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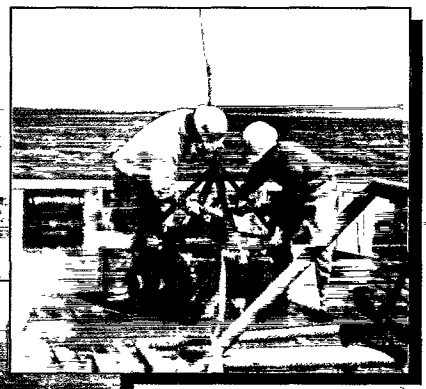
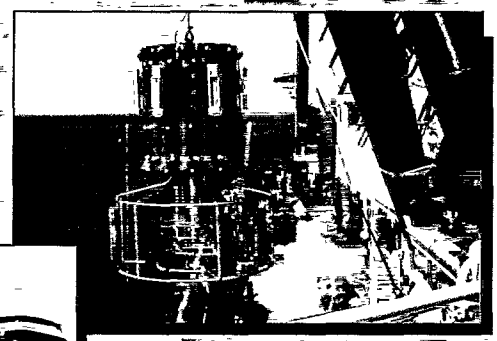
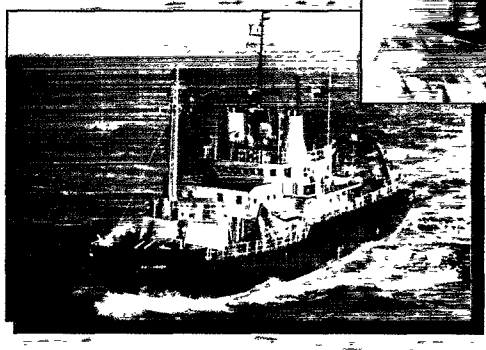
Cruise Report







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CRUISE REPORT No. 13

RRS *DISCOVERY* CRUISE 226
12 MAR - 10 APR 1997

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

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1997

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ABSTRACT

Discovery Cruise 226 (Leg 2) was the second 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.

Cruise 226 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 as long as possible after the previous year's input and to service deployed moorings. The cruise experienced excellent weather and, with the exception of some gear failures and losses, the most serious being the loss of an imprint lander system, was very successful, achieving almost all of the intended sampling.

KEYWORDS

BENTHIC COMMUNITIES, BIOTURBATION, CORING, CRUISE 226 1997, CURRENT METERS, DETRITUS, *DISCOVERY*/RRS, LANDERS, MICROBIOLOGY, NORTHEAST ATLANTIC, PHOTOGRAPHY, RESPIROMETRY, SEDIMENT CHEMISTRY, SEDIMENT TRAPS, TRAWLING, WATER SAMPLING

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Arrive work area 1200Z Friday 14 March 1997

Depart work area 0700Z Tuesday 8 April 1997

Arrive Vigo 0930 (local) Thursday 10 April 1997

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DALE, Paul	Seaman 1A
DAY, Steve	Seaman 1A
DEAN, Paul	Seaman 1A
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CARRINGTON, Dick	Motorman
NYE, Nick	Catering Manager
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THOMPSON, Cathy	Mess Steward
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INTRODUCTION

Discovery cruise 226 was the second in a series of cruises within a 3-year contract, BENGAL, funded under the MAST III programme of the EU (see *Discovery* cruise 222, Leg 2, Report). The overall objective of BENGAL (High resolution temporal and spatial study of the benthic biology and geochemistry of a north-eastern Atlantic abyssal locality) is to understand how the physics, chemistry and biology of the abyssal boundary layer respond to, and modify, the incoming chemical signal from the overlying surface layers and thus affect the palaeoceanographic record in the underlying sediments. References in this report to "tasks" refer to the technical annexe of the BENGAL contract.

The chosen study area, centred on 48°50'N:16°30'W on the Porcupine Abyssal Plain, is known to be affected by the regular seasonal deposition of phytodetritus normally arriving on the bottom in May-June. The BENGAL programme therefore aims to follow the temporal changes associated with this phenomenon with a series of cruises within a 12 month period from March 1997 to March 1998. The first BENGAL cruise (*Discovery* cruise 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. Cruise 226 was therefore the first of the main series, to obtain baseline data and samples at the end of the winter period and before the arrival of the new phytodetritus.

SPECIFIC SCIENTIFIC OBJECTIVES

1. To recover and redeploy sediment trap, Bathysnap and recolonisation experiment (MAC) moorings deployed on *Discovery* 222.
2. To deploy and recover a series of short-term moorings during the cruise.

   a) Up to seven deployments of the new NIOZ lander.

   b) Up to five deployments of the Goteborg lander

   c) Up to three deployments of the Hamburg amphipod trap mooring

   d) A series of deployments of the DEMAR amphipod trap with increasing bottom times.

   e) Two deployments of sediment enrichment experiments (BIOFEED).

f) One short-term (within the cruise) deployment of the NIOZ sediment trap mooring and one long-term deployment.

g) Two deployments of the SOC baited bathysnap.

3. To obtain a series of mid-water and benthic samples and data including:

a) About 15 multiple corer samples

b) About 15 box corer samples

c) About three samples each with the Chalut à perche, SOC epibenthic sledge and semi-balloon otter trawl. (Because of the large amount of deck gear on the ship before sailing, the planned epibenthic sledge sampling was cancelled and the gear was landed (see below)).

d) Four near-bottom hauls each with the one square metre and ten square metre MOCNESS systems.

NARRATIVE (SEE TRACK CHART, FIG. 1)

Wednesday 12 March

The ship was due to sail at 0900 but this was delayed until 1200Z because of the necessary organisation of gear on the after deck and the late delivery of Argos equipment for the NIOZ lander. In view of the large amount of equipment loaded, the NIOZ box corer and the SOC epibenthic sledge were off-loaded and stored in Vigo.

After a boat drill in Vigo bay south of Punta Corbeiro dos Castros the ship proceeded to the main work site centred on 48°50'N:16°30'W.

Friday 14 March

The PES fish was streamed at 1030Z/14 and the first station position was reached at 1157Z. With a 20 knot WSW wind and rather confused moderate to heavy swell a MAC deployment (13077#1) was completed by 1219 and an *in situ* MAC, deployed during cruise 222 (12930#5) was released and successfully taken inboard by 1550. A full depth CTD was completed by 2030 and a second MAC (#3) was deployed at 2114. The NIOZ lander (#4) was deployed at 2152 and the Goteborg lander (#5) by 2347. Not a bad start for the first day.

Saturday 15 March

The ship now moved to the centre position for the beginning of the coring programme. A successful multiple corer deployment (#6) was followed by a plain box corer deployment (#7) in which the sample was spoiled by a double strike, possibly due to the continuing fairly heavy swell with the wind now at around 25 knots from the SSW. The box corer was inboard at 0900 and the ship now moved to the northeast to recover a bathysnap (12930#96) which had been deployed during cruise 222. The mooring was released at 1036 and was taken aboard at 1229. The current metre appeared to have worked well, but the camera was flooded on arrival on deck. Nevertheless, about one quarter of the film had passed through the camera. On the advice of Kodak, the exposed film was maintained for the remainder of the cruise in daily changes of distilled water. (Although the film was successfully developed subsequently, much of the emulsion had lifted off and the results were unusable.)

After a return to the centre position a box corer deployment (#8) resulted in no sample apparently because the gear pre-triggered in the swell. Amazingly, the normally ultra-reliable multiple corer (#9), inboard at 2050 also produced no cores. A CTD cast (#10) to 1000 metres was completed by 2330, collecting water at a variety of depths, including 1000m water to make up preservative for the proposed SOC sediment trap deployment.

Sunday 16 March

A SAPS deployment (#11), with SAPS at 50, 100 and 1000m was completed successfully by 0435/16, but by now the swell was too heavy to permit further coring. The ship accordingly hove to awaiting an improvement. By 0900 the situation was sufficiently improved to allow a multiple corer deployment (#12) at 0920, completed by 1236 with 12 good cores. A further multiple corer cast (#13) provided 12 good cores for the first BIOFEED enrichment experiment (#14) which was launched at 1804 with an expected arrival time on the bottom of 2005. A box corer cast (#15) again produced no sample because of pre-triggering.

Monday 17 March

A deep CTD (#16), shot at 2258/16 and inboard at 0303/17, produced 12 bottles of near bottom water, but only by firing on 25 separate occasions, revealing

problems with closing deep bottles that was to be feature of the cruise. A shallow CTD (#17) to 100m obtained water at 3,5,10,20,30,40 and 100m. The wind, still from the SSW had by now decreased to about 15 knots and the swell was correspondingly rather less. A multicorer cast (#18), inboard by 0618, produced 12 not very good cores, while a plain box core cast inboard at 1118 produced a good sample, the first of the cruise with this gear.

The ship now moved to the Goteborg lander position for its retrieval, but no contact could be made with it and after 3.5 hours of effort the attempt was given up for the time being.

Instead, the ship returned to the centre position to obtain two multiple corer samples (#20 and 21) for the second (16 core) BIOFEED experiment. Although the resulting cores were slightly disturbed, particularly from the first drop, they were acceptable and the experiment was prepared.

During the evening, the Irish contingent and all honorary Irishmen and women (i.e. everyone in the bar) paid due reverence to St Patrick.

