter in the water column, particularly near the seabed at the study sites, and to investigate the benthic ichthyofauna and bioluminescence using bottom landers.

This cruise provided data for the EU FP6 project HERMES (Hotspot Ecosystem Research on the Margins of European Seas), as well completing work for the EU FP5 project EUROSTRATAFORM.

KEYWORDS

cruise 297 2005, *Discovery*, EUROSTRATAFORM, HERMES, Iberia, Nazare Canyon, Portugal waters, Setubal Canyon, submarine canyons

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THE GEOBIOLOGY OF THE NAZARÉ AND SETUBAL CANYONS, PORTUGUESE CONTINENTAL MARGIN

CONTENTS

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Arrived	Porto	16th August 2005

OBJECTIVES

To complete the geological survey of the Setubal and Nazare canyons including more sidescan sonar survey in the canyon mouths and on the lower continental rise north of the mouth of Setubal mouth. To carry out sampling of the seabed for meio and macro fauna at 3 depth transects in each canyon. To run a series of SHRIMP video runs in the canyons at different depths to quantify the seabed organisms. To measure the amount and type of particulate matter in the water column, particularly near the seabed at the study sites. To investigate the benthic ichthyofauna and bioluminescence using bottom landers.

BACKGROUND

This cruise will provide data for the EU FP6 project HERMES (Hotspot Ecosystem Research on the Margins of European Seas) (Weaver et al., 2004), and complete the geological survey work for the EU FP5 project EUROSTRATAFORM. Canyons were chosen as a focus for HERMES because they are key environments on the continental margin that are affected by dynamic geological and physical oceanographic processes. These processes regulate the distribution and the diversity of the fauna in a number of different ways, offering valuable comparisons to open slope environments. A key aim of HERMES is to understand how environmental variables affect the biodiversity, structure, function and dynamics of faunal communities on the continental slope. Canyons are hotspots of biodiversity (Rogers et al., 2003), major pathways for the transportation and burial of organic carbon (Heussner et al., 1996; van Weering et al., 2001) and fast-track corridors for material transported from the land to the deep sea (Puig et al., 1999). Canyons act as temporary buffers for sediment and carbon storage. However, rapid, episodic flushing of canyons may mobilise large amounts of sediment, carrying it to the abyss and annihilating benthic ecosystems over a wide area (Thomsen et al., 2003). The frequency of these potentially catastrophic events and the fluxes of particles produced are largely unknown, as are the rates of recolonisation and restoration of the canyon ecosystems. There is considerable scope, therefore, for novel science in these relatively unknown environments.

The study of canyons has been constrained severely by the lack of technology for working in their complex, mountainous topography. However, with advances in swath bathymetry, sidescan sonar, precise navigation, seabed imaging systems, Remotely Operated Vehicles (ROVs), digital data processing and Geographic Information Systems (GIS) it is now possible to make significant advances in our knowledge. This is particularly true in large multidisciplinary projects, like HERMES, where geological, physical, biogeochemical and biological data can be cross-referenced and interrelated.

Initial work in HERMES will focus on canyons off Portugal and in the Western Mediterranean. Later the study will spread to the Eastern Mediterranean and the Irish margin. SOC has a particular interest in the canyon systems off Portugal having built up a comprehensive picture of the bathymetry and sediment characteristics of the Nazaré and Setubal Canyons in EUROSTRATAFORM (EU FP V project). These two canyons, while having similar topography and extending from the shallow water to the abyss, are radically different. The Setubal Canyon is connected to the Duoro river system while the Nazaré Canyon has no direct riverine input. This appears to affect the degree of activity of the canyon and the biogeochemical setting, both likely to be important in determining the fauna present.

The study of the geobiology of the Nazaré and Setubal Canyons will be an important first step in SOC's contribution to HERMES. Using the detailed bathymetric charts and knowledge of the geology and sedimentology of the canyons we will characterise the distribution of the fauna using suspended camera techniques (SHRIMP – Seabed High Resolution IMaging Platform), corers (Megacorer) and towed gear (Agassiz trawls and rock dredges). Using the SHRIMP images we will plan further precision sampling of the sedimentary environment to characterise sediment transport processes and the sources of organic matter within canyon systems.

Using the data generated by the cruise we will build up a comprehensive picture of the canyon ecosystems from local to the regional scales. This will guide future work; in particular the data will allow us to make best use of the ISIS ROV dive time planned for 2006, for instance in the study of deep-water coral communities and/or methane hydrate outcropping at the heads of canyons. The cruise will host scientists from a number of European institutions that are collaborating in HERMES. Current meter moorings, sediment trap arrays and lander experimental and observational platforms will be recovered and replaced. Detailed CTD surveys will be undertaken within and outside the canyon system, including the use of transmissometers and stand alone pumps to quantify suspended particulate material. The quality of organic matter will be determined by analysing lipid and chlorophyll/ carotenoid biomarkers (with University of Liverpool). Acoustic and photographic methods will be used to characterise and quantify the benthopelagic fauna.

The abundance, biomass and diversity of the benthic fauna within canyons will be compared with benthic communities at the same depth outside the canyons. This will determine whether the canyons are distinct in species composition and whether there is greater similarity between fauna at different depths within a canyon than at the same depth on the open slope. Stable isotope analysis (^{15}N and ^{13}C) will be used to determine trophic relationships between fauna. Protozoan and metazoan meiofauna, macrofauna, megafauna (invertebrates and fish) will be studied. Lander experiments (University of Aberdeen) using respirometry, time-lapse photography and acoustic tags will be used to compare fish abundance and activity. The reproductive patterns of dominant species will be determined to explain how establishment and maintenance of species within canyons occurs.

Canyons channel and focus sediments thereby increasing the level and transport of pollutants in comparison to surrounding slope areas (Grousset et al., 1995; Buscail et al., 1997). The lack of exposure of deep-sea animals to many of the chemicals that are found in run off from land may mean that they are particularly susceptible to low levels of pollutants. We will endeavour to use the new pressurised aquaria facilities (IPOCAMP) at SOC to test the susceptibility of deep-sea fauna to pollutants under *in situ* temperature and pressure conditions.

The overall aim is to provide the scientific context for broad management plans for European canyon systems. The work is important in habitat conservation, the potential disposal of carbon dioxide, fisheries management, and the long-term effect of pollutants fast-tracked to the deep-sea ecosystems from land.

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NARRATIVE

26th July In port Lisbon. All equipment was loaded on time in port prior to sailing. One box had not been delivered from Southampton and this contained equipment critical for running the stand-alone-pumps. Arrangements were made for the box to be dispatched for pick-up next day.

27th July Safety briefing at 09.00. Box arrived at 13.00. Talk to scientists and technicians at 13.30. Ship sailed at 15.00 heading west to the start of a `TOBI line This line is planned to extend about 60 miles along the continental margin north of the mouth of the Setubal Canyon. There was a possibility that landslides would be seen in this area that may have fed the turbidite layers on the Tagus Abyssal Plain.

28th July Began to deploy TOBI at 00.30 (Station D15725). TOBI working well. Also deployed 3.5 kHz profiler, but this had a major wiring problem that took all night to fix. Proceeded to run TOBI survey all day. The coring winch is regarded as non-functional by the ship's engineers who have been working to repair it. One of the circuit boards has been replaced and found not to be the problem. The fault was then traced back to one of the junction boxes that could not be opened whilst the winch system was operating with TOBI out.

29th July Continued TOBI survey. A problem with the winch scrolling occurred at 10.00 and the ship had to turn towards deeper water to enable pay-out of cable. As this was near the end of the line further TOBI survey was cancelled. The survey showed the continental margin to be gullied and canyoned along most of the track with no obvious landslides. The mouth of the Cascais Canyon however, showed significant downslope sediment transport with boulders and erosive tails. Near the end of the TOBI track a problem with the cable-lay on the drum was noticed. This necessitated paying out cable and so the ship had to deviate downslope and the end of the TOBI line was sacrificed. The problem was rectified and TOBI was hauled-in, but about 2 hours were lost. The benthic landers DOSOL (Station D15726) and ROBIO (Station D15727) were deployed next on the broad canyon floor at 4300 m. They were spaced 2 km apart. ROBIO photographs animals attracted to bait and DOSOL photographs bioluminescence. These were both deployed by 21.00 and a test of the terminations of the CTD wire were then made prior to deploying the CTD at a station mid-way between the two landers. The CTD was run to 10m off the seabed and brought back (Station D15728#1). The upcast readings from the transmissometer were different to the downcast readings and the reason for this was not clear.

30th July The SAPS was then deployed at the CTD site (Station D15728#2). The ship drifted over 1.5 nmi during this deployment of 5 hours and the Bridge was asked to improve their station keeping before the work in the narrow part of the canyon began. The landers were then recovered and both were inboard by 14.00. A report back from the landers showed then to have failed – DOSOL because of too much light for the bioluminescence camera and ROBIO due to a battery failure. The coring winch was now ready to test and we moved to the site of the next station to carry out these tests. The cable was lowered with a weight on the end and recovered with no problems so we decided to proceed. SHRIMP was launched at 23.30 on a track that would cross part of the mouth of the Cascais Canyon where recent sedimentary features had been seen on the TOBI sidescan (Station D15729#1).

31st July Shrimp worked well and about 4 hrs of video was recorded, showing seabed features related to a landslide deposit and later reworking by turbidity currents. Shrimp was back onboard at 06.30. The weather had now deteriorated to winds of Force 8, although the swell was light and the sky clear. The Captain halted operations waiting on a weather report. At 09.30 we began a box core station at a site on the Shrimp line (Station D15730#1). The corer was recovered at 14.00 and contained a good core that contained 24 cm of stiff grey mud with 3-4 cm of soupy brown mud above. We then headed for a site en-route to Nazare Canyon to attempt a megacore at 700 m water depth for infaunal incubation experiments.

1st August The passage was fairly rough and so we hove-to at 00.30 to wait for better weather. Eventually the weather improved and we found a suitable site. The megacore (D15731#1) was deployed at 11.00, but returned with just a small amount of sand and gravel. Thus the seabed was too coarse to sample and no other possible core locations had been identified on the 3.5 kHz profiles. We therefore moved to the lander deployment positions in the Nazare Canyon. The ROBIO and DOSOL landers were deployed on a broad terrace at c3100m (Stations D15732#1 and D15733#1, respectively) and an amphipod trap was then deployed on a nearby terrace (Station D15734#1). We moved downcanyon to our site at 4200m to take some cores.

2nd August Two megacore attempts were made at Station D15735#1, and they recovered 8/12 and 2/12 cores of sediment respectively. These were about 27 cm long and consisted of mud over sand. We next deployed SHRIMP (Station D15736) but a fault was detected soon after it entered the water and so it was recovered. Whilst SHRIMP was being repaired we moved back to the lander sites to recover the landers. All three were recovered successfully by 19.30. Meanwhile water ingress into the transformer was identified as the problem with SHRIMP. The transformer was stripped and thoroughly cleaned and refilled with oil and the source of the problem addressed. We tested the vehicle in water and some damage had been done to the transformer but it was just about functional. We then deployed the megacorer twice at the same site (D15737#1 and #2). These each recovered 2 tubes of mud out of the 12 possible in each deployment. At this site the sediment is muddy and soft and the megacorer should have worked better.

3rd August Some effort was put into improving the megacorer which was a newly purchased system, though there was no obvious problem. A Shrimp station was tried at 0400, but problems were encountered with one of the power leads from the swivel which proved to have burnt out. No replacement leads or connectors were onboard and so calls were made to Southampton to source replacement parts. However, connectors and leads were eventually cannibalised from the TOBI spares and the system was rebuilt by the technicians. Meanwhile a CTD was deployed followed by a SAPS station (Stations D15737#3 and #4). We then tried the megacorer again at the same site as the last attempts (Station D15737#5), again recovering only two tubes out of twelve. Another megacore was tried on a different terrace that could have been flatter to see if this was the source of the problem (Station D15738#1) but again we only recovered 2 tubes. We do not know why we cannot fill all the tubes – at this site the sediment is very soft and so the megacorer must be penetrating the seabed.

4th August The SHRIMP was tested in the water but the cable jumped off the winch and became damaged. SHRIMP was recovered but 60m of cable had to be cut away and the new end re-terminated. We proceeded with a piston core on a terrace (Station D15738#2) and this recovered 9 m of mud, though the head of the corer was buried in the process. A second piston corer was attempted on a terrace to the west (Station D15739#1) and recovered 12m. As the corer was being brought inboard a winch problem occurred and we ended winch operations while the ship's engineers investigated the problem. To maintain activity we moved to the deeper water site along the canyon to deploy the landers and amphipod trap.

