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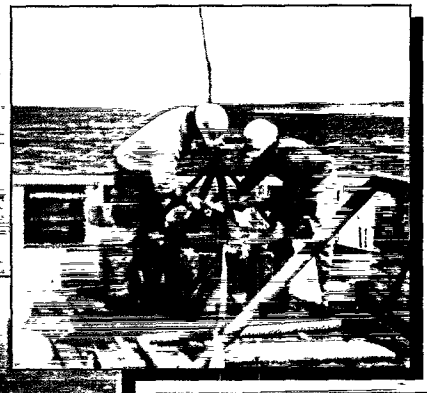
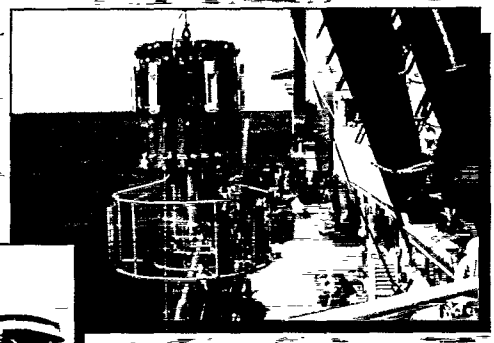
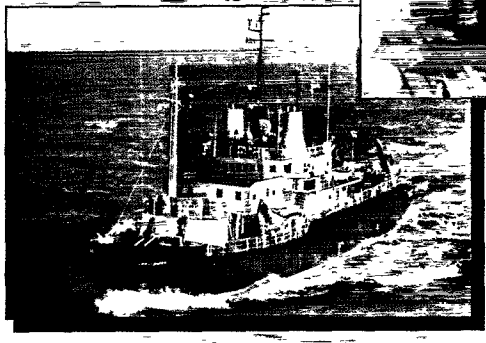
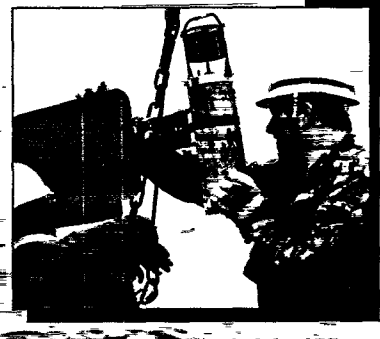
Cruise Report









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SOUTHAMPTON OCEANOGRAPHY CENTRE

CRUISE REPORT No. 18

RRS *DISCOVERY* CRUISE 231
28 FEB - 30 MAR 1998

BENGAL
High resolution temporal and spatial study of the
BENthic biology and Geochemistry of a
north-eastern Atlantic abyssal Locality

Principal Scientist
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1998

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ABSTRACT

Discovery Cruise 231 was the fifth of a series of cruises within a 3-year contract (MAS3 CT950018), BENGAL, funded under the MAST III programme of the EU and running from February 1996 to January 1999. The overall objective of the contract is to monitor the influence of the seasonal sedimentation of phytodetritus on the benthic biology and chemistry of a study site on the Porcupine Abyssal Plain.

Like the second BENGAL cruise (*Discovery* 226, March/April 1997) cruise 231 was timed to precede the current year's input of phytodetritus expected in May/June. The intention was to obtain a series of samples and data to compare with those taken during cruise 226 and to service deployed moorings. The cruise generally experienced good weather and, with the exception of some gear failures, was very successful, achieving almost all of the intended sampling.

KEYWORDS

BENGAL, BENTHIC COMMUNITIES, BIOTURBATION, BOTTOM PHOTOGRAPHY, CORING, CRUISE 231 1998, CURRENT METERS, DETRITUS, *DISCOVERY*, LANDERS, MICROBIOLOGY, NORTHEAST ATLANTIC, RESPIROMETRY, SEDIMENT GEOCHEMISTRY, SEDIMENT TRAPS, TRAWLING, WATER SAMPLING

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Depart work area 1309 Friday 27 March

Arrive Southampton 0930 Monday 30 March

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INTRODUCTION

Discovery cruise 231 was the fifth in a series of cruises within a 3-year contract, BENGAL, funded under the MAST III programme of the EU. The overall objective of BENGAL is to understand how the physics, chemistry and biology of the abyssal benthic boundary layer respond to, and modify, the incoming chemical signal from the overlying water column and thus affect the palaeoceanographic record in the underlying sediments.

The chosen study area, centred on 48° 50'N, 16° 30'W on the Porcupine Abyssal Plain and at a depth of about 4850m, was known to be affected by a regular seasonal deposition of phytodetritus, normally arriving in May-June each year. The BENGAL programme therefore aimed to follow the temporal changes associated with this phenomenon with a series of cruises within a 12 month period between March 1997 and March 1998. The first BENGAL cruise (*Discovery* 222 in August-September 1996) was a lead-in to the main series for the servicing of long-term moorings and the development of techniques. This was followed by *Discovery* cruise 226 in March-April 1997 and *Discovery* cruise 229 in July 1997 (see SOC Cruise Reports 13 and 15). A planned cruise on the French research vessel *l'Atalante* in September 1997 was cancelled because of a seamen's strike and was replaced by a short cruise on RRS *Challenger* in October 1997.

The original expectation of cruise 231 was that it should obtain samples and data for comparison with those taken on 222 and to complete the series of observations on the effects of the 1997 phytodetrital deposition. However, by autumn 1997 it was clear that the phytodetrital drop that year had been either very light or unusually late, probably the former (see cruise report 15 and the BENGAL second annual report). Accordingly, an extra short BENGAL cruise on *Discovery* was organised for October 1998 in addition to the already arranged opportunity to undertake some BENGAL work on FS *Meteor* in July and on *Discovery* cruise 235 in August-September (within the MAST III ALIPOR programme). The mooring objectives of cruise 231 were therefore the deployment of sediment traps, Bathysnap and MAP to record the phytodetrital drop in 1998 and to be recovered later in the year.

SPECIFIC OBJECTIVES

1. To recover long term moorings deployed on *Discovery* 229 in July 1997:
   a) SOC sediment traps, 13200#96
   b) Bathysnap, 13200#95
2. To operate short-term (intra-cruise) moorings:
   a) Goteborg lander (up to 6 deployments)
   b) BIOFEED, one deployment
   c) Moored stand alone pumping system (SAPS), one deployment

d) Amphipod traps (DEMAR), up to four deployments.

3. To deploy long-term (inter cruise) moorings:
   a) SOC sediment traps
   b) Bathysnap
   c) MAP
   d) MAC

4. To operate a variety of seabed samplers:
   a) Multiple corer, about 15 good deployments
   b) Box corer, about 6 good deployments
   c) Kasten corer, one good (2m) deployment
   d) Seafloor profiling instrument (SPI) on 5 occasions.

5. To operate a variety of towed gears:
   a) Semi-balloon otter trawl, 4 deployments within the BENGAL area, 2 outside it.
   b) Beam trawl (Chalut a perche), 4 deployments.
   c) Wide angle seabed photography system (WASP), 4 deployments.
   d) Epibenthic sledge, 2 deployments.

6. Several CTD/rosette multisampler deployments for water column data and water collection.

NARRATIVE

The vessel sailed from Southampton at 0900Z Saturday 28 February into moderate to strong northwesterly to southwesterly winds.

Monday 2 March

On the previous cruise, the trawling wire had parted at a tension of only 4.5 tonnes while being used for a NIOZ box corer deployment. Since this had indicated that the outboard end of the wire had seriously deteriorated, some 2000m had been removed during the port call and a section of the new end had been sent away for testing. The results of the test were received on Monday, indicating that this section parted at 10.5 tonnes, more than 2 tonnes less than the breaking strain of an equivalent new wire, but deemed to be adequate for the trawling expected to be undertaken during this cruise.

The PES fish had been deployed pm 1 March and, after an uneventful passage, the ship arrived at the work area at 2345/2.

Tuesday 3 March

A shallow CTD (Station 13368#1), to collect water for microbiology, was completed by 0025/3 and was followed by a full depth CTD (13368#2) for near-bottom water and for

wire tests for the Goteborg lander and the BIOFEED rig. A false start was corrected by the removal of a faulty swivel. The fluorescence and oxygen readings were erroneous from the start. Finally, at a depth of about 500m all sensor signals apart from pressure went haywire. The cast was nevertheless completed by 0535 with the wire test of releases and near-bottom water collection objectives having been achieved.

The ship now moved to a proposed MAC position (that of a previous MAC, 13200#5) but with daylight it was clear that the heavy swell from the south west was unfavourable for mooring deployments. The vessel therefore returned to the centre position for a multi-corer cast (#3) which was completed by 1230. The 12 cores were used for meiofaunal work but were too disturbed for full chemistry treatment. In the last hour of this cast the wind had veered from southwesterly to northeasterly, as forecast. In the hope that this might result in improved sea conditions, if only temporarily, a second multi-corer cast (#4), again at the centre position, was completed by 1648, and resulted in 12 excellent cores. A third multiple corer cast (#5), again at the centre position and this time for subsampling by IFREMER for meiofauna, was completed successfully by 2208/3.

Wednesday 4 March

The faulty CTD had been replaced by a spare instrument and was employed for a full depth cast (#6), also to collect near-bottom water and for wire tests of releases and the epibenthic sledge monitor, completed by 0310/4.

In deteriorating conditions, with winds fairly consistently at gale force and backing to the northwest, a multiple corer cast (#7) was successfully completed at the centre station by 0705/4, but by this time the sea state was such that no further work could be contemplated until the weather improved significantly. The vessel accordingly hove to.

By late afternoon, conditions had improved sufficiently to contemplate deploying the MAC, MAP and Goteborg landers, removing the first two from the afterdeck being a pre-requisite of any towed gear operations. Accordingly the vessel made for an earlier MAC position at c48°55'N 16°28'W and the gear was deployed successfully at 2008/4 (#8). This was followed by the deployment of the MAP lander (#9) some 2nm to the north east at 2135, and the Goteborg lander (#10) a further 2nm to the northeast at 2328. The lander sank rather slowly, not reaching the bottom until 0236/5.

Thursday 5 March

With conditions still just about acceptable for the BIOFEED deployment, but with the wind rising, a multiple corer cast at the centre position (#11) was completed by 0615. The resulting excellent cores were used to prepare the BIOFEED experiment and the rig was deployed (#12) with some difficulty at 0751. During the deployment two of the four bridles parted, leaving the frame canted during its descent. Nevertheless, when it bottomed out at

0955 interrogation of the release indicated that it was standing square and upright on the seabed.

The difficulty experienced during the BIOFEED launch prompted a re-evaluation of the use of safety harnesses on the after deck in all operations in which the after rail is removed, and during the following day attachment points and wires were fitted on the deck for this purpose.

By the completion of the BIOFEED deployment the weather conditions had once more deteriorated to a point where further work was impossible and the vessel was hove to awaiting an improvement.

Friday 6 March

By 0700 the ship had moved some 25 nm southwest of the centre position with the wind still a firm force 8 from the southwest. Although the forecast was still not good, the ship returned to the Goteborg lander position to check its condition. In the swell it took until 1500 to reach the lander which, however, responded satisfactorily. The ship then moved some 8nm to the west, to the position of the Swedish lander lost on *Discovery* 226 (13077#5). Despite repeated attempts to interrogate the lander, no response could be elicited.

The wind having dropped marginally, the ship now made for the centre station for another deep CTD cast. However, in the prevailing strong southwesterly winds the ship first made to the east with the intention of approaching the central position from the north east. The first section of this dog leg took the vessel to the south of the new Goteborg lander position (#10) deployed shortly before midnight on Wednesday. During this period the Goteborg team continued to blast the lost lander with its release frequency in the forlorn hope that they might still release it. Shortly before the course change on the dog leg, at about 2005 two firm ranges were obtained and shortly thereafter a pinger signal suggesting that lander had, indeed, been released. A short period of confusion and subdued elation quickly gave way to despair when it was realised that the new lander had been fitted with a MORS release with the same codes as the lost one! It was clearly the new lander which had been released. Shortly after the ship turned to retrace its course to rendezvous with the lander, good radio signals were received from it indicating that it was already on the surface. Visual contact with its flashing beacon was made shortly after 2100.

Saturday 7 March

Unable to contemplate recovering the lander in the prevailing conditions, the ship stood by it through the night while it drifted on a roughly easterly course at a little over 1 knot.

Having now fairly accurately determined the lander's speed and direction, due presumably mainly to surface currents rather than wind drag, a deep CTD (#13) was

undertaken with the intention of returning to the lander after its completion if conditions had improved sufficiently. Although the wind speed decreased a little during the cast, which was completed at 1310, the swell was still far too large to recover the lander, though there seemed to be a possibility that a brief weather window might permit recovery early the following day.

Accordingly, the vessel dog-legged back to the centre position, arriving at about 1815, in order to obtain a further multiple corer sample. This cast (#14) was completed at 2208/7 but the cores were disturbed and only two were used.

Sunday 8 March

A second multiple corer cast at the centre position (#15) was deployed at 2315/7 and completed at 0245 with seven usable cores but with several tubes empty.

The ship now moved towards the predicted position of the lander based on its known movements since its release. An Argos position was received during this passage, radio contact was made at about 0615 and visual contact at 0630. Its position when located was 48° 58.3'N 15° 32.9'W, some 25 nm from its deployment position and 38nm from the centre position. The weather had improved significantly, the wind having fallen to less than 20 knots, though a considerable swell was still running. However, there was little alternative but to pick it up. On close inspection, the lazy line float had disappeared, the knot securing it having come adrift, and the line was tangled around the buoyancy. A pole hook attached to a lifting strop was therefore inserted into the ring on the top of the lander frame and it was lifted aboard over the starboard side using the crane in the quarter. During this operation the lander buoyancy package struck the rail during a roll causing some minor damage to two of the syntactic foam blocks and shearing some bolts on the frame, but otherwise the lander was retrieved at 0848 without mishap.

After the lander was partially dismantled and secured the ship returned to the centre position, arriving at about 1400.

Two unsuccessful box corer deployments (#16 and 17) were followed by a SPI cast begun at 23280/8 (#18).

Monday 9 March

SPI was recovered at 0715/9 but was found not to have operated correctly. By now the wind had fallen very significantly, leaving a long, low swell from the southwest.

After returning to the centre position a multiple corer cast (#19) was completed at 1130. As the corer was being lifted out of the water, a roll brought the corer's feet against the ship's side in the gap at the foot of the bulwark. The lip of one of the feet caught under the bulwark as the corer was being lifted, shearing the securing bolt at the top of the leg and

severely bending one of the cross struts. The 12 excellent cores, however, remained undisturbed.

A box core (#20) at the central position was completed at 1600, but with a short and disturbed sample. A second cast (#21), this time with the stops removed, was completed at 2042. It produced a deeper sample, but again disturbed and with evidence of a double bite. For the next box core cast it was decided to have a stop at an intermediate level.

The Goteborg lander was now prepared for deployment and was eventually launched some 6 miles to the east of the central position at 2344 (#22) and watched down for about 30 minutes.

Tuesday 10 March

The trawling warp having been installed, the ship now moved north to a position ten miles downwind of the centre position for an OTSB haul (#23). The gear was all away at 0120, was estimated to have been on the bottom from about 0600 until 0910 and reached the surface in force 8 SW winds and a heavy swell at 1300. The sweeps were badly twisted and the doors locked. The moderate catch was nevertheless landed successfully at 1335. The problem was diagnosed as a jammed swivel at one of the doors and this was replaced for the next haul.

Under the deteriorating weather the vessel moved to the sediment trap position to the northwest of the centre position, with the intention of recovering the mooring whenever conditions permitted. Continuing force 7/8 winds, veering to the northwest and expected to go further north, made recovery of the sediment traps impossible. The vessel therefore moved to a position to the south of the centre for a trawl haul towards the north and west, but by 2200 it was clear that conditions were not good enough for this and work was abandoned until the following morning.

Wednesday 11 March

By 0700/11 conditions were improving significantly, though there were still force 6/7 winds from the northwest. It was eventually possible to shoot the trawl (#24) at 1145 and land it at 0008/12, this time with no problems. It was estimated to have been on the bottom from 1639 to 1947 and had taken a good, clean catch.

Thursday 12 March

The ship now moved to the position of the Goteborg lander to release it into early light. It was released at 0640, reached the surface at 0750 and was landed at 0843. The pick up was rather difficult because of the remaining heavy swell and the absence of handling lines on the rig. It was nevertheless recovered without damage.

The vessel now moved to the long-term sediment trap mooring (13200#96) laid on *Discovery* 229. It was released at 1100 and recovered without significant difficulty by 1511. On initial appraisal all three current meters and traps appear to have operated correctly.

In ever improving conditions, and with the ship now in a high pressure region expected to remain stationary for some time, the Bathysnap mooring (13200#95) also deployed on 229, was recovered without difficulty at 1645. It also seems to have worked satisfactorily.

With the expectation of a continuation of the good weather, the ship returned to the centre position for vertical wire work and the trawling wire was replaced by the coring wire.

Friday March 13!

The failure to take acceptable box cores had been attributed partly to unsuitable weather, but also to the inflexibility of the particular instrument being used (the RVS "stainless steel" corer). With its stops fitted, this corer took shallow (c30cm) cores which leaked or, without the stops, deep cores but with the surface disturbed. Accordingly, the "yellow" corer, with stops in an intermediate position, was used for the next deployment. It seemed to confirm this interpretation and an acceptable sample (# 25) was obtained at 0005/13. (Subsequent deployments with this corer consistently produced deep cores with no leakage, but often disturbed surfaces probably from resuspended material entering the box through the baffles before closure on recovery.)

This was followed by a successful multi-core drop (#26) completed at 0412 and a further box core drop (#27) by 0412, but this time again producing a somewhat disturbed sample which was therefore used only for biomass. Another successful multi-core drop (#28) was again followed by an unacceptable box core (#29), completed at 1637, this time with a large ophiuroid on the surface but some disturbance.

The vessel now moved some three miles to the southeast of the central position for the deployment of the Goteborg lander (#30) at 1740 in near ideal conditions.

After returning to the central position, a WASP deployment (#31) was abandoned with 4040 mwo when all signals were lost at 2143. Here endeth the 13th!

Saturday March 14

In good and improving conditions, a determined effort was now made to obtain good box cores at the centre position. A series of six box core deployments (#32-36) was completed by 1905. The first (#32) failed to fire because the retractor pin had jammed and, of the remainder, only #33 was deemed acceptable.

The day was completed by a good multiple corer cast (#37) completed at 2348.

Sunday March 15

A shallow CTD (#38) was followed by a box corer cast (#39) completed by 0440. A successful multiple corer (#40) was followed by a further series of four box cores (#41-44) completed by 0108/15. The last two of these produced good cores resulting in a total of 7 acceptable ones. In the meantime, between series 41 and 42 the Goteborg lander was released at 1330 and safely recovered at 1530/14.

Monday March 16

Since the lander had failed to retrieve any cores, the vessel now moved to the position where it had been deployed for a multiple corer cast (#45) which was completed by 0655 with good cores.

After returning to the centre position a Kasten corer cast (#46) was completed at 1050 but the core tube had been overfilled.

The wires were now changed over and in light southeasterly winds a beam trawl haul (#47) was begun at 1615 and completed by 0133/17. It was estimated to have fished from 1933 to 2026/16 and produced a moderate but clean catch.

Tuesday 17 March

A further beam trawl haul (#48) was shot at 0406/17 and landed at 1430, again with a very clean catch, this time considerably larger than the first.

The ship now moved to the next Goteborg lander deployment locality to the south of the centre position and the lander was deployed at 1620 (#49).

After watching the lander's descent for forty minutes the ship now moved to the northwest for an OTSB haul to the southeast (#50).

Wednesday 18 March

The trawl was recovered at 0620/18 with a good clean catch. A second trawl (#51), over a similar track, was completed at 2230, again with a clean catch.

Thursday 19 March

The beam trawl (#52) was shot at 0206, again into southeasterly winds, now freshening. The net was landed at 1345 with yet another good, clean catch.

A second beam trawl haul (#53) was begun at 1628 and completed at 0415/20.

Friday 20 March

With the intention of retrieving the lander (#49) in the morning, a CTD cast was now undertaken to collect bottom water and for a wire test of the remaining releases to be used. This cast (#54) was completed at 0920 but none of the bottles had closed.

The ship now made for the lander position and it was released at 1227. It surfaced at 1328 and was landed at 1400.

The vessel now moved to the old sediment trap mooring position for its replacement (#55). This was completed at 1937 in a sounding of 4693ucm, that is about 100m shallower than its predecessor.

Having now completed all of the intended trawl hauls with the exception of two OTSB hauls to be made away from the main work site, the wires were switched during the sediment trap deployment in preparation for more vertical deployments. However, as the day wore on it became clear that the problems with the SPI and WASP systems would not be resolved for some time. Consequently, apart from the second required Kasten core sample, no gear was ready for deployment on the coring cable. Accordingly, the ship undertook a zig-zag track to the east overnight to undertake an echo-sounding survey in preparation for the offsite trawls, returning to a position for the final lander deployment to the north and west of the centre position.

Saturday 21 March

The lander (#56) was deployed at 1537 and watched partly down. The ship now moved downwind three quarters of a mile for a multi core sample (#57) for the lander team. The corer was retrieved with reasonable cores at 2002, having suffered a delay of almost half an hour when the coring wire jumped a sheave. The ship then returned to the centre position for the second Kasten core (#58), this time with half the weights removed to attempt to decrease the penetration.

Sunday 22 March

The Kasten core was retrieved at 0047/22 with an excellent core of which only the top few centimetres was missing.

A SPI deployment (#59) was commenced at 0134 and completed at 0757, having again suffered a winch stoppage of 40 minutes due to a sheave-jumping wire during hauling. The camera had apparently worked correctly but the flash had failed due to leakage (see gear report).

With a faulty SPI, and with WASP still not deployable, the ship now moved to a start position for an OTSB haul to the southeast, centred about 25 nm to the east of the main station, the wires being changed over during this passage.

The trawl deployment (13369#1) commenced at 1138 but had to be aborted because of the inability of the winch to pay out wire. The gear was eventually launched at 1427 and was brought inboard at 0221/23 with a good clean catch.

Monday 23 March

A second "off-site" trawl (13369#2), along more or less the same track as the previous one, was shot at 0658 and landed at 1912 with another clean catch.

The ship now returned to the neighbourhood of the Goteborg lander to deploy the moored SAPS rig in preparation for the recovery of both the lander and the SAPS the following morning.

Tuesday 24 March

The SAPS deployment (13370#1) was outboard at 0130 and was watched part way down. The vessel now moved clear of this position for a CTD (#2) which, with one minor hiccup because no pinger was attached to it initially (and with no altimeter), was completed at 0652.

The SAPS rig was released at 0730, sighted at 0900 and was all inboard by 0936.

The lander (13368#56) was released at 1030, sighted at 1133 and inboard at 1200.

With SPI and WASP still not operational, the sledge was rigged with the digital video camera and, after some delay, was eventually shot at 1600 (13370#3). It was on the bottom from 1915 until about 2145 shortly after which the weak link parted and the sledge turned upside down. It was nevertheless landed with little difficulty at 0034/25. It had taken a rather small catch and the still camera had failed to work, but the video camera had operated correctly for an hour on the bottom and had obtained good images, though frequently obscured by the bow wave of mud ahead of the gear.

Wednesday 25 March

The ship now moved to the BIOFEED position (13368#12) and the mooring was released at 0600. It was sighted on the surface at 0800 and was successfully taken on board at 0900. The cores were relatively intact and the gear had clearly operated correctly despite the presence of only two bridles.

The vessel now moved to the position of the 13368#49 lander deployment to obtain a multicore sample. This cast (13370#4) was shot at 1325, but at 1445, with 3500mwo it was stopped and hauled in because of a distress call. At 1518, now with 1730mwo, the call was found to be a false alarm and paying out was resumed. The gear was eventually landed at 1752 with 12 good cores.

SPI was now deemed to be operational and was accordingly deployed at the central position (13370#5) from 1940/25 to 0325/26. Of 55 photograph attempts, the gear had obtained 24 good ones and a small number of less acceptable ones.

Thursday 26 March

With the wind now gusting to 35 kts, a final multiple core sample (13370#6) was taken at the central position and completed at 0800. Good samples were obtained despite the considerable seas.

A CTD (13370#7) was begun at 0910. At 1003, with 1437mwo, the cast was aborted, again because of a distress call. Although this one turned out to be genuine, a man overboard from a vessel some 90 miles from *Discovery*, our assistance was not required.

With some 30 hours left before the cut-off time of 1600/27 the hope was now that two sledge hauls with the video and still cameras, but with no net attached, could be completed, together with the Bathysnap deployment, before our departure. This, however, turned out to be doomed to failure.