Tuesday 18 March

The BIOFEED rig (#22) was deployed without problems at 0140/18 but no contact with it could be obtained as it sank. The fear, later justified, was that it would not be retrievable; two losses, of rather different magnitudes, within a few hours!

The Goteborg team were now "given" the ship for a further attempt to contact their lander with the proviso that the vessel should be over the NIOZ lander by about 0700. Despite an extensive search, no sign of the lander could be found. Since the rig carried an Argos beacon, but no information from the Argos organisation was subsequently received, it was assumed that the system had suffered some catastrophic failure, perhaps an implosion of buoyancy causing massive damage to the acoustic system.

By 0630 the weather was superb, with hardly any wind and a long, low, easy swell. From this point on the cruise was blessed with exceptional conditions. Not much sun, but rarely any significant winds and certainly nothing to prevent work except for one short period.

The NIOZ lander was released shortly after 0700, reached the surface at 0902 and was inboard by 0930.

The ship now returned to the centre position via the BIOFEED deployment but had no success in contacting it.

Once back at the centre, a box corer deployment (#23), inboard by 1357, produced a good sample. This was followed by a multiple corer drop at the centre (#24) and one at the vacated NIOZ lander position which was inboard by 2145. Both casts produced 12 good cores.

Wednesday 19 March

The coring cable was now replaced by the conducting cable in preparation for a series of MOCNESS hauls, initially with the 1 square metre version which had the highest priority. Each of the nine nets was to be given a separate series number.

The first MOCNESS haul (#26-34) was shot at 0117, fished on a northwesterly heading and was inboard by 1300. It was apparently completely successful except for the loss of one of the cod-end buckets, and therefore the sample, from one of the 50 mab nets.

The SOC sediment trap array (12930#35) deployed on *Discovery* cruise 222 was now recovered. It was released at 1423, the first buoyancy reached the surface at 1437 and the rig was all inboard by 1709. The 1000m and 3000m traps appeared to have worked correctly, 10 samples having been taken by each of them. However, the last sample in the 3000m trap was lost during recovery because it was entangled with the second buoyancy package and came aboard inverted. The lower trap had not operated and no samples were collected.

The ship now moved to the west of the sediment trap position, but still to the north of the centre position, for the second NIOZ lander deployment at 1832 (35).

Thursday 20 March

A second MOCNESS haul (#36-44) was shot at 2100/19 into very light SE winds and was all inboard at 0900/20. One net command appeared to have failed, but all the important nets apparently operated correctly.

The ship now moved to a position north of the central position for a moored SAPS deployment (#45). The objective of this exercise was to obtain a SAPS sample from closer to the sea floor than would be possible with the instruments clamped on a wire. Instead, a SAPS was mounted on an SOC fish trap frame on an acoustically released array. The rig was launched at 1150 and reached the bottom at about 1350. The system was programmed to sample from 1500 to 1700. In the meantime the ship was again given over to the Swedes to try once more to contact their lander, but with the proviso again that they return to the SAPS mooring site shortly after 1700. No sign of the lander was found and at about 1600 the search was abandoned.

The SAPS deployment was released at 1722 and while it was ascending the vessel moved about a mile to the west for the deployment of the NIOZ sediment trap mooring (#46) which was to be recovered later in the cruise.

The ship now returned to the SAPS position for its arrival at the surface at 1855. Unfortunately, as the vessel approached the floating rig to pick it up, it became fouled on the bows, the dhan buoy assembly becoming jammed in the bow thrust inlet on the starboard side while the rest of the rig, supported by the main buoyancy package was on the port side. Despite the best efforts of the scientists and ship's crew, only the main buoyancy package was retrieved.

This exercise was completed at 2145 and the ship now moved to a position to the northwest of the centre of the station for a third MOCNESS deployment.

Friday 21 March

This haul (#47-55) was completed at 1018/21. One cod-end bucket was again missing, but otherwise the haul was successful.

The bow thruster was now tested and found to be operating normally, that is unaffected by the events of the previous evening. The vessel therefore returned to the centre position and, in the meantime, the conducting cable was replaced by the coring warp.

A plain box core haul (#56), completed at 1706, produced a double bite sample which was rejected, though it did contain a fine specimen of the large foraminiferan *Reticulamina.*

An attempt to fit a vegematic box to the corer was unsuccessful because we had apparently been supplied with the wrong boxes for this corer. It was therefore decided to deploy the multiple corer instead and try to modify the vegematic boxes in the meantime. In the event, the modifications required to the vegematic boxes turned out to be considerably more extensive than at first thought. Consequently, two multiple corer hauls (#57 and 58) were completed by 0039/22.

Saturday 22 March

A plain box core cast (#59) produced a good core and was followed by a multiple corer (#60) which also produced good samples and was inboard at 0800. This was followed by a deep CTD (#61) to collect water for Patras. Water was successfully collected at 3300m, but attempts to close bottles at 4800m failed.

The ship now moved to the site of the recovered SOC sediment trap mooring to deploy a replacement (#62). This deployment began at 1500, the vessel approaching the proposed position from the north because of a southerly wind. The immediate vicinity of the proposed deployment position was known to be flat and at a suitable depth. But this part of the study area was also known to be close to rough ground though not having been surveyed adequately. The mooring was outboard down to the release by c1710 with ship still 1.9 nm from proposed position. Since the soundings were still bad, the deployment was held up while the mooring was towed at 2kts until we were closer to the selected position and the soundings had improved. The mooring was finally let go at c18.10 and watched down.

The ship now returned to the centre position for a box core cast (#63) which was inboard at 2351 having collected the best core of the cruise so far.

Sunday 23 March

A SAPS deployment (#64) with pumps at 1000m and 3000m was shot at 0125. It was programmed to sample from 0225 to 0425 and was retrieved with successful samples at 0555.

The vessel now moved to the NIOZ lander position with the wind now southwesterly at about 20knts. The lander was released at 0656 and successfully taken on board by 0830. This seems to have been an excellent deployment with all systems apparently having worked.

After a return to the centre position a multiple core cast (#65) was completed by 1315 and was followed by a box core (#66) which was retrieved at 1711 having sampled about one quarter of an enigmatic "fairy ring", but with no convincing evidence of the ring's maker!

A proposed CTD to full ocean depth together with the marine snow profiling camera system (MSP) was delayed because of difficulty in organising the geometry of the frame. This cast (#67) was eventually shot at 1942. Some difficulty was experienced in firing the bottles near the bottom. Eventually, seven were fired here and the remainder, apparently with no problems, at 3800m. The MSP appeared to work satisfactorily, the cast being completed at 0013/24.

Monday 24 March

During the previous evening the wind had gradually increased to near gale force and we began to experience swell from a series of depressions some hundreds of miles to the north west.

A wire SAPS (#68) was deployed at 0055 to sample at 10mab and 100mab from 0310 to 05100 and was recovered by 0700. By this time we were experiencing moderate to heavy swells from the north-west under gloomy skies.

A multiple corer cast (#69) was completed by 1040, retrieving 12 reasonable cores. This was followed by a vegematic box core (#70) which retrieved a good sample at 1412.

The ship now moved about 5 nm east of the centre position for the deployment of the NIOZ lander and an amphipod trap mooring, the coring wire being replaced by the trawling wire in the meantime.

The NIOZ lander (#71) was deployed at 1546 and, after a further move two nm to the east, the Hamburg amphipod trap (#72)was deployed by 1817.

Discovery now moved to the north east to fish the MOCNESS system on a southwesterly course.

Tuesday 25 March

The gear was shot at about 2000/24, but this haul (#73-75) had to be aborted at midnight, during the near-bottom fishing operation, because of the loss of all signals.

When the system came aboard at 0330 the nets were found to be tangled, but three samples appeared to be OK. The problem appeared to be in the termination which was accordingly re-made. Since there was insufficient time to repeat the MOCNESS haul before the amphipod mooring was due to be retrieved later in the day, it was decided to do a CTD/camera drop at the centre position in the meantime.

A shallow (100m) CTD (#76) was undertaken to check the camera system, and particularly the orientation of the camera relative to the flash unit. This cast was started at about 0800, but shortly thereafter the wire jumped out of the spooling gear and the cast was held up until this could be rectified. The gear was inboard at 0920 and the ship was hove to until the film had been developed, the battery pack replaced and the rosette sampler changed. The film seemed OK so the MSP work was continued with this arrangement.

A deep CTD/MSP (#77) cast was now undertaken with the intention of collecting water from 4000m, 4700m and close to the bottom. Problems were again experienced in firing the deep bottles and while adequate samples were obtained from near the bottom and from 4000m, only one bottle was definitely fired at 4700m.

Decreasing visibility due to mist and the delays to the CTD casts prompted a decision to abandon recovery of the amphipod mooring until the following morning and to conduct a MOCNESS haul in the meantime. Accordingly, the ship now moved to the MOCNESS start position and the system (#78-86) was shot by 1745. When the gear reached the proposed fishing depths no response could be received to the closing commands, suggesting that the bottom bars might have been hung up. Nevertheless, since the additional time would be minimal, the fishing operation was completed despite the lack of these signals.