ROBIO was deployed at 15.30 (Station D15740#1), the amphipod trap at 16.30 (Station D15741#1) and DOSOL at 17.30 (Station D15742#1). Work was now progressing on the coring winch that had a major problem of scrolling, the conducting cable that needed a re-termination, the CTD cable that needed re-termination and the megacorer. SHRIMP was repaired and ready to go. By 2000 the engineers reported that the coring winch could not be repaired, but a specialist engineer could be flown out to join the ship. We agreed to do this as a last resort to rescue the coring operations.

5th August Whilst waiting for news of the trip to port we continued with a CTD station (Station D15743#1) and followed this with a SAPS deployment (Station D15743#2). The upcast measurements of the CTD were seriously affected by a termination problem associated with an unraveling of the torque balanced cable. This necessitated 500m of cable being cut away and another re-termination being made. We then attempted to bring up the DOSOL lander but it refused to leave the seabed and after several attempts we were forced to abandon it. The ROBIO lander and amphipod trap were successfully recovered. At 17.30 we left for the shallow water canyon site en route for Figueiro da Foz. A SHRIMP station (Station D15744#1) was run down a flatter area of the canyon wall and into the thalweg at depths of 700 to 1000m. This produced excellent data except at the end of the run where the vehicle dropped into the thalweg and the visibility was too poor to see the seabed.

6th August SHRIMP was recovered at 0200 and the ROBIO lander was deployed at a site selected along the SHRIMP track (Station D15745#1). At 0300 we departed for Figueiro da Foz to pick up the winch engineer. The engineer boarded at 0730 and we set off back to the shallow canyon area. Work on the winch proceeded through the day. We picked up the lander at 1530 and waited while the work on the winch proceeded including a trial. The coring winch was now apparently repaired – the logic board was bypassed by connecting to the logic board of the trawl winch and a problem in the winch control cab was also rectified. Future swapping of the trawl and coring cables would entail a 2 hour delay to swap the boards. We therefore set about collecting all the core stations. At 1800 we attempted a megacore (Station D15746#1) but this returned empty even though the SHRIMP video showed a sedimented seabed. We redeployed the lander (Station D15747#1) and then deployed the box corer (Station D15748#1), which produced a very disturbed sample of soupy mud and hard fine grained sediment. This was not kept. A second box core was attempted along the SHRIMP track in a hollow (Station D15749#1) and this recovered a full box of soft mud. The surface was disturbed and thus the sample was not suitable for biology, however a subcore was collected for sedimentology.

7th August The continual failure of the megacorer suggested it had a serious fault although none could be identified (perhaps the plastic blocks were of the wrong composition and these were deforming under pressure). We therefore abandoned this instrument and built the multicorer. This was deployed three times (Stations D15749#2, #3 and #4) and recovered 36/36 tubes of mud providing ample samples for the meiofauna studies. At 0400 we departed for Figueiro da Foz to drop off the engineer, arriving at 0830 in dense fog. We retuned to the shallow canyon area to pick up the lander, and the fog cleared in time for us to be able to carry out this operation. Our intention was to then carry out a CTD and SAPS station in the thalweg of the canyon based on the SHRIMP data, which had shown high levels of particulate matter in this area. The CTD (Station D15750#1), however, did not show these high particulate values and we thought this may be because they are tidally induced. We therefore postponed the SAPS operation and moved down-canyon to run a SHRIMP deployment over an area where corals had been reported previously (Station D15751#1). SHRIMP was launched and reached 260m water depth when the conducting cable came off the drum. This caused a major problem of recovery. The station was abandoned and the technicians and ship's crew spent four hours recovering the situation. Work with this cable was halted at this point thus preventing any more SHRIMP or TOBI work for the rest of the cruise. We moved back to the shallow water site to continue work with other winches. A CTD station (Station D15752#1) was run in the channel thalweg – again the upcast measurements were of poor quality – presumably due to cable problems.

8th August A SAPS deployment was carried out at the CTD site (Station D15752#2) and produced large amounts of particulates in the two instruments that entered the thalweg channel thus verifying the earlier SHRIMP data. We then moved to the 3200m location along the canyon to carry out a coring programme. This began with two multicore stations that each produced 12 tubes of mud (Stations D15753#1 and #2). The ROBIO lander was launched (Station D15754#1) and a box core followed at the multicore site (Station D15755#1). This also worked well producing a full box of mud with a good sediment surface. We then moved a short way down canyon to core a terrace with the piston corer (Station D15756#1). This produced a full core with 10m of soft mud.

9th August A second piston core was planned in the flat plain immediately after the canyon broadened (Station D15757#1). The TOBI record here was unreflective but the 3.5 kHz showed no penetration. We therefore used a 6m barrel but even this did not recover any sediment. In moving to the next station we crossed the DOSOL lander site and managed to communicate with the lander, but it still failed to release from the seabed. We reoccupied the deep canyon site (4330m) and took two box cores (D15758#1 and #2) followed by two multicores (D15758#3 and #4). Some new Xenophyophores were found in the box and multicores.

10th August Two more box cores (Stations D15758#5 and #6) were collected at the same deep-water site, the first of which was not successful. We then attempted a piston core (Station D15759#1) on a reflective area of the TOBI record on the canyon floor. This produced a short core of mixed sands and muds (58 cm), but the surface contained a large amount of wood fragments. We moved back to the 3300m location and recovered the ROBIO lander. This was followed by another box core Station D15760#1). We attempted a CTD station located over and into the thalweg but the equipment was not working and so we proceeded with a SAPS station (D15761#1) before the CTD. It was difficult to be certain the SAPS entered the thalweg channel because of the side echoes.

11th August We attempted the CTD station again (Station D15761#2) but there was a problem with the electrical connection that appeared at about 2000m. It would take a considerable time to rectify this so we abandoned this station and took another box core (Station D15762#1). This completed the core sampling at the 3200m location and we moved back to the 4200m location to take a piston core on a levee but in another relatively reflective area of TOBI record (Station D15763#1). This produced 3.4m of layered sand and mud, this time without wood fragments. We launched the ROBIO lander (Station D15764#1) and then deployed the box corer (Station D15765#1). This produced a disturbed sample and so the station was repeated (Station D15765#2).

12th August This attempt at box coring worked and this brought to an end the coring programme in the canyons. We then attempted to rescue the lost lander DOSOL. Two clump chain weights were separated by several metres of wire and connected to the coring cable. The weights were then lowered to the seabed and dragged across the lander site. However, such dragging is difficult in this water depth and we were not able to free the lander. We gave up the attempt at 11.30 and recovered the weights, intending to return following the trawling activities. ROBIO was then recovered and we moved back to the 3400m location. The winch electronics were swapped from coring to trawl during this transit ready for the Agassiz trawls and epibenthic sledge runs. The canyon levee that was our chosen site at 3400m was rather small to carry out a complete trawl and so we devised a new method. This involved installing large weights ahead of the trawl and then lowering the assembly to the seabed whilst drifting the ship and continually paying out cable. The idea was to create an approximately vertical cable with the weights and trawl on the seabed and then drift dragging the trawl behind. The idea worked perfectly, significantly cutting the fishing time and producing a bumper haul of over 1000 Holothurians (Station D15766#1).

13th August Following the success of the Agassiz trawl we tried the same method with the epibenthic sledge (Station D15766#2). The method did not work this time as the sledge snagged something and the weak link broke. Only one crinoid and one rock were recovered. We then tried a CTD in the thalweg channel (Station D15767#1). The CTD again did not work, even though many of the connectors had been replaced. It was recovered for further work but the problem may lie with the cable. The SAPS station proceeded based on previous CTD data and our requirement to sample close to the seabed in the thalweg. The CTD was re-examined during the SAPS deployment and we agreed to give it a final try (Station D15767#3). On this occasion one of the temperature sensors failed to give good results, but a second temperature sensor on the instrument did work, providing satisfactory data. We then deployed the Agassiz trawl at the 4200m location (Station D15768#1).

14th August The winches were switched from trawling to coring and we had a second attempt to recover the lost DOSOL lander using a number of lengths of cable and some large weights. After 12 hours of dragging these across the seabed with no success we gave up and set off to the north for two out-of-canyon sites at 4300m and 3200m. The ROBIO lander was dropped on the 4300m site (Station D15769#1) and the first of three multicores were recovered from nearby (Station D15770#1).

15th August Two more multicores were collected from the same site (Stations D15770#2 and #3) and then the ROBIO lander was recovered. We moved north to find a sedimented location at 3400m

SUMMARY OF RESULTS

1. TOBI

A single TOBI 30 hr run was conducted along the base of the continental slope north of Setubal canyon with the aim of identifying any active downslope sediment transport pathways on this part of the margin. Most of the margin appears to be inactive, with the exception being the axis of Cascais Canyon which shows striking evidence of erosion in the form of furrows and large-scale comet marks. A later SHRIMP camera run and box core confirmed this interpretation, showing a thin (2-3 cm) layer of very soft mud overlying much stiffer sediment. Several outcrops of indurated sediment protruding though the softer cover were seen on the SHRIMP video.

A second TOBI run, planned to complete coverage of the distal Nazare Canyon, could not be carried out because of winch problems which terminated use of the conducting cable.

Doug Masson

2. PISTON CORING

Six piston coring stations were occupied in Nazare Canyon. The first three targetted terraces just above the thalweg of the canyon in water depths between 3400 and 3800 m. The aim here was to recover the most recent depositional sequences in the canyon. Previous experience has shown that these deep terraces are generally sediment covered and are the best sites for piston coring. All three cores were successful, each recovering between 0.58 and 10 m of interbedded muddy sediments and sand/silt turbidites. The other three piston cores targetted the upper part of the broad lower valley of Nazare Canyon, between 4100 and 4300 m. The aim was to assess the distribution of Holocene mud deposition in this part of the canyon and to allow groundtruthing of the TOBI imagery. Two of these cores recovered 3m and 0.5 m of mixed sand and mud turbidites, but with little evidence of 'recent' mud deposition, suggesting that mud depsoition is currently restricted to the flanks of the narrow upper canyon, shallower than about 4000 m. The third core failed.

Doug Masson

3. 3.5 KHZ PROFILER

The 3.5 kHz profiler operated throughout the cruise but rarely gave useful information in the rough canyon topography because side-echo reflections from the canyon walls obscured the true canyon floor.

Doug Masson

4. MEGACORER AND BOX CORER

At the start of the cruise it was intended that a new Megacorer purchased by UKORS from Ocean Scientific International Ltd (OSIL) was to be used to sample meiofauna and macrofauna. This would allow a common approach to sampling small seabed fauna and would save a considerable amount of wire time. In the event the Megacorer proved temperamental and did not sample consistently. It gave us so many problems that we had to revert to the older technology of a USNEL-pattern box corer ($0.25m^2$ box) and a Multicorer for macrofauna and meiofauna sampling respectively. In addition a USNEL-pattern box corer was used for sedimentology. The lack of performance by the Megacorer severely curtailed the scientific programme. It had been intended to sample both within the Nazaré Canyon and on the adjacent slope for all faunal groups. This aim was realised only for the meiofauna and microbiology owing to the sampling time lost.

The first deployment of the Megacorer in the Nazaré Canyon (St. 15735#1) was moderately successful with some short cores obtained in 8 of the 12 core tubes. These samples were used for meiofaunal analyses. However, following this deployment the Megacorer only took two cores out of twelve per deployment (in total 5 deployments), a poor yield that meant we could not rely on it as the preferred sediment sampling equipment. On the final and sixth unsuccessful deployment (St. 15746#1) none of the core units worked. Of the two cores taken in each case they were good long samples, indicating that the tubes had all penetrated to sediment. However, none of the other units had triggered, so neither the top core seal nor the core catcher had operated. The two cores always occurred on the same side of the coring head. This trend persisted even when the individual core units were mixed up and placed in different positions on the coring head and when the number of cores was reduced from 12 to 8 on each deployment.

A thorough overhaul of the Megacorer was undertaken. No obvious problems were noted in the way the corer operated apart from the ease with which the individual core units could move vertically on the coring head. On deck, before deployment, the individual units were easy to move. When they returned on deck having been to the bottom of the ocean the units were very difficult to move. It was suspected that the materials used in the construction of the corer may have been at fault, because there was no obvious mechanical reason for the difficulty.