The first two attempts at launching the sledge were aborted because the c2 tonne weak link parted after less than 100 metres had been paid out and the sledge had to be landed backwards. The cause was deemed to be the heave of the ship in the heavy swell, although the southwesterly winds were no more than force 7. Accordingly, for a third attempt the link was replaced by a 3 tonne one, still less than the SWL of the downgraded main warp. This time, two attempts to lower the gear both ended with only a few tens of metres of wire out, this time because the gear turned over. Finally, at 1715 the sledge was brought inboard and a plastic bread tray and small glass sphere were attached to the upper back bar to act as a drogue. At 1941, more than five hours after the initial attempt, the gear was shot and stayed upright during the initial pay out. However, with less than 100mwo this haul also had to be aborted when the pinger signal ceased. On recovery it transpired that during the various deployments and landings in rising seas the sledge had received some significant bashes against the ship's stern. Presumably these had also loosened the monitor end cap resulting in the tube flooding. The damage was not as serious as initially thought, but despite gallant efforts by Ian Waddington and Alan Taylor, by 2200 it was clear that the instrument could not be used on this cruise and the sledge was aborted. The vessel therefore moved slowly towards the previous Bathysnap position for a replacement deployment and final CTD the following morning.

Friday 27 March

By breakfast time the wind had risen to forty knots and a high sea was running. Nevertheless, the Bathysnap rig (13370#8) was deployed successfully at 1106 and reached the bottom shortly after 1300. In deteriorating conditions the proposed CTD was abandoned and the ship left the worksite for Southampton at 1309/27.

Saturday 28 to Monday 30 March

The weather improved markedly overnight 27/28 and a good passage was made in a long, low following sea. After a very social weekend, the ship was alongside at Empress Dock, Southampton at 0930 on Monday 30.

Epilogue

This was, in general, a very successful cruise. Despite some bad weather at the beginning and towards the end, some lost scientific time due to winch problems and malfunctions of gear, the vast majority of the objectives were achieved. The major exceptions were the continued failure of WASP, following a long and dishonourable tradition, the very limited success with SPI, and the regrettable failure to fish the epibenthic sledge with the digital video camera for a second time.

As my last cruise, I was delighted that it was so hassle-free. It is therefore a pleasure to record my thanks to all on board, ship's company, scientists and technicians, for their willing help, hard work, and pleasant company.

GEAR REPORTS

SOC Sediment trap array

Recovery of sediment trap array deployed as station 13200#96

The rig was released at 11:00 on 12 March 1998; the first buoyancy surfaced at 11:15 and the recovery began at 12:36 and was completed by 15:11.

All three current meters (TOP s/n 8240, MID s/n 8248, BOT s/n 9904) appeared to be in good condition and their data were successfully downloaded onboard ship.

The data downloaded from the sediment trap loggers were as follows:

```
dy229-trapa-1000mS/N 520#01
     07/27/97 12:00:19 21.5 Vb 7.9 Vr 6.1 C Rotor aligned
     07/27/97 12:00:56 20.9 Vb 7.9 Vr 6.1 C Rotor aligned
#02  08/10/97 12:00:16 21.0 Vb 7.9 Vr 7.0 C Rotor aligned
     08/10/97 12:00:53 20.5 Vb 7.9 Vr 7.0 C Rotor aligned
#03  08/24/97 12:00:13 20.8 Vb 7.9 Vr 7.0 C Rotor aligned
     08/24/97 12:00:50 20.3 Vb 7.9 Vr 7.0 C Rotor aligned
#04  09/07/97 12:00:10 20.5 Vb 7.9 Vr 5.7 C Rotor aligned
     09/07/97 12:00:47 19.8 Vb 7.9 Vr 5.7 C Rotor aligned
#05  09/21/97 12:00:07 20.3 Vb 7.9 Vr 5.3 C Rotor aligned
     09/21/97 12:00:44 19.6 Vb 7.9 Vr 5.3 C Rotor aligned
#06  10/05/97 12:00:04 20.3 Vb 7.9 Vr 6.6 C Rotor aligned
     10/05/97 12:00:41 19.6 Vb 7.9 Vr 6.6 C Rotor aligned
#07  10/19/97 12:00:32 20.2 Vb 7.9 Vr 6.6 C Rotor aligned
     10/19/97 12:01:09 19.4 Vb 7.9 Vr 6.6 C Rotor aligned
#08  11/16/97 12:00:18 20.1 Vb 8.0 Vr 7.0 C Rotor aligned
     11/16/97 12:00:55 19.2 Vb 7.9 Vr 7.4 C Rotor aligned
#09  12/07/97 12:00:25 20.0 Vb 8.0 Vr 6.6 C Rotor aligned
     12/07/97 12:01:02 19.0 Vb 7.9 Vr 6.6 C Rotor aligned
#10  12/28/97 12:00:32 19.8 Vb 7.9 Vr 7.4 C Rotor aligned
     12/28/97 12:01:09 18.9 Vb 7.9 Vr 7.4 C Rotor aligned
#11  01/25/98 12:00:18 19.7 Vb 7.9 Vr 7.4 C Rotor aligned
     01/25/98 12:00:55 18.8 Vb 7.9 Vr 7.0 C Rotor aligned
#12  02/22/98 12:00:04 19.6 Vb 7.9 Vr 6.6 C Rotor aligned
     02/22/98 12:00:41 18.4 Vb 7.9 Vr 6.6 C Rotor aligned
#13  03/08/98 12:00:32 19.5 Vb 7.9 Vr 6.6 C Rotor aligned
     03/08/98 12:01:09 18.5 Vb 7.9 Vr 6.6 C Rotor aligned

trapB-dy229-middle-3000mS/N 532
#01  07/27/97 12:00:22 21.5 Vb 8.0 Vr 1.0 C Rotor aligned
     07/27/97 12:00:59 20.8 Vb 8.1 Vr 1.4 C Rotor aligned
#02  08/10/97 12:00:19 21.4 Vb 8.0 Vr 1.4 C Rotor aligned
     08/10/97 12:00:56 20.7 Vb 8.0 Vr 1.4 C Rotor aligned
#03  08/24/97 12:00:16 21.2 Vb 8.0 Vr 1.0 C Rotor aligned
     08/24/97 12:00:53 20.5 Vb 8.0 Vr 1.0 C Rotor aligned
#04  09/07/97 12:00:13 21.1 Vb 8.0 Vr 1.0 C Rotor aligned
     09/07/97 12:00:50 20.4 Vb 8.0 Vr 1.4 C Rotor aligned
#05  09/21/97 12:00:10 21.0 Vb 8.0 Vr 1.4 C Rotor aligned
     09/21/97 12:00:47 20.3 Vb 8.0 Vr 1.4 C Rotor aligned
#06  10/05/97 12:00:07 20.9 Vb 8.0 Vr 1.4 C Rotor aligned
     10/05/97 12:00:44 20.3 Vb 8.0 Vr 1.4 C Rotor aligned
#07  10/19/97 12:00:04 20.8 Vb 8.0 Vr 1.4 C Rotor aligned
     10/19/97 12:00:41 20.2 Vb 8.0 Vr 1.4 C Rotor aligned
#08  11/16/97 12:00:21 20.5 Vb 8.0 Vr 1.4 C Rotor aligned
     11/16/97 12:00:58 20.0 Vb 8.0 Vr 1.0 C Rotor aligned
#09  12/07/97 12:00:28 20.5 Vb 8.0 Vr 1.4 C Rotor aligned
```

```
    12/07/97 12:01:05 20.0 Vb 8.0 Vr 1.0 C Rotor aligned
#10 12/28/97 12:00:04 20.4 Vb 8.0 Vr 1.4 C Rotor aligned
    12/28/97 12:00:41 19.8 Vb 8.0 Vr 1.0 C Rotor aligned
#11 01/25/98 12:00:21 20.3 Vb 8.0 Vr 1.4 C Rotor aligned
    01/25/98 12:00:58 19.7 Vb 8.0 Vr 1.4 C Rotor aligned
#12 02/22/98 02:00:16 20.2 Vb 8.0 Vr 1.0 C Rotor aligned
    02/22/98 02:00:53 19.5 Vb 8.0 Vr 1.4 C Rotor aligned
#13 03/08/98 12:00:04 20.3 Vb 8.0 Vr 1.4 C Rotor aligned
    03/08/98 12:00:41 19.5 Vb 8.0 Vr 1.4 C Rotor aligned

dy229-trapC-bottom-100mabS/N 543
#01 07/27/97 12:00:21 21.5 Vb 8.0 Vr 1.4 C Rotor aligned
    07/27/97 12:00:58 20.5 Vb 8.0 Vr 1.0 C Rotor aligned
#02 08/10/97 12:00:18 21.2 Vb 8.0 Vr 1.0 C Rotor aligned
    08/10/97 12:00:54 20.5 Vb 8.0 Vr 1.0 C Rotor aligned
#03 08/24/97 12:00:14 21.1 Vb 8.0 Vr 1.0 C Rotor not aligned
    08/24/97 12:00:55 20.4 Vb 8.0 Vr 1.0 C Rotor not aligned
#04 09/07/97 12:00:15 21.1 Vb 8.0 Vr 0.5 C Rotor not aligned
    09/07/97 12:00:56 20.4 Vb 8.0 Vr 1.0 C Rotor not aligned
#05 09/21/97 12:00:16 21.0 Vb 8.0 Vr 1.0 C Rotor not aligned
    09/21/97 12:00:57 20.2 Vb 8.0 Vr 1.0 C Rotor not aligned
#06 10/05/97 12:00:17 20.9 Vb 8.0 Vr 1.0 C Rotor not aligned
    10/05/97 12:00:58 20.3 Vb 8.0 Vr 1.0 C Rotor not aligned
#07 10/19/97 12:00:18 20.9 Vb 8.0 Vr 1.0 C Rotor not aligned
    10/19/97 12:00:59 20.2 Vb 8.0 Vr 1.0 C Rotor not aligned
#08 11/16/97 12:00:08 20.5 Vb 8.0 Vr 1.0 C Rotor not aligned
    11/16/97 12:00:49 20.0 Vb 8.0 Vr 1.0 C Rotor not aligned
#09 12/07/97 12:00:19 20.5 Vb 8.0 Vr 1.4 C Rotor not aligned
    12/07/97 12:01:00 20.0 Vb 8.0 Vr 1.0 C Rotor not aligned
#10 12/28/97 12:00:30 20.4 Vb 8.0 Vr 1.0 C Rotor not aligned
    12/28/97 12:01:11 19.7 Vb 8.0 Vr 1.0 C Rotor not aligned
#11 01/25/98 12:00:20 20.3 Vb 8.0 Vr 1.0 C Rotor not aligned
    01/25/98 12:01:01 19.7 Vb 8.0 Vr 1.4 C Rotor not aligned
#12 02/22/98 12:00:10 20.2 Vb 7.9 Vr 1.0 C Rotor not aligned
    02/22/98 12:00:51 19.5 Vb 8.0 Vr 1.0 C Rotor not aligned
#13 03/08/98 12:00:11 20.3 Vb 8.0 Vr 1.4 C Rotor not aligned
    03/08/98 12:00:52 19.5 Vb 8.0 Vr 1.0 C Rotor not aligned
```

The samples from the TOP trap were processed on recovery; all bottles were correctly positioned and labelled. The pH of each sample was measured: pH 6 in bottles 1 to 8, and 13, and pH 6.5 in bottles 9 to 11. One millilitre of 40% aristar formaldehyde was added to each sample, and the samples were stored at approximately 4 °C.

The samples from the MID trap were processed in the same way after storage at approximately 4 °C for three hours. All bottles were correctly positioned and labelled. The pH values recorded were: pH 6 in bottles 1 to 9, 11 and 12, and pH 6.5 in bottles 10 and 13. (Note that bottle 13 was half-empty and had probably been completely drained by an inverted recovery).

The samples from the BOT trap were processed, as above, on recovery of the trap. All bottles were correctly positioned and labelled. The pH values recorded were: pH 6 in bottles 1 to 4, 6, 8 and 10 to 12, and pH 6.5 in bottles 5,7, 9 and 13.

Re-deployment of sediment trap array as station 13368#55

The recovered sediment trap rig was refurbished for deployment, including the replacement of all short rope lengths (<100 m) and some re-design to simplify recovery (see following diagram). Traps and baffles were thoroughly cleaned with decon and were kept covered until immediately prior to their re-deployment. Deep water (1500 m) was collected on Saturday 14 March 1998 during CTD cast 13368#37 and stored at 4 °C. Sediment trap preservative was made up, on Tuesday 17 March 1998, as follows: 100 g NaCl, 5 g borax, 1 l aristar 40% formaldehyde and 19 l of deep water. New sample bottles were engraved and labelled as follows:

TOP trap: XXIII-A-1 to XXIII-A-13
MID trap: XXIII-B-1 to XXIII-B-13
BOT trap: XXIII-C-1 to XXIII-C-13

Sample bottles were filled with preservative, mounted on the traps and topped up with a further addition of preservative.

The sediment traps were programmed as follows:

DY231 XX111 TrapA 1000m Mar98 - Sep98
Event 01 of 14 = 03/22/98 12:00:00
Event 02 of 14 = 04/05/98 12:00:00
Event 03 of 14 = 04/19/98 12:00:00
Event 04 of 14 = 05/03/98 12:00:00
Event 05 of 14 = 05/17/98 12:00:00
Event 06 of 14 = 05/31/98 12:00:00
Event 07 of 14 = 06/07/98 12:00:00
Event 08 of 14 = 06/21/98 12:00:00
Event 09 of 14 = 07/05/98 12:00:00
Event 10 of 14 = 07/19/98 12:00:00
Event 11 of 14 = 08/02/98 12:00:00
Event 12 of 14 = 08/16/98 12:00:00
Event 13 of 14 = 08/30/98 12:00:00
Event 14 of 14 = 09/13/98 12:00:00

DY231 XX111 TrapB 3000m Mar98-Sep98
Event 01 of 14 = 03/22/98 12:00:00
Event 02 of 14 = 04/05/98 12:00:00
Event 03 of 14 = 04/19/98 12:00:00
Event 04 of 14 = 05/03/98 12:00:00
Event 05 of 14 = 05/17/98 12:00:00
Event 06 of 14 = 05/31/98 12:00:00
Event 07 of 14 = 06/07/98 12:00:00
Event 08 of 14 = 06/21/98 12:00:00
Event 09 of 14 = 07/05/98 12:00:00

Event 10 of 14 = 07/19/98 12:00:00
Event 11 of 14 = 08/02/98 12:00:00
Event 12 of 14 = 08/16/98 12:00:00
Event 13 of 14 = 08/30/98 12:00:00
Event 14 of 14 = 09/13/98 12:00:00

dy229-trapC-bottom-100mab
Event 01 of 14 = 03/22/98 12:00:00
Event 02 of 14 = 04/05/98 12:00:00
Event 03 of 14 = 04/19/98 12:00:00
Event 04 of 14 = 05/03/98 12:00:00
Event 05 of 14 = 05/17/98 12:00:00
Event 06 of 14 = 05/31/98 12:00:00
Event 07 of 14 = 06/07/98 12:00:00
Event 08 of 14 = 06/21/98 12:00:00
Event 09 of 14 = 07/05/98 12:00:00
Event 10 of 14 = 07/19/98 12:00:00
Event 11 of 14 = 08/02/98 12:00:00
Event 12 of 14 = 08/16/98 12:00:00
Event 13 of 14 = 08/30/98 12:00:00
Event 14 of 14 = 09/13/98 12:00:00

Ian Waddington prepared the three RCM8 current meters. The TOP RCM is s/n 3308 and is equipped with a 0-3000 psi pressure sensor, the MID RCM is s/n 9440 and is equipped with a 0-8000 psi pressure sensor, the BOT RCM is s/n 9903 and is a standard unit. All three RCMs are set to sample at one-hour intervals and collected their first data at 15:00 on 4 March 1998 (J Day 63).

The rig was re-deployed on Friday 20 March 1998 starting at 17:16, with the rig cut away at 19:32. As each trap was deployed all bottles appeared to be well sealed with no leaks apparent. The mooring reached the bottom at 20:17 and the pinger was switched off at 20:20. The position of the rig at launch was 48°59.83'N, 16°13.73'W with a sounding of 4723m.

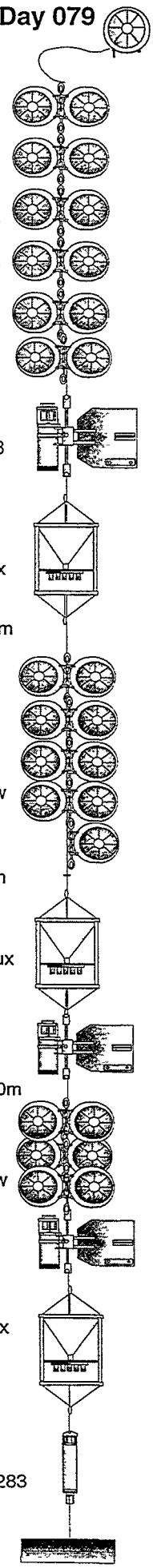
Recovery is intended on RRS *Discovery* cruise 236 in October 1998. The release details are as follows:

MORS RT661 B2S s/n 283
ON A562
PING A566
REL1 A561+A585
OFF A563

BRIAN BETT, IAN WADDINGTON, DAVE JOLLY

Mooring Deployed 20th March 1998 Day 079

Station 13368 55



1717 buoys o/board

Swivel

20m 14mm

20m 14mm

O/board 1720

3 x 474m
1x 377m

Swivel

1 x 100m 12mm Paraline

O/board 1816

1m 1/2" chain

300m
100m
400m
500m
300m

1.3m chain + swivel

50m 14mm

O/board 1855

2 x 20m 12mm Polyester

10m Nylon 16mm + 2 x 25m Polyester 12mm

Anchor away 1932 on bottom 2017 Good bottom echo

SedMrg98D1

WASP – Wide Angle Seabed Photography

The WASP system was as used on preceding BENGAL cruises (*Discovery* 222, 226 and 229) with the addition of a new digital video system, the Ocean Cam 6000 V jointly developed by SOC and the BBC Natural History Film Unit. WASP consists of a simple tow frame on which are mounted a variety of system components: altimeter, still camera, digital video camera, two 250W video lamps, acoustic monitor, three Deep-Sea Power and Light 24V batteries and a 1200J flash gun. WASP is operated from the starboard gantry of *Discovery* and towed near bottom with the ship towing or drifting the vehicle at around half a knot. With altimeter data telemetered via the acoustic monitor, WASP is fished close to the bottom by small adjustments of the metres of wire out in an attempt to maintain an altitude of 5 m.

For the first deployment (13368#31) WASP was set up with a 30 m load of Ilford HP5+ black and white film and the digital video system set on automatic for all functions other than focus which was manually adjusted to 3.75 m in air. Initial deck start-up tests suggested that the camera systems were operating correctly. Within ten minutes of deployment the acoustic telemetry suggested that the cameras were activating in mid-water. The acoustic record shows that the altimeter was frequently returning spurious data in the 0-10 m range and consequently the monitor was starting both the still and video cameras. One hour and twenty minutes in to the deployment all acoustic telemetry stopped abruptly and the deployment was immediately aborted with approximately 4040 metres of wire out.

On recovery the monitor was silent, but gave a brief ping as it was switched off. A normal clean start-up was then performed and all systems (monitor, cameras, lights and flashgun) operated normally. The still camera was found to have taken some 70 shots in mid-water and the videotape had just run out, having run almost continuously. By great fortune, the video does contain a brief sequence as WASP is hauled passed a specimen of the swimming sea cucumber *Peniagone*.

A series of deck tests were then run. 1. From a clean start-up the monitor started normally and the flash and video lamps powered up as normal, with the exception that there was one extra flash and the video stayed on for three minutes. After the start-up routine was completed there were occasional flashes and numerous video starts presumably resulting from spurious in-range altimeter data being received by the monitor. 2. With the altimeter disconnected and the power to the video removed the monitor was run for twelve hours continuously without apparent problem and negligible battery drain. 3. With the altimeter still disconnected but with power on the video the monitor was given a clean start and the flash and video lamps powered up as normal then remained off after the start up period. Clearly spurious altimeter data was responsible for the excessive mid-water camera operations. The

total loss of power on the monitor was most like a result of the switch being rotated too far initially, then working its way to the off position by itself.

The altimeter was tested in the laboratory by connecting it to a PC running a Windows terminal emulation. The altimeter was delivering apparently sensible data, but commands from the PC would not break in to the altimeter. As the monitor does not 'talk' to the altimeter this later problem would not influence WASP operations. In a rather vain hope that it might reduce potential interference problems the RS232 Rx line in the altimeter was disconnected and the incoming RS232 Tx was commoned to the 0 v line.

Two further deck tests were then carried out, one without power to the video and one with power to the video. In both cases there were considerable numbers of spurious altimeter returns that activated the cameras. It was clear that to deploy WASP in this condition would only serve to generate another hour of mid-water video. New WASP system software was e-mailed from Dave Edge at SOC to *Discovery*. The new software requires three consecutive altimeter returns in range before activating the cameras. Alan Taylor (RVS computer group) burned the new software in to the spare WASP EPROMS (intended for use in DE 1 mode). The EPROMS were fitted to the monitor and a laboratory test performed; the monitor cycled through the start-up sequence correctly and switched to an appropriate tune after start-up.

The monitor was refitted to the WASP vehicle and two deck tests performed; one with and one without power to the video. In both cases the star-up sequences occurred normally and the flash and video lamps then remained off. However, with the altimeter in a large water but both cameras were only infrequently activated. Observation of the waterfall display suggested that about 80% of altimeter returns were out of range. The altimeter was producing little more than random numbers. Without useful altimeter data, WASP would be impossible to fish and further deployments were cancelled.

BRIAN BETT

Bathysnap

Bathysnap is a free-fall time-lapse photography system deployed on a bottom-landing frame with a simple mooring arrangement above. Objectives for this cruise were to recover a Bathysnap deployed on RRS *Discovery* cruise 229 (July 1997) and to re-deploy the rig for intended recovery on RRS *Discovery* cruise 236 (October 1998).

Recovery of Bathysnap deployed as station 13200#95

The mooring was released at 14:48 on 12 March 1998 and surfaced at approximately 16:00. The rig was recovered to the ship without incident, the flash was seen to fire at approximately 16:30 during the final stage of the recovery. Flash fires were subsequently seen at 21:19/12, 06:55/13 and 11:43/13. On opening the camera an appropriate amount of film

(approximately 25 m) was found to have run through and all settings were as they should be. The current meter on the rig was down loaded aboard ship giving data for the entire deployed period, though the record becomes a little noisy towards the end of the deployment. Otherwise the various component parts of the rig appeared to be in good condition.

Redeployment of Bathysnap as station 13370#8

Ian Waddington refurbished the recovered mooring rig. The camera (P5A-04) was loaded with approximately 50 m of Kodak VISION 250D, focussed at 1.3 m, stopped to f8/11 and set to take 5 shots per day (module C switch 7). The databack date was good; though time was six minutes slow and could not be reset. The Bathysnap acoustic release unit (MORS OEM 2 pyro unit, s/n 332) was successfully tested on an early CTD deployment and has the following codes: ON A282, REL1 A281+A224, PYRO A281+A291, PING A294, OFF A223. Prior to deployment flash fires were seen at 20:27/26, 01:15/27, 06:03/27 and 10:51/27.

A current meter was prepared for deployment; however, large seas on the day of deployment suggested removal of the current meter to simplify the final lift and to reduce the risk of damage to the camera on launch. Bathysnap was deployed at 11:06 on 27 March 1998 at position 48° 59.73' N 16° 13.03' W, with a sounding of 4790 ucm. The rig sank at a rate of 40 m/min, somewhat slower than usual as a result of removing the current meter. Bathysnap landed on the seafloor at 13:06.

BRIAN BETT

SOC camera systems

Four SOC camera systems were employed during RRS *Discovery* cruise 231.

WASP vehicle

WASP was fitted with an OIL Mk7 camera mounted in the nose of the vehicle and an OIL 1200J flashgun mounted in the tail of the vehicle. Prior to the first deployment of WASP the Mk7 camera was set up under Forth control as follows:

```
FULL_FRAME
2 DE
300 P1_TOUT 1E!
STAT_OFF
IS      (item 6 changed to 15, i.e. to suit HP5+)
```

In normal camera control the frame count was zeroed, time and date were set correctly, external mode was selected, 10 second interval was selected, 1/30 shutter speed was selected, flash mode X was selected and film speed set to 400 asa. The camera was loaded with 30m of Ilford HP5+ film stock.

WASP was also fitted with the newly developed Ocean Cam 6000 V digital video system comprising a Sony DCR-VX1000E and a Video System Controller in a 6000m rated pressure case, two Deep Sea Power & Light video lamps (SL24/250, 60 degree narrow floods, 250W) and a Deep Sea Power & Light battery (24V, 38A). The video was mounted centrally in the vehicle looking vertically downwards, the lamps were mounted towards the ends of the vehicle and pointed directly downwards, the battery was fitted to the forward battery holder on the vehicle.