Wednesday 26 March

The last net was closed at 0152 and the gear was brought inboard at 1500. All the samples seemed to be normal and therefore probably OK. However, with no response signals the fishing depths are uncertain and the haul must therefore discarded as acceptably quantitative. Rather than try another MOCNESS haul immediately, it was therefore decided to switch once more to the coring wire and to try to discover

the problem in the meantime. At the same time it was found that the end of the conducting cable was damaged and would need reterminating.

While the wires were being switched the ship proceeded to the amphipod trap mooring (#72) for recovery. The gear was released at 0725 and taken inboard by 1015.

The ship now returned to the centre position and successfully completed a vegematic box core (#87), a Kasten core (#88) and a plain box core (#89) by 0100/27.

Thursday 27 March

A multiple corer cast (#90) obtained 11 acceptable cores from the centre position for the Goteborg group by 0449. By this time, the wind having increased to 30+ knts from the south overnight, the ship was hove to awaiting an improvement instead of releasing the NIOZ lander as intended. With only a marginal improvement by 0900, it was decided to move to the neighbourhood of the long-term sediment trap mooring to conduct a deep CTD/MSP cast and to attempt to collect water from near bottom and from the elusive 4700m layer. Accordingly, the CTD (#91) was shot at 1054 and was inboard by 1512.

By now the weather had improved sufficiently for the recovery of the NIOZ lander (#71). It was released at 1632 at a slant range of 7.5km and while it was rising a DEMAR rig (#92) was deployed at 1740 some 2nm closer to the centre position.

Discovery now returned to the lander position, recovered it by 1835, and returned once more to the centre position.

A plain box core (#93) (completed by 2330) was followed by a shallow (100m) CTD/MSP (#94) shot at 2359 as the "midnight" cast of a series at roughly four hour intervals throughout a composite 24 hours.

Friday 28 March

Series 94 was inboard by 0032 but an intended vegematic box core was delayed because of the need to clear the box from the previous cast. Consequently, #95 was not launched until about 0200 and was inboard at 0515. The corer had struck twice, sufficiently badly for the core to be rejected. Because of the urgent need for more

vegematic samples a Kasten core planned for later in the day would be replaced by a further vegematic box core.

Discovery now moved to the previous NIOZ lander position to obtain a multiple core sample (#96) which was inboard at 1012 with 12 good cores.

The ship now moved to the south east of the centre position for an amphipod trap deployment (#97) which was shot at 1107 with a bottom ETA of 1223.

In the meantime the ship returned to the centre position for the replacement vegematic box core (#98) which was completed successfully at 1545.

We now moved to the 24 hour DEMAR site (#92) for its recovery and the deployment of the NIOZ lander during its ascent. DEMAR was released at 1649 and the lander (#99) was launched at 1729 with an ETA on the bottom of 1850. DEMAR surfaced at 1806 and was all inboard at 1837. The ship now moved some ten nm to the north of the centre position to commence a Chalut à perche haul.

Having reached the limit of the SOC biological data base series numbers we now adopted station number 13078 for the remainder of the cruise.

Saturday 29 March

The beam trawl (13078#1) was shot at 2225/28 and landed at 0517/29, having been deemed to have fished from 0023 to 0140: the c 2 cubic metres of mud contained a small catch.

The ship now returned to the amphipod trap mooring (13077#97) which was released at 0912 and taken aboard by 1130. The mid-day CTD/MSP cast was now conducted (#2), after which the ship moved to a position some ten miles to the south east of the centre for a nominal 48 hour DEMAR deployment (#3) which was completed at 1300. After watching the DEMAR to the bottom the Principal Scientist decided that in view of the excellent weather we had experienced and the good progress made with the programme, a short Easter break was called for.

Sunday 30 March

Accordingly, from 1700/29 to 0800/30 the ship undertook an echo-sounding survey of some of the least well-known areas in the vicinity of the worksite, returning

to the centre position in time for the 0800h CTD/MSP cast (#4) which was completed at 0832.

We then deployed a further amphipod trap mooring (#5) some 7 nm to the east of the centre position followed by a second beam trawl. This haul (#6) was shot at 1236 and landed at 2053, having fished from 1538 to 1737, covering more than 5 km and obtaining a good clean catch.

The day's work was completed with a multiple core cast (#7) which was to be the first of four more or less back-to-back multiple corer casts, three to carry NIOZ tubes (see separate report).

Monday 31 March

#7 was completed by 0115, having taken the usual 12 good cores. The second and third multiple corer casts in this series (#8 and #9) were completed by 1030 and the ship then moved to the amphipod mooring (#5) for its recovery. It was released at 1148 and taken aboard about 1400 with a good catch. The 48 hour DEMAR (#3) was now released at 1435 and taken aboard at 1610.

The fourth multiple corer cast (#10) was completed by 2110 after which the ship made for a position to begin the third beam trawl haul (#11).

Tuesday 1 April

The beam trawl was shot at 2232/31 and was inboard at 0648/1, having fished from 0104 to 0333, covering more than 6 km and obtaining a large muddy catch.

In view of the date, the next few hours were characterised by a range of happenings in varying degrees of bad taste, some of the worst involving participation by the PS who should have known better!

The weather had been pretty good for some days with moderate winds and good visibility. This morning, however, the very moderate southerly wind and long low swell was accompanied by increasingly poor visibility. After the beam trawl was safely on board the vessel moved to the NIOZ lander (13077#99) position for its retrieval. It was released at 0811 and while it was rising the ship moved off about 4 miles to investigate a small radar contact that might possibly have been the Goteborg lander. In extremely poor visibility, no more than a couple of hundred metres, the

target was approached gingerly and found to be an Associated Octel container washed overboard from a cargo vessel. It was left severely alone but reported to the Hydrographic Office. (This container, and another apparently lost at the same time, was subsequently retrieved by Octel, but we never found out what they contained!) We now returned to the lander position and took it aboard successfully by 1030.

Discovery now moved to the north, to a position some ten miles northeast of the centre station for a further amphipod trap mooring deployment. This mooring (#12) was deployed at 1100 with a bottom ETA of about 1230 and, as before, was to be left on the bottom for about 24 hours.

A plain box core cast at the centre position (#13) obtained a good core and was followed by a DEMAR deployment (#14) some 5 miles to the northeast of the centre position. Its deployment began at 1810, and with a bottom ETA of about 2100 it was planned to retrieve it during the following forenoon after about 12 hours on the bottom.

In the intervening period a vegematic box core deployment at the centre position (#15) obtained an excellent sample shortly before midnight and was followed by a Kasten core.

Wednesday 2 April

The Kasten core (#16) was taken aboard at about 0400 with a good sample but lacking the surface layer. It was followed by another vegematic box core (#17) which produced a moderate but acceptable sample.

In brilliant weather with light and variable airs, a calm sea and a cloudless sky the DEMAR rig (#14) was released at 0956 and taken inboard shortly before mid-day. With the amphipod trap mooring only about three miles away, this was released at 1218 and taken on board by 1430. Both moorings had obtained excellent catches. In combination with the superb weather we seemed to be on a winning streak. However, the next operation, a plain box core cast at the centre position (#18), came inboard at about 1900 with a poor sample which was not suitable for sieving.

The NIOZ lander was now deployed for its fifth and final time on the cruise, this time a few miles to the southwest of the centre position (#19). It was launched at about 2030 with a bottom ETA of about 2200.

Having put an enormous amount of effort into sorting out problems with the WASP system (see separate report) we were finally in a position to use it in anger. It was accordingly launched at 2130 with the expectation of fishing it through the night. However, less than an hour later all signals from it disappeared and it had to be retrieved. When it arrived on deck at 2315 the monitor was found to be completely flooded - more or less the end of the story as far as WASP and this cruise was concerned.

A hurried change to 'plan B' resulted in the beam trawl being fished for the third time (#21).

Thursday 3 April

The trawl was taken aboard at 0720, having fished for a calculated 6km or so from 0238 to 0423 but retrieving only a very small and disappointing catch. Things did not look nearly as good this morning as they had yesterday, though the weather was still magnificent.

The DEMAR rig was deployed for a nominal 6 hour bottom time (#22) to be released at around 1730. In the meantime three CTD casts were to be made at the centre position. The first of these (#23), to full ocean depth to obtain near bottom water, was completed at 1352 but only three of the twelve bottles had fired successfully. The second (#24), to 500m and to collect water from 12 separate depths for Gif, was completed successfully at 1524, while the third (#25), the nominal 1600h MSP cast in the time series, was completed at 1625. The ship now returned to the DEMAR position, released it as planned at 1730, and took it on board with a good catch at 1905.

The 2000 MSP time series cast (#26) was now undertaken before the beam trawl (#27) was fished overnight for the fourth and final time.

Friday 4 April

The beam trawl was landed at 0330 having fished for a calculated 3.8km and obtaining a small catch.

The 0400 MSP time series cast was now completed (#28) and the ship made for a position to the northeast of the centre position for the first of the four intended otter-trawl hauls. With less than four days of sampling time remaining, these long hauls would have to be carried out at all times of the day and night and somehow fitted around the other remaining operations. This first one (#29) was shot at 1000, fished on a southwesterly course and landed at 2300 with a large catch and a great deal of mud. It had fished from 1420 to about 2010 and had been very difficult to lift off the bottom, having traversed an estimated 20.8km.