On two deployments of the Megacorer the main warp caught around the main shaft of the corer. The corer was recovered at the surface on both occasions without much difficulty and with no damage to the corer or the wire.

Apart from the box core samples in the Nazaré Canyon a number of other samples were taken. A successful box core sample, about 24cm long, was taken at the mouth of the Cascais Canyon, c. 4500m (St 15730#1). Push core sub-samples were taken for meiofauna (University of Ghent and NCS) and microbiology (CoNisMa). A Megacore was attempted at 728m on the continental slope to the south of the Nazaré Canyon, but retrieved only a small amount of coarse sediment in four out of 12 core tubes.

Within the Nazaré Canyon three localities were sampled with the box corer; 1) on the upper slope in close proximity to the canyon (c. 750m), 2) middle canyon terrace (c. 3400m) and 3) lower canyon floor adjacent to the thalweg (c. 4300m). Neither of the cores on the upper slope were very good. One core had little penetration through a shallow sand layer (the short core slumped badly in the box and turned upsode down as it was being retrieved from the box, and the second core penetrated too deeply through a much softer mud at a nearby location. The deeper box core samples were used for macrofauna as detailed below. Six out of nine box core deployments produced a useful sample.

Ben Boorman, David Billett

Macrofauna

Within the Nazaré Canyon macrofauna were obtained from 6 good box core samples, three at the mid canyon 3400m locality and three at the deep canyon 4300m site. The samples were sieved at 300_m and 500_m at six depth horizons: 0-1cm, 1-3cm, 3-5cm, 5-10cm, 10-15cm and 15-20cm. The samples from 0-1cm and 1-3 cm were placed in formalin before sieving. The following table gives details of the stations and the number of cores used at each site.

Station	Depth (m)	Position	
		N	W
15755#1	**3478**	**39° 30.62**	**09° 56.19**
15758#2	**4364**	**39° 35.02**	**10° 18.95**
15758#6	**4367**	**39° 34.99**	**10° 19.00**
15760#1	**3482**	**39° 30.02**	**09° 56.17**
15762#1	**3481**	**39° 30.02**	**09° 56.22**
15765#2	**4369**	**39° 35.00**	**10° 19.04**

In addition, fauna, mainly xenophyophores (some new forms) were hand picked off from the sediment surface of a number of box cores, including those not used for full macrofaunal sampling. The unsuccessful cores slumped or the overlying water had drained out through large cracks in the sediment prior to sampling on deck.

Teresa Amaro, Teresa Madurell, David Billett, Andy Gooday.

5. SHRIMP (SEABED HIGH RESOLUTION IMAGING PLATFORM)

SHRIMP deployments: biological observations

General comments: the number of SHRIMP deployments was limited to two, owing to problems with the winch for the deep tow cable. However, the quality of the observations obtained was superb and we thank the SHRIMP technicians for the efforts put in to obtain such high quality images.

Station 15729#1: Cascais Canyons ca 4550m 38º23.00N 09º59.00W

The seabed at this depth was remarkable for the amount of megafauna visible even in real time. The seabed was mainly soft sediment although there were sporadic pieces of rock (?drop stones). The most obvious megafauna was the pennatulid *Umbellula* sp., which occurred regularly throughout the transect. In addition we observed anemones, ophiuroids and holothurians, and small burrows with radiataing 'spokes' that we interpreted as echiuran burrows. Other evidence of 'lebenspurren' include gastropod trails and trails of either sea urchins or holothurians, or both. Less common were crinoids, cerianthid sea anemones and brisingid seastars. Fish swam into and out of the view regularly the most common being *Coryphaenoides* sp. and synaphobranchids. In many of the observations there appeared to be a structure that looked somewhat like a bunch of grapes. A sample was collected and the organism turned out to be a xenophyophore and thus most likely one of the most common species at this site.

Station 15744#1: Upper Nazaré Canyon ca 760 to 1050m, 39º34.41N 09º25.078W

This shallower station was also rich in megafauna. Particularly common thoughout the deployment were anemones, the holothurian *Laetmogone violacea*, white brisingid seastars, white seastars, cerianthids and gorgonians. The dominant fish appeared to be *Trachyrhynchus* sp. but morids were also fairly common. A rare echinothurid sea urchin was also observed. There was a great deal of bioturbation but it is not clear from the real time video what is causing this bioturbation. Below about 1050m the water column became very turbid and it was not possible to see the benthos.

Abigail Pattenden, Paul Tyler and David Billett

6. AGASSIZ TRAWL

Two deployments of the Agassiz Trawl were made for megafauna. The target areas for both the mid canyon and lower canyon study sites were rather small, in the former case because there are very few areas within the Nazaré Canyon flat enough to take a trawl, and in the latter case because the DOSOL Lander was stuck on the seabed in the middle of the trawl location. A new method for fishing the Agassiz Trawl was needed therefore, with a large weight added 100m in front of the trawl. The net was lowered to the seabed vertically and then with the ship proceeding at about 1 knot over the ground the weight was kept within 5m of the seabed, as measured by a pinger 50m higher up the wire. The trawl was dragged across the seabed for about half a mile.

The results of this technique were remarkably successful, much to the surprise of those with great technical knowledge of the Agassiz Trawl. It had been known from box core and multicore samples that molpadiid and ypsilothuriid holothurians were very common in the area, and so it proved in the trawl, when over a thousand, perfectly washed specimens of *Molpadia* sp. and *Ypsilothuria bitentaculata* were recovered, from what otherwise at first looked like a very unpromising cod end. A few scaphopods, gastropods and ophiuroids were collected.

The second trawl was fished in much the same way but came up with a disappointingly small catch, mainly ophiuroids, scaphopods and apodid holothurians (*Protankyra brychia*).

David Billett, Ben Boorman.

Megafauna

Megafauna from the two Agassiz trawls were sampled and preserved in a number of different ways in order to study their trophic biology.

At the mid canyon station (St. 15766#1, 3446-3462m corr) the following samples were taken:

1. *Molpadia* sp.
10 specimens in ethanol for molecular work
10 specimens in ethanol for TEM
50 specimens frozen in a plastic bag
10 gut contents for pigments preserved in liquid nitrogen
10 gut contents for lipids preserved in liquid nitrogen
32 specimens with 3 different size classes for stable isotopes in liquid nitrogen.
Remainder of specimens (c. 861) in formalin

2. *Ypsilothuria bitentaculata*
50 specimens frozen in a plastic bag
20 specimens in ethanol for molecular work
20 specimens for stable isotopes preserved in liquid nitrogen.

3. Ophiuroidea (species unknown)
1 cryovial with arms for stable isotopes measurements preserved in liquid nitrogen
1 cryovial with disk for stable isotopes measurements preserved in liquid nitrogen

4. Scaphopoda (species unknown)
1 vial for stable isotopes measurements preserved in liquid nitrogen

5. Gastropoda (species unknown)
1 vial for stable isotopes preserved in liquid nitrogen.

At the lower canyon station (St. 15768#1) (4394-4422m corr):

1. Ophiuroidea

Ophiuroid sp.A – 2 specimens, one for stable isotopes and one preserved in ethanol Ophiuroid sp.B – 14 specimens, half for stable isotopes and the other half preserved in ethanol

2. Scaphopoda
4 specimens frozen in liquid nitrogen for stable isotopes
5 specimens preserved in ethanol for molecular analyses.

Teresa Amaro, David Billett

7. AMPHIPOD TRAP

Two amphipod traps deployments were made, both in the Nazaré Canyon. One was placed on a terrace adjacent to the main canyon channel at the mid-canyon locality (c. 3400m) and the other was deployed adjacent to the thalweg in the lower canyon (c. 4300m). Mackerel was used as bait and the trap had two chambers one close to the seabed and the other set about 1 m above the sediment surface.

On the first deployment the trap frame suffered some damage, with the release slipping right through its retaining brackets, and a metal bracket holding the ballast weight shearing off. Otherwise the frame was unscathed. The reason for the damage was not immediately obvious. However, a ROBIO lander deployed at the same time and in the same general vicinity (slightly shallower and about 3 miles distant) (St 15732#1) also suffered damage owing to a strong current event that lasted for about 30 minutes. The current caused the lander mooring to tilt at a steep angle and to be dragged along the seabed, finishing up at a depth 20m deeper than where it had been deployed. It is likely that the amphipod trap had been affected by the same strong current.

The deployment at 3619m (St 15734#1) had only a moderate number of amphipods in the trap, especially in the VET Trap situated 1m above the seabed. The result may have been influenced by the current event noted above, whatever else may have damaged the amphipod trap and also by the soft sediment; it is possible that the bottom amphipod trap might have been partially submerged, although there was no evidence of this in the trap.

The deployment at 4317m (St 15741#1) was highly successful with a large and varied catch.

Ben Boorman, Teresa Madurell, David Billett

8. SANDERS EPIBENTHIC SLEDGE

One deployment of the Sanders Epibenthic Sledge (kindly loaned by the Scottish Association for Marine Science) was made for larger macrofauna, particularly suprabenthic crustaceans. A similar towing method as described for the Agassiz Trawl was used. While towing the sledge across the seabed at the mid canyon site (c. 3400m) there was a sudden increase in the tension on the wire to 5.3 tons. On recovery the weak link on the epibenthic sledge was found to have parted and the sledge was recovered by its safety strop. Many of the G-links used had almost pulled out and we were lucky to get the sledge back in one piece.

While lumps of mud were found on the sledge frame, inside the net there were only a few rocks and one stalked crinoid. The rock was lithified sediment very similar to the mud found in the cores, but obviously of a much greater age.

Dave Billett

9. CTD

Faults

Stainless steel system : Seabird plus #09P31240-0720
The CTD unit was left in poor state after D294 (S.Africa- Falmouth) Transmissometer 5 pin bulkhead (JT6) connector was replaced after severe corrosion was noted. Bulkhead connector JT5 on the seabird unit also shows initial signs of corrosion but a replacement connector was not available. Interconnecting cables between the Seabird unit and the BOB were replaced for JT5 and JT6.The BBRT was removed from the frame, due to damage to the instrument's bulkhead connector and the bulkhead connector on the BOB was blanked. Temperature sensors were found unblanked.

Several electrical reterminations where carried out, the most pertinent of these occurred after the CTD unit was recovered while spinning dangerously, damaging the cable for several hundred metres. The reason for the induced spinning is unknown. (The CTD is fitted with a guide fin, which from previous experience provides adequate protection from spin)

Water sampling
There was no water sampling for D295-D297. Although 20litre niskin bottles were fitted. Damage was found to one bottle drain plug (Bottle #11 has plug missing and metal guide pin is bent) It should also be noted that the CTD cable sheds significant amounts of rust into the water during deployment. It is uncertain how this will effect scientific measurments, particularly concerning particle counts in the water.

D297 CTD sensor suite:
Primary Temp *
Secondary Temp
Primary Conductivity
Secondary Conductivity
Pressure
BBRT
Transmissometer
Flourometer

* the primary temperature sensor failed during the final deployment (cast 8) but data was still logged using the identical secondary sensors.

James Cooper

10. WATER COLUMN BIOCHEMISTRY

In order to investigate the amount and quality of organic particulate material, that serves as a food source for the benthic and benthopelagic ecosystems in submarine canyons, particulate material on precombusted (400°C; >4 h) GF/F filters (293mm diameter) was collected using 3 UKORS SAPS (Stand-Alone Pumping Systems; Challenger Oceanic). Samples were recovered from two contrasting Portuguese canyons, Satubal Canyon (1deployment) and Nazare Canyon (5 deployments). Three sites were selected from the Nazaré Canyon. A deep site at the lower edge of the canyon (~4300 m depth; 2 deployments), a slightly shallower site further upstream (~3500 m depth; 2 deployments) and a site closer to the mouth of the canyon (~1100 m depth; 1deployment). The second deployments on the deep and middle depth sites were taken as close as possible to (possibly right above) the thalweg of the canyons. The sampling depths were at 10-20 m above bottom (mab; mostly in the benthic boundary layer) and two intermediate depths (see Table x) usually taken at or close to the upper and lower edges of the Mediterranean Water that impinges on the slope (~600-1500m water depth). Material was abundant (visual estimate) only in the shallowest site (~1100 m), particularly close to the bottom, where a thick brown-greenish coating was plainly evident on the filters. The other sites clearly had less material, as seen by the faint colouring on the filters although definite conclusions will only be obtained after the completion of the lab analyses. The pumps were operated at the chosen depths for two or 1.5 hours. The pumps worked faultlessly and were recharged within 2-3 hours. On recovery, the filters were folded, wrapped in precombusted (400°C; >4 h) aluminium foil labelled and stored in -70° C for subsequent organic biochemical analyses (POC, TN, lipid, pigment, _^{13}C and _^{15}N of POM). No analyses were carried out on board. A number of sediment multi and mega cores were also collected whole and kept frozen (-70°C) from most of the above sites, as well as from an open slope environment for comparisons (full details in A. Gooday’s report).