The video camera was set up as follows:

A SHUTTER ON
D ZOOM OFF
16:9 WIDE OFF
ZEBRA OFF
COMMANDER VTR4
HEADPHONE MID
BEEP ON
EVF MODE
FRAME REC OFF
INT REC OFF
SELF TIMER 10 SECS
CUSTOM OFF
CLOCK SET – date and time set correctly
AUTO LOCK ON
MANUAL FOCUS ON – focussed at 3.75 m
ZOOM TO FULL W
BATTERY REMOVED
CAMERA ON
STANDBY ON
VIDEO OUT LEAD IN
DC IN LEAD IN
LANC LEAD IN
DIP SWITCHES 1,7,8 ON, 2-6 OFF

WASP was deployed once (13368#31) and did not reach the seafloor before the monitor stopped and the deployment was aborted. On recovery the Mk7 camera was found to have taken some 70 shots, the film was discarded. The videotape had all but run out. The video contains a very short sequence of a swimming sea cucumber and so will be retained.

Epibenthic sledge

The epibenthic sledge was fitted with an IOS Mk4 camera as normal, and a new OIL 25J flashgun mounted in the standard position. The camera was loaded with 15 m of Ilford HP5+ and set up as per normal sledge deployments. The sledge was also fitted with the Ocean Cam 6000 V system as described above. The video housing and the battery were mounted

slung below the top bars of the sledge. The camera was faced downwards and outwards to look between the two starboard side bridles. One video lamp was mounted on the starboard front upright of the sledge and the other slung below the front top bar towards the port side.

The sledge was deployed once (13370#3). At launch the flashgun did not fire, this fault was subsequently traced to incorrect wiring for operation with the sledge camera; the two new 25J flashguns have now been modified to the correct wiring arrangement. Bench and deck tests with the re-wired flash guns indicate a significant number of spurious flashes this should be investigated prior to further deployment and may be linked to positive pulse triggering by the camera operated with a flash gun that only requires a short. Given the flash failure the film from the Mk4 camera was discarded. The videotape had run its full length on the seafloor and will be retained.

Bathysnap

Bathysnap is operated with an IOS Mk5 camera and flashgun. On recovery from deployment 13200#95 the flash was observed to fire at the expected times. On opening the camera an appropriate quantity of film had run through and all camera settings were correct. The film was removed and retained. The Bathysnap deployed as station 13370#8 used the same camera as that recovered though the flash was swapped for another with fresh batteries. The camera was loaded with Kodak VISION 250D an updated version of E5297 that has been used for Bathysnap operations in recent years, and set up in the normal manner to give a frame interval of five shots per day.

BRIAN BETT

Sediment Profile Imagery (SPI)

The principal objectives were to obtain sediment profile images from 5 different locations around the central PAP site. Comparison of small scale variability within site and between sites was to be undertaken with reference to differences in microtopography and quantifiable features such as presence or absence of burrow structures. The first deployment took place on the night of March 8th (13368#18) in 4810m of water (48° 49'53" N, 016° 30'07" W). The SPI machine received a heavy blow off the side of the ship prior to entering the water. This may or may not have resulted in damage which caused failure of the apparatus during attempted imaging. Subsequent diagnostics carried out with the help of J.P. Brulport, IFREMER and RVS engineers revealed a major shorting problem in the electronics which had destroyed the voltage regulator IC on the power distribution board. In addition, the boiler glass protecting the flash tube had leaked a small amount of water. Fortunately this was distilled and did not result in damage to the flash tube following drying out. Repairs were effected with the help of RVS engineers, Ian Waddington and Alan Taylor. A problem with

multiple triggering which had been cured prior to the cruise, resurfaced, and required a considerable effort from Alan Taylor to rectify. The SPI was deployed again on March 22nd (13368#59) in 4839 m of water. While the camera and electronics functioned normally, the flash assembly again leaked resulting in unusable images. Upon retrieval the flash assembly was stripped down and reassembled using oversized o-rings in an attempt to prevent subsequent leaks. The flash tube was replaced with a spare donated by Ian Waddington and at the suggestion of Swedish colleagues, Anders Tengberg and Hakan Millqvist, the flash assembly was re-engineered to facilitate filling with silicon oil. The SPI was deployed for a final time on March 25th (13370#5) in 4840m of water. The machine functioned normally during approximately two thirds of the deployment. Of 26 images taken on the bottom, a total of 24 were good revealing fine scale details of the sediment-water interface. The eventual failure of the machine was attributed to a broken flash tube. The camera and electronics were still in working order and the flash assembly had not leaked upon recovery.

While the primary scientific objectives were only partially realised during the cruise, considerable progress was made in ironing out remaining technical problems which should benefit the achievement of objectives during the remaining cruises of the programme. I would like to take this opportunity to express my sincere thanks to all of the above who contributed to the final successful deployment of the SPI, especially Alan Taylor for his patience.

ANTHONY GREHAN

MAC (Module Autonome de Colonisation)

During the previous BENGAL cruises, MAC experiments have been done in order to obtain data on recolonisation of an artificial substrate enriched with organic matter (fish flour) at different concentrations. Four deployments were planned to obtain a long-term experiment during winter (September 96-March 97), a short-term and a long-term experiment during spring-summer (March 97-July 97, March 97-September 97), and a short-term in summer (July 97-September 97). One of these deployments failed, we never recovered it (March 97-September 97). So, a long term spring-summer experiment was lacking and we hopefully will obtain this in 1998. The MAC was deployed on 04.03.98 (13368#8) and is scheduled for recovery in September-October on the next BENGAL cruise.

MAP (Module Autonome Pluridisciplinaire)

The MAP is a lander equipped with a MORS current meter (to measure pressure, temperature, current speed and direction), an IFREMER nephelometer (to measure light diffusion through particles in suspension), a of BENTHOS-MORS camera-flash system(to obtain pictures of the bottom), a TECHNICAP sequential sediment trap (to measure the material flux on the bottom), and two MORS releases. One MAP has already been deployed

during the Bengal programme: it was deployed in August 1996 (*Discovery* 222a) and recovered in October 1997 (*Challenger* 135). It was mostly successful despite obtaining no pictures because the camera was flooded. This absence of photographic data will hopefully be filled by this second mooring.

The MAP (13368#9) was deployed on 04.03.98 at 21H35. Hopefully it will be recovered during the next BENGAL cruise in September-October 1998.

PHILIPPE CRASSOUS, JEAN-PIERRE BRULPORT

Multiple corer

The multiple corer was deployed 15 times, 12 deployments at the central site and 3 at different lander sites (Table 1). It generally performed well, returning a total of 170 usable cores out of a possible maximum of 180. Final lowering speeds were usually 15m min^{-1}. In two cases the speed was adjusted to 12m min^{-1} (13368#40) or 17m min^{-1} (13370#6) in response to favourable or unfavourable sea conditions; both of these deployments yielded good cores. A number of problems was encountered. Two deployments (13368#3, 14) made when sea conditions were far from ideal yielded disturbed sets of cores. In a third case (13368#15), the cores were unusually short (<23cm) and two of the core catcher arms were pulled downwards and twisted through 90°. More seriously, the corer suffered fairly major damage during one recovery (13368#19) when the bottom of a leg caught on the gunwale, shearing the bolt at the top of one leg, distorting one side of the frame and bending a cross tie. The damage, the worst inflicted on this particular corer, was repaired with great efficiency by the RVS engineering team and coring operations continued normally.

The cores resembled those taken during previous cruises at the PAP site. As expected, there was no phytodetritus and the worm casts seen during Cruise 222 (September 1996) were not observed. Burrows, however, were sometimes present and xenophyophores made an appearance on four cores from different deployments. The cores themselves were generally 28-34 cm long and had a distinct discontinuity at about 24cm between darker brown sediment above and lighter brown below. At the central site this discontinuity occurred at the base of a poorly defined darker band 2-3cm thick. At the lander sites, the darker band was missing; instead, the sediment tended to become progressively darker down to the colour discontinuity.

Table 1. Multiple corer deployments.

Deployment	Usable	Length (cm)	Site	Remarks
13368#3	6	31-34	Central	Wire at angle; all cores disturbed;
13368#4	12	30-34	Central	Good cores with clear water; 1 xeno
13368#5	12	28-35	Central	Reasonable cores for meiofauna (IFREMER)
13368#7	12	30.5-35	Central	Clear water, some cracking, otherwise good; 1 xeno
13368#11	11	28-31	Central	All cores somewhat disturbed; 1 lost in CT lab; BIOFEED set
13368#14	12	29.5-34	Central	Heavy swell; all cores very disturbed; 3 used, rest dumped
13368#15	10	13-22	Central	2 arms twisted; cores short, 3 undisturbed, others cloudy water
13368#19	12	29.5-32	Central	Frame damaged on recovery; cores OK
13368#26	12	29.5-31.5	Central	Excellent undisturbed cores, no surface features
13368#28	12	30-32.5	Central	Excellent undisturbed cores, a few burrows and mudballs
13368#40	12	29.5-34	Central	Excellent undisturbed cores; 1 stone, 1 xeno
13368#45	12	28-32	Lander	Excellent cores, no surface features, Lander site 13368#30;
13368#57	11	24, 30-33	Lander	Somewhat disturbed, no surface features, Lander site 13368#56
13370#4	12	31-34.5	Lander	Good cores with Rhizammina; Lander site 13368#49
13370#6	12	31-34.5	Central	Good cores despite weather, several burrows, 1 xeno

As on previous cruises, the cores will be used for a variety of BENGAL projects (Table 2), namely: metazoan meiofauna and pigment analyses (GENT: Tasks 60-63), metazoan meiofauna (IFREMER), foraminiferal studies (SOC: Tasks 56-59), BIOFEED (Tasks 64/65), comparison of sediment and holothurian gut enzyme activity (QUB: Task 68), phytopigment analyses (NIOZ), radioisotopes (GEOMAR), organic chemistry, RNA/DNA extraction, studies of silicate, barite and enzymatic activities (LUDO, Ancona, Patras: Tasks 50/51), DNA analyses and bacterial activity determinations using thymidine and leucine (Galway: Tasks 52-53). Cores from the lander sites were used for pore-water profiles (nutrients, alkalinity, DOC, DON, silicates, calcium, inorganic carbon) and porosity determinations (Göteborg). Sediment contact water was taken from a number of cores for DNA analyses and activity determinations using thymidine (Galway). In addition, several cores were used for non-BENGAL purposes, namely: live meiofauna and juvenile polychaetes (GENT/SOC) and foraminiferal studies (SOC).

Table 2. Fate of multiple cores. (C = central site, L = lander site)

Station number	13368													13370	
SERIES NUMBER	3	4	5	7	11	14	15	19	26	28	40	45	57	4	6
SITE	C	C	C	C	C	C	C	C	C	C	C	L	L	L	C
GENT:Meiofauna	1	2	0	2	0	0	2	2	0	2	2	0	0	0	0
GENT:Pigments	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
SOC: forams 0-20cm	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SOC: forams to 5cm	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0
SOC: forams to 2cm	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
UL	0	3	0	3	0	0	1	4	3	3	3	0	0	0	0
UNIVAN	0	1	0	1	0	0	0	0	1	1	1	0	0	0	0
PATRAS	0	2	0	2	0	0	0	0	2	2	2	0	0	0	0
UCG:activity	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0
UCG: DNA	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0
QUB	1	1	0	1	0	1	1	1	1	1	1	0	0	0	0
BIOFEED	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0
NIOZ: Pigments	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
IFREMER: meiofauna	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0
Goteborg	0	0	0	0	0	2	0	0	1	1	1	12	11	6	6
GEOMAR: Radionucleides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Live material	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Worm project	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
Forams	0	0	0	1	0	0	0	2	1	1	0	0	0	1	0
Sediment contact water	0	0	0	0	0	0	0	0	0	0	2	2	7	0	12
CORES USED	6	12	12	12	11	3	7	12	12	12	12	12	11	12	12

ANDY GOODAY

Kasten core

For this cruise, the Kasten corer was equipped with a 2m barrel in order to provide a longer sedimentary record than the 1m barrel used on Cruises 226 and 229. The corer was deployed twice and on both occasions buried itself beyond the top of the barrel, thereby losing the upper several decimetres of sediment. However, penetration was not as deep on the second deployment which was made with half of the weights removed.

Both deployments yielded excellent, undistorted cores, the upper parts of which were similar to the 1m-long cores collected on previous cruises. In particular, there was a very distinct colour discontinuity at 41cm (13368#46) and 52cm (13368#58) below the top of the barrel. The lower sections (not sampled by the 1m barrel) were partly occupied by a grey clay with a soft, creamy consistency which was interrupted by a much denser horizon, 4cm thick, consisting of hard, 'dry', dark grey clay. A thicker but less clearly defined layer of similar material was present at the base of both cores.

Subsamples were taken using 1.5m lengths of conduit piping with a U-shaped cross section. Six lengths of piping were pressed into the sediment, three overlapping along the

length of the core at one level and three arranged in a similar fashion at a deeper level, thereby providing two complete records from each core. These will be used for an analysis of palaeomagnetism.

ANDY GOODAY

Box Corer

Macrofauna was sampled using a modified USNEL-type box corer. Two box corers were used, the first one (stainless steel) for the four first operations, the second one (yellow) for the rest of the cruise. The first box corer was used firstly without depth constraint but it did not work well; the box was full of sediment but the surface was disturbed and washed. Then depth limiters were put on the column but the holes in the column were not at a suitable height to work with this quality of sediment, very soft, so we obtained two small cores of about 25cm depth, disturbed and washed, without supernatant water. The fourth boxcore was tried without depth limiters, the result was not good, disturbed, washed and double contact. Then it was decided to change the box corer: the yellow one was used, with depth limiters at the usual height used during the previous BENGAL cruises. The first deployment produced a good core, about 35cm deep, not disturbed, with clear supernatant water. All the first 5 boxcores were obtained with sea conditions acceptable but not ideal. The weather then turned to good to excellent conditions until the end of the series. Despite this improvement in the weather, 4 more cores were not acceptable. The paying-out speed when arriving on the bottom and the hauling-in speed were changed several times to try to get better cores. Finally it was decided that the best speeds were 20m/min going down and coming up. The series finished with an excellent core.

The good or acceptable cores were processed according to the IOS protocol. Large specimens present at the surface or encountered when cutting the core were picked-off prior to sieving and were frozen. Standards sievings (1mm, 500µm, 300µm, 250µm for the 4 upper layers : 0-1cm, 1-3cm, 3-5cm, 5-10cm, and just 1mm and 500µ for the deeper 10-15cm and 15-20cm layers) were carried out. In these same cores one vegematic subcore was regularly taken for P. Lamont (DML) ; the upper 10cm layer was cut off and preserved in formalin for macrofaunal analyses.

Box corer sampling :

Station	Depth m	Depth limiter	Core quality	Sampling protocol	Remarks
13368#16	4842	-	Not good	IFREMER	Xenos (A Gooday)
13368#17	4842	fitted	Not good	IFREMER	Xenos (A Gooday) Photo (N Cosson)
13368#20	4844	fitted	Not good	IFREMER	
13368#21	4841	-	Not good	IFREMER	Double contact
13368#25	4842	fitted	Good	IOS	*Rhizammina* (A Gooday), *Segonzactis* (frozen, J Galeron), VG subcore (P Lamont)
13368#27	4845	fitted	Not good	IFREMER	Xenos and *Rhizammina* (A Gooday)
13368#29	4846	fitted	Not good	IFREMER	Double contact *Ophiomusium* at the surface : photo (N Cosson), (frozen, J Galeron)
13368#33	4845	fitted	Reasonable	IOS	VG subcore (P Lamont) Xenos and *Rhizammina* (A Gooday)
13368#34	4844	fitted	Not good	IFREMER	Double contact Ascidian at the surface (frozen, J Galeron)
13368#35	4842	fitted	Not good	IFREMER	Stone covered with forams, *Rhizammina* (A Gooday)
13368#36	4845	fitted	Reasonable	IOS	VG subcore (P Lamont)
13368#39	4845	fitted	Good	IOS	VG subcore (P Lamont) Pink ophiuroid at the surface (frozen, J Galeron) 2 Xenos (A Gooday)
13368#41	4845	fitted	Not good	IFREMER	Xenos (different) and *Rhizammina* (A Gooday)
13368#42	4845	fitted	Good	IOS	VG subcore (P Lamont) One clinker with *Rhizammina* (A Gooday)
13368#43	4844	fitted	Reasonable	IOS	VG subcore (P Lamont)
13368#44	4844	fitted	Excellent	IOS	VG subcore (P Lamont) 4 Xenos (A Gooday)

Epibenthic Sledge

The epibenthic sledge was deployed successfully once during the cruise (Station 13370#3). A number of modifications were made to the sledge including:

1) The addition of a new digital video system, Ocean Cam 6000V, developed jointly by SOC and the BBC Natural History Unit, together with 2 x 250W lamps and 1 x 24v 38AH DSPL battery.

2) The replacement of an angled cutting bar with a simple round bar on the bottom of the benthic net.

3) The removal of the suprabenthic net and bars to give room for the new video camera.

In addition, the epibenthic sledge had the usual camera, flash, odometer, angle sensor, monitor and mercury switches.

On the way to the bottom the acoustic signal from the monitor showing the depth of the sledge was lost. However, most of the other acoustic signals were obvious, particularly the one indicating the correct orientation of the sledge, so the haul was continued. Once on the bottom, the haul proceeded well and the tow lasted 1 hour before hauling. About half an hour after hauling was commenced the weak link on the sledge parted and the sledge turned over. It took a further hour to lift the sledge off the seabed, during which time the camera systems were hauled backwards through the sediment. They survived this harrowing experience rather well. A reasonable video was obtained.

The first half an hour of the video showed many different animals on the seabed, mainly the holothurians *Amperima rosea, Psychropotes longicauda, Oneirophanta mutabilis* and *Pseudostichopus villosus*. Unfortunately, one of the towing strops partially obscured the field of view. The effect of the bow wave in front of the net could be seen easily as it stirred up the sediment and sent neutrally buoyant holothurians rolling several feet in front of the sledge. The video showed just how easily the sediment surface is disturbed, an important consideration for corers with a bow wave, such as the box corer. The sledge kicked up more mud as the tow progressed, so that the seabed was obscured for most of the remaining time (half an hour) that the video lasted (total playing time 60 minutes).

The ordinary Mk IV camera worked, but the flash gun had been wired up incorrectly by the suppliers, so no still photographs were obtained.

A good small clean catch was obtained. The weak link on the bottom bar of the net had parted at some stage during the haul. There were several *Amperima rosea* in the catch, in better condition than those caught by the otter trawl but of a similar size. There were also several specimens of what are believed to be *Ellipinion delagei* and *Kolga hyalina.*

Further attempts to launch the sledge were unsuccessful. Weather conditions were far from ideal and the weak link on the sledge parted several times owing to surging and the increased tension on the wire when the sledge was in surface waters. A stronger weak link was put in place, but the sledge turned over repeatedly. During each recovery of the sledge it battered against the stern of the ship, in one case with enough force to bend one of the runners. A drogue was fitted to the sledge which appeared to cure the problem. However, the monitor end cap had worked loose with all the banging the sledge had received, and at a depth of a few tens metres the monitor flooded. On recovery a small quantity of water was found to have entered the monitor. Fortunately, this shorted out the power supply circuit first, with little obvious damage to other circuitry. All further work with the epibenthic sledge was aborted.

DAVID BILLETT, BRIAN BETT, BEN BOORMAN

Trawling and megabenthos

During the cruise the megafauna was sampled ten times; six times using the SOC otter trawl (OTSB 14) and four times using the IFREMER chalut à perche (see below). All of the chalut à perche trawls and four of the otter trawls were fished close to the central PAP station. In addition, two trawls were made at a location some 20 miles east of the central station, in order to confirm that the change in benthic communities detected during the BENGAL cruises had occurred over a much wider area.

Otter trawl

The otter trawl used on this cruise was the same as that used on previous BENGAL cruises (see cruise report for *Discovery* Cruise 229 for a brief description). The width of the net when it is fishing on the bottom has been estimated at about 8.6m. The distance run on the bottom for the trawls varied between 9604m and 18464m, and the area fished varied between 7.97and 15.33 hectares.

The catches from the 4 trawls at the central station (Station 13368#23, #24, #50, #51) and the 2 trawls at the "out of area" site (Station 13369#1,#2) are summarised in the section on megabenthos. All the trawls were fished in a similar way. Once the net had been shot the ship's speed was increased to 4 knots and the wire was paid out at a rate of 60m/min. For each trawl about 11000m of wire was paid out and then the ship's speed was reduced to 1.5 knots to allow the net to settle onto the bottom. In the first trawl (13368#23) 11140m of wire were paid out and the net took just 25 minutes to settle on the seabed. In the last trawl (13369#2) 11007m of wire were paid out and it took a full 110 minutes for the net to reach the seabed. Usually the settling time was about 75 minutes. Once the net was on the bottom the ship's speed was increased to 2 to 2.5 knots.

Hauling was commenced after two hours on the seabed, except at St. 13369#1 when the net lifted off the seabed after 105 minutes. In the first trawl (13368#23) it took two hours after hauling for the net to lift off the seabed. On recovery of this trawl one of the swivels on the trawl doors was found to have seized and the trawl door wires had become tangled. A good catch was obtained by this trawl, so it was thought that the trawl worked well on the seabed. However, in this trawl, and in the subsequent trawl (#24) the fish catch was much lower than in the other otter trawls.

DAVID BILLETT, BEN BOORMAN

Beam Trawl (Chalut à Perche)

The chalut à perche used during this cruise has been described in the *Discovery* 226 cruise report. It was fished 4 times during the cruise :

Station	On the bottom	Off the bottom
13368#47	*16.03.98, 19H33*	*16.03.98, 21H00*

Ship speed about 1.5 knots, paying out at increasing speed up to 40m/min. The chalut was on the bottom with 7250m wire, then paying out at decreasing speed 35,30,25,20 m/min to 8100m. The tension which increased slowly suddenly made peaks during 10 min. Stop paying out at 8560 m wire (1300m payed out when the trawl was on the bottom), the tension came back stable. Start hauling in at 10 m/min, 15 min later the trawl was off the bottom.

The haul produced a clean good catch of about 11 kg of invertebrate megafauna and 3.3 kg of fish. The fauna was clean and in good condition, there was nearly no clinker. Nearly all the fauna was preserved in formalin after having been counted and weighed by taxon. A few specimens from 7 taxa were weighed and frozen to be used in laboratory to evaluate the organic carbon content.

13368#48 *17.03.98, 08H02* *17.03.98, 10H32*

Ship speed of about 1.5 knots at the beginning of paying out (30m/min) during 1H30 (3500m wire), then increasing speed up to 2.3 knots during 1H30 (45-55m/min, to 8500m wire), then reducing at 1.5 knots. Paying out stopped 5 min later, the trawl was on the bottom 10 min later (8790m wire). Paying out at 20-10m/min to 9000m wire (130m). The tension increased slowly. After about 1H30 on the bottom start hauling in at 10m/min during one hour until the chalut was out of bottom, then increasing speed up to 40m/min.

The second haul contained about 47 kg of invertebrate megafauna and only five small fish (half kg). The fauna was clean and in reasonable condition despite a small amount of clinker in the catch. The major part of fauna was preserved in formalin after having been counted and weighed by taxon. A few specimens from most of the taxa were weighed and frozen to be used in the laboratory to evaluate the organic carbon content.

13368#52 19.03.98, 08H24 19.03.98, 09H40

Ship speed of about 2 knots, paying out at 30m/min during about 4 hours to 8500m wire. Then stop paying out, speed reduced to 1.5 knots. Five minutes later start paying out at 10m/min to 9000m wire. Ship speed reduced to 1.3 knots, the trawl was on the bottom about 50 min later. Starting paying out at 10m/min to 9225m wire. Start hauling in 10m/min after 30 minutes on the bottom, during 45 minutes. Then it was out of the bottom and the hauling in rate increased up to 40m/min.

The third haul contained a lot of clinker, about 20 kg of invertebrates and 4kg of fish (12 specimens). The sampling of specimens for evaluation of organic carbon rate was completed with specimens from 11 taxa, the others being preserved in formalin as usual.

13368#53 19.03.98, 20H25 20.03.98, 0H09

Ship speed of about 2 knots, paying out at 30m/min during 40 minutes (1235m wire), then 50m/min during 2 hours (7300 m wire). Ship speed decrease to 1.5 knots, winch stopped after 30 min (8900m wire). After 10m starting paying out at 10-20m/min; 20 minutes later the trawl was on the bottom (9150m wire), paying out was stopped at 9250m. One hour later, starting hauling in at 10m/min for 1 hour, 20m/min for 1 hour and 30m/min for 20 minutes before the trawl left the bottom. This haul was the longest with 3H45 on the bottom.