Saturday 5 April

A CTD (#30) to collect water at 4775 and 4826m was completed at 0445 and the ship made for a position again north and east of the centre position for a second otter-trawl haul, this one to be fished on a more westerly course. Shooting this haul (#31) commenced at 0730 and the net reached the bottom at 1120. Hauling commenced at 1550 and the gear apparently left the bottom only some ten minutes later, but with considerable tension on the wire. When the otter boards reached the surface at 1900 it was obvious that the net contained a very large catch of mud. With considerable difficulty, partly as a result of the parting of the lazy line when it was used to try to lift the cod end over the stern, the catch was landed shortly before 2000. It consisted of about 4 tonnes of mud and a rather small biological sample with no fish. Clearly, the net had not fished efficiently over the estimated 12 km it had traversed on the bottom.

The NIOZ sediment trap mooring was now deployed (#32) at 2330, and with an estimated bottom ETA of about 0030/6, at a position to the northwest of the centre, this deployment to be recovered during the next BENGAL cruise in July.

Sunday 6 April

A full depth CTD (#33) was completed close to the sediment trap position by 0322, water having been collected at 4775 and 4827m.

The ship now moved to the site of the long-term BIOFEED mooring (13077#14) for its recovery into first light. To save time it was intended to pop up the nearby NIOZ lander (13078#19) more or less simultaneously. Accordingly, the BIOFEED rig was released at about 0530 and, after monitoring the first part of its ascent, we moved to the lander position and released it at 0700. In the still moderate (15-20 knt) winds and low swell, now from the ESE, the operation went smoothly, the BIOFEED rig being picked up at 0815 and the lander about an hour later.

The ship now moved to a position to the north and west of the centre position for a third otter trawl, this one to be on a more easterly course. The net was shot at about 1100, but at 1135 and with only about 1200mwo, pump trouble caused the winches to operate only at extremely slow speeds. The haul was therefore aborted and the gear was brought inboard by 1700. Attempts to obtain technical advice from ashore were unsuccessful (not surprisingly, it being a Sunday) until after 2100.

In the meantime, an "overnight" DEMAR (#35) was deployed at 1830 and monitored to the bottom which it reached at 2108.

Monday 7 April

Attempts to mend the winch were finally successful shortly before 0100 and a shallow CTD cast (#36) was undertaken to collect 100m water. Over-the-side work was now abandoned for the night to allow the technicians to get some rest after the protracted efforts to rectify the winch.

At 0600 a fourth otter trawl was shot (#37), this one to be fished on a southeasterly course. This proved to be the "perfect" haul. The gear reached the bottom at 1002 with some 11000mwo, hauling commenced at 1147 and the trawl lifted off seven minutes later, having fished an estimated 9.8km. When the catch was landed at 1500 it was good, clean and contained many fish.

This was a good way to end the trawling operations, although it was disappointing that there was not time for a further haul. As it was, with a cut-off time of 0700 the following morning things would be extremely tight to achieve the remaining operations, a MOCNESS haul, the recovery of the DEMAR rig and the deployment of a bathysnap mooring to be recovered on the next cruise. Things rarely go perfectly according to plan for this Principal Scientist, mainly due to ineptitude.

This was an exception! A start point for the MOCNESS haul was chosen from which it was calculated that an easterly course would result in the net coming aboard very close to the DEMAR position and the proposed bathysnap position. It worked! The MOCNESS deployment (#38-46) began at 1800/7 and the first near-bottom net was opened at 2214.

Tuesday 8 April

The last net was closed at 0138 and the gear was all inboard by 0417, by which time the ship was only a couple of miles away from the DEMAR rig. This was released at 0457, and while it was ascending a last abortive attempt was made to release the lost BIOFEED rig. At 0628 the long-term bathysnap (#47) was deployed with a bottom ETA of 0743 and DEMAR was grappled and taken aboard at 0652. By 0706 all was secured on the after deck and course was set for Vigo. (The Master gave the PS a hard time about the 6 minutes, but he was joking - I think!) The PES fish was recovered in the afternoon after a final echosounding run across the southeastern corner of the general study area and, after an uneventful passage, the vessel was secured on her berth in VIGO at 0934 local time on Thursday 10 April after an extremely pleasant and successful cruise.

GEAR AND TOPIC REPORTS

Multiple corer (See Figs. 2 and 3)

The corer was deployed 20 times and recovered a total of 223 cores out of a possible maximum total of 240 cores (Table 1). Fourteen of the deployments were at the central site, four were at NIOZ lander sites and one was a repeat of Stn 12930#45 (*Discovery* Cruise 222 leg 2). The 13078#9 deployment was taken at one of two proposed Lander 4 sites, unfortunately the wrong one. The one failure (Stn 13077#9) was due to lowering the corer at a final speed of 10m per minute in rough weather. During later deployments, samples were obtained in similar conditions with a paying out rate of 15-20m per minute. In general, the cores were more often disturbed than during *Discovery* Cruise 222 (August/September 1996), presumably because of the sea state. However, when the sea was calm (e.g. 13077#24) excellent results were obtained.

Table 1 Multiple corer deployments and their characteristics

Series	Length (cm)	Cores	Site	Remarks
13077#6	30-33	12	Central	Good cores
13077#9		0	Central	Force 6-7, final speed (10m sec^{-1}) too low
13077#12	29-33	11	Central	Water cloudy, cores somewhat disturbed.
13077#13	no data	12	Central	Clear water; all cores for BIOFEED 12; 1 large xeno
13077#18	32-37.5	12	Central	Cloudy water, fairly disturbed surfaces
13077#20	27.5-34.5	12	Central	All cores cloudy but less disturbed than #18; 1 xeno; BIOFEED 11
13077#21	29.5-32.5	12	Central	Good cores; BIOFEED 11
13077#24	30-35.5	12	Central	Excellent cores
13077#25	25-28.5	12	Lander 1	1 core with disturbed surface despite clear water
13077#57	29-32	12	Central	Good cores
13077#58	31-33	12	Central	Clear water but several cores disturbed; 8 for Swedish incubation
13077#60	30.5-33.5	12	Central	Heavy swell; all cores somewhat disturbed
13077#65	30.5-34	12	Central	Heavy swell; cores fairly good but several with surface cracks
13077#69	32-34	12	Central	Several cores with cracks but otherwise a reasonable set
13077#90	22.5-25.0	11	Central	Short but fairly undisturbed cores taken in bad conditions
13077#96	30.0-33.5	12	Lander 3	Good cores used for pore-water chemistry and pigments
13078#7	30.0-32.5	12	Lander 4	Good cores used mainly for phytopigments; 6 discarded
13078#8	28.5-30.5	12	12930#5	Good cores; repeats deployment made during D222.
13078#9	25.5-30.5	12	Lander 5	Good cores despite bad weather; used mainly for pigments
13078#10	25, 30-33	12	Lander 2	Good cores used for pore-water chemistry and pigments

Table 2 Fate of multicorer samples. C=central site; L=lander site

	Station 13077																13078	
Site	#6	#9	#12	#13	#18	#20	#21	#24	#57	#58	#60	#65	#69	#90	#25	#96	#7	#8
	C	C	Cl	Cl	C	C	C	C	C	C	C	C	C	C	L1	L3	L5	*
Activities 1.3/2.2b																		
Tasks 28, 40	2				1		1	2	1	2		2	2		1			2
Activity 2.1a																		
Task 34 G'borg Pore-water chem														7	7	8		
Activity 2.2c																		
Task 43 NIOZ Pigments													2	3	3	3	3	6
Activity 2.3																		
Tasks 50/51																		
UL			3		4			4	3		2	2	2					
Univan			1		1			1	1		1	1	4					
Patras			2		2			2	2		2	2						
Activity 3.1																		
Tasks 52/53 UCG	3				2				2		1	2						
Activity 3.3																		
Tasks 56-59 SOC																		
0-20cm	2		2				2		1		1	1	1					
0-2cm																	1	1
Tasks 60-63 UGENT	2		2				4	2	1	2	2							
Task 64 SOC,UL,UCG,UGENT				12		12	4											
Activity 3.6																		
Task 68 QUB	1		1		1		1	1			2							
Activity 4.2																		
Tasks 74, 76 IUEM	2				1		1	2	1	2		2	2	1	1			2
No task																		
NIOZ: Oxygen profiles	1				1							1	1	1	1	1	1	
NIOZ: Porosity/resistivity																		3
Goteborg: Radionucleides														1			1	
Goteborg: C^{13} algal experiment										8								
Lancaster University	1										1	1						
Discarded																	6	
TOTAL USABLE CORES	**12**	**0**	**11**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**

* 13078#8 replicated a multiple corer deployment (12930#45) made during *Discovery* cruise 222

The cores were generally 30-34cm long. As expected, no trace of phytodetritus was observed on the sediment surface and there was also no sign of the worm casts which occurred fairly frequently on D222 cores. However, burrows of various sizes were fairly common. The stratigraphy of cores taken at the central site was identical to that observed last year (see D222 Leg 2 cruise report, p.26) with a distinctive narrow, dark layer at 20-22cm depth. However, this band was not developed at the outlying lander sites. The cores from Lander site 2 (13078#10) were unusual in appearing almost completely homogeneous and devoid of stratigraphy; sediment at the base of these cores was also softer than at other sites.