SAPS sampling information

Date	Station	Latitude	Longitude	Sampled depths	Water depth	Volume pumped	Pumping time
30/07/2005	15728#2	38 06.52-60	10 01.27-84	10-30 mab	4460	1325	2
30/07/2005	15728#2	38 06.52-60	10 01.27-84	1500	4460	1448	2
30/07/2005	15728#2	38 06.52-60	10 01.27-84	750	4460	1642	2
03/08/2005	15737#4	39 30.0	09 56.10	10-30 mab	3435	1265	1.5
03/08/2005	15737#4	39 30.0	09 56.10	1600	3435	1128	1.5
03/08/2005	15737#4	39 30.0	09 56.10	900	3435	992	1.5
05/08/2005	15743#2	39 34.97	10 19.97	10-15 mab	4360	1036	1.5
05/08/2005	15743#2	39 34.97	10 19.97	1600	4360	1128	1.5
05/08/2005	15743#2	39 34.97	10 19.97	750	4360	1384	1.5
08/08/2005	15752#2	39 36.07-9	09 24.09-12	20 mab	1135	610	1.5
08/08/2005	15752#2	39 36.07-9	09 24.09-12	850	1135	1025	1.5
08/08/2005	15752#2	39 36.07-9	09 24.09-12	400	1135	1131	1.5
10/08/2005	15761#1	39 30.03-12	09 55.02	20 mab	3500	963	1.5
10/08/2005	15761#1	39 30.03-12	09 55.02	1600	3500	1296	1.5
10/08/2005	15761#1	39 30.03-12	09 55.02	900	3500	1187	1.5
13/08/2005	15767#2	39 34.60	10 20.05	20 mab	4360	1212	2
13/08/2005	15767#2	39 34.60	10 20.05	1600	4360	1636	2
13/08/2005	15767#2	39 34.60	10 20.05	750	4360	1581	2

Kostos Kiriakoulakis

11. LANDERS

Ichthyofaunal assessment using baited camera landers within the Nazaré Canyon using the RObust BIOdiversity (ROBIO) lander

<u>Technology:</u>

The RObust BIOdiversity lander (ROBIO) is a free-fall lander equipped with a digital stills camera (Kongsberg Maritime, OE14-208), flash unit (Kongsberg Maritime, OE11-242), Aquadop current meter, rechargeable battery pack, and twin acoustic ballast release system (MORS AR and RT). The current meter was programmed to measure depth, temperature, and current velocity and direction at 30-second intervals throughout the deployment. The camera was programmed to take digital photographs at 60-second intervals, with an average of 700 photos per deployment.

Deployments:

The ROBIO lander was deployed at 8 stations. Images were not captured during deployment 1 (station 15727#1) in the Setúbal Canyon due to camera programming problems. A total of 7 fully successful deployments were achieved. Capturing 4918 images, at depths ranging from 891 – 4302 m UC (Table 1).

ROBIO deployment positions							
Dep	Station	Latitude	Longitude	Depth (m) UC	Date	Time camera on (GMT) (hh:mm)	Number of images
1	15727#1	38° 06.41' N	09° 59.61' W	4433	29/07/05	18:38	-
2	15732#1	39° 30.30' N	09° 55.50' W	3300	01/08/05	17:21	968
3	15740#1	39° 35.00' N	10° 15.00’ W	4254	04/08/05	15:35	747
4	15745#1	39° 35.72' N	09° 24.34' W	896	06/08/05	02:47	703
5	15747#1	39° 35.73' N	09° 24.30' W	891	06/08/05	19:49	380
6	15754#1	39° 30.20' N	09° 56.70' W	3402	08/08/05	12:19	713
7	15764#1	39° 35.01' N	10° 15.02' W	4260	11/08/05	15:53	738
8	15769#1	40° 06.04’ N	10° 22.20’ W	4302	14/08/05	19:30	669

Preliminary results:

Dominant species attending bait are highly specific to depth strata, with the abyssal grenadier, *Coryphaenoides (Nematonurus) armatus* (Hector, 1875; Figure 1a) and deepwater arrow tooth eel, *Histiobranchus bathybius* (Günther, 1877) being the most common species in all deployments >3300 m. At shallower depths (891 – 896 m uc) *Synaphobranchus kaupii* Johnson 1862 (Kaup’s arrow tooth eel) were numerically dominant with intermittent visitation by *Mora moro* (Risso, 1810) (common Mora), *Phycis* sp. Artedi 1792 (Forkbeard), and 3 species of elasmobranch, 2 of which are potentially *Deania calceus* (Lowe, 1839; Figure 1b) (Birdbeaked dogfish) and *Centrophorus squamosus* (Bonnaterre, 1788) (Portuguese dogfish).

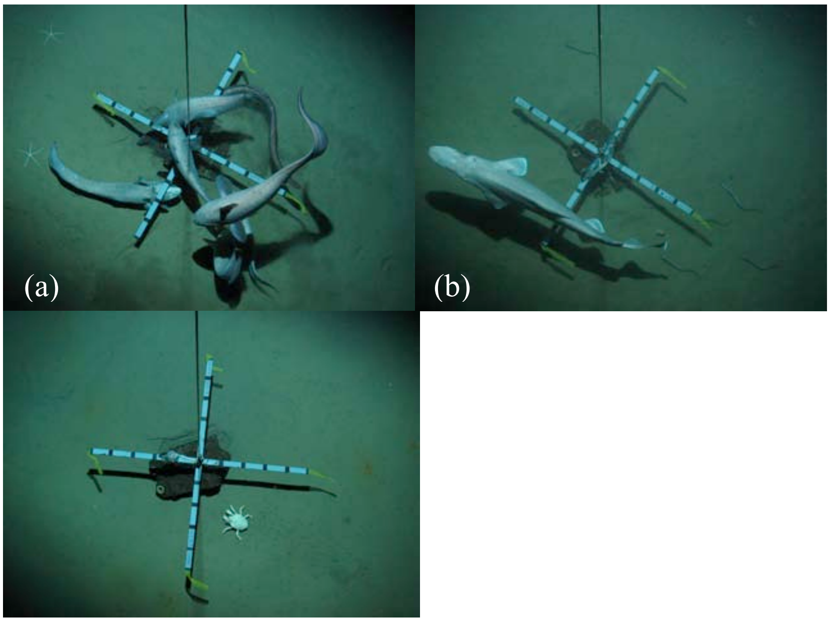

Figure 1: Images from the ROBIO lander. (a) Coryphaenoides (Nematonurus) armatus with ophiuroids in background (b) Deania calceus? With Synaphobranchus kaupii in the background, (c) Munidopsis sp.

Invertebrates observed at the bait at both shallow sites were decapod shrimps, asteroidea, gastropoda (*Colus* sp.?), amphipoda, and paguridae. Invertebrates were less common at the deeper sites, however specimens of decapod shrimps (2 spps. one potentially *Plesiopenaeus* sp.), ophiuroidea, amphipoda, and scyphozoa were observed. In addition a specimen of *Munidopsis* sp. (Figure 1c) was recorded in deployment 7 (15764#1). Species have yet to be confirmed.

During deployment 2 (15732#1; Table 1) current velocity became elevated six hours post touchdown. The increase in current above the lander caught the mooring line, dragging the lander down a slope increasing the depth by 20 m (Figure 2). Current velocity at all sites is indicative of a strong tidal cycle.

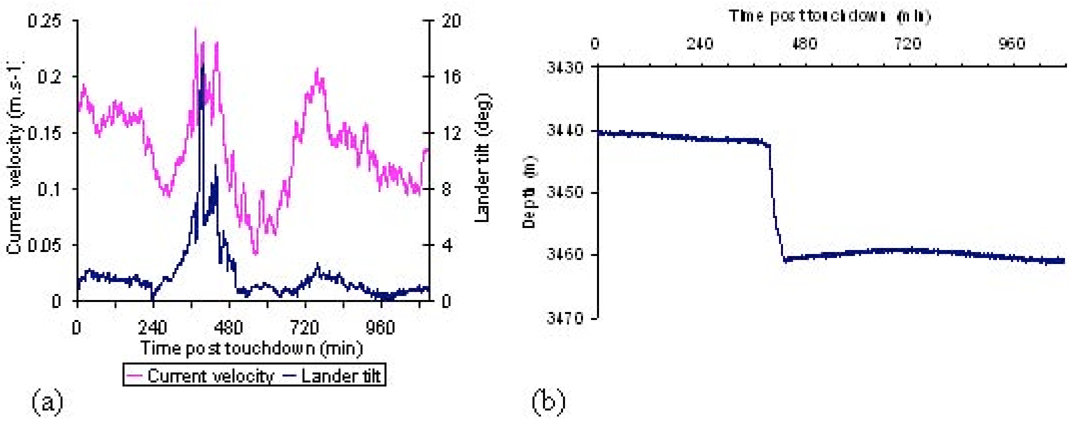

Figure 2: Current meter readings from deployment 2 (15732#1). (a) Current velocity (m.s^{-1}) and lander tilt (°), (b) Depth (m).

Analysis:

Analysis of the ROBIO data will consist of a) image analysis; simple time series counts, length frequency determination, bait visitation by individuals, abundance estimate calculation, confirmation of species identification, behavioural observations, and b) collation and interpretation of current meter data.

Deep sea bioluminescent species and interactions within the Nazaré Canyon using the Deep Ocean Stealth Observation Lander (DOSOL)

Background

In the marine environment, a large number of organisms have the capacity to emit visible light or bioluminescence. The main objective of this cruise was to observe spontaneous benthic bioluminescence in relation to deep-water canyons off Portugal and to identify organisms responsible for the light emissions.

Technology

The DOSOL (Deep Ocean Stealth Observatory Lander) is designed to study deep-sea benthic bioluminescence. It is equipped with a very sensitive ISIT (Intensified Silicon Intensifier Target) camera to record bioluminescence as well as a low-light CCD camera, that records which animals are present in the field of view. Both cameras work simultaneously and are vertically orientated above bait. Red LED lights provided sufficient illumination for the CCD camera to obtain an image. The red light was filtered from the ISIT using a 620nm cut off filter.

Dep.	Station	Latitude	Longitude	Depth (m) UC	Date
1	15726	38°06.61" N	10°00.97" W	4498	29/07/05
2	15733	39°30.22" N	09°56.69" W	3424	01/08/05
3	15742	39°34.54' N	10°18.00' W	4317	04/08/05

Deployments

During the first two deployments, excess red illumination resulted in ISIT saturation, preventing the detection of bioluminescence. This optical saturation was fixed by reducing light levels. The third deployment took place inside the Nazaré canyon at a depth of 4317m. Unfortunately, the lander failed to return to the surface during recovery. The landers position was triangulated using the through hull transducer and acoustic deck unit which established a seafloor position 188m north east of the deployment site. Two attempts to salvage the lander using a 2 and 3 clump drag wire were unsuccessful.

Dr. A. Jamieson, Mr. J Polanski, Miss N. King and Miss A. Heger

12. BATHYSNAP

It had been hoped to deploy two Bathysnap systems during the cruise, one short term for the duration of the cruise and one for a period of a year (to be recovered in 2006). Unfortunately, one of the releases supplied failed a wire test and so the short term deployment could not be made. Then, the camera system was found to have a fault and so the long-term deployment was cancelled. This camera had only arrived back at NOCS the day before sailing after being repaired and serviced. All appeared to work correctly with the test box, but would not operate when connected to the flash unit. Subsequently the camera locked up as it had on the *Crozex* cruise (RRS *Discovery*, December 2004) and would not accept any inputs. Although the camera software had been reloaded as part of its service it seems that there is still a major error in its programming.

Ben Boorman, David Billett

13. MARINE MAMMALS

During the 19 days campaign the marine mammal observer spent an effort of 130 hours in the look-out for whales and dolphins. We had 22 positive sightings; 9 systematic (during sighting time) and 13 opportunistic (in no-sighting time). The frequency of the systematic sightings is 0,07 (one every 14,4 hours of effort).

66 hours of observation were done in Nazaré Canyon where all the systematic sightings (9) took place. That means a frequency of sighting of 0,14 (one sighting *every 7,3* hours) in Nazaré.