It produced 122 kg of invertebrates and 8.7 kg of fish. There was a lot of clinker and a little amount of mud. The animals were not really in good condition but not too bad. All of them were preserved in formalin after being counted and weighed.

The 4 chalut à perche deployments were successful and we did not notice any problem during these operations.

PHILIPPE CRASSOUS

Goteborg benthic lander (VIRUS III)

By using a benthic chamber lander we were able to measure directly sediment-water exchange rates of oxygen, total carbonate (C_T or ΣCO_2), alkalinity (A_T), Σnitrate, ammonium, silicate, phosphate, calcium and dissolved organic carbon (DOC) *in-situ* at four localities in the BENGAL area (12 successful incubations). In addition, by collecting sediment with a multiple corer, pore water distributions were determined for the above solutes and sub-samples were taken for later analysis of grain size, organic C and N, ^{210}Pb, ^{14}C, $^{228}Th/^{228}Ra$ (or $^{228}Th/^{232}Th$ ratio) in the solid phase of the sediment (see Table 3). Furthermore samples of bottom water were collected with Rossette bottles (mounted on a CTD) at regular intervals throughout the cruise and analysed for oxygen, alkalinity and total carbonate.

The development of a new lander (Virus III)

During *Discovery* cruise 226 in March 1997 the Göteborg Virus I lander was lost, probably due to the implosion of the buoyancy glass spheres mounted on the lander. To be able to continue with deep-sea research and to fulfil our BENGAL and ALIPOR contracts a new lander was constructed, partly financed by Swedish sources (NUTEC) and partly by a University loan.

Construction started in September 1997 and was completed only shortly before the start of cruise 231. The ideas for the basic technical solutions adopted on this new (third generation) lander essentially came from the previous lander, which to a large extent was developed in co-operation with Laboratoire Arago (Banyuls-sur-Mer, France) through the building of the Banyuls lander. In addition, a considerable amount of new development and improvement was undertaken, to a large extent through inspiration by and close co-operation with other lander users (most of them involved in the ALIPOR project).

The Virus III is built as a modular system where one or several of the four experimental modules (with sampling syringes, electrodes, stirring motors etc.) can be exchanged as desired. A quick and easy assembly and dismantling of a complete chamber module not only gives the possibility to continue incubations on deck (if desired), but also makes it easy to acid wash (which generally is necessary to avoid contamination of nutrients and DOC) the whole chamber in one move. All chamber modules went through such an acid wash, followed by a careful rinse, prior to the first station.

The lander can perform up to 90 different preprogrammed mechanical actions (e.g. activating different sampling devices with stepper or DC motors or with burn-wires) as well as register signals from up to 32 different sensors (e.g. oxygen sensors, temperature, conductivity, revolution counters for stirring motors, resuspension etc.) and controlling a video camera. Effort has been put into the development of the controlling microprocessors so that they can perform advanced experiments (e.g. changing the hydrodynamics inside a chamber as a function of changing conditions outside, simulation of a benthic storm, scanning over a larger area with the video camera etc.). In its present version, the lander is equipped with four square benthic chamber modules each capable of enclosing an area of 400 cm^2 of the sea floor and perform measurements with sensors and/or water sampling in this isolated environment. The design of the chambers and their stirring devices is a result of two extensive hydrodynamic intercalibration workshops held within the ALIPOR project. In each chamber, 9 water samples (+start values from the bottom water outside the chambers) are collected with syringes and used to calculate concentration changes with time (benthic fluxes). After terminating the benthic flux measurements the incubated chamber sediment is brought to the sea surface together with the ambient bottom water with a technique similar to the one used

on the "Multiple Corer". This gives the possibility to determine the water volume incubated in each chamber (necessary for calculating the flux) as well as possibilities to continue the experiments on-board ship. To recover the instrument, ballast weights are dropped by either of two acoustic releases. Once at the surface, spotting is possible by a flash, flags, radar reflector, radio (VHF) and a satellite signal (ARGOS). To facilitate transport, service and storage between and during different expeditions a container is used. Effort was made to construct the lander compact enough so that it could be fitted with wheels and rolled into the container without dismantling. In spite of its compact size (2m x 2 m x 2.2 m high), and the use of titanium for the whole construction, the total weight of the lander is 1500 kg. This is because the lander has been fitted with a syntactic foam buoyancy package (accounting for 2/3 of the lander weight in air) instead of glass spheres. Foam floats have the advantage of resisting heavy impact (during deck handling and transport) and the risk of implosion is insignificant (if used at rated conditions).

Sediment sampling and pore water extraction

Sediment for pore water and solid phase studies was collected using the multiple corer according to the sampling schedule given in Table 3. The aim was to collect sediment at the same site as the lander was deployed, and at some additional sites at the central coring position (see Table 3 for information on sample treatment, number of cores, slicing intervals etc.).

Chemical analyses

Concentrations of alkalinity and total carbonate were determined on-board the ship using systems that were developed in Göteborg. The precision of the alkalinity titration was better than 0.25 % RSD (n=10) using a sample volume of 1 ml, and the precision of the newly developed IR-based system for determination of total carbonate was 0.20 % RSD (n=10), using a sample loop of 4 ml.

The rest of the collected samples will be analysed in various labs with various methods (see Table 8). The initial goal was to measure DOC on-board by high temperature catalytic oxidation (HTCO) using a SHIMADZU TOC-5000 total C analyzer after acid treatment to remove dissolved inorganic carbon. Since the baseline of the instrument was not stable enough due to the movement of the ship we decided to freeze the samples (in acid washed glass vials) and do the analyses in Göteborg.

Preliminary results

In spite of company guarantees, the same release codes had been given to the acoustic releases on both the old and new Virus landers. This led to an accidental and premature

release from the bottom while doing a search for the old lost lander. The new lander was released and surfaced in bad weather and was left drifting, since it would have been too risky to try to recover it. All data from this station were lost. During the next two deployments faulty software led to some limitations in both data collection from the sensors and in the amount of water samples taken from the incubations (35 of 45 syringes were activated). However, incubation results of good quality could still be obtained. During the last two stations all systems worked as planned except that the sediment collected in the chambers was too disturbed to be used for porewater distributions. To compensate this led us to an enhanced use of the Multiple corer. The reason for the disturbed samples is probably lack of sufficient power in the springs sealing the chamber lid during chamber extraction from the sediment. The average lander descent and ascent speeds were 38 m/min and 80 m/min, respectively, at all stations. Throughout the cruise all surface spotting systems worked without any difficulties. The VHF-radio gave the exact moment of surfacing and a possibility to do short range spotting (at maximal distances of 10 nautical miles) whereas the ARGOS positioning system gave longer range spotting with about 1 hour time intervals. Both acoustic releases worked without problems.

Preliminary data (from C_t and alkalinity effluxes as well as for oxygen uptake) suggests an overall low benthic activity. In general the alkalinity fluxes and C_t fluxes were always outgoing and varied between 0.46-1.86 mmol/m^2*day (for alkalinity) and from 0.69 to 1.26 mmol/m^2*day (for C_t) (see Fig 1 and 2 for typical C_t and alkalinity fluxes).

The average sediment oxygen uptake rates for replicate incubations varied between 1.16 mmol/m^2*day and 1.79 mmol/m^2*day for the different stations (see Fig. 3 for a typical oxygen uptake plot from a chamber incubation). The oxygen uptake rates seem to be about a factor 3-4 higher than what has previously been reported for the same area during the same season last year (measured with the NIOZ lander).

The bottom water concentration of oxygen was 249.1 ± 2.6 µM (measured from 21 Winkler titration's done on samples collected both from the Niskin bottles mounted on a CTD and glass syringes mounted on the lander) and showed no significant variation in-between sites.

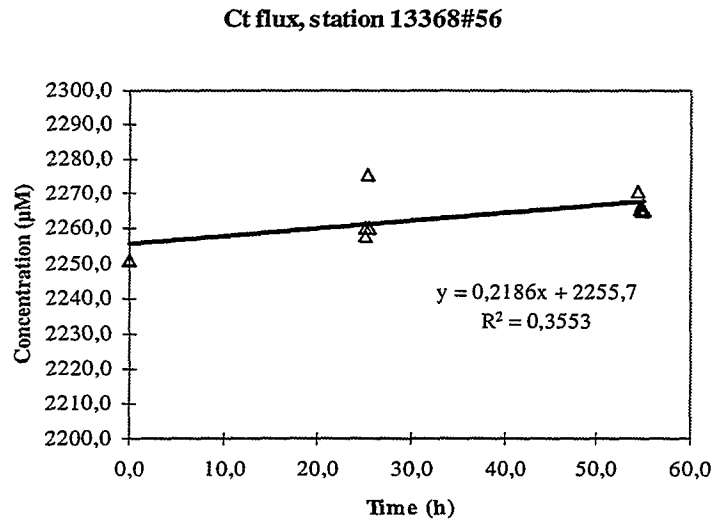


Fig. 1: BENGAL 231, station 13368#56, chamber number 4. C_t efflux. The measured rate was 1.05 mmol/m^2*day.

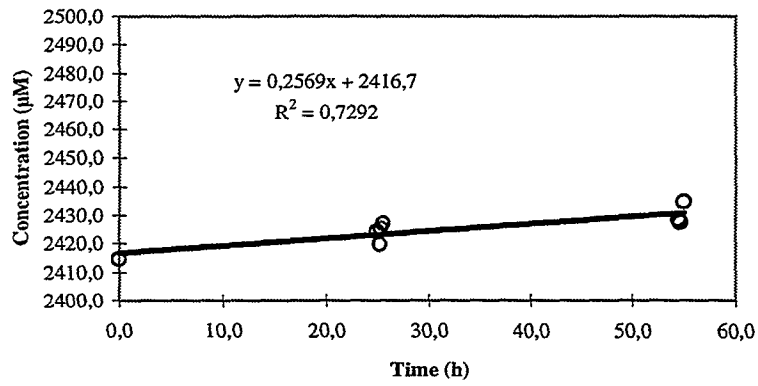
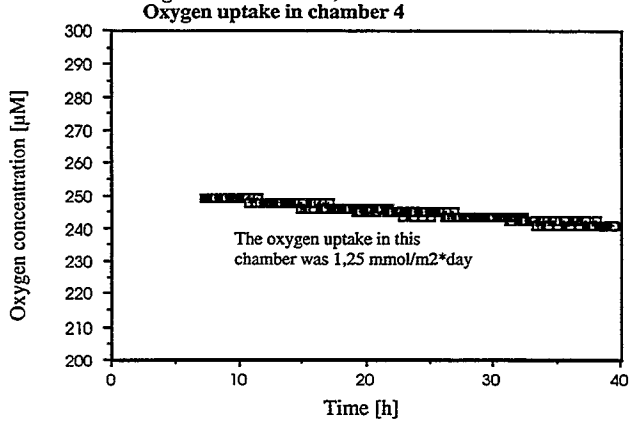


Fig. 2: BENGAL 231, station 13368#56, chamber number 4. C_t efflux. The measured rate was 1.23 mmol/m^2*day.

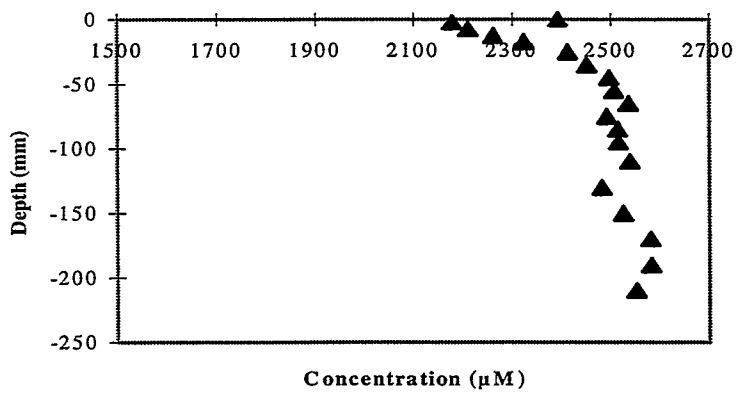
Fig. 3: BENGAL 231, station 133368#56
Oxygen uptake in chamber 4



Water column profiles of temperature and salinity done with the CTD corresponded well with profiles done with the lander during its descent and ascent. Both the CTD and the lander registered a bottom water temperature of 2.60°C at all stations. The CTD gave salinity values of 34.90 for the bottom water at all stations while the lander measured a slightly lower salinity (average of 34.60). Furthermore during bottom deployment the pressure sensor on the lander clearly measured the variations in the sea surface levels due 6 hour tidal variations.

Sediment profiles of alkalinity and C_t that were analysed on-board generally seemed to be of good quality and all showed the same general pattern (see Fig. 4)

Fig. 4. BENGAL 231, station 13368#45.
Alkalinity profile



We thank the captain and his skilful crew on *RRS Discovery*. This study was financially supported by grants from the BENGAL programme within MAST III and from the Swedish national research council (NFR).

HAKAN MILLQVIST, HENRIK STAHL, ANDERS TENGBERG

Table 3. Samples taken during BENGAL 231 cruise by the Göteborg group.

Sample for	Type of sample	Specifications	Sample treatment	Sample storage	Station # (no. of replicates)	Collection device	Remarks
Dr. Oliver Rageneau Univ. of Brest	Pore water for silicate+sediment	0-4 (5 mm); 4-10 (10 mm) 10-25 (20 mm)	Centrifuge at 4 deg ; 3500 RPM for 20 min, filtered with (0.45μ) cellulose acetate filter	Cold room at 4 in supplied vials; sediment frozen	13368#45(2) 13368#57(1) 13370#4(1)	MUC	Lander site #30, Lander site #56, Lander site #49,
Dr. Oliver Ragenau Univ. of Brest	Flux samples for silicate	From lander incubation 3 ml from each water sample	Filtered with (0.45μ) cellulose acetate filter	Cold room at 4 in supplied vials	13368#30(1) 13368#49(2) 13370#4(1)	Lander	Chamber 4 Chamber 1&2 Chamber 1
Dr. Christophe Rabouille Gif-sur-Yvette	Flux samples for calcium	From lander incubation 5ml from each water sample	Filtered with (0.45μ) cellulose acetate filter	Cold room at 4 in our acid washed vials	13368#30(1) 13368#49(2) 13370#4(1)	Lander	Chamber 4 Chamber 1&2 Chamber 1
Dr. Per Roos Univ. of Lund	Sediment for analysis of sedimentation rates	Whole sediment core	Freeze the whole core upstanding	Frozen	13368#26(1) 13368#28(1)	MUC	
Dr. Per Hall Univ. of Göteborg	Pore water for analysis of nutrients & DOC/DON	0-2 (5 mm); 2-10 (10 mm) 10-20 (20 mm)	Centrifuge at 4 deg ; 2400 RPM for 30 min, filtered with (0.45μ) celluslose acetate filter	Froozen in acid washed vials	13368#40(1) 13368#45(2)*(3) 13368#57(2)*(2) 13370#4(1)*(1)	MUC	*no. of replicates of DOC/DON profiles
Dr. Per Hall Univ. of Göteborg	Pore water for analysis of alkalinity & total inorganic carbon (Ct)	0-2 (5 mm); 2-10 (10 mm) 10-20 (20 mm)	Centrifuge at 4 deg ; 2400 RPM for 30 min, filtered with (0.45μ) celluslose acetate filter		13368#14*(1) 13368#40(2) 13368#45(2)*(2) 13368#57(2)*(2) 13370#4(1)*(1)	MUC	*no. of replicates of Ct profiles
Dr. Per Hall Univ. of Göteborg	Sediment samples for porosity analysis	0-2 (5 mm); 2-10 (10 mm) 10-20 (20 mm)	From each level 5ml of wet sediment was taken with a syringe	Cold room in plastic vials sealed with parafilm and a lid	13368#45(1) 13368#57(1) 13370#4(1)	MUC	
Dr. Per Hall Univ. of Göteborg	Sediment samples for C/N analysis	0-2 (5 mm); 2-10 (10 mm) 10-20 (20 mm)	5ml of centrifuged sediment from each level	Frozen in small plastic bags	13368#45(1) 13368#57(1) 13370#4(1)	MUC	
Dr. Per Hall Univ. of Göteborg	Sediment samples for grain size analysis	0-2 (5mm); 2-10 (10mm) 10-20 (20mm)	5ml of centrifuged sediment from each level	Frozen in small plastic vials supplied by Dr. A. Grehan	13370#4(1)	MUC	To be analysed by Dr. A. Grehan
Dr. Per Hall Univ. of Göteborg	Flux samples for O2, Alk, Ct, DOC/DON & Nu	O2 measured *in situ* with electrodes, the rest 9 discrete water samples per incubation	Alk, Ct, DOC/DON & Nu filtered with (0.45μ) cellulose acetate filter	Alk and Ct were analysed on board, Nu and DOC/DON frozen in acid washed vials	13368#22 13368#30 13368#49 13368#56	Lander	#22 O2 did not work, #22 & #30 only two complete incubations
Dr. Per Hall Univ. of Göteborg	Bottom water samples of O2, Ct & alk	For background values	Alk & Ct filtered with (0.45μ) cellulose acetate filter	Analysed onboard	13368#2, 22 & 37 13370#2	CTD	

CTD

The CTD system was deployed nine times during the cruise. The second deployment was attempted using a conducting swivel but this failed a few metres down and was removed. Two deployments were shallow casts to 150m, the rest were full depth of 4800m apart from the last one which had to be ended at 1400m due to a distress call received by the ship. The CTD casts were made at the following stations:

1) 13368 series1 (150m)

2) 13368 series2 (4800m)

3) 13368 series6 (4800m)

4) 13368 series13 (4800m)

5) 13368 series37 (4800m)

6) 13368 series38 (150m)

7) 13368 series54 (4800m)

8) 13370 series2 (4800m)

9) 13370 series7 (1400m)

The CTD system consists of Conductivity, Temperature and Depth sensors, with oxygen sensor, fluorometer and 2 transmissometers.

On the first cast the oxygen sensor failed at approximately 20m. This parameter was not displayed and the fact unnoticed until later. The second cast followed immediately and at 750m the sensor housing of the CTD flooded. The cast continued to the bottom and water samples were successfully collected. The CTD unit was changed for subsequent casts. As the water bottle rosette was 'firing' without problems it was changed in order to test the spare rosette for cast 7. Despite having been just returned from service by the manufacturers this rosette failed to fire any bottles. The original rosette was replaced for casts 7,8 and 9 though no bottles were fired on cast 9.

TSG & Met

The Surfmet system operated continuously as normal although was not required for the cruise.

DAVID JOLLY

GROUP/TOPIC REPORTS

Microbiology

Long-term incubation of near surface Water

This experiment was a repeat of one carried out on *Discovery* cruise 222 with the exception that the water sample (150m) was collected from a shallow CTD cast (St:13368#1) that did not go below 150m. The aim of the experiment is to see if it is possible to adapt a near-surface bacterial community to deep-sea conditions and may shed some light on the role of surface derived microbial communities transported to the benthos by sinking particles. Samples were incubated at 3°C and both 1 atm and 480 atm pressure. Sub-samples were retrieved at intervals (4 days) and their short term (12hr) rate of thymidine incorporation determined at both 1 and 480ats. Samples were also preserved for subsequent analyses of bacterial biomass.

Water Samples.

A number of water samples were collected with the rosette multisampler on the CTD or from the multiple corer for sediment contact water (SCW). Varying amounts of water were filtered through 0.2μM Sterivex depth filters for collection of bacterial biomass. 1.8 ml of lysis buffer (sucrose, EDTA, NaCl) was added to the filter cartridge which was then frozen for nucleic acid studies.

Station	Depth (metres)	Amount filtered (litres)
13368#6	1008	25
13368#6	3008	30
13368#38	56	38
13368#38	105	37
13368#38	155	36
13370#2	SCW	3.5
13370#2	100 above bottom	38
13370#2	10 above bottom	38
13370#6	SCW	4

Moored SAPS

A SAPS (Stand Alone Pumping System) was successfully deployed as a mooring. The SAPS unit was attached to a length of scaffold pole, and the pole slung within the DEMAR amphipod trap (trap removed), which was deployed and recovered as normal. This allowed a water sample to be collected from 1 metre above the bottom. 420 litres of water was pumped through a 0.2μm Nucleopore filter in 2 hours. Upon recovery the filter was preserved in 40% glycerol and frozen. The filter will be used for bacterial nucleic acid studies.

Bacterial activity

Bacterial activity was investigated by observing the incorporation of radiolabelled compounds by samples incubated at both surface (1at) and sea bed (480 at) pressures. All incubations were carried out at the near - bottom temperature of 3°C and were for intervals up to approximately 18hrs. Bacterial DNA production was followed by the incorporation of [methyl-^{3}H] thymidine and protein production by the incorporation of L-[4,5 -^{3}H] leucine. Activity experiments were performed on sediment and SCW. The table below lists all the activity experiments.

Station	Sample	Tracer
13368#15	sediment core	thymidine and leucine
13368#19	sediment core	thymidine and leucine
13368#26	sediment core	thymidine and leucine
13368#40	SCW	thymidine
13368#45	SCW	thymidine
13370#6	SCW	thymidine

Holothurians

Samples of gut contents were taken from four regions of gut for each of three species of holothurian during the course of this cruise as well as sections of gut wall and bacterial count samples. In all cases the samples were preserved in glycerol and frozen for laboratory analyses of bacterial community structure using nucleic acid based techniques. The three species chosen were *Oneirophanta mutabilis*, *Psychropotes longicauda* and *Pseudostichopus* sp. The gut was divided into four sections; the oesophagus, anterior intestine, posterior intestine and the rectum.

Gut contents were sourced as follows

OTSB 13368#23 (*Psychropotes longicauda*)

OTSB 13368#24 (*Pseudostichopus* sp)

OTSB 13368#51 (*Oneirophanta mutabilis*,)

A series of pooled experiments were also carried out with University of Liverpool and Queens University Belfast from the following sources:

Pseudostichopus sp from OTSB 13368#23

Psychropotes longicauda from OTSB 13368#51

DONAL EARDLY AND JOSEPH GALLAGHER

Metazoan Meiofauna

Twelve cores of 25.52 cm^2 were collected from 6 multiple core deployments (2 cores per deployment). Each core was sectioned into slices of 5 mm for the first centimeter, then 1 cm slices down to 5 cm and finally one slice of 5 cm down to 10 cm. Sectionning took place in the constant temperature room at *in situ* temperature (4-5°C). From one core from 3 deployments, one subsample of 1ml was taken for estimating bacterial densities (University of Galway). From these cores, in addition to three other cores from three deployments, a second subsample of 1ml was taken for organic Carbon/Nitrogen analysis. . The remaining sediment was fixed to a final concentration of 4% formaldehyde. Meiofaunal standing stock, composition and size spectra will be investigated from these cores. Two additional cores were collected and sectionned as described above. Each slice was stored in a petri dish and frozen for later analysis of pigment concentrations

ANN VANREUSEL

Xenophyophores

As on previous cruises, all multiple core and box core surfaces were more or less thoroughly examined for xenophyophores and other objects of interest. This time the pickings were relatively modest, comprising 14 xenophyophores, 10 from the box-cores and 4 from multiple cores. The occurrence of specimens among the 14 carefully examined box-cores suggests that their distribution is somewhat patchy, a conclusion also reached during Cruise 226.

Specimens per box core	0	1	2	3	4
Frequency	9	2	2	0	1

Reticulammina labyrinthica was represented by five specimens and *Galatheammina erecta* and a plate-like species of *Galatheammina* were each represented by four specimens. One of the plate-like specimens had clearly developed 'growth lines'. The other xenophyophore was a small *Reticulammina* with lamellate branches, an interesting new species first encountered on Cruise 229 (July 1997).

Several small pieces of clinker and coal were picked off from core surfaces and found to be densely encrusted by the foraminifer *Telammina fragilis.*

ANDY GOODAY

Megafauna

Catches from the 4 chalut a perche trawls are summarized in tables 4 and 5.

Holothurians dominated the catches, representing 69-89% of the invertebrate abundance, 89-96% of biomass. In terms of abundance *Amperima rosea* was largely the most important as it represented 50-73% of the total, while in biomass it accounted for 12-22%. In the first and the third hauls the individual weight of *Amperima rosea* was lower (2.1-2.7g) than in the second one (4g) and the fourth one (5.7g). *Oneirophanta mutabilis*, *Pseudostichopus spp.* and *Psychropotes spp.* were the other important holothurian species, representing together 9-15% of invertebrate abundance and 69-74% of biomass. Apart from holothurians, actiniarians, polychaetes and asteroids represented each more than 1% of abundance in each catch but in terms of biomass polychaetes were not important. These results seem not to differ from the samples taken on the previous BENGAL cruises.