Central site cores and their overlying water will be used for the following purposes (Table 2 and other parts of this report): pore water chemistry (Task 34), isotope measurements in order to estimate bioturbation rates (Task 40), organic chemical analyses, RNA/DNA extraction, studies of silicate, barite and enzymatic activity (Tasks 50/51), microbiological studies (Tasks 52-53), studies of the abundance, species diversity, seasonal population dynamics of foraminifera (Tasks 56-59) and metazoan meiofauna (Tasks 60-63), the BIOFEED experiment (Task 64) and to compare sediment and holothurian gut enzymatic activity (Task 68), phytopigment analyses and oxygen profiles (NIOZ). Cores from the lander sites will be used mainly for analysis of phytopigments and porosity (either by measuring pore-water content or resistivity) A special deployment was made at the site of 12930#45 in order to collect cores for Task 40 (a core collected here during D222 had an unusual stratigraphy)

Large agglutinated rhizopods

As on previous cruises, xenophyophores were picked from box core surfaces. Substantially fewer specimens were found than on *Discovery* 222, a total of 7 from 11 box cores (total surface area 27,500cm^2) and 3 from 227 multiple cores (total surface area 5788cm^2). The overall density was 0.75 specimens per m^2 compared with >5 per m^2 on D222. As observed previously, distribution appeared patchy with three specimens on box core 13078#13 and 1 specimen on each of four cores. There were no taxonomic surprises among this small collection. The two most common PAP species, *Galatheammina erecta* and *Reticulammina labyrinthica,* were represented by 5 and 2 specimens respectively, 1 specimen was an irregularly shaped lump, possibly

the *Homogammina* species which has been seen before at this site, 1 was indeterminate and 1 was lost on the BIOFEED 16 deployment. They varied considerably in size. The two *R. labyrinthica* specimens were both 20mm maximum dimension while the two *G. erecta* specimens from 13078#13 were tiny juveniles measuring 8mm and 6mm maximum dimension, including the well-developed 'root' system. Five of the xenophyophores were fixed in 4% gluteraldehyde for ultrastructural studies.

In addition to xenophyophores, a number of the more obvious looking mudballs were picked off the surfaces of box cores. The best of these proved to be members of the genus *Lana* with a mass of fine black tubules emerging from the mudball surface.

Kasten Corer

The two Kasten corer samples were taken for the study of long-term sedimentation rates, the intention being to sample the whole of the holocene sediments. The resulting cores were subsampled using U-shaped plastic channel throughout their lengths. However, since the core tops were missing because of over-penetration in both cases, sub-cores were also taken from a box-core sample (13078#36).

PASCAL L'HENORET

BIOFEED (Tasks 64/65; SOC, UL, UCG, UGENT)

Following the successful deployment and recovery of an 8-core rig on *Discovery* Cruise 222, the intention on this cruise was to improve the degree of replication by deploying two BIOFEED experiments, one with 12 cores (BIOFEED 12) and the other with two sets of 8 cores (BIOFEED 16). This arrangement would provide two replicates of 12 cores (6 enriched and 6 control) with space left on BIOFEED 16 for 4 NIOZ cores fitted with stirring devices to test the effect of stirring on oxygen profiles. It had not been possible to prepare the 12 core rig prior to the cruise and so a makeshift tube-rack was constructed on board, largely from two milkcrates. For the D222 experiment, natural phytodetritus from SAPS had been used as the enrichment substrate. In order to quantify the amount of material added more accurately, the enrichment substrate used on this cruise was freeze-dried cultured algae (*Dunaliella* and *Emiliania*). Pre-weighed amounts (0.501-0.526 mg) were added to

the cores by suspending the powdered algae in seawater and pipetting the suspension into the core-top water.

BIOFEED proceeded as follows:

1) Multiple corer deployment 13077#13 yielded 12 good cores, containing a few worm holes and a large xenophyophore (*Galatheammina erecta*).

2) The algal powder was added to the top water of 6 randomly selected cores (nos 1,3,6,8-10). These enriched cores and the remaining 6 unenriched control cores (see Table 3) were loaded into the milkcrate rig and successfully deployed on a DEMAR frame on March 16th (13077#14).

3) Sixteen further BIOFEED cores were collected during multicorer deployments 13077#20 and 21, four of them using NIOZ 'splitable' tubes. Six cores (13077#20 cores 2,5,8,10; 13077#21 cores 1,12) were enriched as described above and the NIOZ tubes (13077#20 cores 6,7,9,11) were fitted with electrical stirrers; the remaining six cores acted as controls. The cores were loaded onto two separate 8-berth BIOFEED rigs and deployed aboard a DEMAR frame on March 17th (13307#22).

4) An attempt to communicate with BIOFEED 16 shortly after it reached the bottom failed.

5) BIOFEED 12 was recovered successfully on 6th April, after 21 days on the seafloor. The cores were sampled for chemistry (UL), bacteria (UCG), metazoan meiofauna (UGENT) and foraminifera (SOC) according to the protocol in Table 3. Note that each core was sampled for two of these purposes so that different parameters could be compared directly without the need to homogenise the sediment. The xenophyophore was removed and preserved separately.

6) All efforts to communicate with BIOFEED 16 on April 7th, and to release it on the morning of April 8th, failed.

Table 3. Fate of cores deployed on BIOFEED 12.

BIOFEED 12 (13077 SERIES 14)

First use	Second use	Enriched core	Control core
Bacteria	Foraminifera	6	2
Bacteria	Meiofauna	1	4
Bacteria	Chemistry	3	5
Chemistry	Meiofauna	8	7
Chemistry	Foraminifera	9	11
Foraminifera	Meiofauna	10	12

During the D222 BIOFEED experiment, the SAPS 'phytodetritus' material added to the enriched cores was clearly visible as a distinct greenish layer on the sediment surface. The algal powder added to the cores on BIOFEED 12 disappeared into the core-top water without a trace. There was no visual difference between the enriched and unenriched cores, either before or after the incubation.

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Spade box corer (see Figure 2 and 3)

The type of box corer used during this cruise and the protocols followed in the treatment of samples were the same as those used on BENGAL Cruise 1a (*Discovery* Cruise 222 Leg 2, August-September 1996), and are described in the report for that cruise.

Initial attempts to obtain samples were unsuccessful, and minor changes in the preparation of the corer and in the fishing protocol were made. Although weather during the cruise was good, cross-wind swells led to heavy rolling on occasions, resulting in pretriggering during paying out and double contacts with the bottom. The first problem was overcome by tying down the spade arm with 4-6 strands of sisal rather than only one. Problems associated with double contacts were considerably reduced by increasing the pay-out speed between hang-off and bottom contact from 15m/min to 30m/min. The nature of sediments on the Porcupine Abyssal Plain is such that normal penetration of the box is c50cm. Cores of this depth are vulnerable to

compression damage and to surface disturbance. In order to reduce this effect, stops were fitted to the corer column which limited penetration to c40cm.

The box corer was deployed on 19 occasions, 13 with the plain box and 6 with the vegematic box. Five deployments were unsuccessful, 2 as a result of pretriggering and 3, including 1 with the vegematic box, as a result of double bottom contacts. Cores obtained were for the most part in good condition with undamaged surfaces and only slight compression. One plain box deployment was fished without the depth stops to obtain long subcores for CFR/CNRS, Gif (see Table 4).

Core structure was similar to that found on previous cruises to this locality. Fine-grained sediment, very soft in the top 3cm, changed from a creamy beige colour to a darker richer colour with a hint of orange in it with increasing depth. At about 20-25cm a 3-4cm deep layer of very fine sticky grey-brown sediment was sharply demarcated from an underlying pale grey layer with a relatively high *Globigerina* content. Frequently, bioturbation was evident both above and below the grey-brown layer.

In general, core surfaces were fairly flat with at most minor mounds and hollows although 13078#13 had what appeared to be an old and decayed "gash mound" (echiuran) and 13077#66 sampled half a 450mm diameter "fairy ring" (?enteropneust). The structure of the latter appeared to be double, with one ring of holes superimposed on the other and displaced by about 70mm. Sub-surface structure under the rings was obscure, and no clear evidence of the organism responsible could be detected, although some fragments of decayed tissue were found. Burrows, mostly <5mm diameter were present in all cores, and fine (lumen <2mm) worm tubes were common. The large agglutinated foraminifer *Rhizammina* was present on the surface of all plain box cores. Xenophyophores and komoki were present but less abundant. Occasional megafaunal organisms (echiuran, sipunculan, polychaete, ophiuroids) were found on or in cores.