Six different species were observed: Common dolphin *(Delphinus delphis),* Striped dolphin *(Stenella coeruleoalba),* Bottlenose dolphin *(Tursiops truncatus), Long*-finned pilot whale *(Globicephala melas),* Sperm whale *(Physeter macrocephalus)* and Fin whale *(Balaenoptera physalus).* Some of the animals could not be identified to specific level because of being too far from the ship.

Ruth Fernández García

TABLES

D297 STATION LIST

Setubal

Station	Cast	Gear	Event	Date	Time_UTC	Latitude	Longitude	Depth (m, uncorr)	Remarks	Core length (cm)	Institute responsibe for sample
D15725	1	TOBI	start acquisition	28/7/05	2:20	38.8724	-10.8624	2963			NOCS
D15725	1	TOBI	end acquisition	29/7/05	10:00	38.0654	-10.2294	4548			NOCS
D15726	1	DOSOL	deployed	29/7/05	18:19	38.1102	-10.0162	4498			Oceanlab
D15727	1	ROBIO	deployed	29/7/05	18:47	38.1068	-9.9935	4433	recording failed		Oceanlab
D15728	1	CTD	on bottom	29/7/05	21:18	38.1090	-10.0112	4461			UniLiv
D15728	2	SAPS	start acquisition	30/7/05	4:00	38.1087	-10.0212	4474	ship has drifted considerably during SAPS pumping		UniLiv
D15728	2	SAPS	end acquisition	30/7/05	6:00	38.1100	-10.0307	4474	SAPS at 10, 3000 and 3750 m wire out		UniLiv
D15726	1	DOSOL	surfaced	30/7/05	10:29	38.1102	-10.0162	4498			Oceanlab
D15727	1	ROBIO	surfaced	30/7/05	14:05	38.1072	-9.9940				Oceanlab
D15729	1	SHRIMP	start acquisition	31/7/05	1:27	38.3833	-9.9837	4546			NOCS
D15729	1	SHRIMP	end acquisition	31/7/05	4:50	38.3516	-9.9727	4495			NOCS
D15730	1	Boxcore	on bottom	31/7/05	11:54	38.3542	-9.9800	4518		24	NOCS

between canyons

D15731	1	Megacore	on bottom	1/8/05	11:54	39.2070	-10.1768	728	small amount of sand and gravel, no mud for incubation	0	IUB

Nazare, deep site (>4000 m)

Station	Cast	Gear	Event	Date	Time_UTC	Latitude	Longitude	Depth (m, uncorr)	Remarks	Core length (cm)	Institute responsibe for sample
D15735	1	Megacore	on bottom	2/8/05	0:19	39.5833	-10.3194	4340	8 cores out of 12	27	NOCS
D15735	2	Megacore	on bottom	2/8/05	4:20	39.5852	-10.3158	4336	2 cores out of 12	22	NOCS
D15736	1	SHRIMP	deployed	2/8/05	7:18	39.5641	-10.2728		fault, SHRIMP run aborted		NOCS
D15740	1	ROBIO	deployed	4/8/05	15:41	39.5833	-10.2508	4254			Oceanlab
D15741	1	AT	deployed	4/8/05	16:33	39.5833	-10.2750	4286			NOCS
D15742	1	DOSOL	deployed	4/8/05	17:25	39.5825	-10.2992	4314			Oceanlab
D15743	1	CTD	on bottom	5/8/05	0:14	39.5835	-10.3322	4362	CTD wire twisted badly on recovery, spiky data		UniLiv
D15743	2	SAPS	start acquisition	5/8/05	4:30	39.5827	-10.3327	4359	SAPS at 10, 2800 and 3650 m wire-out		UniLiv
D15743	2	SAPS	end acquisition	5/8/05	6:00	39.5830	-10.3342	4360			UniLiv
D15742	1	DOSOL	surfaced	5/8/05	10:30	39.5825	-10.2992	4314	lander released the weight but did not surface		Oceanlab
D15740	1	ROBIO	surfaced	5/8/05	14:24	39.5833	-10.2508	4254			Oceanlab
D15741	1	AT	surfaced	5/8/05	16:55	39.5833	-10.2750	4286			NOCS

D15757	1	Pistoncore	on bottom	9/8/05	3:46	39.5583	-10.1482	4072	empty, tiny bit of coarse sand on outside core catcher. Mica pieces>1mm	0	NOCS
D15758	1	Boxcore	on bottom	9/8/05	9:10	39.5837	-10.3168	4335	disturbed		NIOZ
D15758	2	Boxcore	on bottom	9/8/05	13:09	39.5823	-10.3167	4332	sliced and sieved for macrobenthos	25	NIOZ
D15758	3	Multicore	on bottom	9/8/05	17:45	39.5830	-10.3174	4435	12 cores out of 12	27	NOCS
D15758	4	Multicore	on bottom	9/8/05	21:24	39.5835	-10.3167	4335	12 cores out of 12	25	NOCS
D15758	5	Boxcore	on bottom	10/8/05	1:18	39.5833	-10.3165	4335	partly washed out		NIOZ
D15758	6	Boxcore	on bottom	10/8/05	5:28	39.5832	-10.3167	4335	sliced and sieved for macrobenthos	22	NIOZ
D15759	1	Pistoncore	on bottom	10/8/05	10:45	39.5867	-10.2365	4224	mainly sandy core, large amount of plant remains on top	58	NOCS
D15763	1	Pistoncore	on bottom	11/8/05	13:00	39.5645	-10.1773	4074		3300	NOCS
D15764	1	ROBIO	deployed	11/8/05	15:58	39.5835	-10.2503	4260			Oceanlab
D15764	1	ROBIO	surfaced	12/8/05	15:45	39.5835	-10.2503	4260			Oceanlab
D15765	1	Boxcore	on bottom	11/8/05	18:58	39.5832	-10.3172	4336	washed out on deck; same location as #15758		NIOZ
D15765	2	Boxcore	on bottom	11/8/05	22:37	39.5833	-10.3173	4336	same location as #15758	28	NIOZ
D15767	1	CTD	on bottom	13/8/05	7:30	39.5760	-10.3343	4352	error at 1180m wire-out, CTD recovered on deck		UniLiv
D15767	2	SAPS	start acquisition	13/8/05	11:00	39.5757	-10.3340	4348	SAPS at 700, 1610 and 4350 m depth		UniLiv
D15767	2	SAPS	end acquisition	13/8/05	13:00	39.5765	-10.3342	4336			UniLiv
D15767	3	CTD	on bottom	13/8/05	17:28	39.5763	-10.3348	4328			UniLiv
D15768	1	Agassiz	start acquisition	13/8/05	21:27	39.5853	-10.3352	4361			NOCS

D15768	1	Agassiz	end acquisition	13/8/05	22:12	39.5852	-10.3493	4388			NOCS
D15769	1	ROBIO	deployed	14/8/05	19:30	40.1007	-10.3700	4300			Oceanlab
D15770	1	Multicore	on bottom	14/8/05	21:36	40.0733	-10.3653	4277	12 cores out of 12	17	NOCS
D15770	2	Multicore	on bottom	15/8/05	0:44	40.0732	-10.3650	4275	12 cores out of 12	17	NOCS
D15770	3	Multicore	on bottom	15/8/05	4:05	40.0733	-10.3657	4275	12 cores out of 12	16	NOCS

Nazare, middle site (~3400m)

Station	Cast	Gear	Event	Date	Time_UTC	Latitude	Longitude	Depth (m, uncorr)	Remarks	Core length (cm)	Institute responsibe for sample
D15732	1	ROBIO	deployed	1/8/05	17:28	39.5050	-9.9247	3320			Oceanlab
D15733	1	DOSOL	deployed	1/8/05	18:42	39.5037	-9.9448	3410			Oceanlab
D15734	1	AT	deployed	1/8/05	19:32	39.4963	-9.9648	3600			NOCS
D15733	1	DOSOL	surfaced	2/8/05	12:44	39.5037	-9.9448	3410			Oceanlab
D15732	1	ROBIO	surfaced	2/8/05	15:27	39.5050	-9.9247	3340			Oceanlab
D15734	1	AT	surfaced	2/8/05	17:00	39.4963	-9.9648	3600	slight damage to amphipod trap		NOCS
D15737	1	Megacore	on bottom	2/8/05	21:22	39.5000	-9.9371	3453	2 cores out of 12	37	NOCS
D15737	2	Megacore	on bottom	3/8/05	0:48	39.4998	-9.9354	3480	2 cores out of 8	38	NOCS
D15737	3	CTD	on bottom	3/8/05	8:20	39.5017	-9.9385	3428			UniLiv
D15737	4	SAPS	start acquisition	3/8/05	12:30	39.5000	-9.9350	3435	SAPS at 10m off bottom, 1600m depth and 900m depth		UniLiv
D15737	4	SAPS	end acquisition	3/8/05	14:00	39.5000	-9.9350	3435			UniLiv

D15737	5	Megacore	on bottom	3/8/05	18:00	39.5000	-9.9375	3461	2 cores out of 8	40	NOCS
D15738	1	Megacore	on bottom	3/8/05	21:37	39.4963	-9.9637	3577	2 cores out of 8	45	NOCS
D15738	2	Pistoncore	on bottom	4/8/05	4:51	39.4968	-9.9628	3541	pull out 5.3 t	750	NOCS
D15739	1	Pistoncore	on bottom	4/8/05	9:52	39.4997	-9.9087	3432	pull out 5.23 t	1050	NOCS
D15753	1	Multicore	on bottom	8/8/05	7:04	39.5004	-9.9365	3528	12 cores out of 12	40	NOCS
D15753	2	Multicore	on bottom	8/8/05	10:08	39.4998	-9.9370	3425	12 cores out of 12	33	NOCS
D15754	1	ROBIO	deployed	8/8/05	12:25	39.5039	-9.9445	3399			Oceanlab
D15755	1	Boxcore	on bottom	8/8/05	14:50	39.5103	-9.9365	3461		56	NIOZ
D15756	1	Pistoncore	on bottom	8/8/05	21:50	39.5098	-10.0903	3850		1000	NOCS
D15754	1	ROBIO	surfaced	10/8/05	16:18	39.5003	-9.9450	3402			Oceanlab
D15760	1	Boxcore	on bottom	10/8/05	18:57	39.5003	-9.9362	3465	same site as 15755#1, sieved for macrobenthos	47	NIOZ
D15761	1	SAPS	start acquisition	10/8/05	22:50	39.5005	-9.9171	3560	difficulties detecting channel bottom on echosounder		UniLiv
D15761	1	SAPS	end acquisition	11/8/05	0:20	39.5020	-9.9162	3560	SAPS at 10m off bottom, 1745m depth and 1045m depth		UniLiv
D15761	2	CTD	on bottom	11/8/05	4:27	39.5008	-9.9165	3413	major problems with CTD wire, CTD did not reach bottom		UniLiv
D15762	1	Boxcore	on bottom	11/8/05	7:29	39.5003	-9.9370	3464	same site as 15755#1, sieved for macrobenthos	47	NIOZ
D15766	1	Agassiz	start acquisition	12/8/05	20:41	39.4995	-9.9302	3429			NOCS
D15766	1	Agassiz	end acquisition	12/8/05	21:14	39.4993	-9.9418	3441	mainly holothurians		NOCS
D15766	2	Sanders	start acquisition	13/8/05	2:26	39.4993	-9.9305	3438			NOCS
D15766	2	Sanders	end acquisition	13/8/05	2:50	39.4992	-9.9380	3442	weak link parted		NOCS

Nazare, shallow site (<1200 m)