Catches from the 6 otter trawls are summarised in Tables 6 and 7.

Once again holothurians dominated the catches, notably *Oneirophanta mutabilis*, *Psychropotes longicauda*, *Pseudostichopus villosus* and *Amperima rosea*. At the central station the holothurians accounted for 94 to 96% of the invertebrate wet weight biomass, while at the two "out of area" stations the proportion was 85 to 90%.

There was an indication of two size fractions of *Amperima rosea*, but confirmation of this feature will have to await a thorough analysis of the catch. There were at least 16 different species of holothurians taken in the catches, including one specimen tentatively identified as *Scotothuria*, a species hitherto found usually in midwater trawl samples and only once before in trawl samples on the Porcupine Abyssal Plain.

Of the other invertebrates there were at least 8 species of actiniarians including *Actinauge abyssorum*, *Amphianthus bathybium*, *Doaentesia*, *Iosactis*, *Kadosactis*, *Sicyonis biotrans* and *Segonzactis platypus*, many polychaetes, the anomuran decapods *Munidopsis* and *Stereomastis*, and the asteroids *Dytaster grandis*, *Hyphalaster inermis* and *Styracaster spp.*

Table 4. DISCOVERY 231, Station 13368. Abundance of invertebrate megafauna from chaluts a perche

TAXON	13368#47		13368#48		13368#52		13368#53	
	No	%	No	%	No	%	No	%
Porifera	1	0,1			1	0,1	1	0,0
Pennatulacea	1	0,1	12	0,5	8	0,4	4	0,1
Actiniaria	34	2,2	117	4,4	148	8,3	239	4,2
Scleractinia	1	0,1	4	0,2	4	0,2	12	0,2
Zoantharia	28	1,8	53	2,0	142	8,0	214	3,8
Polychaeta	44	2,8	72	2,7	90	5,1	100	1,8
Echiura			2	0,1	5	0,3	8	0,1
Sipunculida			3	0,1	2	0,1		
Bivalvia	2	0,1	5	0,2	14	0,8	10	0,2
Gastropoda	2	0,1	1	0,0	5	0,3	5	0,1
Scaphopoda					1	0,1	1	0,0
Cephalopoda					2	0,1	3	0,1
Pycnogonida	2	0,1	1	0,0			7	0,1
Cirripedia	2	0,1	1	0,0	6	0,3	10	0,2
Decapoda natantia	8	0,5	1	0,0	3	0,2	1	0,0
Decapoda reptantia			13	0,5	7	0,4	13	0,2
Amperima rosea	1140	73,5	1700	63,9	900	50,5	3760	66,3
Benthodytes sordida			3	0,1			4	0,1
Deima validum	1	0,1	6	0,2	2	0,1	9	0,2
Kolga sp.+ Ellipinion sp.	110	7,1	190	7,1	90	5,1	300	5,3
Mesothuria sp.			7	0,3	3	0,2	15	0,3
Oneirophanta mutabilis	63	4,1	166	6,2	140	7,9	419	7,4
Paroriza prouhoi	1	0,1	9	0,3	2	0,1	8	0,1
Peniagone sp.	1	0,1	2	0,1	2	0,1	1	0,0
Pseudostichopus villosus	12	0,8						
Pseudostichopus sp.	29	1,9	84	3,2	38	2,1	115	2,0
Psychropotes ssp.	38	2,5	144	5,4	79	4,4	254	4,5
Others	1	0,1	3	0,1	2	0,1	4	0,1
Total	1396	90,1	2314	86,9	1258	70,6	4889	86,2
Holothuroidea								
Asteroidea	20	1,3	28	1,1	54	3,0	90	1,6
Ophiuroidea	2	0,1	13	0,5	9	0,5	24	0,4
Crinoidea					2	0,1	2	0,0
Tunicata	7	0,5	22	0,8	20	1,1	41	0,7
Total	1550	100,0	2662	100,0	1781	100,0	5674	100,0

Table 5. Discovery 231, Station 13368. Biomass of invertebrate megafauna from chaluts a perche

TAXON	13368#47 W	%	13368#48 W	%	13368#52 W	%	13368#53 W	%
Porifera	8	0,1			18	0,1	84	0,1
Pennatulacea	3	0,0	231	0,5	15	0,1	95	0,1
Actiniaria	97	0,9	1224	2,6	606	2,9	1908	1,6
Scleractinia	4	0,0	8	0,0	12	0,1	19	0,0
Zoantharia	10	0,1	14	0,0	31	0,1	57	0,0
Polychaeta	46	0,4	92	0,2	90	0,4	129	0,1
Echiura			11	0,0	31	0,1	34	0,0
Sipunculida			2	0,0	3	0,0		
Bivalvia	4	0,0	8	0,0	36	0,2	28	0,0
Gastropoda	2	0,0	1	0,0	29	0,1	16	0,0
Scaphopoda					1	0,0	3	0,0
Cephalopoda					730	3,5	393	0,3
Pycnogonida	4	0,0	1	0,0			10	0,0
Cirripedia	5	0,0	2	0,0	14	0,1	22	0,0
Decapoda natantia	69	0,6	217	0,5	56	0,3	251	0,2
Decapoda reptantia			168	0,4	110	0,5	177	0,1
Amperima rosea	2420	22,0	6754	14,5	2430	11,8	21300	17,4
Benthodytes sordida			1176	2,5			1970	1,6
Deima validum	122	1,1	574	1,2	108	0,5	615	0,5
Kolga sp.+ Ellipinion sp.	51	0,5	309	0,7	130	0,6	580	0,5
Mesothuria sp.			135	0,3	179	0,9	648	0,5
Oneirophanta mutabilis	2377	21,6	9332	20,1	5100	24,7	29700	24,2
Paroriza prouhoi	232	2,1	1590	3,4	990	4,8	2700	2,2
Peniagone sp.	57	0,5	19	0,0	6	0,0	11	0,0
Pseudostichopus villosus	1365	12,4	7501	16,1	2870	13,9	21700	17,7
Pseudostichopus sp.	443	4,0	1650	3,6	675	3,3	2100	1,7
Psychropotes spp.	3445	31,3	15017	32,3	5826	28,2	37000	30,2
Others	2	0,0	10	0,0	4	0,0	9	0,0
Holothuroidea total	10514	95,6	44067	94,8	18318	88,6	118333	96,5
Asteroidea	217	2,0	395	0,8	528	2,6	925	0,8
Ophiuroidea	5	0,0	23	0,0	20	0,1	49	0,0
Crinoidea					2	0,0	2	0,0
Tunicata	6	0,1	13	0,0	17	0,1	32	0,0
Total	10994	100	46477	100	20667	100	122567	100

JOELLE GALERON, NATHALIE COSSON, PHILIPPE CRASSOUS, JEAN-PIERRE BRULPORT

Table 6. Megafauna from otter trawls from the central BENGAL locality

		13368#23		13368#24		13368#50		13368#51	
		Wet wt	per hectare 15.87904 hectares	Wet wt	per hectare 14.17882 hectares	Wet wt	per hectare 12.61964 hectares	Wet wt	per hectare 8.38758 hectares
PORIFERA				10	0.7	6	0.5	7	0.8
PENNATULACEA	Umbellula	104	6.5	14	1.0	24	1.9		
ACTINIARIA	Actinauge abyssorum	187	11.8	313	22.1	88	7.0	101	12.0
	Amphianthus bathybium	52	3.3	125	8.8	65	5.2	68	8.1
	Doantesia	28	1.8	55	3.9	8	0 6	3	0.4
	Iosactis	27	1.7	30	2.1	19	1.5	52	6.2
	Kadosactis	27	1.7	37	2.6	6	0.5	3	0.4
	Misc	1	0.1						
	Segonzactis platypus	18	1.1	15	1.1	6	0.5	3	0.4
	Sicyonis biotrans			608	42.9	114	9.0		
	Total Actiniaria	**340**	**21.4**	**1183**	**83.4**	**306**	**24.2**	**230**	**27.4**
MADREPORARIA				6	0.4	29	2.3	32	3.8
ZOANTHIDEA		9	0.6	58	4.1	10	0.8	14	1.7
ECHIURA		130	8.2	125	8.8	72	5.7	42	5.0
NEMERTINA				3	0.2				
SIPUNCULA		46	2.9	9	0.6	26	2.1	59	7.0
ANNELIDA	Polynoidae	57	3.6	121	8.5	80	6.3	72	8.6
	Worm tubes			149	10.5	56	4.4	84	10.0
	Total Annelida	**57**	**3.6**	**270**	**19.0**	**136**	**10.8**	**156**	**18.6**
CIRRIPEDIA		30	1.9	27	1.9	3	0.2		
DECAPODA	Benthesicymus	99	6.2						
	Munidopsis	28	1.8	27	1.9	21	1.7	18	2.1
	Natantia	52	3.3	85	6.0	137	10.9	89	10.6
	Plesiopeneus armatus							71	8.5
	Stereomastis	23	1.4	31	2.2	9	0.7		
	Total Decapoda	**202**	**12.7**	**143**	**10.1**	**167**	**13.2**	**178**	**21.2**
PYCNOGONIDA		2	0.1	12	0.8	5	0.4	6	0.7
GASTROPODA		11	0.7	28	2.0	4	0.3		
SCAPHOPODA				3	0.2				
BIVALVIA		1	0.1	10	0.7			2	0.2
CEPHALOPODA		158	10.0	130	9.2	380	30.1	620	73.9
ASTEROIDEA									
	Dytaster	122	7.7	200	14.1	60	4.8	104	12.4
	Freyella	3	0.2	8	0.6	7	0.6	3	0.4
	Hyphalaster	139	8.8	423	29.8	15	1.2	66	7.9
	Misc			22	1.6				
	Styracaster	56	3.5	71	5.0	5	0.4	42	5.0
	Total Asteroidea	**320**	**20.2**	**724**	**51.1**	**87**	**6.9**	**215**	**25.6**
OPHIUROIDEA		26	1.6	85	6.0	4	0.3	6	0.7
ECHINOIDEA									
HOLOTHURIOIDEA	Amperima rosea	2400	151.1	4400	310.3	4085	323.7	3626	432.3
	Benthodytes sordida	453	28.5	493	34.8			800	95.4
	Deima validum	513	32.3	522	36.8	354	28.1	730	87.0
	Ellipinion/Kolga	62	3.9	74	5.2	100	7.9	70	8.3
	Mesothuria candelabri	219	13.8	355	25.0	304	24.1	258	30.8
	Misc	21	1.3	2	0.1	5	0.4	1	0.1
	Molpadia blakei	110	6.9	133	9.4			77	9.2
	Oneirophanta mutabilis	8609	542.2	13572	957.2	7719	611.7	8320	991.9
	Paroriza prouhoi	1252	78.8	4830	340.6	1323	104.8	234	27.9
	Peniagone					72	5.7	49	5.8
	Protankyra brychia	4	0 3	7	0.5	4	0.3	2	0.2
	Pseudostichopus sp.	1046	65.9	2000	141.1	637	50.5	1216	145.0
	Pseudostichopus villosus	6900	434.5	9592	676.5	2829	224.2	3700	441.1
	Psychropotes longicauda	8337	525.0	5724	403.7	13249	1049.9	13500	1609.5
	Psychropotes semperiana	31	2.0					110	13.1
	Total Holothuroidea	**29957**	**1886.6**	**41704**	**2941.3**	**30681**	**2431.2**	**32693**	**3897.8**
CRINOIDEA						2	0.2	1	0.1
TUNICATA		11	0.7	19	1.3	15	1.2	47	5.6
OTHER	Clinker	27000	1700.4	30500	2151.1	6700	530.9	9100	1084.9
	Fish	8500	535.3	4700	331.5	18903	1497.9	18293	2181.0
Total Invertebrates		**31404**	**1977.7**	**44563**	**3142.9**	**31957**	**2532.3**	**34308**	**4090.3**
GRAND TOTAL		**66904**	**4213.4**	**79763**	**5625.5**	**57560**	**4561.1**	**61701**	**7356.2**

Table 7. Megabenthos from otter trawls taken about 20 nm from the central BENGAL locality

		13369#1		13369#2	
		Weight	per hectare 8.25944 hectares	Weight	per hectare 10.30796 hectares
PORIFERA		102	12.3	146	14.2
PENNATULACEA	Umbellula	76	9.2	51	4.9
ACTINIARIA	Actinauge abyssorum	102	12.3	147	14.3
	Amphianthus bathybium	33	4.0	60	5.8
	Doantesia			2	0.2
	Iosactis	9	1.1	31	3.0
	Kadosactis	5	0.6	1	0.1
	Misc			2	0.2
	Segonzactis platypus			4	0.4
	Sicyonis biotrans	130	15.7	250	24.3
	Total Actiniaria	**279**	**33.8**	**497**	**48.2**
MADREPORARIA		22	2.7	24	2.3
ZOANTHIDEA		5	0.6	2	0.2
ECHIURA		26	3.1	90	8.7
NEMERTINA					
SIPUNCULA		14	1.7	29	2.8
ANNELIDA	Polynoidae	41	5.0	100	9.7
	Worm tubes	152	18.4	70	6.8
	Total Annelida	**193**	**23.4**	**170**	**16.5**
CIRRIPEDIA		6	0.7	8	0.8
DECAPODA	Benthesicymus				
	Munidopsis	66	8.0		
	Natantia	227	27.5	532	51.6
	Plesiopeneus armatus	39	4.7	75	7.3
	Stereomastis	18	2.2		
	Total Decapoda	**350**	**42.4**	**607**	**58.9**
PYCNOGONIDA		5	0.6	2	0.2
GASTROPODA		21	2.5	14	1.4
SCAPHOPODA					
BIVALVIA			0.0	8	0.8
CEPHALOPODA		830	100.5	663	64.3
ASTEROIDEA					
	Dytaster	136	16.5	766	74.3
	Freyella	2	0.2	19	1.8
	Hyphalaster	3	0.4	112	10.9
	Misc			57	5.5
	Styracaster			28	2.7
	Total Asteroidea	**141**	**17.1**	**982**	**95.3**
OPHIUROIDEA				2	0.2
ECHINOIDEA		1	0.1		
HOLOTHURIOIDEA	Amperima rosea	1572	190.3	1278	124.0
	Benthodytes sordida	754	91.3		
	Deima validum	345	41.8	252	24.4
	Ellipinion/Kolga	15	1.8		
	Mesothuria candelabri			64	6.2
	Misc	2	0.2	13	1.3
	Molpadia blakei	31	3.8		
	Oneirophanta mutabilis	5188	628.1	5288	513.0
	Paronza prouhoi	790	95.6	533	51.7
	Peniagone	1060	128.3	69	6.7
	Protankyra brychia				
	Pseudostichopus sp.	1200	145.3	690	66.9
	Pseudostichopus villosus	5043	610.6	2136	207.2
	Psychropotes longicauda	2945	356.6	7816	758.2
	Psychropotes semperiana			163	15.8
	Total Holothuroidea	**18945**	**2293.7**	**18302**	**1775.5**
CRINOIDEA		1	0.1		
TUNICATA		72	8.7	51	4.9
OTHER	Clinker			7500	727.6
	Fish	27200	3293.2	35100	3405.1
Total Invertebrates		**21089**	**2553.3**	**21648**	**2100.1**
GRAND TOTAL		**48289**	**5846.5**	**64248**	**6232.9**

Holothurian Feeding Strategies

Five holothurian species (*Oneirophanta mutabilis*, *Psychropotes longicauda*, *Pseudostichopus villosus*, *Pseudostichopus sp.* and *Deima validum*) were sampled for enzyme profiles. Three replicate specimens were sampled for each species and all work was carried out in the CT lab at *in situ* temperatures. Sections were taken from the pharyngeal/oesophageal (**p/o**), anterior intestinal (**ai**), posterior intestinal (**pi**) and rectal/cloacal (**r/c**) gut regions. The contents of each gut section and the corresponding gut tissue (washed with 0.2μM microbially filtered seawater) were placed in separate eppendorfs and all samples were frozen at -70°C. Gut contents and tissue samples from *Paroriza prouhoi* were also taken for enzyme analysis, but only from the **ai** region of the gut.

Further samples of the gut contents from the **p/o** and **r/c** gut regions were taken from *O. mutabilis*, *P. longicauda* and *P. villosus* for possible radioisotope analysis.

Tentacle sections from these species were also taken for transmission electron microscopy (TEM). Ten full tentacles were dissected from specimens of each species and half of each tentacle was placed in absolute alcohol and sealed in a labelled glass vial. Tissue blocks measuring approximately 2mm x 2mm were then dissected from the other tentacle half and fixed in a gluteraldehyde/buffer fixative. Following three hours of fixation, the tissue pieces were processed through several Sodium Cacodylate buffer washes over a period of three days. All work with both fixative and buffer was carried out in the fume cupboard and following the final wash, all glass vials were sealed and stored at 3°C.

Samples of sediment were obtained multiple corer deployments at the central site for use as control sediment in holothurian enzyme analysis. Nine samples were taken, each from separate multicorer deployments: 13368#3 (core 2), #4 (core 12), #7 (core 6), #14 (core 5), #15 (core 2), #19 (core 1), #26 (core 6), #28 (core 1) and #40 (core 5). From each core, sediment horizons from the top 0-5mm and 5-10mm were removed in the CT lab and stored at -70°C.

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University of Liverpool (Tasks 50/51, 64/65).

Tasks 50/51

Sediment and pore water samples from 6 multiple corer deployments (2 or 3 cores per deployment; see Table 8) were collected. The cores used for sediment sampling were sectioned as follows: 0-5 mm, 5-10 mm, 10-20 mm, 20-30 mm, 30-40 mm, 40-50 mm, 50-60 mm, 60-100 mm, 100-150 mm, 150-200 mm. However, the sections taken for pore water sampling were 0-10 mm, 10-20 mm, 20-30 mm, 30-40 mm, 40-50 mm and 50-60 mm. The sediment samples were stored in solvent rinsed, foil wrapped petri dishes. Sections taken for

pore water analyses were centrifuged in prewashed (Decon, MQ) 50ml plastic centrifuge tubes (15 min; 2500 rpm; 4°C). The supernatant pore waters were then transferred, using a glass pipette (solvent extracted) into prewashed (Decon, MQ, solvent extracted) glass vials. Whenever possible (see Table 8), back up sediment cores were taken, these were extruded whole while still frozen, and wrapped in solvent wiped foil. All samples were frozen to -70°C initially, and then stored in the freezer at -20°C for the rest of the cruise.

Table 8. Sediment samples for Liverpool University

Date	Station # no	position	no of cores	Use	Gear
3/03/98	13368#4	central	3	whole sediment chemistry porewater chemistry	multicore
4/03/98	13368#7	central	3	whole sediment chemistry porewater chemistry	
8/03/98	13368#15	central	1	sediment chemistry	
13/03/98	13368#26	central	3	whole sediment chemistry porewater chemistry	
14/03/98	13368#28	central	3	whole sediment chemistry porewater chemistry	
15/03/98	13368#40	central	3	whole sediment chemistry porewater chemistry	

BIOFEED (Tasks 64/65)

This was the final short-term artificial enrichment experiment in a series initiated during RRS *Discovery* Cruise 222. The BIOFEED mooring is based on the original IOS DEMAR amphipod trap system, the trap being replaced by the core carrying unit. The core carrier and acoustic release (MORS OEM unit firing two pyroleases) are mounted on a small bottom landing frame with a recessed ballast weight. The mooring above the frame consists of a 30m braid line to a Billings triple pack float (G6600-3), a 10m braid line to a Billings recovery float fitted with a xenon flasher, and a final 15m length of polypropylene line with a single Billings float (G6600).

Details of the BIOFEED deployments are summarised below. When initially recovered by the multicorer, all the cores were somewhat disturbed and had fairly featureless surfaces. During the BIOFEED deployment the eyebolts securing two of the lifting bridles sheared when subject to heavy strain at the sea surface as the ship pitched in deteriorating weather. The rig was recovered without incident using the two remaining bridles. Inevitably, however,

it tipped almost onto its side when pulled out of the water. Fortunately, this caused no obvious disruption to the cores.

Station	Gear	Details	Comment
13368#11	Multicorer	Cores on deck at 0618hrs, 5.III.98	12 cores, one lost in lab
13368#12	BIOFEED	Deployed at 0753hrs, 5.III.98 Recovered at 0900hrs, 25.III.98	2 lifting bridles detached

Before the multicore deployment, numbers for the six enriched cores (1,4,6,9-11) and the six control cores (2,3,5,7,8,12) were chosen at random. As on cruises 226 and 229, preweighed amounts (~2 mg) of the algal mixture (*Emiliana huxlei : Dunaniella minuta : Haslea ostrearia* = 1:1:1) were provided by LUDO for the enrichment of the cores. The mixture was hydrated in 3ml artificial seawater (35gNaCl per ltr MQ), frozen into cubes and the cubes placed on top of the cores designated for enrichment. The cubes thawed and delivered the algal mixture into the sediment contact water. During a previous BIOFEED experiment (Cruise 222, Station 12930#7) many of the cores, controls as well as enriched, returned with their surfaces partly covered by phytodetritus-like material which had not been observed prior to the BIOFEED deployment. This material may possibly have entered the core tubes from the water column. For the present deployment, a fine-meshed gauze was stretched and secured over the tops of all the tubes in order to prevent the entry of such particles.

Following recovery of the BIOFEED rig the cores were quickly photographed and taken to the CT lab where each core was sliced into layers (0-0.5, 0.5-1.0, 1.0-1.5, 1.5-2.0, 2-3, 3-4, 4-5cm) and sampled for two purposes, as indicated below.

13368#11	13368#12	Treatment	Samples
Multicore position	BIOFEED position		
6	A1	Enriched	Nematodes-Forams
9	A2	Enriched	Chemistry-Bacteria
10	A3	Enriched	Chemistry-Forams
4	D1	Enriched	Nematodes-Chemistry
11	D2	Enriched	Nematodes-Bacteria
1	D3	Enriched	Bacteria-Forams
7	C1	Control	Chemistry-Bacteria
3	C2	Control	Bacteria-Forams
2	C3	Control	Lost (see above)
5	B1	Control	Chemistry-Forams
12	B2	Control	Nematodes-Bacteria
8	B3	Control	Nematodes-Chemistry

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University of Ancona (Tasks 50/51)

Five replicate cores were collected from separate multiple corer deployments, (see table 9) and sectioned as described above (see Liverpool sediment sampling). Four replicate cores were taken from a separate deployment, for these cores, 1 cm^3 subsamples of sediment from each section were collected, and placed in sterile plastic test tubes. Approximately 3 mls of 2% formalin were added to each sample (1ml pipettman pipette, autoclaved tips) the mixture was homogenised by shaking. Samples were stored as before.

Table 9. Sampling for the University of Ancona.

Date	Station#series	position	no. of cores	Use	Gear
3/03/98	13368#4	central	2	slicing	multicore
4/03/98	13368#7	central	2	slicing	multicore
9/03/98	13368#19	central	4	DNA	multicore
13/03/98	13368#26	central	2	slicing	multicore
14/03/98	13368#28	central	2	slicing	multicore
15/03/98	13368#40	central	2	slicing	multicore

University of Patras (Tasks 20, 50/51)

Tasks 50/51

Two cores from 5 multiple corer deployments were sectioned for the University of Patras (see table 10). Cores were sectioned and stored as described above.

Table 10. Sampling for the University of Patras.

Date	Station#series.	position	no.of cores	Use	Gear
3/03/98	13368#4	central	2	trace metals	multicorer
4/03/98	13368#7	central	2	trace metals	multicorer
13/03/98	13368#26	central	2	trace metals	multicorer
14/03/98	13368#28	central	2	trace metals	multicorer
15/03/98	13368#40	central	2	trace metals	multicorer

Minimum gut residence time of abyssal holothurians

The determination of minimum gut residence time for abyssal holothurians required an estimate for the maximal proteolytic activity which occurred within the gut sediment of collected animals, and a quantification of the amount of total hydrolysable amino acids present within the contents of the fore gut and rectum. Proteolytic activity within the gut contents of the *Oneirophanta mutabilis* and *Pseudostichopus villosus* was assessed from shipboard experiments which measured the rate of cleavage of an artificial substrate, L-leucine 7-amido-4-methylcoumarin, to yield a fluorogenic product.