Table 4. Spade Box Cores from Stations 13077 and 13078

Series	Box	Rating*	Depth of core (cm)	Protocol	Sample fate	Remarks
13077						
7	P	0			SOC/SAMS	Double contact
8	P	0				Pretriggered; no sample
15	P	0				Pretriggered; no sample
19	P	3	40.5	SOC	IFREMER/SOC/ SAMS(sc)	Good core, slight compression, a few ejecta on surface
23	P	3	39.0	SOC	IFREMER/SOC/ SAMS(sc)	Good core, slight damage and compression, surface intact
56	P	0			SOC	Double contact
59	P	4	39.5	SOC	IFREMER/ SAMS(sc)	Very good core, very slight compression
63	P	4	39.0	SOC	IFREMER/ SAMS(sc)	Excellent core, many burrows
66	P	4	40.0	SOC	IFREMER/SOC	Very good core, very slight coimpression, dominated by 450mm fairy ring
70	V	2		SAMS	SAMS	Moderate core, all subcores somewhat disturbed, C2 sectioned in detail
87	V	3		SAMS	SAMS	Good core, slight damage to most subcores, C3 sectioned in detail
89	P	3	39.0	SOC	IFREMER/SOC/ SAMS(sc)	Good core, slight compression and minor deformation, 70x40mm clinker at surface
93	P	2	39.0	SOC	IFREMER/ SAMS(sc)	Acceptable core, some compression and cracking
95	V	0				Double contact
98	V	2		SAMS	SAMS	Moderate core, all subcores more or less disturbed, C3 sectioned in detail
13078						
13	P	3	39.0	SOC	IFREMER/SOC/ SAMS(sc)	Good core, very slight compression and cracking
15	V	4		SAMS	SAMS	Very good core, C3 sectioned in detail
17	V	1		SAMS	SAMS	Rather poor core, all subcores more or less disturbed, just acceptable, C4 sectioned in detail
18	P	2	53.0	GIF	GIF/SOC	Moderate core, subsampled for geochemistry

sc - subcore: *core rating; 0 = not suitable, 1 = just acceptable, 2 = moderate, 3 = good, 4 = very good

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Megafauna

The megafauna was sampled with the IFREMER beam trawl (the Chalut à perche) and the SOC otter trawl (OTSB14).

Chalut à perche (See Fig. 4)

The Chalut à perche as used during this cruise consisted of a wooden beam attached to two solid iron shoes together acting as a frame for the net. The oak beam was 6.1m long, square in section and 0.2m on a side, strengthened with iron bands of 5cm width on each side. The shoes were 1.0m high. The net was 16m long and 6m across the mouth and with a 1.4m codend. The mesh size decreased from 2 cms to 1 cm. The foot rope was 8.5m long and weighted with a chain. The net was roped to the beam and shackled to the shoes. A tickler chain, 7.4m long, was attached to the shoes. Six metre chain bridles, one incorporating a weak link, were attached to the leading edge of the shoes at one of 5 possible positions. The OTSB pinger was mounted under the beam. The trawl was connected to the main warp via a swivel, a 50m wire pennant, another swivel, a 525kg weight, and a third swivel.

First haul: 13078#1 28.iii.97.

Deployment was complicated by the length of the beam necessitating a sideways-on launch, and by the bridles which were too long for a clean lift over the stern. The gear was shot at a ship's speed of 1.5kts and a pay-out speed of 50m/min. Good pinger traces were received all the way down and bottom contact with 5200mwo was indicated clearly by both the pinger depth trace and the cable tension record. Pay out was stopped at 5490mwo. After 10min the net began to lift off and pay out was resumed to 5900mwo. The depth trace was lost during this phase. The tension increased slowly for 16min and then decreased suddenly. Hauling in at 20m/min resulted in a further increase in tension followed by another drop at c5550mwo which was taken as an indication that the net had come off the bottom 77min after first contact.

Recovery of the gear was achieved with the beam square-on using two deck winches, but spare space between the A-frame bases is absolutely minimal, and the technique is practical only in good weather conditions. The situation was complicated by 2-3 tonnes of mud in the codend which required a crane to lift it inboard. The net

had washed over the pinger bracket during deployment resulting in a 1.5m tear in the roof of the net. The codend was hung up and washed out with a deck hose prior to release of the catch. Some of the mud was pale grey and very solid, suggesting that it had come from at least 25cm below the sediment surface.

The catch was small and not in good condition.

Second haul: 13078#6, 30.iii.97

Modifications were made to the gear and fishing technique in an attempt to overcome some of the problems encountered during the first haul. The pinger bracket was modified to reduce the likelihood of further damage to the net, the chain bridles were shortened to facilitate deployment and they were attached to the shoes at the second from bottom position instead of the highest in an attempt to prevent the net from digging into the bottom. In order to increase the length of wire used, the 525kg weight was replaced by around 300kg of chain.

A higher ship speed of 1.7-1.8kts was adopted because we thought that for the first haul insufficient wire was deployed. Wire paid out at 40-45m/min. The depth trace disappeared with 4075mwo but the tilt traces remained and revealed first bottom contact with 6700mwo which was confirmed by a decrease of tension. Paying out stopped at 6800mwo when the pinger trace was indicating "just below horizontal". Ship speed during tow was 1.5kts, and the maximum mwo was 6900. Hauling commenced after 82min on the bottom, and the tilt trace showed "45° up" with 6542mwo 119min after first bottom contact.

The trawl was recovered on the slant after jamming between the grab rails on the A-frame bases and contained a good catch of animals in good condition but with no mud.

Third haul: 13078#11, 31.iii.97

No changes made to the trawl. The ship speed was held at 1.7-1.8kts while paying out at 50m/min. The trawl reached the bottom after 2h20 with 6345mwo. To keep the tilt traces between horizontal and 45° down required a maximum of 6910mwo with a ship speed of 1.6kts. Hauling commenced after 2 hours on the bottom and the net lifted off with 6330mwo after fishing for 149min.

The trawl was recovered on the slant without problems. The catch was in good condition with some soft mud. It suggested an abundance a little higher than that from 13078#6, but apparently with a higher individual weight: 2 large *Psychropotes longicauda*, large holothurians, larger *Amperima.*

Fourth haul: 13078#21, 02.iv.97

No changes made to the trawl. Ship speed in the range 1.1-2.0kts while paying out 45m/min for the first hour and 40m/min thereafter. On the bottom after 2h45 with 6600mwo. The net was fished with the tilt traces between upwards and 45° up, ship speed at 1.7kts, and a maximum of 6830mwo. Hauling commenced after 90min on the bottom and lift-off occurred with c6570mwo after fishing for 105min.

The trawl was recovered this time square-on with the frame tilted up sufficiently for the ends of the beam to clear the A-frame grab rails (- the 6m trawl really is that tight!)

The catch was very small - only 1 *Oneirophanta mutabilis,* 2 *Psychropotes longicauda* and rather few *Amperima.* A combination of small catch and tilt traces suggest that the trawl had been only skimming the bottom for much of the time, and that more wire should have been paid out.

Fifth haul: 13078#27, 03.iv.97

The poor performance on the previous haul may have resulted, in part at least, from pinger orientation. The pinger was accordingly adjusted so that the transducer was horizontal.

Ship speed 1.3-1.6kts while paying out at 50m/min. The trawl reached bottom after 125min with 5850mwo, increased during the haul to 6360mwo. A relatively low ship speed gave good pinger tilt traces, horizontal when paying out, 45 up otherwise. The net came off the bottom immediately hauling commenced giving a fishing time of 97min. Recovery was as in #21. The catch was good with no mud, but only half the size of those from #6 and#11. The relatively small catch, tilt traces, and immediate lift-off on hauling suggest that the net attitude was critical and that the gear may not have fished effectively throughout the haul. The cost in time of paying out an extra

100-200m of wire is extremely cheap if it results in the net fishing with full effectiveness throughout the haul and producing a genuinely large catch.

Catches from the 5 Chalut à perche hauls are summarized in Table 5. The holothurian *Amperima rosea* was the most abundant organism in each of the hauls, representing 33-77% of the total catch. Holothurians collectively dominated the catches (75-95%), and the only other major taxa to account for at least 1% of the total catch in each of the hauls were the Actiniaria (1-7%) and Polychaeta (1-4%).

Semi-balloon otter trawl (See Fig. 5)

The otter trawl is a commercial shrimp trawl fished with 1.0x1.5m dihedral otter boards and a 25cm glass deep-sea float on the headline. The effective width of the net when fishing is 8.6m. The body of the net is 41 and 37mm stretch mesh netting, and the codend has a 6mm mesh liner. The trawl is fished on a single warp, but in order to deploy the otter boards and to gain full benefit from them, the boards are launched on 50m bridles run off deck winches. These bridles are singled up onto a swivel attached to the main warp termination prior to paying out to operating depth. Recovery reverses this process.

The otter trawl was fished 3 times during the cruise (13078#29, #31, #37). For the first 2 hauls wire was paid out at 50-60m/min reducing to 35-50m/min with the ship making 2.5-3kts reducing to 2-2.5k. In both cases the net reached the bottom with c9800mwo when towing speed was reduced to c1.5kts. Hauling slowly (6-15m/min) after 90 and 60min respectively resulted in extended bottom contact times (5h50min and 4h41min) and a reluctance for the net to come off the bottom (6820 and c7950mwo). Large quantities of mud were present in the codend of the net: on haul #31 the bag was so large that the double-barrelled capstan, which has a pull of 3 tonnes, was unable to recover the net. While efforts were being made to transfer the load to a crane, the lazy line attachment tore out of the net. Serious consideration was given to sacrificing the net. Eventually, and with some difficulty, strops were passed round the throat of the net, and the codend was recovered in two crane lifts. The load in the bag was estimated at 4 tonnes. For both hauls, the codend was suspended and washed out with deck and fire hoses to reduce the weight to manageable proportions. The large quantity of mud and almost total absence of fish together with evidence from

the otterboards themselves - mud on lower and upper leading corners - indicated that the boards had collapsed onto the sediment surface during the hauls. This collapse is attributable to the low towing speed - the doors are heavy and have a minimum design speed of 2.5kts. For the third haul (#37), ship speed was maintained at 3kts during veering, slowed to 2kts with 10750mwo. The net made the bottom at 11500mwo and hauling was commenced immediately. By balancing ship speed and rate of haul, the speed of the net over the ground was kept at 2.3-3.3kts. The net came off the bottom after 1h52min with c9480mwo. The catch was absolutely clean and contained 21 fish. The moral is clear.