Station	Cast	Gear	Event	Date	Time_UTC	Latitude	Longitude	Depth (m, uncorr)	Remarks	Core length (cm)	Institute responsibe for sample
D15744	1	SHRIMP	start acquisition	5/8/05	22:28	39.5747	-9.4154	768	depth values from SHRIMP acquisition		NOCS
D15745	1	ROBIO	deployed	6/8/05	2:53	39.5953	-9.4057	896			Oceanlab
D15744	1	SHRIMP	end acquisition	6/8/05	1:51	39.6013	-9.4026				NOCS
D15745	1	ROBIO	surfaced	6/8/05	15:48	39.5953	-9.4057	896			Oceanlab
D15746	1	Megacore	on bottom	6/8/05	18:57	39.5823	-9.4123	748	combi: small and large cores. All failed		NOCS
D15747	1	ROBIO	deployed	6/8/05	19:56	39.5955	-9.4050	891			Oceanlab
D15748	1	Boxcore	on bottom	6/8/05	21:26	39.5814	-9.4122	727	sluggish mud overlaying stiff clay with compaction layering. Not good for biology, discarded		NOCS
D15749	1	Boxcore	on bottom	6/8/05	23:18	39.5746	-9.4148	725	box overflowed. One subcore for geology	55	NOCS
D15749	2	Multicore	on bottom	7/8/05	1:12	39.5752	-9.4153	740	12 cores out of 12	33	IUB
D15749	3	Multicore	on bottom	7/8/05	2:33	39.5748	-9.4145	720	12 cores out of 12	34	NOCS
D15749	4	Multicore	on bottom	7/8/05	3:41	39.5748	-9.4152	740	12 cores out of 12	30	NOCS
D15747	1	ROBIO	surfaced	7/8/05	12:30	39.5955	-9.4050	891			Oceanlab
D15750	1	CTD	on bottom	7/8/05	14:04	39.6013	-9.4023	1130	no nepheloid layer on bottom, SAPS delayed		UniLiv
D15751	1	SHRIMP	start acquisition	7/8/05	15:46	39.5584	-9.4618		winch problem, SHRIMP run aborted before reaching bottom		NOCS

D15752	1	CTD	on bottom	7/8/05	21:29	39.6010	-9.4048	1065	repetition of station 15750#1		UniLiv
D15752	2	SAPS	start acquisition	7/8/05	23:45	39.6012	-9.4015	1130	SAPS at 10, 300 and 750 m wire-out		UniLiv
D15752	2	SAPS	end acquisition	8/8/05	1:15	39.6013	-9.4023	1130			UniLiv

Slope Sites

Station	Cast	Gear	Event	Date	Time_UTC	Latitude	Longitude	Depth (m, uncorr)	Remarks	Core length (cm)	Institute responsible for sample
D15769	1	ROBIO	Deployed	14/8/05	19:30	40.10067	-10.37	4300			Oceanlab
D15770	1	Multicore	On bottom	14/8/05	21:36	40.07327	-10.3653	4277	12 cores out of 12	17	NOCS
D15770	2	Multicore	On bottom	15/8/05	0:44	40.07317	-10.365	4275	12 cores out of 12	17	NOCS
D15770	3	Multicore	On bottom	15/8/05	4:05	40.07333	-10.3657	4275	12 cores out of 12	16	NOCS
D15771	1	Multicore	On bottom	15/8/05	15:12	40.595	-10.3673	3400	12 cores out of 12		NOCS
D15771	2	Multicore	On bottom	15/8/05	17:52	40.5955	-10.368	3401	12 cores out of 12		NOCS
D15771	3	Multicore	On bottom	15/8/05	20:39	40.59567	-10.3682	3403	12 cores out of 12	13	NOCS

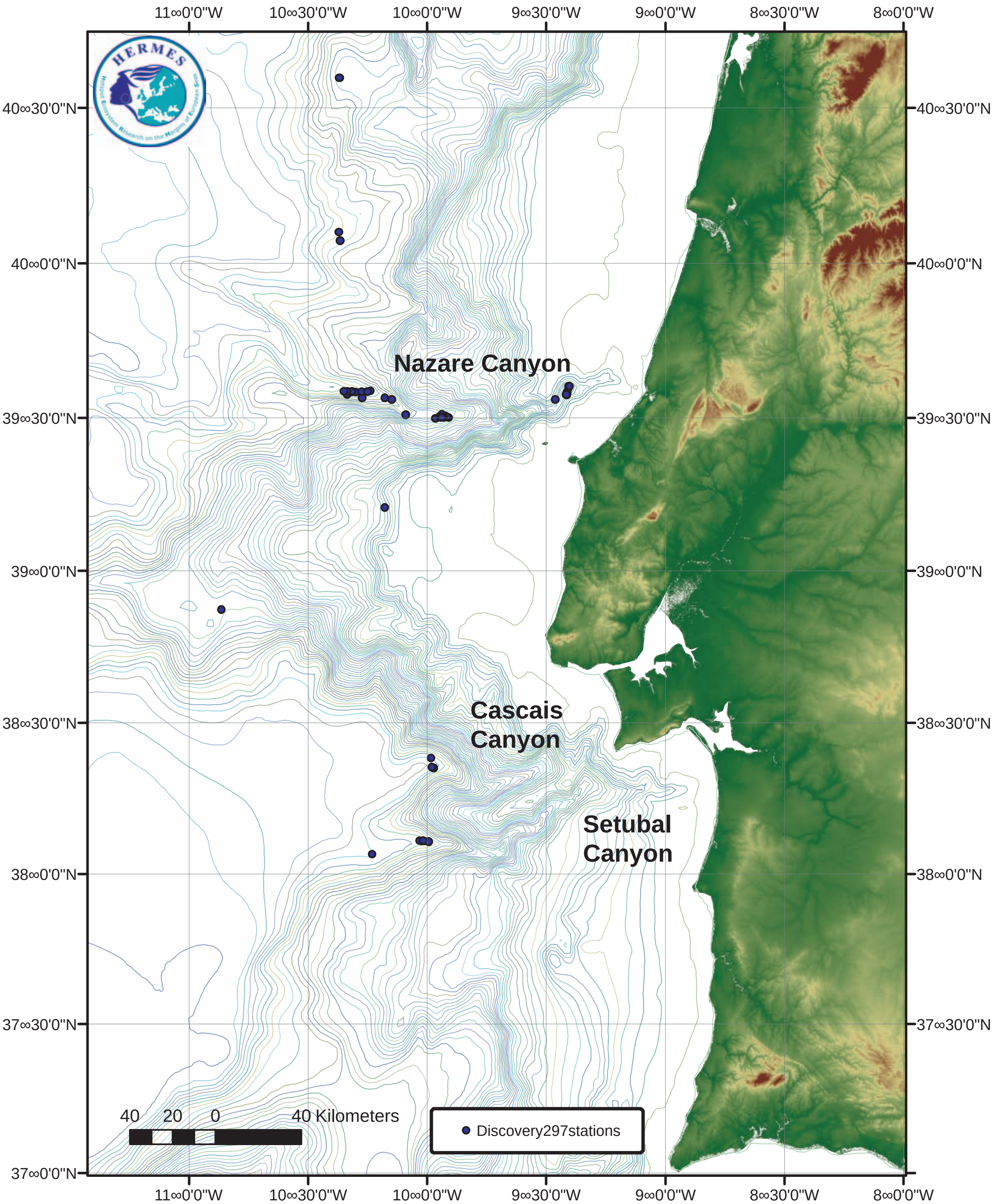

Figure 1. Overview map of cruise area with station positions marked

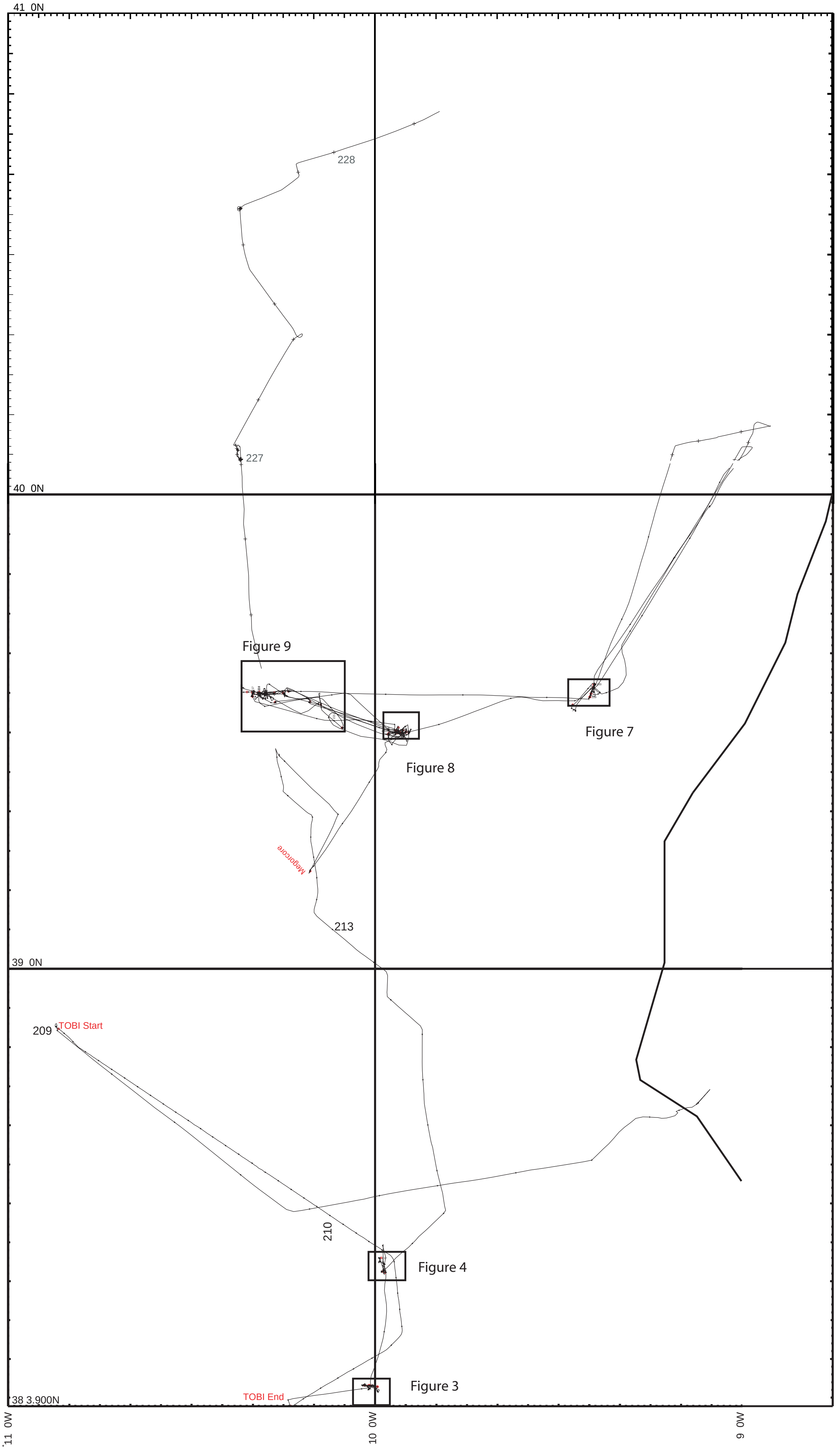

Figure 2. Track chart for cruise D297.