The assay protocol which was similar to that described in previous BENGAL cruise reports, was as follows. Gut sediments were recovered from two *O. mutabilis* and one *Pseudostichopus*, respectively and then diluted with an equal volume of artificial seawater (NaCl 3.5% w/v) in order to facilitate pippetting. 1ml of the diluted gut sediment was added to sterile plastic bags that contained an appropriate amount of the assay substrate such that in the final reaction volume of 1.8 ml the concentration of the substrate varied between 0.11 mM and 14.2 mM. Air was excluded from all the bags which were then heat-sealed, and finally incubated under in situ conditions (480 bar, 4°C) for one hour. At this point the contents of each bag were transferred to Eppendorf tubes whereon the reaction was stopped by heat-treatment (65°C, 20 min), and the sediment removed by centrifugation (2,500 rpm, 20 min). Fluorescence was measured using an excitation wavelength of 375 nm and an emission wavelength of 455 nm . In order to take these measurements 10 ml of the supernatant was added to 2 ml sodium tetraborate buffer (4.77 g per 500 ml H_2O, pH adjusted to 10.0 with NaOH). Fluorescence was converted to mmoles of substrate cleaved from an appropriate calabration of the fluorescent product (amidomethylcoumarin), and Vmax was determined from a Lineweaver-Burke plot. The results are shown in Table 11.

Table 11. Vmax data for leucine aminopeptidase activity within holothurian gut contents

Station#dep.no.	Gear	Species	Vmax nmol hr^{-1} ml $sediment^{-1}$
13368#	OTSB	*O. mutabilis*	440
13368#	Chalut	*O. mutabilis* *P. villosus*	480 1600
13368#	Chalut	*O. mutabilis* *P. villosus*	300 520
13368#	Chalut	*O. mutabilis* *P. villosus*	520 420

Quantification of the total hydrolysable amino acids present within the gut contents will be determined in Liverpool from other samples collected during the course of the cruise: these are described in Table 12. In addition to this sampling a number of other holothurians were collected and then dissected to provide tissue material for biochemical studies to be carried out at Liverpool. Details of the animals and tissues which were taken are also described in Table 12.

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Table 12. Holothurian gut contents and tissue samples taken for analysis in Liverpool

Date	Animal	Deployment	no of specimens	dissection
10/3/98	*Oneirophanta*	13368#23	1	body, gut walls (four regions)
10/3/98	*mutabilis*	**13368#23**	**2**	**body, gonads, gut walls (four regions)**
11/3/98		13368#24	1	body, gonads, gut walls (four regions),
11/3/98		**13368#24**	**2**	**body, gonads, gut walls (four regions), gut contents (four regions)**
11/3/98		13368#24	6	gut contents (four regions) (samples from each animal pooled)
18/3/98		**13368#49**	**1**	**body, gonads, gut walls (four regions), gut contents (four regions)**
10/3/98	*Pyschropotes*	13368#23	1	body, gut walls (four regions)
10/3/98	*longicauda*	**13368#23**	**1**	**body, gonads, gut walls (four regions)**
18/3/98		13368#50	2	body, gonads, gut walls (four regions), gut contents (four regions)
19/3/98		**13368#52**	**3**	**gut contents (four regions) (samples from each animal pooled)**
10/3/98	*Pseudostichopous*	13368#23	3	body, gonads, gut walls (four regions)
10/3/98	*villousus*	**13368#23**	**1**	**body, gonads, gut walls (four regions), anterior gut and rectum contents**
10/3/98		13368#24	1	body, gonads, gut walls (four sections), gut contents (four regions)
18/3/98		**13368#50**	**1**	**body, gonads, gut walls (four regions), gut contents (four regions)**
10/3/98		13368#23	**3**	gut contents (four regions) (samples from each animal pooled)
19/3/98	*Amperima rosea*	13368#52	53	frozen whole
10/3/98	*Deima* spp.	13368#23	1	body, gonads, gut walls (four regions), gut contents (four regions)
11/3/98		**13368#24**	**1**	**body, gonads, gut walls (four regions), gut contents (four regions)**
Date	Animal	Deployment	no of specimens	Dissection
11/3/98	*Paroriza prouhoi*	13368#24	1	body, gonads, gut walls (four regions), gut contents (four regions)
		13368#	**1**	**body, gonads, gut walls (four regions)**
23/3/98	*Pseudostichpous* spp.	13369#2	3	body, gut walls (not sectioned)
10/3/98	*Molpadia blakei*	13368#23	2	body, gut walls (not sectioned)

The four gut regions that were sampled were the oesophagus, anterior gut, posterior gut, and rectum

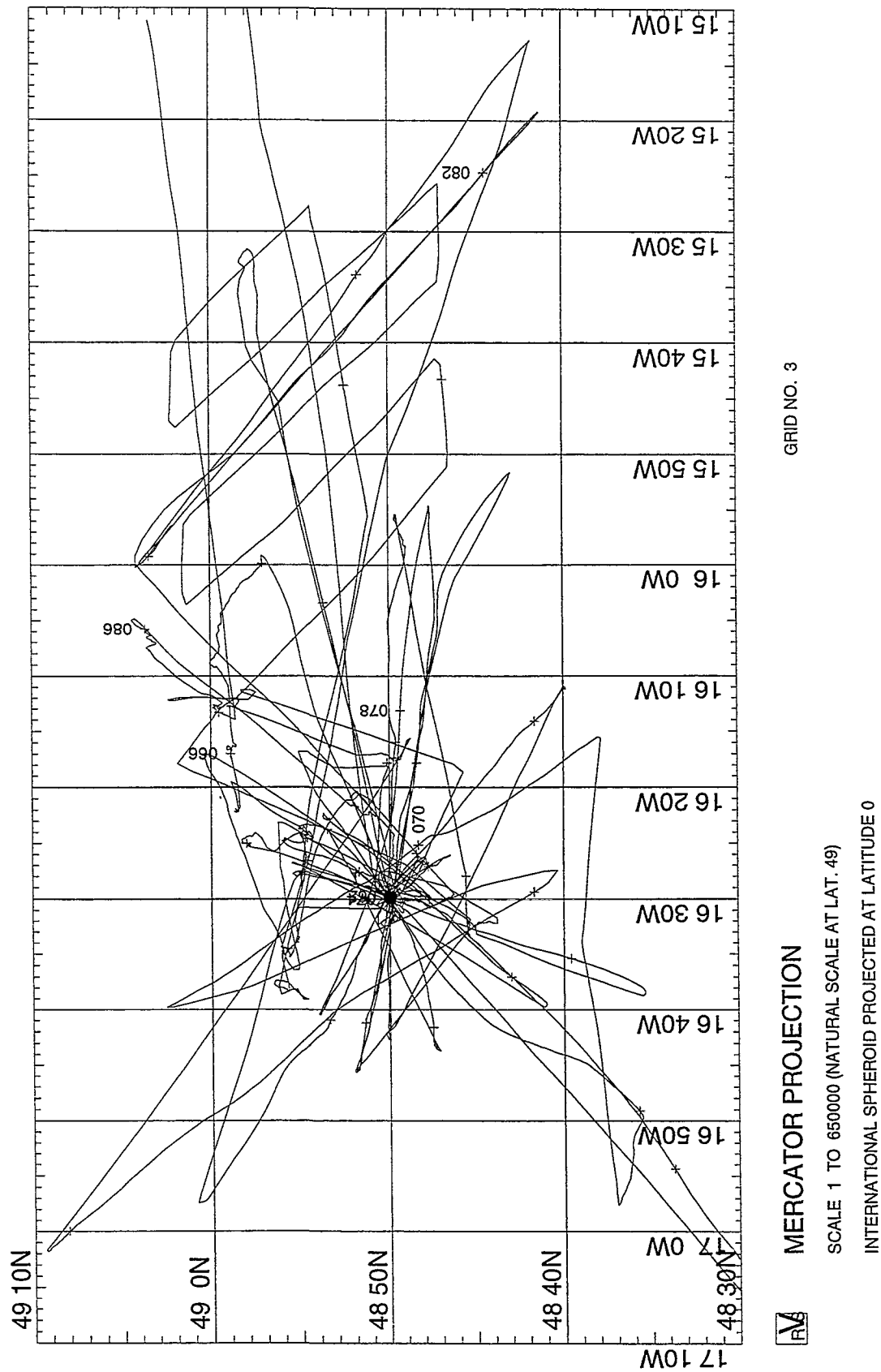

Figure 5. *Discovery* cruise 231. Track chart in the main work area and the adjacent area.

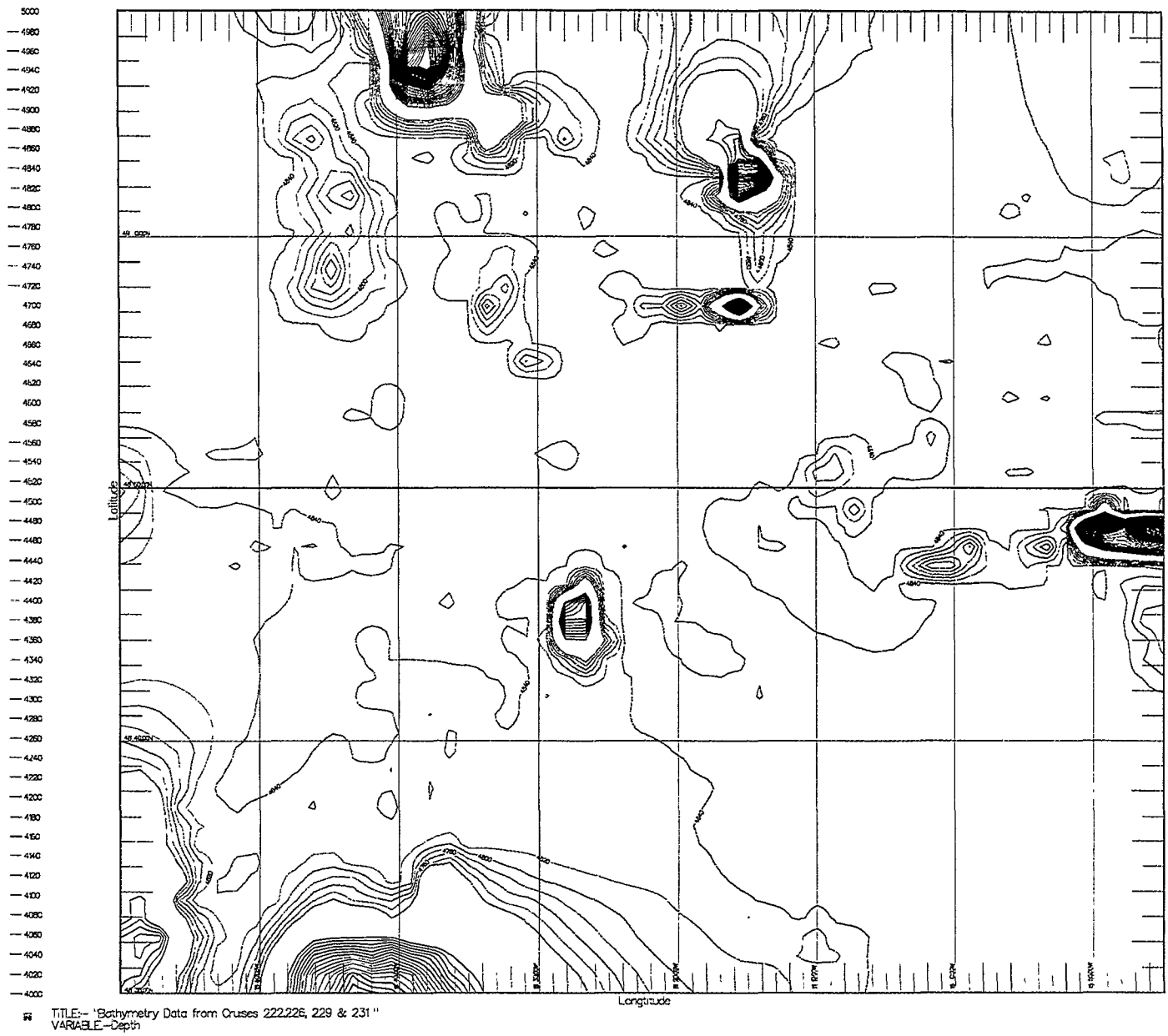

Figure 6. Computer generated bathymetry of the work area including data from *Discovery* cruise 231.

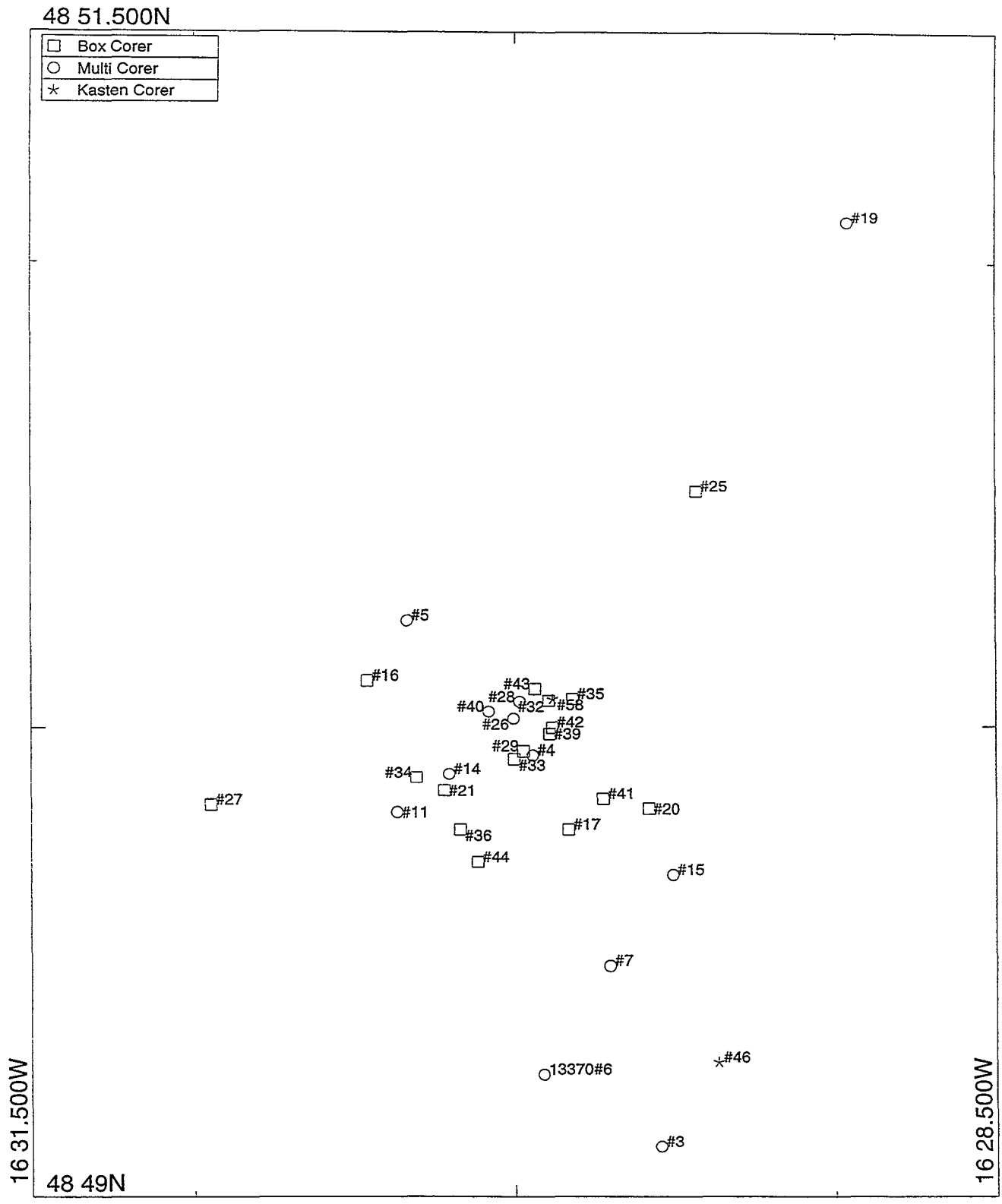

Figure 7. Positions of box, multi and Kasten cores in the central area.

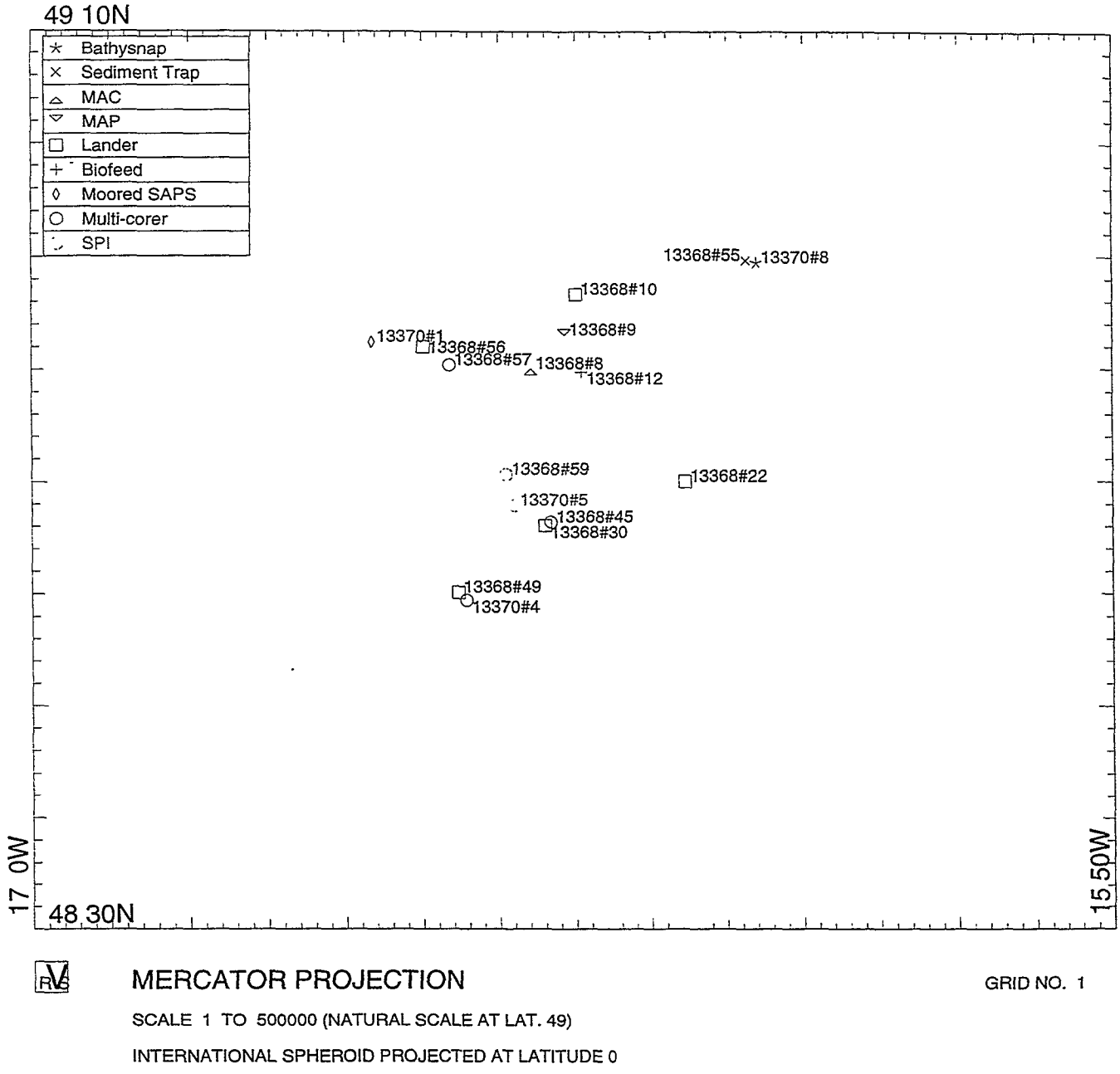

Figure 8. Positions of the moored gears and vertical deployments outside the central area.

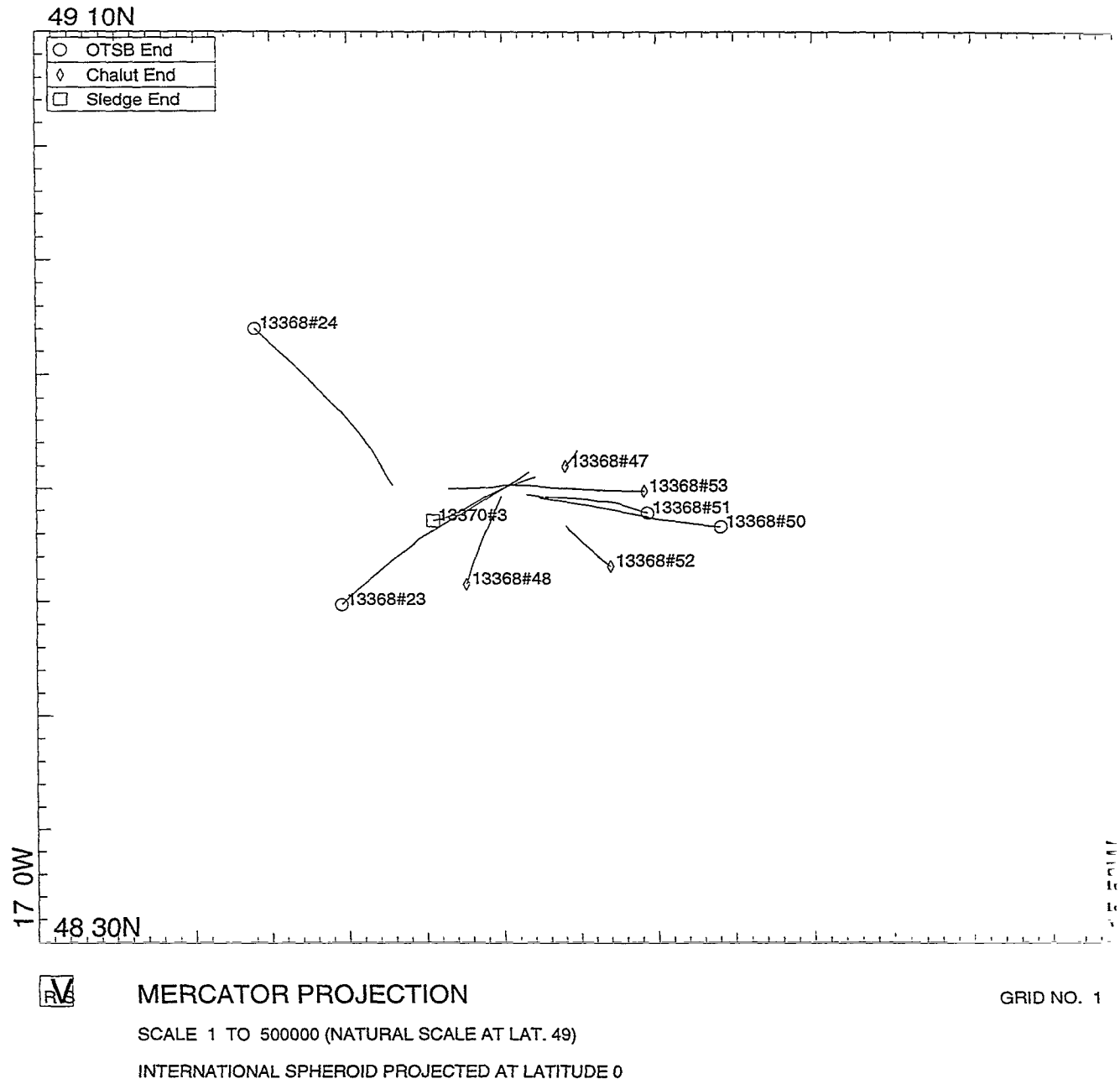

Figure 9. Bottom tracks of towed gears at the BENGAL site

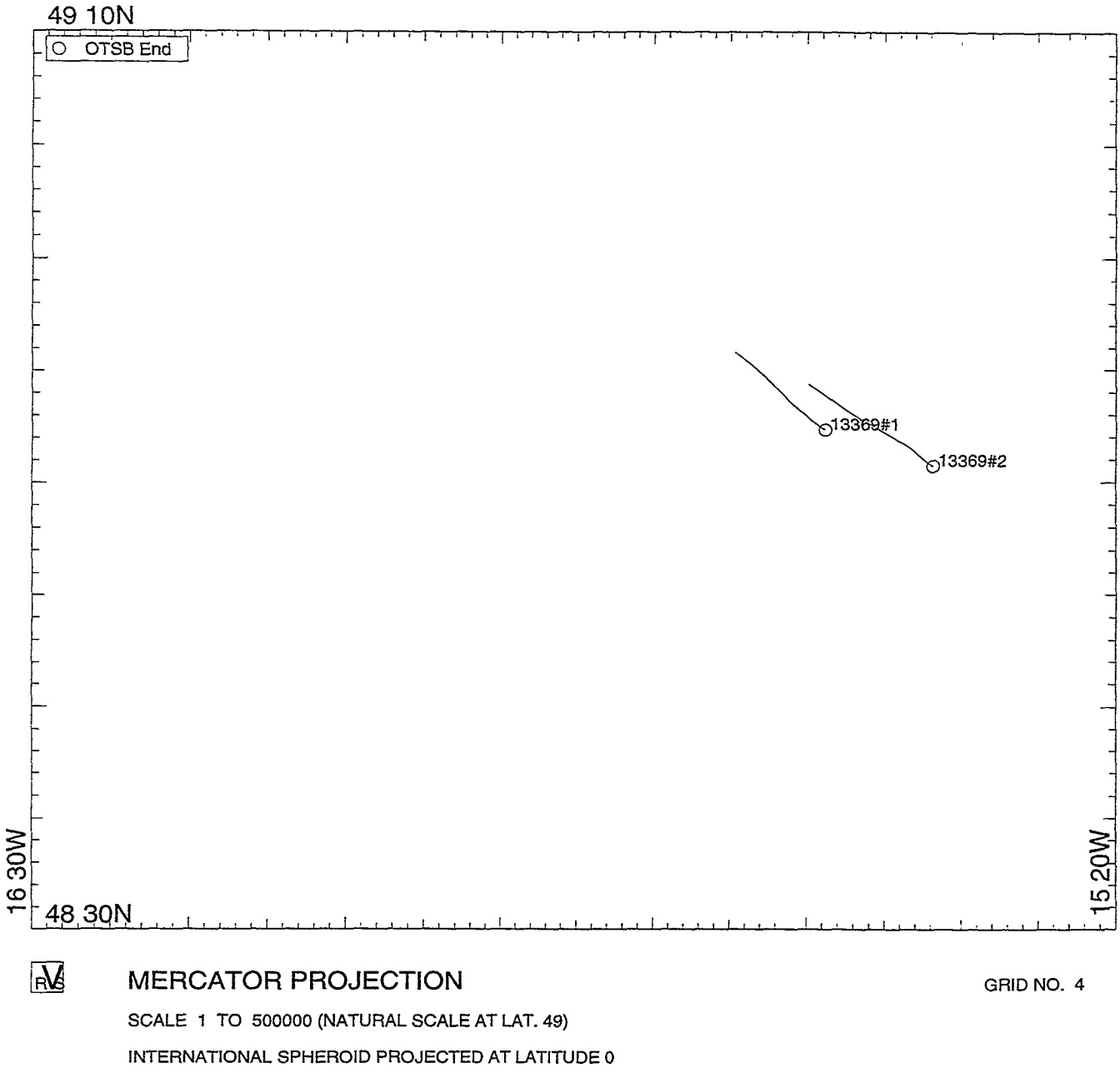

Figure 10. Bottom tracks of the two OTSB hauls adjacent to the BENGAL site.