Catches from #29 and #31 were washed on the 16mm and 4mm baskets from the sieving system prior to sorting, while that from #37 was clean and was sorted direct. Fresh wet weights were obtained for all material, at the specific or generic level for major contributors, and at higher taxonomic levels for less significant groups (Table 6). Fish catches from the first two hauls were unrepresentative; #29 containing 3 *Histiobranchus bathybius* weighing 1445g in total, and #31 no fish at all. In contrast, 21 fish were obtained from #37, 5 *H. bathybius*(2150g), 6 *Coryphaenoides armatus* (14230g), 1 *Chalinura leptolepis* (950g), and 9 smaller unidentified rattails (675g), with a total weight of 18005g.

Table 5.

DISCOVERY 226, BENGAL 2, Chalut à perche						
TAXON	Genus species	13078#1	13078#6	13078#11	13078#21	13078#27
Pennatulacea	Umbellula sp.		1	1		1
Actiniaria	Actinauge abyssorum	10	18	29		13
	Amphiantus bathybium	4				
	Sicyonis biotrans		1	1		
	Kadosactis sp.	2	4	5		7
	Segonzactis platypus	1	1	2		2
	Daontasia sp.	1	2	15		4
	Iosactis sp.			16	2	2
	Gen. sp.			1		
Zoantharia	Epizoanthus sp.	6	18	40		5
Scleractinia	Fungiacyathus sp.	1	2	6		1
Nematoda (parasit)	Gen.sp.	3				
Polychaeta	Polynoidae gen. sp.	10	24	29	2	14
Serpulidae	Gen. sp.		2			1
Echiura	Gen. sp.		1	2		2
Sipunculida	Gen. sp.	1		6		
Bivalvia	Gen. sp.	5	2	5		5
Gastropoda	Gen. sp.			8		3
Scaphopoda	Gen. sp.	2		1		
Cephalopoda	Cirrothauma sp.					1
Pycnogonida	Gen. sp.		1			1
Cirripedia	Scalpellum sp.	1				2
Decapoda natantia	Acanthephyra microphthalma		3	1		
	Benthesicymus			3		3
Decapoda reptantia	Stereomastis sp.	2	2	1		1
	Munidopsis parfaiti		1			
Holothuroidea	Oneirophanta mutabilis	42	64	119	1	29
	Pseudostichopus sp.	34	39	94	3	20
	Psychropotes longicauda	9	46	66	2	27
	Paroriza prouhoi		4	4		4
	Mesothuria sp.		4	7		2
	Amperima rosea	82	1300	1020	105	600
	Kolga sp.	20	125	335	35	80
	Peniagone			3	1	2
	Deima (validum ?)			1		2
	Gen. sp.	2		3		
Asteroidea	Hyphalaster sp.	3	9	7		2
	Styracaster sp.	3	2	9		2
	Dytaster sp.	2	1			
	Freyella sp.			2		
	Gen. sp.	1				
Ophiuroidea	Ophiomusium sp.	1	3	5	2	4
	Gen. sp.					1
Tunicata	Culeolus sp.	1	6	8	1	6
Pogonophora	Gen. sp.			1		
Indetermine	Actinian or ascidian			4		3
Pisces	Bathysaurus ferox			1		
	Gen. sp.		5	4		3
	Coryphaenoides armatus	2		3		5
Total		251	1691	1868	154	860

Table 6. Fresh wet weight biomass of invertebrate megafauna from otter trawl hauls

TAXON	13078#29 Weight (g)	%	13078#31 Weight (g)	%	13078#37 Weight (g)	%
Porifera					15	
Pennatulacea	5		10		80	0.1
Actiniaria	2034	1.7	387	0.8	387	0.7
Scleractinia	38				20	
Zoanthidea	37		12		13	
Echiura	360	0.3	203	0.4	150	0.3
Sipuncula	10		16		18	
Annelida	115	0.1	10		70	0.1
Cirripedia	30		8			
Decapoda Natantia	306	0.3	8		380	0.7
Decapoda Reptantia	350	0.3	60	0.1	59	0.1
Pycnogonida	6				20	
Gastropoda	51		18		5	
Scaphopoda	6					
Bivalvia	34		10			
Cephalopoda			160	0.3	110	0.2
Asteroidea	1056	0.9	381	0.8	330	0.6
Ophiuroidea	20		13		10	
Amperima rosea	18900	15.7	10900	23.7	5300	9.8
Benthodytes sordida	2300	1.9	500	1.1		
Deima validum	1200	1.0	430	0.9	520	1.0
?*Kolga hyalina*	2300	1.9	1000	2.2	720	1.3
Mesothuria sp	1800	1.5	320	0.7	150	0.3
Molpadia blakei	255	0.2	120	0.3	60	0.1
Oneirophanta mutabilis	23270	19.4	10347	22.5	16920	31.4
Paroriza prouhoi	5600	4.7	2500	5.4	1269	2.4
Peniagone sp					15	
Pseudostichopus spp	26300	21.9	10000	21.7	5607	10.4
Psychropotes spp	34560	28.8	8568	18.6	21568	40.0
Holothurioidea indet	60		10			
Total Holothurioidea	116545	97.1	44695	97.2	52129	96.7
Tunicata	28		4		90	
Total	120031	100.0	45995	100.0	53886	100.0

MIKE THURSTON, JOELLE GALERON, PHILIPPE CRASSOUS

Benthic necrophagous amphipods

Benthic necrophagous amphipods were obtained from three sources (see Figs. 6 and 7). Five deployments of DEMAR, the free-fall baited trap system used by SOC, were undertaken. On-bottom times approximated to 6, 12, 24, 36 and 48 hours. Video recordings taken from the NIOZ lander during *Discovery* Cruise 222 had shown the presence of large numbers of amphipods at bait deployed to attract fish. During the present cruise simple baited tube traps were attached to the lander at heights of 450, 1050 and 2010mm above the sea floor at each of the five deployments which lasted a little over three days. Attempts to sample at 50mab were frustrated when the trap attached to a buoyancy pack was smashed during recovery. Thirdly, amphipods were attracted to, and recovered with, the IFREMER Module Autonome de Colonisation (MAC).

The shorter DEMAR deployments were dominated by *Eurythenes gryllus, Paralicella tenuipes, P. caperesca,* and three species of *Orchomene* (*s. lat.*). The longer deployments took these same species together with smaller numbers of several other entities including *Valettietta gracilipes, Paracallisoma alberti, ?Paracallisoma* sp. nov. and *?Paracentromedon* sp. nov. A similar spectrum of species was found in the NIOZ traps. *?Paracallisoma* sp. nov. occurred in relative abundance (up to 100+) per sample, and was much commoner than in samples taken prior to 1996.

Numbers of specimens trapped increased from the 6 hour to the 12 hour to the 36 hour deployment. Unprotected bait (a whole mackerel) was consumed within 24 hours, and numbers of specimens from the 24 and 48 hour deployments were relatively low. These two deployments together with the NIOZ traps held significant numbers of apparently predated cuticles. The 36 hour deployment contained a specimen of *Pachycara obesa,* an apparently sluggish zoarcid fish also seen in NIOZ videos. The fish had fed extensively on amphipods in the trap, but, fortunately, digestion was at a very early stage, and identification was still relatively easy.

The MAC rig had been on the bottom for about six months, and various of the trays contained a total of four species of amphipod. Two species belonged to the Oedicerotidae, a ubiquitous family of fossorial beasts common in the deep sea. Also

present were some specimens of *V. gracilipes* and, most interestingly, about 30 specimens of an undescribed species close to the Antarctic genus *Oradarea.*

MIKE THURSTON

Microbiology

Samples for community structure analyses

The gut contents from three holothurian species were preserved in 40% glycerol and held at -20 °C until community structure analyses can be carried out in the laboratory using nucleic acid based techniques. The three species involved are *Oneirophanta mutabilis*, *Psychropotes longicauda* and *Pseudostichopus* sp. For this purpose, the gut was divided into four regions; the oesophagus and pharynx, the anterior intestine, the posterior intestine and the rectum and cloaca. The gut walls from these four regions were also preserved as above for fluorescent *in situ* hybridisation studies.

CTD rosette water was filtered using a 0.2 mm pore size sterivex filter. Typically five litres of water was sampled and the filter preserved in a lysis solution (50 mM NaCl, 40 mM Sucrose, 10 mM EDTA) and frozen.

Sediment cores from the multicorer were taken and sectioned every cm to a depth of 5 cm and frozen until further analyses to be carried out in the laboratory.