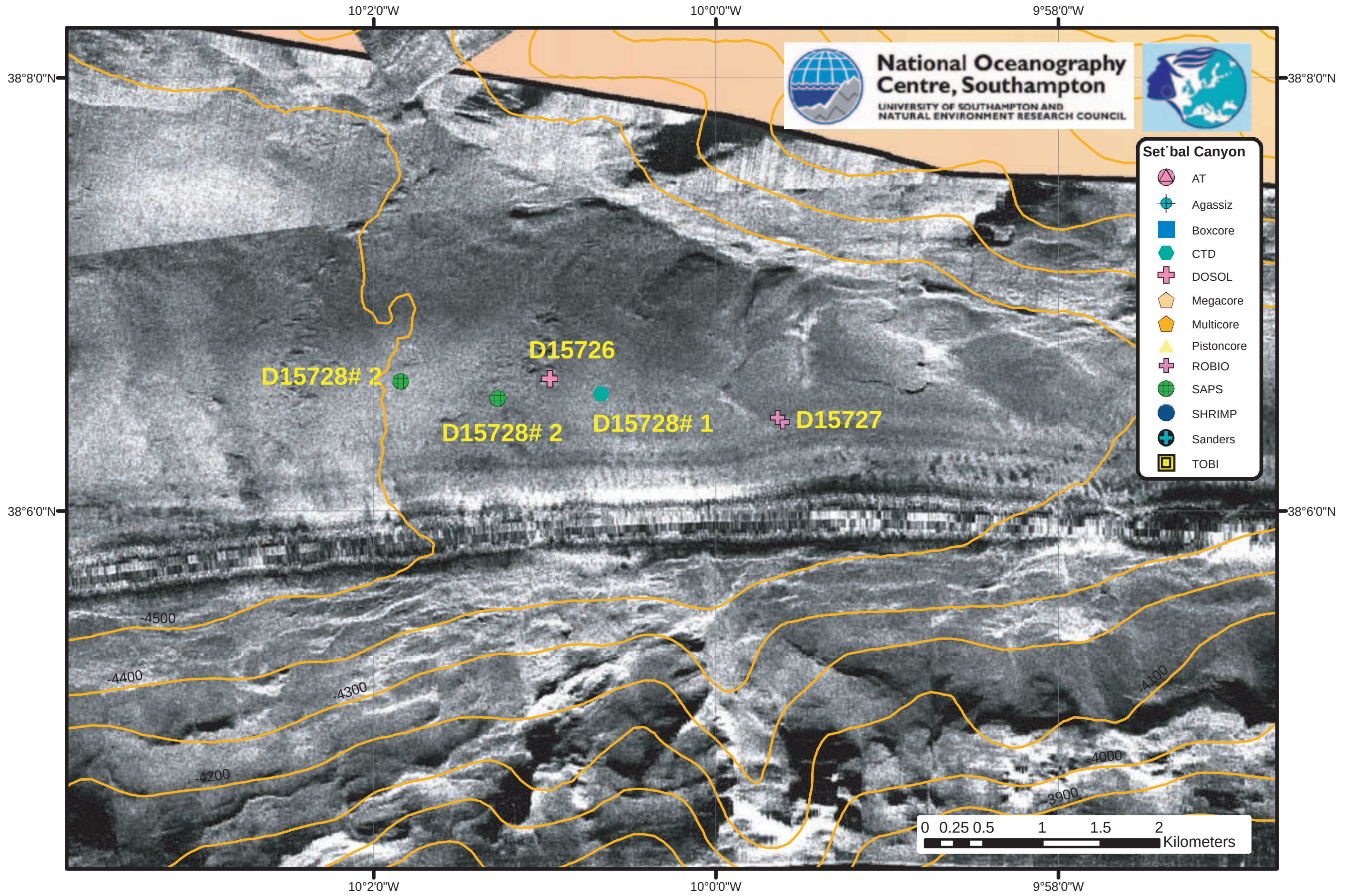

Figure 3. Location of stations on the TOBI sidescan image at the 4500m location in the Setubal Canyon.

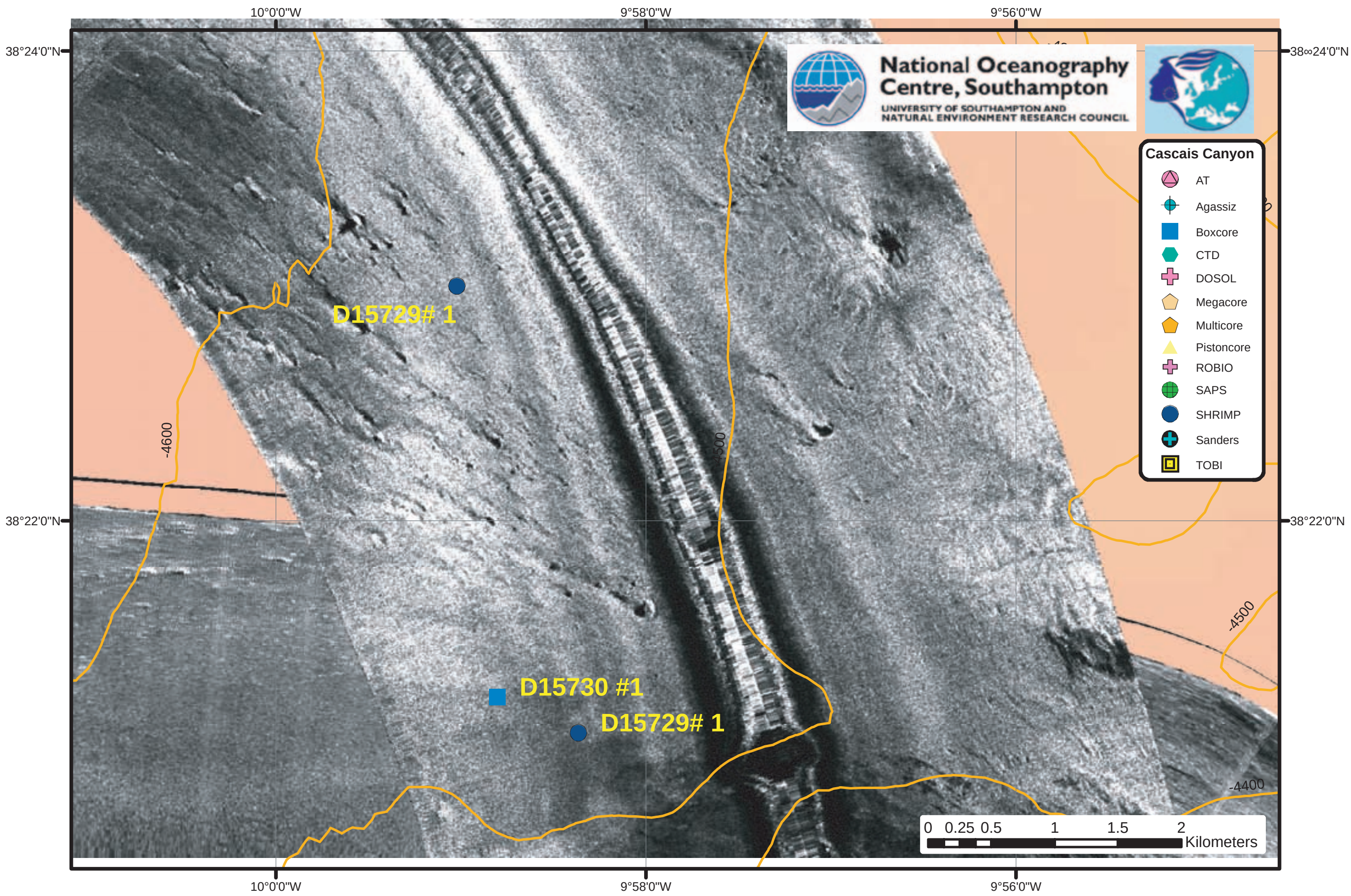

Figure 4. Location of stations on the TOBI sidescan image in the mouth of the Cascais Canyon.