GEAR USED ON DISCOVERY CRUISE 231

BIOFEED	Short-term enrichment experiment based on multiple corer samples
BOX CORER	Spade box corer (0.25m^2), modified USNEL type, fitted with plain box
BSNAP	BATHYSNAP: free-fall time-lapse camera system
CP	Chalut à perche: 6m beam trawl
CTD	Conductivity-temperature depth probe
GOTEBORGL	Goteborg multifunction lander system (VIRUS III)
KASTEN	Kasten corer with square section core tube 10cm on a side, length 2m
MAC	Module Autonome de Colonisation: long-term enrichment and recolonisation experiment
MAP	Module Autonome Pluridisciplinaire
MLT CORER	Multiple corer, Barnett pattern, using 12 57mm i.d. core tubes
MS	Multi-sampler: water bottle rosette mounted on CTD frame
OTSB14	Semi-balloon otter trawl with 14m headline. effective fishing width 8.6m
MSAPS	Stand alone pump system mounted on free fall rig
SED TRAP	Sediment trap array. SOC version with three carousel traps at 1000m, 3000m and 100mab: NIOZ version with one carousel trap 10mab
SPI	Sediment Profile Imagery camera
WASP	Wide Angle Survey Photography instrument

STATION LISTS AND BIO LOGS

STN	DATE 1998	POSITION LAT.	LONG.	GEAR	DEPTH (m)	TIMES GMT	COMMENT	MEAN SOUND. (m)
13200 #95	26/07 12/03	48 57.92N	16 11.62W	BSNAP	-4842	10:59-14:48	Camera flashing on recovery	4842
13200 #96	26/07 12/03	48 59.41N	16 12.97W	SED. TRAP	-4842	15:28-11:00	Traps and current meters OK	4842
13368 # 1	02/03 03/03	48 50.06N 48 49.80N	16 29.83W 16 29.53W	CTD/MS	0- 150	23:55-00:25	Bottles at 60, 100 and 150 m	4844
13368 # 2	03/03	48 49.82N 48 49.45N	16 29.71W 16 29.36W	CTD/MS	0-4820	01:23-05:35	CTD failed, bottles and wire test OK	4845
13368 # 3	03/03	48 49.11N	16 29.54W	MLT.CORER	-4846	10:46-	12 poor cores	4846
13368 # 4	03/03	48 49.94N	16 29.94W	MLT.CORER	-4848	15:10-	12 good cores	4848
13368 # 5	03/03	48 50.23N	16 30.34W	MLT.CORER	-4846	20:29-	12 good cores	4846
13368 # 6	03/03 04/03	48 49.90N 48 49.87N	16 29.86W 16 30.02W	CTD/MS	0-4836	23:25-03:10	Bottles at 48, 1008, 3008 and 4836 m	4846
13368 # 7	04/03	48 49.49N	16 29.70W	MLT.CORER	-4844	05:38-	12 Good cores	4844
13368 # 8	04/03	48 55.02N	16 27.91W	MAC	-4848	21:38-	For recovery D236, Oct 1998	4848
13368 # 9	04/03	48 56.52N	16 25.74W	MAP	-4848	23:05-	For recovery D236, Oct 1998	4848
13368 #10	05/03 06/03	48 58.32N	16 24.99W	GOTEBORGL	-4852	02:36-20:00	Released in error, 36 hours adrift	4852
13368 #11	05/03	48 49.82N	16 30.37W	MLT.CORER	-4845	04:50-	12 Good cores for BIOFEED	4845
13368 #12	05/03 25/03	48 54.88N	16 24.62W	BIOFEED	-4851	09:55-06:03	2/4 bridles parted on launch	4851
13368 #13	07/03	48 58.30N 48 57.13N	16 01.65W 15 59.33W	CTD/MS	0-4840	09:20-13:10	Bottles at 80, 3956 and 4804 m	4845

STN	DATE 1998	POSITION LAT.	LONG.	GEAR	DEPTH (m)	TIMES GMT	COMMENT	MEAN SOUND. (m)
13368 #14	07/03	48 49.90N	16 30.21W	MLT.CORER	-4844	20:27-	12 Poor cores	4844
13368 #15	08/03	48 49.68N	16 29.51W	MLT.CORER	-4845	01:04-	10/12 cores of variable quality	4845
13368 #16	08/03	48 50.10N	16 30.46W	BOX CORER	-4842	15:41-	Deep core (no limiter), poor sample	4842
13368 #17	08/03	48 49.78N	16 29.83W	BOX CORER	-4842	20:22-	Short core, top water leaked	4842
13368 #18	09/03	48 50.06N 48 49.94N	16 29.73W 16 32.21W	SPI	4842-4849	01:40-05:35	60 attempts, no profiles	4846
13368 #19	09/03	48 51.09N	16 28.96W	MLT.CORER	-4842	09:54-	12 Excellent cores, frame damaged	4842
13368 #20	09/03	48 49.83N	16 29.58W	BOX CORER	-4844	14:19-	Short core (limiter), top water leaked	4844
13368 #21	09/03	48 49.86N	16 30.22W	BOX CORER	-4841	18:48-	Deep core (no limiter), very disturbed	4841
13368 #22	10/03 12/03	48 50.00N	16 17.74W	GOTEBORGL	-4845	02:10-06:53	Power problems, not full function	4845
13368 #23	10/03	48 50.70N 48 44.84N	16 28.34W 16 40.44W	OTSB14	4842-4844	05:05-09:10	Fair catch, sweeps twisted together Dist. run 18.5 km	4844
13368 #24	11/03	48 50.31N 48 57.01N	16 37.30W 16 46.02W	OTSB14	4802-4844	16:39-19:47	Good clean catch Dist. run 16.5 km	4844
13368 #25	12/03	48 50.51N	16 29.43W	BOX CORER	-4842	22:15-	Good sample, full protocol	4842
13368 #26	13/03	48 50.02N	16 30.00W	MLT.CORER	-4844	02:32-	Twelve excellent cores	4844
13368 #27	13/03	48 49.83N	16 30.95W	BOX CORER	-4845	07:20-	Poor core, limited protocol	4845
13368 #28	13/03	48 50.06N	16 29.98W	MLT.CORER	-4841	11:20-	Twelve excellent cores	4841

STN	DATE 1998	POSITION LAT.	LONG.	GEAR	DEPTH (m)	TIMES GMT	COMMENT	MEAN SOUND. (m)
13368 #29	13/03	48 49.95N	16 29.97W	BOX CORER	-4846	15:07-	Poor core, limited protocol	4846
13368 #30	13/03 15/03	48 48.02N	16 26.99W	GOTEBORGL	-4842	19:55-13:35	Fitted with new batteries	4842
13368 #31	13/03	48 49.98N	16 30.10W	WASP	-4844	21:49-	Aborted, midwater shots and video	4844
13368 #32	14/03	48 50.06N	16 29.89W	BOX CORER	-4844	01:15-	No sample, release jammed	4844
13368 #33	14/03	48 49.93N	16 30.00W	BOX CORER	-4845	04:55-	Fair core, full protocol	4845
13368 #34	14/03	48 49.89N	16 30.31W	BOX CORER	-4842	09:04-	Poor core, limited protocol	4842
13368 #35	14/03	48 50.06N	16 29.82W	BOX CORER	-4844	13:34-	Disturbed core, reduced protocol	4844
13368 #36	14/03	48 49.78N	16 30.17W	BOX CORER	-4845	17:27-	Good core, full protocol	4845
13368 #37	14/03	48 49.83N 48 50.11N	16 30.28W 16 30.20W	CTD/MS	0-4839	20:20-23:48	Successful deep cast	4844
13368 #38	15/03	48 50.03N 48 49.97N	16 29.93W 16 29.89W	CTD/MS	0- 155	00:24-00:50	Successful shallow cast	4844
13368 #39	15/03	48 49.99N	16 29.89W	BOX CORER	-4845	03:02-	Excellent core, full protocol	4845
13368 #40	15/03	48 50.03N	16 30.08W	MLT.CORER	-4846	06:44-	Twelve good cores	4846
13368 #41	15/03	48 49.85N	16 29.72W	BOX CORER	-4845	11:04-	Poor core, reduced protocol	4845
13368 #42	15/03	48 50.00N	16 29.88W	BOX CORER	-4845	17:46-	Reasonable core, full protocol	4845
13368 #43	15/03	48 50.08N	16 29.94W	BOX CORER	-4844	21:18-	Good core, full protocol	4844

STN	DATE 1998	POSITION LAT.	LONG.	GEAR	DEPTH (m)	TIMES GMT	COMMENT	MEAN SOUND. (m)
13368 #44	16/03	48 49.71N	16 30.12W	BOX CORER	-4844	01:07-	Excellent core, full protocol	4844
13368 #45	16/03	48 48.18N	16 26.62W	MLT.CORER	-4844	05:26-	Twelve good cores, lander site	4844
13368 #46	16/03	48 49.29N	16 29.36W	KASTEN	-4842	09:21-	Good core, but top lost	4842
13368 #47	16/03	48 51.63N 48 50.93N	16 25.18W 16 25.99W	CP	4844-4844	19:33-20:26	Fair / small catch Dist. run 1.7 km	4844
13368 #48	17/03	48 49.64N 48 45.78N	16 30.12W 16 32.37W	CP	4841-4845	08:24-10:30	Good catch Dist. run 7.7 km	4844
13368 #49	17/03 20/03	48 45.06N	16 32.68W	GOTEBORGL	-4840	18:24-12:27	Successful deployment	4840
13368 #50	17/03 18/03	48 49.58N 48 48.25N	16 27.72W 16 15.91W	OTSB14	4840-4840	23:28-02:04	Good catch Dist. run 14.7 km	4840
13368 #51	18/03	48 49.71N 48 48.88N	16 28.42W 16 20.61W	OTSB14	4840-4840	15:59-17:50	Another good catch Dist. run 9.8 km	4840
13368 #52	19/03	48 48.30N 48 46.57N	16 25.97W 16 23.00W	CP	4839-4839	08:31-09:40	Small catch Dist. run 4.9 km	4839
13368 #53	19/03 20/03	48 49.98N 48 49.86N	16 33.53W 16 20.84W	CP	4842-4846	20:25-00:10	Enormous catch Dist. run 15.6 km	4844
13368 #54	20/03	48 48.99N 48 49.62N	15 58.77W 15 55.65W	CTD/MS	0-4843	05:47-09:12	Bottles failed	4848
13368 #55	22/03	48 59.83N	16 13.73W	SED. TRAP	-4723	12:00-	Uneventful deployment	4723
13368 #56	21/03 24/03	48 56.00N	16 34.94W	GOTEBORGL	-4840	17:48-10:32	Successful deployment	4840
13368 #57	21/03	48 55.19N	16 33.24W	MLT.CORER	-4841	18:32-	Twelve good cores	4841
13368 #58	21/03	48 50.06N	16 29.88W	KASTEN	-4841	23:08-	Good but too long	4841

STN	DATE 1998	POSITION LAT.	LONG.	GEAR	DEPTH (m)	TIMES GMT	COMMENT	MEAN SOUND. (m)
13368 #59	22/03	48 50.30N 48 50.12N	16 29.54W 16 28.28W	SPI	4839-4843	03:38-05:28	No profiles, flash leaked	4839
13369 # 1	22/03	48 55.79N 48 52.33N	15 44.66W 15 38.85W	OTSB14	4826-4841	19:14-21:00	Good catch near PAP Dist. run 9.6 km	4837
13369 # 2	23/03	48 54.37N 48 50.72N	15 39.93W 15 31.86W	OTSB14	4828-4837	12:18-14:37	Good catch, lots of fish Dist. run 12.0 km	4833
13370 # 1	24/03	48 56.22N	16 38.29W	MSAPS	-4840	05:00-07:00	424 litres at 1 mab	4840
13370 # 2	24/03	48 55.25N 48 54.73N	16 38.15W 16 39.06W	CTD/MS	0-4837	03:10-06:52	Successful cast	4840
13370 # 3	24/03	48 50.48N 48 48.54N	16 27.91W 16 34.53W	BN1.5/C	4839-4840	19:15-21:45	With video, went upsidedown Dist. run 9.3 km	4839
13370 # 4	25/03	48 44.71N	16 32.17W	MLT.CORER	-4839	16:23-	12 good cores, lander site	4839
13370 # 5	25/03 26/03	48 48.94N 48 47.07N	16 28.99W 16 26.65W	SPI	4839-4840	21:30-01:30	24 good profiles	4840
13370 # 6	26/03	48 49.26N	16 29.91W	MLT.CORER	-4839	06:29-	12 Good cores	4839
13370 # 7	26/03	48 47.66N 48 46.33N	16 30.83W 16 29.61W	CTD/MS	0-1419	09:10-11:15	Cast aborted, no samples	4839
13370 # 8	27/03	48 59.73N	16 13.03W	BSNAP	-4823	13:06-	For recovery D236, Oct 1998	4823

Gear used	Depth	Notes on catch
3200#95 SNAP	4809 ucm =4842 m corr.	10:59 - 14:48 z 26/07/1997 - 12/03/1998 4842 m 48° 57.92´ N 16° 11.62´ W Recovery of Bathysnap laid on Discovery cruise 229. Rig was in good condition and one of the timed flashes occurred as the camera was being recovered. Other flashes occurred on cue on deck over the following day. An appropriate quantity of film had passed throught the camera.
3200#96 ED. TRAP	4809 ucm =4842 m corr.	15:28 - 11:00 z 26/07/1997 - 12/03/1998 4842 m 48° 59.41´ N 16° 12.97´ W Recovery of sediment trap array laid on Discovery cruise 229. All three traps (1000m, 3000m and 100m above bottom) worked. Detrital material in all containers. Fauna (crustaceans and polychaetes) in some containers too. All containers apparently with preservatice still (pH range 6.0 to 6.5). Top (A, 1000m) and bottom (C, 100mab) traps recovered vertically, middle trap (B, 3000m) on its side. Bottom trap (c) had a slight rotor misalignment (one notch) by end of deployment.
13368#1 CTD/MS	4810 ucm =4844 m corr.	23:55 - 00:25 z 02/03/1998 - 03/03/1998 0 - 150 m 48° 50.06´ N 16° 29.83´ W - 48° 49.8´ N 16° 29.53´ W Shallow CTD to collect bacteria for incubation experiments by the University College Galway. Six bottles fired at 150 m (5 successful) - water from these used. Samples also taken at 100 m (3 bottles) and 60 m (1 bottle) - used for calibration.
13368#2 CTD/MS	4811 ucm =4845 m corr.	01:23 - 05:35 z 03/03/1998 - 03/03/1998 0 - 4820 m 48° 49.82´ N 16° 29.71´ W - 48° 49.45´ N 16° 29.36´ W On downcast temperature and conductivity failed at 750 m. No oxygen data and apparently no fluorometer data. The cast was continued to within 25 m of the seabed (sounding 4845 m) and 5 bottles (+1 misfire) taken at this depth. Samples used by the University of Gotenborg for DOC, TOC, CO2, O2, nutrients and to fill syringes in the Goteborg lander system. Other samples taken at 4027 (2), 2988 m (1), 1955 m (3) - used for calibration. Release test for BIOFEED (MORS s/n 333) and two MORS releases for the Goteborg lander.
13368#3 MLT.CORER	4812 ucm =4846 m corr.	10:46 z 03/03/1998 4846 m 48° 49.11´ N 16° 29.54´ W Difficult to see when multicorer reached the seafloor. Final separation of pinger from the seabed was about 15 m. Not a good wire angle. Twelve poor samples. Three frozen for NIOZ, one QUB for organics/sediment analysis, one for SOC and one for Gent. All these were later discarded because the quality of the cores was not good. Cores c. 30 cm long, tops of all cores sloped. Some burrows.
13368#4 MLT.CORER	4814 ucm =4848 m corr.	15:10 z 03/03/1998 4848 m 48° 49.94´ N 16° 29.94´ W Twelve good cores, 31-35 cm long. One core with a xenophyophore (a second specimen of a new species of Reticulammina found originally on RRS Discovery cruise 229 - July 1997). Samples replaced those taken at #3, used for NIOZ (3 cores frozen for pigment analysis), QUB sediment analysis (1 core), meiofauna (Gent and SOC 1 core each), and organic chemistry (Liverpool 6 cores).
13368#5 MLT.CORER	4812 ucm =4846 m corr.	20:29 z 03/03/1998 4846 m 48° 50.23´ N 16° 30.34´ W Twelve good cores. All used by IFREMER for meiofauna studies (metazoan and foraminifera related to the BENGAL programe). A few burrows evident in samples but otherwise no features of note.

Gear used	Depth	Notes on catch
13368#6 CTD/MS	4812 ucm =4846 m corr.	23:25 - 03:10 z 03/03/1998 - 04/03/1998 0 - 4836 m 48° 49.9′ N 16° 29.86′ W - 48° 49.87′ N 16° 30.02′ W To collect deep water samples and to test monitor (epibenthic sledge) and releases (MORS s/n 386 for DEMAR and 283 for SOC sediment trap array). Also carried Aanderaa RCM s/n 9440 for pressure calibration. Five bottles from 10 mab taken for bacterial DNA analysis.
13368#7 MLT.CORER	4810 ucm =4844 m corr.	05:38 z 04/03/1998 4844 m 48° 49.49′ N 16° 29.7′ W Twelve good cores; six for organic chemistry (University of Liverpool), two for metazoan meiofauna (University of Gent), one for foraminifera (SOC), one for bacteria (University College Galway), one for sediment analysis (Queens University Belfast), and one retained in cold room (3 deg. C). One xenophyophore (plate-like) sticking vertically out of core. Several burrows. Some 'lumpy' cores and some cracking apparent in cores 6 and 12 near surface, may indicate some disturbance during sampling. Overlying water clear nevertheless.
13368#8 MAC	4814 ucm =4848 m corr.	21:38 z 04/03/1998 4848 m 48° 55.02′ N 16° 27.91′ W Mooring not watched down. Colonisation chambers open 5-9 hours after deployment. To be recovered during RRS Discovery cruise 236 (Sept/Oct 1998).
13368#9 MAP	4814 ucm =4848 m corr.	23:05 z 04/03/1998 4848 m 48° 56.52′ N 16° 25.74′ W Carries current meter and nephelometer (each recording at 30 minute intervals), camera (6 hr interval) plus temperature sensor and a sediment trap. (Sediment trap - 12 bottles: 22 Mar - 15 Sept, 28, 14, 14, 14, 7, 14, 14, 14, 14, 14, 14 days.
13368#10 GOTEBORGL	4818 ucm =4852 m corr.	02:36 - 20:00 z 05/03/1998 - 06/03/1998 4852 m 48° 58.32′ N 16° 24.99′ W Goteborg multifunction lander for sediment incubation experiments. Four chambers enclosing a sediment sample of 400 cm2. In addition to an O2 electrode in each chamber, water samples are taken, by syringe, every 6 hours for a period of up to 60 hours. Samples of ambient water are taken in parallel. Studies the flux of O2, CO2, TOC, DOC and nutrients. Lander also carries a video camera to record arrival on seabed. Rig released in error while attempting to locate the previous Goteborg lander lost on RRS Discovery cruise 226 - same codes used. Lander arrived at sea surface at night in poor weather. With poor weather forecast the lander was left to drift for retrieval at a later date.
13368#11 MLT.CORER	4811 ucm =4845 m corr.	04:50 z 05/03/1998 4845 m 48° 49.82′ N 16° 30.37′ W Twelve good cores, if a little disturbed, but still considered good enough for the BIOFEED enrichment experiments. Featureless cores apart from a couple of burrows.
13368#12 BIOFEED	4817 ucm =4851 m corr.	09:55 - 06:03 z 05/03/1998 - 25/03/1998 4851 m 48° 54.88′ N 16° 24.62′ W Sediment enrichment experiment. MORS OEM release unit s/n 333 - pinger A294, pyro A276 + A291, release A276 +A279, off A278. Descent rate 44.6 m/min. Two bridles parted on launch causing rig to tilt relative to the buoyancy package, but a diagnostic test showed that the rig had landed the right way up. Parting of the bridles may have resulted from weakening due to use of mild steel bolts on the aluminium frame. However, on recovery the the eyebolts were found to have sheared through - excessive snatch load from large swell againt the flat surfaces of the rig.

Gear used	Depth	Notes on catch
13368#13 CTD/MS	4811 ucm =4845 m corr.	09:20 - 13:10 z 07/03/1998 - 07/03/1998 0 - 4840 m 48° 58.3′ N 16° 1.65′ W - 48° 57.13′ N 15° 59.33′ W Deep CTD and bottle cast. Ten bottles taken at 4804 m. Water used for the Goteborg lander group for the same analyses as with #2.
13368#14 MLT.CORER	4810 ucm =4844 m corr.	20:27 z 07/03/1998 4844 m 48° 49.9′ N 16° 30.21′ W Heavy swell running. Twelve poor cores but all were very disturbed. 29-34 cm long. Three cores used for Queens University Belfast and University of Goteborg.
13368#15 MLT.CORER	4811 ucm =4845 m corr.	01:04 z 08/03/1998 4845 m 48° 49.68′ N 16° 29.51′ W Ten cores 13-22 cm long. Some disturbance but four cores were in good enough condition for 'A' class samples by University College Galway (2 cores), University of Gent (1 core), and SOC (1 core). Two other coes were used by University of Liverpool and Queens University Belfast. Three cores discarded. Arms on the two missing core positions had been turned through 90 degrees and had jammed.
13368#16 BOX CORER	4809 ucm =4842 m corr.	15:41 z 08/03/1998 4842 m 48° 50.1′ N 16° 30.46′ W Deep core almost to the top of the box (no limiter on the column). Surface very disturbed - not much water on top and the core had one or two arguments with the side of the ship on recovery. Conditions marginal for box coring. Sample used by IFREMER for experiment on wet weight biomass to carbon content ratio. Top 5 cm taken and sieved at 1mm, 500um and 300 um. Animals were sorted and frozen at -20deg.C (polychaetes, bivalves, sponges, tanaids, isopods and sipunculids).
13368#17 BOX CORER	4809 ucm =4842 m corr.	20:22 z 08/03/1998 4842 m 48° 49.78′ N 16° 29.83′ W Box half full (limiter in place, half way down the column - to avoid sloshing of water on core surface during recovery). Water lost down the side of the box taking away lighter material from the core surface. Core surface disturbed, not a pretty sight. Sample used as in #16. On surface of core three polychaete tubes c. 5 cm long. Xenophyophores also. Sample sieved at 1mm and 500um only.
13368#18 SPI	4812 ucm =4846 m corr.	01:40 - 05:35 z 09/03/1998 - 09/03/1998 4842 - 4849 m 48° 50.06′ N 16° 29.73′ W - 48° 49.94′ N 16° 32.21′ W System working on deck before deployment, if a bit erratically, but did not work at all on the seabed. No profiling images collected.
13368#19 MLT.CORER	4809 ucm =4842 m corr.	09:54 z 09/03/1998 4842 m 48° 51.09′ N 16° 28.96′ W Twelve excellent cores, despite an experiment on working out the SWL of a multicore leg on recovery. One leg caught in the scuppers between the bulwark and the deck, shearing the top bolt of the leg upper and putting a 90 degree bend in one of the internal crossbars before the winch could be stopped. The cores had slightly cloudy water, but were in better condition than most of the people on deck from the fright of the bolt parting with a thunderous crack. One core had a 'stone' covered in encrusting foraminifera, mainly Telammina minuta Gooday and Haynes, 1983. Samples for the University of Ancona (handled by University of Liverpool) (4 cores), UCG (2 cores), Gent (2 cores), SOC (1 core), QUB (1 core) and two chilled at 2 deg. C for later analysis.

Gear used	Depth	Notes on catch
13368#20 BOX CORER	4810 ucm =4844 m corr.	14:19 z 09/03/1998 4844 m 48° 49.83´ N 16° 29.58´ W Box less than half full (limiter in place). Front of box bowed out. No good seal so overlying water gushed out. Very disturbed surface. Used by IFREMER as in #16. Pull out 8.12 T. Samples sieved at 1 mm and 500 um only (Polychaetes, Sipunculids, Bivalves [pectinids], Scaphopods, Tanaids, Isopods, and Tunicate).
13368#21 BOX CORER	4808 ucm =4841 m corr.	18:48 z 09/03/1998 4841 m 48° 49.86´ N 16° 30.22´ W Deep core (no limiter on column) but surface of core very disturbed again with imprints of the core box. Used by IFREMER as in #16, 1mm and 500 um sieves only. Pull out 8.38 T. Stone covered with foraminifera (Trochammina and Citicidoides wuellerstorfi). Sample otherwise contained polychaetes, sipunculids, tanaids, isopods and an apodid holothurian (? Protankyra).
13368#22 GOTEBORGL	4811 ucm =4845 m corr.	02:10 - 06:53 z 10/03/1998 - 12/03/1998 4845 m 48° 50´ N 16° 17.74´ W Deployment of repaired lander. Sinking rate of 35 m/min. Ascent rate of 90m/min. Recovery of the lander had some problems with the lander swinging around and hitting the ship's side. Consequently the one sediment sample taken was very disturbed. It is thought that there was not enough power to close the other three chambers so they returned empty. 35 out of the 50 syringes took samples of the overlying water in the chambers. Again power problems probably caused the loss of the remaining 15 syringe samples. The main electronics system controlling the oxygen sensor did not work.
13368#23 OTSB14	4810 ucm =4844 m corr.	05:05 - 09:10 z 10/03/1998 - 10/03/1998 4842 - 4844 m 48° 50.7´ N 16° 28.34´ W - 48° 44.84´ N 16° 40.44´ W A good catch, much the same as on previous cruises, though perhaps with fewer Amperima than expected. Holothurians dominant (Psychroptes longicauda, Oneirophanta mutabilis, Pseudostichopus villosus etc.). Catch otherwise not particularly notable, apart from three Umbellula and some fragments of wood. Recovery of the trawl was made in very difficult conditions with harnasses attached to deck workers, A few waves taken over the stern during the operation, more fun for those watching. Trawl doors tangled and sweeps rendered useless, possibly because the swivel on one door had siezed. Moderate catch in terms of size. Several large fish - including eels (? Histiobranchus), Coryphaenoides armatus (1) and three other unidentified species (all preserved). Large amount of clinker.
13368#24 OTSB14	4810 ucm =4844 m corr.	16:39 - 19:47 z 11/03/1998 - 11/03/1998 4802 - 4844 m 48° 50.31´ N 16° 37.3´ W - 48° 57.01´ N 16° 46.02´ W Trawl passed over small 30 m relief mound hence the wider depth distribution for the trawl (32 m) than normally encountered. A good catch of the usual fauna in roughly the same proportions, although the abundance of Amperima was again lower than that encountered last year. There appeared to be quite a number of small Amperima in the catch, another notable difference to previous years. Holothurians dominated, with quite a number of Paroriza prouhoi in this particular catch. Of the other invertebrates, the most notable were the actiniarians Sicyonis, several large specimens that had a significant impact on the biomass of this group. The fish catch was similar to #23. Lots of clinker again.

Gear used	Depth	Notes on catch
13368#25 BOX CORER	4809 ucm =4842 m corr.	22:15 z 12/03/1998 4842 m 48° 50.51´ N 16° 29.43´ W Change to yellow box core from stainless steel with limiter about three quarters way up column. Pull out 8.33 tons in good conditions. Good core with clear water overlying the sediment surface. Slight compression at the front. Surface of core almost flat. Some mats of Rhizammina. Small burrows 1-3 mm diameter at surface. Sample cut in horizons 0-1, 1-3, 3-5, 5-10 cm sieved at 1000, 500, 300 and 250 um. Two further horizons cut at 10-15 cm and sieved at 1000 and 500 um. Apart from Rhizammina, one actinarian Segonzactis platypus (3 cm diameter) found.
13368#26 MLT.CORER	4810 ucm =4844 m corr.	02:32 z 13/03/1998 4844 m 48° 50.02´ N 16° 30´ W Twelve excellent cores with clear overlying water. One core had a gelatinous lump sitting on the surface. Cores for organic chemistry (Liverpool, 6), DNA (2) and baterial activity (1) (Galway), sediment analysis (Belfast), meiofauna (SOC) and for comparisons (Goteborg).
13368#27 BOX CORER	4811 ucm =4845 m corr.	07:20 z 13/03/1998 4845 m 48° 49.83´ N 16° 30.95´ W Good conditions for coring and a 7.85 ton pull out using the yellow box core. Not a good core with lumps of deeper sediment sitting on the surface. A number of small burrows 1-3 mm in diameter, next to a polychaete tube. Crack in surface of core 15 cm long and 3 cm wide believed to be of biological origin at first, but a similar crack appeared in the same place in a later box core. Cause unknown. Samples as for #16 - polychaetes, sipunculids, bivalves, gastropods, scaphopods, aplacophorans, isopods, amphipods and tanaids. Also xenophyophores and Rhizammina.
13368#28 MLT.CORER	4808 ucm =4841 m corr.	11:20 z 13/03/1998 4841 m 48° 50.06´ N 16° 29.98´ W Twelve excellent cores, used for organic chemistry (Liverpool, 6), Gent (2) - metazoan meiofauna, foraminiferans (SOC 1), sediment analysis (Belfast, 1) and 2 spare.
13368#29 BOX CORER	4812 ucm =4846 m corr.	15:07 z 13/03/1998 4846 m 48° 49.95´ N 16° 29.97´ W Yellow corer, good conditions, 8.64 ton pull out, poor core. Surface disturbed and slight impression of box along the side. A large ophiuroid (? Ophiomussium) on the surface. Used as in #16, with polychaetes, sipunculids, bivalves, tanaids, etc apart from the ophiuroid.
13368#30 GOTEBORGL	4809 ucm =4842 m corr.	19:55 - 13:35 z 13/03/1998 - 15/03/1998 4842 m 48° 48.02´ N 16° 26.99´ W Released 13:35 15.III.98. New type of battery fitted to give extra power. Oxygen sensor reprogrammed (worked second of three times on deck before deployment). Estimated sinking rate 36 m/min; ascent rate 80 m/min. Good data collected by O2 sensors, but only 35 of 55 syringe samples had worked. Sediment in one chamber but disturbed. Loss of syringe samples result of software problems.
13368#31 WASP	4810 ucm =4844 m corr.	21:49 z 13/03/1998 4844 m 48° 49.98´ N 16° 30.1´ W Although cameras and other systems worked well on deck, faults with the altimeter became apparent on descent. Spurrious altimeter in range data causing the cameras to activate in mid-water. Video worked and showed a Peniagone sp at a depth of about 4000 m. Monitor stopped at about this depth (4040 mwo) and the deployment was aborted. Monitor pinged on switch off and started correctly on turn on.

Gear used	Depth	Notes on catch
13368#32 BOX CORER	4810 ucm =4844 m corr.	01:15 z 14/03/1998 4844 m 48° 50.06´ N 16° 29.89´ W Corer (yellow) did not close because the retractor pin had jammed. It seemed that tightnng of the bolts before deployment and after the release mechanism had been set, put a vice-like grip on the sliding retractor pin.
13368#33 BOX CORER	4811 ucm =4845 m corr.	04:55 z 14/03/1998 4845 m 48° 49.93´ N 16° 30´ W Deployed in good conditions (yellow box core) and good 8.73 ton pull out. Acceptable core for abundance / diversity research. A slight depression in one corner, about 8 cm in diameter. Polychaete tube and small burrows, 1-3 mm diameter, at surface. Xenophyophores and Rhizammina.
13368#34 BOX CORER	4809 ucm =4842 m corr.	09:04 z 14/03/1998 4842 m 48° 49.89´ N 16° 30.31´ W Yellow corer deployed in almost flat calm conditions. Pull out 8.57 ton. Poor core. Impressions of box core on surface along one side. Surface disturbed with clumps of subsurface sediment sitting on sediment surface. Ascidian (about 3 cm) with a long stolon (c. 15 cm). The base of the stolon was covered completely by Rhizammina. Polychaete tube. Core used as in #16 - polychaetes, sipunculids, bivalves, isopods, tanaids and ophiuroids.
13368#35 BOX CORER	4810 ucm =4844 m corr.	13:34 z 14/03/1998 4844 m 48° 50.06´ N 16° 29.82´ W Surface of core disturbed with clumps of subsurface sediment on the surface. Large crack in middle of core about 15 cm long as in #27. Large burrows and a distinct sinusoidal track apparent. Used for biomass research by IFREMER. With polychaetes, sipunculids, bivalves, amphipods, isopods, tanaids and an aplacophoran.
13368#36 BOX CORER	4811 ucm =4845 m corr.	17:27 z 14/03/1998 4845 m 48° 49.78´ N 16° 30.17´ W Good conditions for coring and a good core with only slight disturbance to one half of the surface. Impression of box along one side. Uneven surface with many small cracks along one side. Two small burrows about 5 mm in diameter and smaller burrows apparent. Track about 10 cm long, 4 mm wide. Used for abundance and community structure determination.
13368#37 CTD/MS	4810 ucm =4844 m corr.	20:20 - 23:48 z 14/03/1998 - 14/03/1998 0 - 4839 m 48° 49.83´ N 16° 30.28´ W - 48° 50.11´ N 16° 30.2´ W Successful cast to 10 mab. Near bottom bottles taken for Swedish lander experiments, and bottles fired at 1511 m for water for sediment trap preservative mixture.
13368#38 CTD/MS	4810 ucm =4844 m corr.	00:24 - 00:50 z 15/03/1998 - 15/03/1998 0 - 155 m 48° 50.03´ N 16° 29.93´ W - 48° 49.97´ N 16° 29.89´ W Bottles at 155, 105 and 56 m for filtration for microbiology nucleic acid extraction. 155 m for comparison with samples taken on previous cruises. 105 and 56 m below and above the temporary thermocline.
13368#39 BOX CORER	4811 ucm =4845 m corr.	03:02 z 15/03/1998 4845 m 48° 49.99´ N 16° 29.89´ W Excellent core with flat surface. Various burrows and tracks. One small, pink ophiuroid (? Ophiocten hastatum) on surface, with two xenophyophores too. Sieved for macrofauna abundance and community analysis.

Gear used	**Depth**	**Notes on catch**
13368#40 MLT.CORER	4812 ucm =4846 m corr.	06:44 z 15/03/1998 4846 m 48° 50.03´ N 16° 30.08´ W Twelve good cores. Xenophyophore on one, a small stone on another. Cores used by Liverpool (6), Gent (2 metazoan meiofauna, 2 pigments), QUB (1) and Goteborg (2).
13368#41 BOX CORER	4811 ucm =4845 m corr.	11:04 z 15/03/1998 4845 m 48° 49.85´ N 16° 29.72´ W Poor core, with surface disturbed and clumps of subsurface sediment sitting on it. Cracks along front half of core. Small mound about 8 cm in diameter and 3 cm high. New sort of xenophyophore. Two large sipunculids in core as well as sponges, polychaetes, echiurans, bivalves, amphipods, tanaids, isopods and ascidians. Used for biomass.
13368#42 BOX CORER	4811 ucm =4845 m corr.	17:46 z 15/03/1998 4845 m 48° 50´ N 16° 29.88´ W Reasonable core with clear overlying water. Sloping surface (gentle incline) from front righthand corner to back right corner. Various burrows including one 12 mm in diameter. One small lump of clinker with Rhizammina attached to it. Sieved for abundance and community structure of macrofauna.
13368#43 BOX CORER	4810 ucm =4844 m corr.	21:18 z 15/03/1998 4844 m 48° 50.08´ N 16° 29.94´ W Good core with clear overlying water. Some small clumps of subsurface sediment sitting on the surface of core, but otherwise the surface looked undisturbed with several burrows and tracks. Sieved for macrofauna abundance and community analysis.
13368#44 BOX CORER	4810 ucm =4844 m corr.	01:07 z 16/03/1998 4844 m 48° 49.71´ N 16° 30.12´ W Excellent core. Surface nearly flat with small mound (8 cm diameter, 2 cm high) in one corner. A tube rose from the centre of the mound. Various burrows and tracks. Also xenophyophores. Sieved for macrobenthos.
13368#45 MLT.CORER	4810 ucm =4844 m corr.	05:26 z 16/03/1998 4844 m 48° 48.18´ N 16° 26.62´ W Twelve good cores from a Goteborg lander site (#30) for comparison with the lander results. Cores sliced for pore water analysis (nutrients, DOC, DON, POC, PON, total CO2, porosity). Samples of silicate for Brest and Calcium for Gif-sur-Yvette.
13368#46 KASTEN	4809 ucm =4842 m corr.	09:21 z 16/03/1998 4842 m 48° 49.29´ N 16° 29.36´ W A 2 m core but the top 20-30 cm was lost (too much weight on core head). Six subsample tubes (conduit piping) taken for Carbon 14 dating and other isotopic stratigraphy, biostratigraphy, porosity and dry density measurements
13368#47 CP	4810 ucm =4844 m corr.	19:33 - 20:26 z 16/03/1998 - 16/03/1998 4844 - 4844 m 48° 51.63´ N 16° 25.18´ W - 48° 50.93´ N 16° 25.99´ W A fairly small catch with some thought that the trawl had lifted off the seabed for part of the haul. Not as many large holothurians as one might have expected.
13368#48 CP	4810 ucm =4844 m corr.	08:24 - 10:30 z 17/03/1998 - 17/03/1998 4841 - 4845 m 48° 49.64´ N 16° 30.12´ W - 48° 45.78´ N 16° 32.37´ W A better trawl (than #47) and a larger catch with similar animals and proportions as the otter trawl.

Gear used	Depth	Notes on catch
13368#49 GOTEBORGL	4807 ucm =4840 m corr.	18:24 - 12:27 z 17/03/1998 - 20/03/1998 4840 m 48° 45.06´ N 16° 32.68´ W Successful lander experiment with all syringe samplers working this time. However, there was only oxygen electrode data from two of the four chambers. All four chambers had sediment, but very disturbed. Chambers pentrated the sediment at 21:00 17.III.98 and the lids closed on the incubatio chambers two hours later. Ascent rate 78 m/mim.
13368#50 OTSB14	4807 ucm =4840 m corr.	23:28 - 02:04 z 17/03/1998 - 18/03/1998 4840 - 4840 m 48° 49.58´ N 16° 27.72´ W - 48° 48.25´ N 16° 15.91´ W A good catch with all the usual fauna. More large Coryphaenoides armatus than the previous two hauls. The catch also notable for the greater abundance / biomass of Psycropotes longicauda.
13368#51 OTSB14	4807 ucm =4840 m corr.	15:59 - 17:50 z 18/03/1998 - 18/03/1998 4840 - 4840 m 48° 49.71´ N 16° 28.42´ W - 48° 48.88´ N 16° 20.61´ W An almost identical catch (to #50), notable for some large cirrate octopods, a few Psychropotes semperiana and, as for #50 less clinker. As for all trawls, many hours were spent picking Amperima rosea off the mesh of the net. Also many Culeolus and annelid worm tubes caught on the bottom chain of trawl.
13368#52 CP	4806 ucm =4839 m corr.	08:31 - 09:40 z 19/03/1998 - 19/03/1998 4839 - 4839 m 48° 48.3´ N 16° 25.97´ W - 48° 46.57´ N 16° 23´ W A haul just over one hour with a small catch, much the same as before for the otter trawls.
13368#53 CP	4810 ucm =4844 m corr.	20:25 - 00:10 z 19/03/1998 - 20/03/1998 4842 - 4846 m 48° 49.98´ N 16° 33.53´ W - 48° 49.86´ N 16° 20.84´ W A much longer haul (almost 4 hours) with a huge catch - just to prove the Chalut is as good as the otter trawl. There must have been some mutterings after the previous haul. Such a large catch, with many Amperima stuck on the net, was not appreciated at such an hour by the army of sorters.
13368#54 CTD/MS	4814 ucm =4848 m corr.	05:47 - 09:12 z 20/03/1998 - 20/03/1998 0 - 4843 m 48° 48.99´ N 15° 58.77´ W - 48° 49.62´ N 15° 55.65´ W Bottles did not close, no water samples. Release test for Bathysnap MORS s/n 332.
13368#55 SED. TRAP	4693 ucm =4723 m corr.	12:00 z 22/03/1998 4723 m 48° 59.83´ N 16° 13.73´ W Trap opens first bottles at 12:00 22.III.98. Traps nominally at 1000m, 3000m, and 100mab, but as we had difficulty in finding water with the correct depth the upper two traps will be shallower than intended. Release MORS RT661 B2S s/n 283, ON A562, PING A563, RELEASE A561 + A585.
13368#56 GOTEBORGL	4807 ucm =4840 m corr.	17:48 - 10:32 z 21/03/1998 - 24/03/1998 4840 m 48° 56´ N 16° 34.94´ W A successful lander deployment with nearly all the syringes taking samples. Three failed owing to mechanical problems. There was sediment in all the chambers, but very disturbed. Three of the four oxygen sensors had worked. Overall, all the oxygen consumption measurements (this and other landers) there is variation by a factor of two.

Gear used	*Depth*	**Notes on catch**
13368#57 MLT.CORER	4808 ucm =4841 m corr.	18:32 z 21/03/1998 4841 m 48° 55.19´ N 16° 33.24´ W Twelve good cores at lander site (#56), sliced as at #45 by Goteborg University. Pore water samples also taken for silicates (University of Brest).
13368#58 KASTEN	4808 ucm =4841 m corr.	23:08 z 21/03/1998 4841 m 48° 50.06´ N 16° 29.88´ W Weight on the core head reduced by half, but sediment still rose to the top of core barrel. Some mud on bottom of core head weight. Six subsamples taken for biostratigraphy, isotope stratigraphy, porosity and dry density measurements. Good core.
13368#59 SPI	4806 ucm =4839 m corr.	03:38 - 05:28 z 22/03/1998 - 22/03/1998 4839 - 4843 m 48° 50.3´ N 16° 29.54´ W - 48° 50.12´ N 16° 28.28´ W No images, flash assembly leaked. Attempted to take 25 images.
13369#1 OTSB14	4804 ucm =4837 m corr.	19:14 - 21:00 z 22/03/1998 - 22/03/1998 4826 - 4841 m 48° 55.79´ N 15° 44.66´ W - 48° 52.33´ N 15° 38.85´ W To check whether the Amperima event was peculiar to the Bengal site , or was applicable to a wider area of the Porcupine Abyssal Plain, two trawls were conducted at a comparable depth some 20 miles to the east of the Bengal site. Amperima rosea did occur at this locality, though with a reduced abundance and biomass. The catch was broadly the same as at the Bengal site. Notable in this haul were a few more sponges, some large cirrate octopods, more Peniagone, and an apparent increase in juveniles of both Pseudostichopus species. Little clinker
13369#2 OTSB14	4800 ucm =4833 m corr.	12:18 - 14:37 z 23/03/1998 - 23/03/1998 4828 - 4837 m 48° 54.37´ N 15° 39.93´ W - 48° 50.72´ N 15° 31.86´ W A similar haul to 69#1 but with rather more of the asteroid Dyaster grandis than we have taken previously. A good catch of Coryphaenoides and eels (? Histiobranchus).
13370#1 MSAPS	4807 ucm =4840 m corr.	05:00 - 07:00 z 24/03/1998 - 24/03/1998 4840 m 48° 56.22´ N 16° 38.29´ W Large volume filtration (424 litres) of water 1 m above sediment surface (2 hours duration) for microbial biomass and nucleic acids studies (University College Galway).
13370#2 CTD/MS	4807 ucm =4840 m corr.	03:10 - 06:52 z 24/03/1998 - 24/03/1998 0 - 4837 m 48° 55.25´ N 16° 38.15´ W - 48° 54.73´ N 16° 39.06´ W Successful cast with deep-water samples. 6 bottles fired 10 m above bottom, two at 3015 and one at 2412. University College Galway used 3 bottles from 10 and 100 m above seabed each for filtration for microbial nucleic acids.

Gear used	Depth	Notes on catch
13370#3 BN1.5/C	4806 ucm =4839 m corr.	19:15 - 21:45 z 24/03/1998 - 24/03/1998 4839 - 4840 m 48° 50.48′ N 16° 27.91′ W - 48° 48.54′ N 16° 34.53′ W The first outing of the new Ocean Cam 6000 V, developed jointly with the BBC Natural History Unit. The sledge also had the usual camera and fish and a coarse (4mm) mesh net. The cutting bar used on previous cruises was replaced by a round bar on the bottom of the net, and a tickler chain was added. There was no suprabenthic net or blind. the odometer and gate switch were added but neither of them worked. Lighting for the video was by two 250 W lamps, one mounted on the front upright starboard side , and one on the top horizontal bar port side. Although the sledge went down in to the water on one side it remained upright once way was put on the ship. The depth trace became confused with the inclinometer trace at 1580 m depth and was then lost. Indications showed that the sledge fished well once an extra 100 m of wire had been paid out (total 8800m). Hauling was
13370#4 MLT.CORER	4806 ucm =4839 m corr.	16:23 z 25/03/1998 4839 m 48° 44.71′ N 16° 32.17′ W Cores at Goteborg lander site #49. Twelve good cores sliced as at #45. Additional samples for grain size analysis by University College Galway.
13370#5 SPI	4807 ucm =4840 m corr.	21:30 - 01:30 z 25/03/1998 - 26/03/1998 4839 - 4840 m 48° 48.94′ N 16° 28.99′ W - 48° 47.07′ N 16° 26.65′ W 55 Attempts at profiles made of which 26 were successful. 24 Good photographs of sediment profiles were taken showing fine detail of the sediment water interface. Fash tube broke during profiling, but did not leak this time.
13370#6 MLT.CORER	4806 ucm =4839 m corr.	06:29 z 26/03/1998 4839 m 48° 49.26′ N 16° 29.91′ W Twelve good cores with clear overlying water. Remarkable in that the weather was poor for coring. Two cores sliced for GEOMAR and three cores frozen for NIOZ (pigment analysis). Rest of cores used by Gent.
13370#7 CTD/MS	4806 ucm =4839 m corr.	09:10 - 11:15 z 26/03/1998 - 26/03/1998 0 - 1419 m 48° 47.66′ N 16° 30.83′ W - 48° 46.33′ N 16° 29.61′ W Cast aborted at 1400m (1437mwo) owing to ship alert/distress call of man overboard from a cable ship c. 90 miles away. No samples.
13370#8 BSNAP	4790 ucm =4823 m corr.	13:06 z 27/03/1998 4823 m 48° 59.73′ N 16° 13.03′ W Bathysnap was laid once more at a locality close to the SOC sediment trap array (13368#55). Satisfactory deployment despite mildly unpleasant weather conditions. Film - Kodak Vision 250D set at 5 photographs per day. First bottom shot timed at 15:33 27.III.98. MORS OEM 2 pyro release s/n 332 ON A282, REL 1 A281+A224, PYRO A281+A291, PING A294, OFF A224.

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