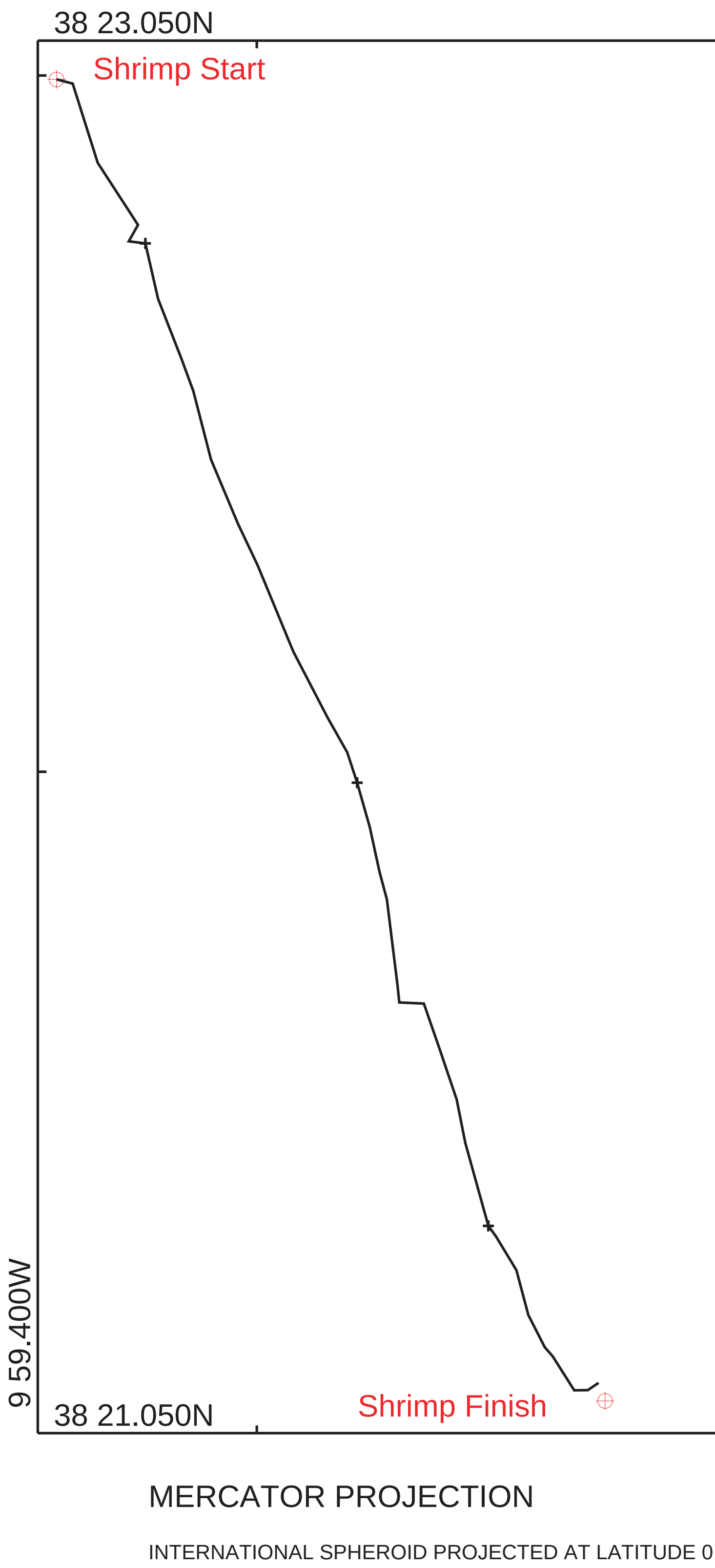

Figure 5. SHRIMP track for Station D15729

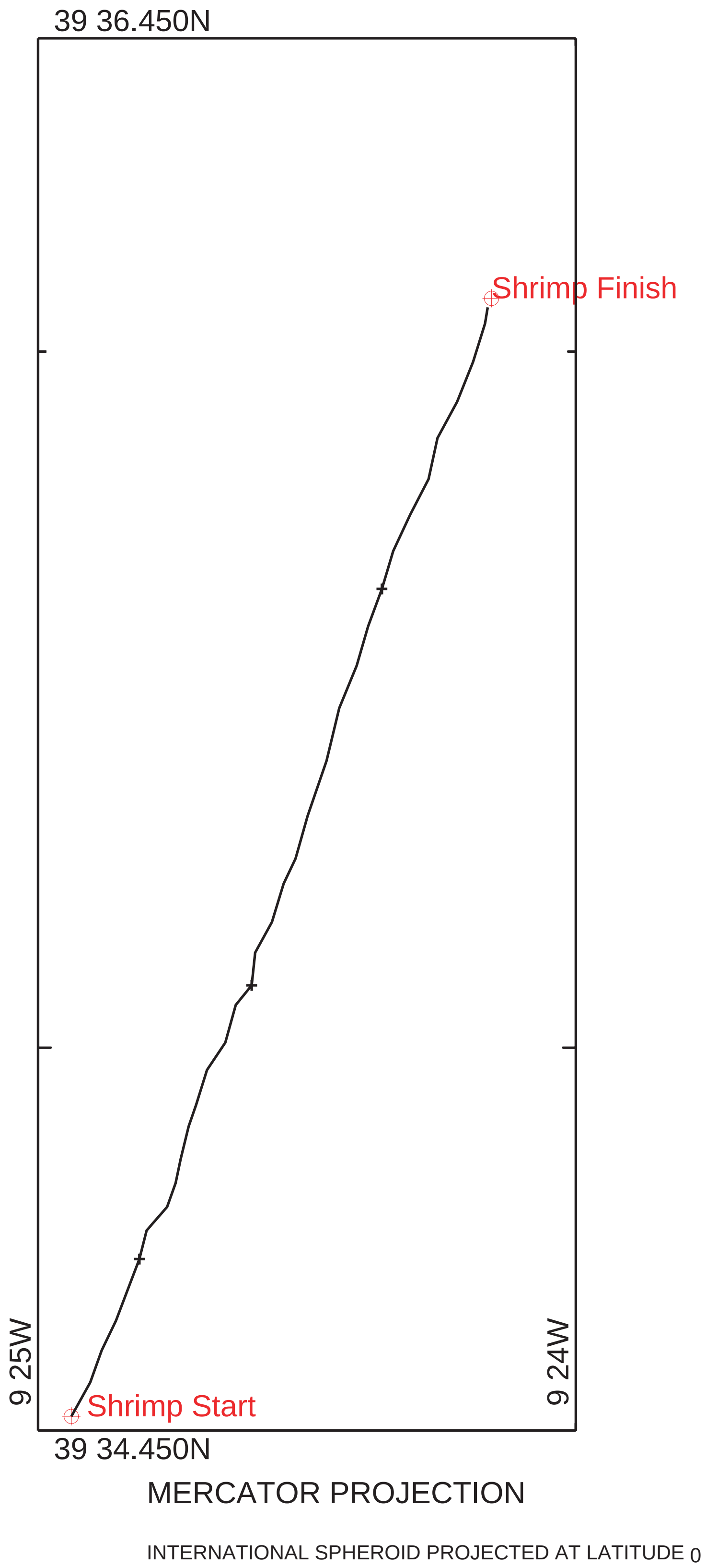

Figure 6. SHRIMP track for Station D15736

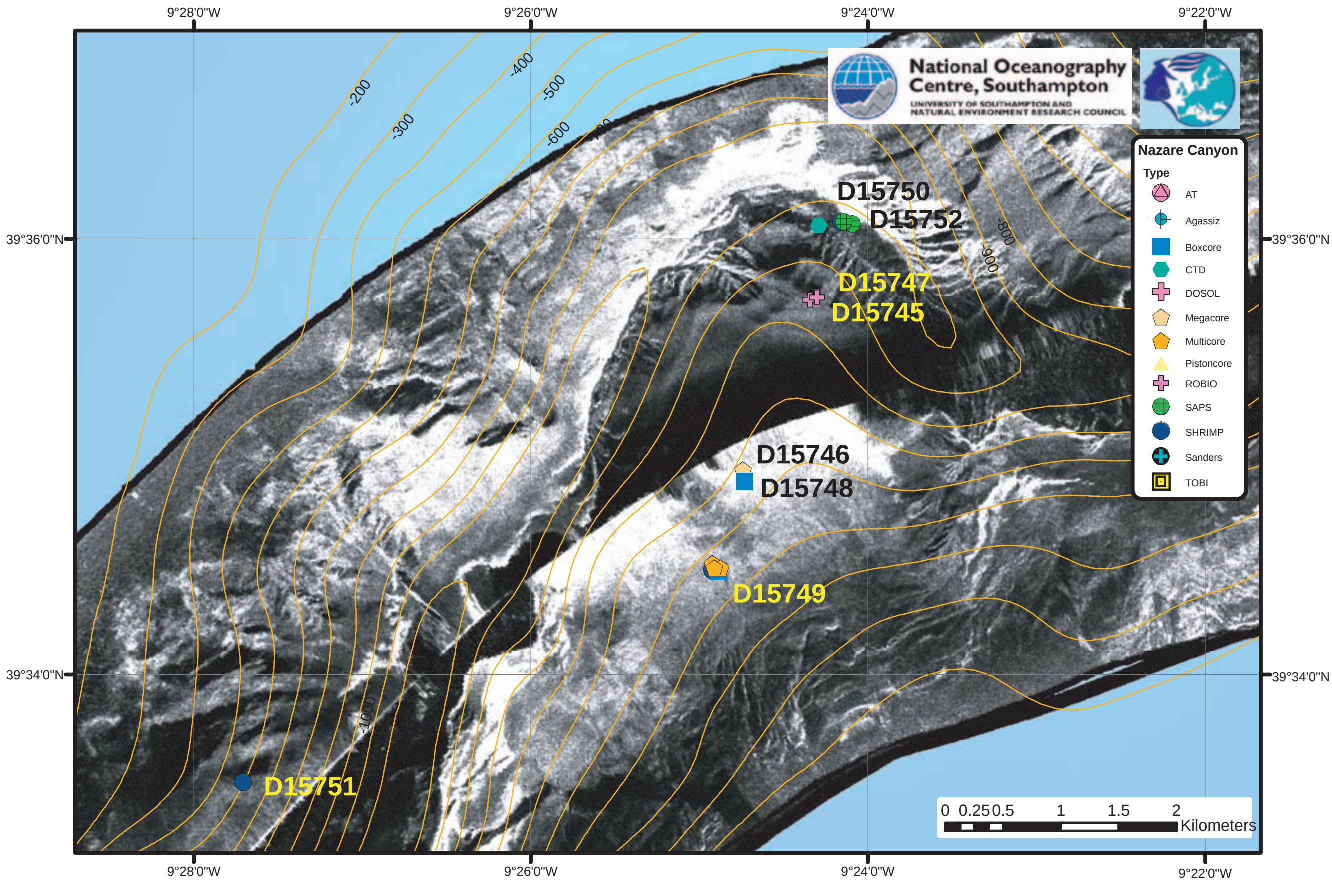

Figure 7. Location of stations on the TOBI sidescan image at the 900m location in the Nazare Canyon.

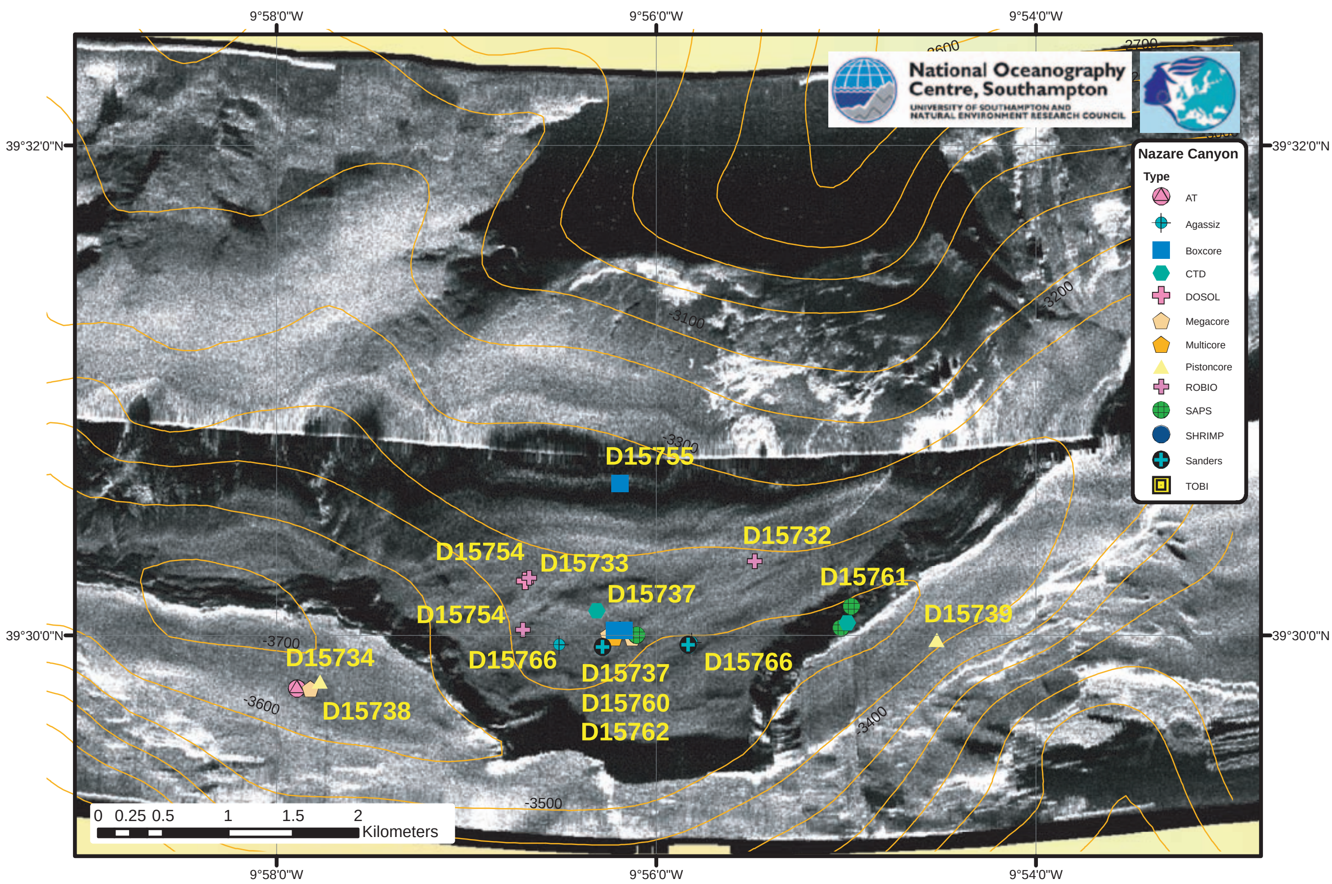

Figure 8. Location of stations on the TOBI sidescan image at the 3400m location in the Nazare Canyon

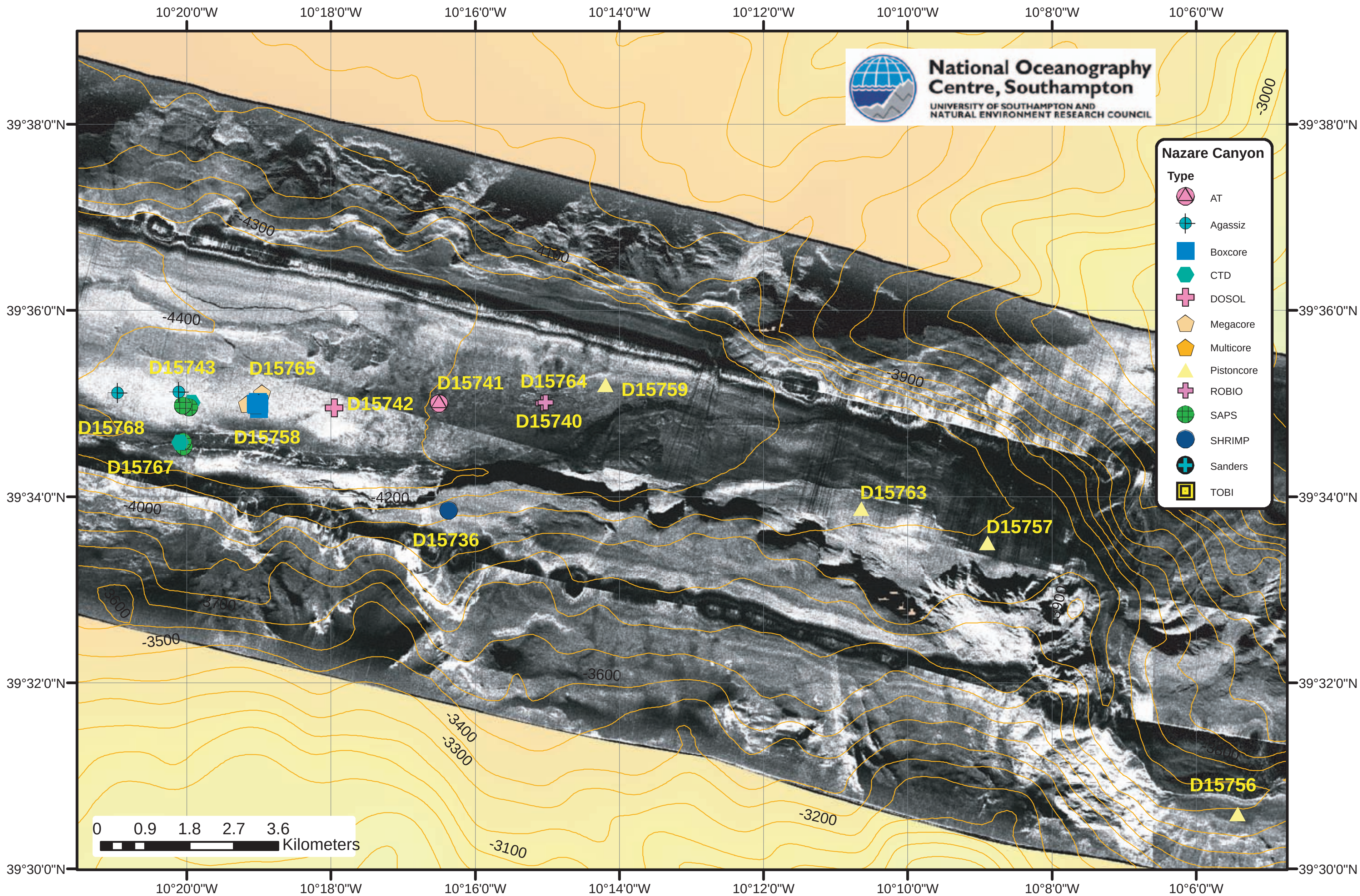

Figure 9. Location of stations on the TOBI sidescan image at the 4300m location in the Nazare Canyon