The SAPS is an in situ pumping system used to concentrate bacterioplankton on a 293 mm diameter cellulose nitrate filter with a pore size of 0.2 µm. Three deployments were made using the coring wire and one deployment of a moored SAPS which was lost during recovery (see Fig. 7). All of the samples taken by UCG were preserved in 40% glycerol and held at -20 °C for nucleic acid analyses (Table 7). The GF/D glass microfibre filters used by UL were also frozen after sampling.

Table 7. Summary of samples taken for Nucleic Acid analyses.

Station No.	Gear	Sample Taken
13077 #6	Multicorer	Two cores was sectioned every cm to 5 cm and frozen.
13077 #11	SAPS	Two filters from 100M and 50M were preserved in 40% Glycerol and frozen.
13077 #16	CTD	5L of water from 8 MAB were filtered using a 0.2µM sterivex filter.
13077 #17	CTD	2 x 5L of water from 100M were filtered using a 0.2µM sterivex filter.
13077 #18	Multicorer	One core was sectioned every cm to 10 cm and frozen
13077 #57	Multicorer	One core was sectioned every cm to 5 cm and frozen
13077 #60	Multicorer	Sediment contact Water
13077 #64	SAPS	One filter from 1000M was preserved in 40% Glycerol.
13077 #65	Multicorer	One core was sectioned every cm to 5 cm and frozen
13077 #68	SAPS	One filter from 13 MAB and one from 100 MAB were preserved in 40% Glycerol and frozen.
13077 #90	Multicorer	3L of sediment contact water were filtered using a 0.2 µm sterivex filter.
13078 #6	Chalut à perche	Contents and gut walls from the four regions of the gut from *Pseudostichopus* were sampled.
13078 #11	Chalut à perche	Contents and gut walls from the four regions of the gut from *Psychropotes* were sampled.
13078 #29	OTSB	Contents and gut walls from the four regions of the gut from *Oneirophanta* were sampled
13078 #31	OTSB	Contents and gut walls from the four regions of the gut from *Oneirophanta* were sampled
13078 #33	CTD	5L of water from 8 MAB were filtered using a 0.2 µm sterivex filter.

Bacterial Activity

Bacterial activity was studied by the incorporation of tritiated thymidine (DNA replication) and tritiated leucine (protein synthesis) in to the bacterial communities in sediment contact water (SCW), sediment, and the guts of three species of holothurian, *Oneirophanta mutabilis*, *Psychropotes longicauda* and *Pseudostichopus* sp. Samples

were incubated under atmospheric and in-situ pressure, and at a temperature of 3°C, for intervals of 18-24 hrs. For SCW, 400mls of water was taken from overlaying water from sediment cores collected with the multiple corer and incubated with thymidine. Sediments were divided into 1cm sections of 0-1, 1-2, 2-3, 3-4 and 4-5 cm, and incubated with thymidine (Thy) and leucine.(Leu) Holothurian gut material was collected from four gut sections, the oesophagus and pharynx, the anterior intestine, the posterior intestine and the rectum and cloaca and incubated mostly with thymidine. Sub-samples were taken from all samples for determining total bacterial numbers by epifluorescent microscopy.

The following list (Table 8) summarises the activity experiments performed.

Table 8. Thymidine and Leucine uptakes on sediment, SCW and holothurian guts.

Station number	Gear	Experiment
13077#6	Multicorer	Thy and Leu on sediment
13077#18	Multicorer	Thy and Leu on sediment
13077#24	Multicorer	Thy on SCW
13077#57	Multicorer	Thy and Leu on sediment
13077#60	Multicorer	Thy on SCW
13077#65	Multicorer	Thy on sediment
13077#96	Multicorer	Thy on SCW
13078#6	Chalut à perche	Thy on *Pseudostichopus*
13078#11	Chalut à perche	Thy on *Psycropotes*
13078#29	OTSB	Thy on *Oneirophanta*
13078#31	OTSB	Thy on *Oneirophanta*
13077#13	BIOFEED lander	Thy on sediment
13078#37	OTSB	Thy on *Psycropotes*

All the samples were taken back to Galway for further processing.

DONAL EARDLY AND MICHEAL CARTON

Holothurian feeding

Three holothurian species (*Oneirophanta mutabilis*, *Psychropotes longicauda* and *Pseudostichopus* spp.) with differing feeding strategies, were sampled for enzyme profiles and meiofauna. For each species, five replicate specimens were sampled. Work was carried out in the CT lab at *in situ* temperatures, for the enzyme studies, and sections were taken from the pharynx/oesophagus (p/o), anterior intestine (ai), posterior intestine (pi) and rectal/cloacal (r/c) regions. The contents of each gut

section was placed in an eppendorf and frozen at -50°C. The corresponding gut tissue was washed with 25 micron filtered seawater and frozen at -50°C. For meiofauna, 1ml gut contents samples were taken from the p/o and r/c, using a cut-off 5ml syringe, and stored in plastic vials in 4% formalin. In addition, for *Psychropotes longicauda* and *Pseudostichopus* spp., the remaining gut contents material from these regions was also fixed. For *Oneirophanta mutabilis*, 5ml samples were taken from the ai and pi to provide greater volumes for the meiofaunal counts. Three replicate p/o and r/c gut contents samples were collected for each species and dried; these will be used to assess damage to foraminiferan tests in the holothurian gut.

Gut tissue and tentacle samples for the three species and for *Paroriza* were fixed for TEM work.

Sectioning of sediment samples was carried out in the CT lab, the top 0.5cm of sediment was removed from six cores (13077 # 6 (core 8), 12 (core 5), 21 (core 11), 24 (core 6), 60 (core 3 and 5) and frozen (-50°C) for enzyme studies.

HEATHER MOORE.

Holothurian Gut Residence Time

Method

Gut contents from the holothurians were collected within two hours of the animals arriving on deck.

The whole gut minus the oesophagus (D1) was used in each of the experiments, each dissection being carried out at *in situ* temperatures in the CT laboratory. For each experiment a minimum of 20mls of sediment is required, therefore for the smaller animals ie *Oneirophanta mutabilis*, the gut contents of 2-3 animals had to be pooled. Gut contents were diluted (x2) with chilled artificial seawater (35g NaCl in 1 ltr MQ), to enable the sample to be pipetted. The diluted material (1ml) was pipetted into sterile plastic bags, to this 0.8 mls substrate was added (leucine -4-amino-7- methyl coumarin, four additions, ranging from 2-620nM, four replicates, and four blanks for each). The bags were then heat sealed, and incubated under *in situ* conditions (1-2 hrs, 4° C, 480 atm.). A second incubation was carried out (four additions, two replicates) at 1 atm. Blanks were heated prior to the addition of

substrate to ensure that the enzymes were completely denatured, this allowed the effect, if any, of heating the substrate to be seen.

After incubation the bags were opened, their contents pipetted into 1.7 ml centrifuge tubes, heated to 100°C for 30 minutes, (to cause the cessation of enzyme activity), and were then centrifuged (2500rpm, 15minutes). The fluorescence of the supernatant was then measured, (Perkin Elmer fluorimeter, excitation 375 nm, emission,450 nm, sample volume,10-100 µl; borate buffer, pH 10.2, 2-3 mls). Vmax calculations were then calculated using a Lineweaver-Burke plot and the results are given in Table 9.

Gut contents (see Table 10) were also collected by dissection from other specimens. The gut regions sampled were as follows; D2, fore gut (first half of anterior intestine), hind gut (last part of posterior intestine and rectum), and the mid gut (remainder of anterior and posterior intestine), D3, oesophagus, anterior intestine, posterior intestine, and rectum. Samples from D3 were pooled with Queen's University Belfast, and the University of Galway.

Table 9: Summary of Vmax calculations.

Deployment	no. of animals	Species	Vmax (µmoles/hr/animal)
13078#6	1	*Pseudostichopus*	n.d
13078#11	1	*P.longicauda*	180
13078#31	2	*O.mutabilis*	n.d
13078#37	2	*O.mutabilis*	45
13078#37	1	*Pseudostichopus*	248.9

Table 10: Holothurian gut samples taken.

	no.of animals		
Deployment	D2	D3	Species
13078#6	1	14	*Pseudostichopus*
13078#11	1	3	*P.longicauda*
13078#27	2		*O.mutabilis*
13078#29	5	20	*O.mutabilis*
13078#31	3	3	*O.mutabilis*
13078#37	3	3	*O.mutabilis*
13078#37	1	1	*Pseudostichopus*

KAREN MACKENZIE

Zooplankton, micronekton and scavengers

Zooplankton and micronekton

The zooplankton was sampled with a 1 m^2-MOCNESS (Multiple opening/closing net and environmental sensing system, Wiebe *et al.*, 1985). The system consists of a frame carrying 9 nets, which can be opened and closed sequentially on command via a conducting cable. The mesh aperture is 333µm. An altimeter measures the distance to the bottom. Information on depth of gear, net angle, flowmeter counts, net number, distance off bottom, temperature and conductivity is transmitted via conducting cable to a shipboard unit and logged on a computer.

For stabilisation, the gear is lowered with the first net open. Three depth layers were fished horizontally at each haul : 15 mab, 50 mab and 100 mab. For each depth stratum, two consecutive nets were used which filtered ca 1800 m^3 of water in 30 min each. The two remaining nets were open during transition between depth strata. A sampling scheme is given in Table 11.

Table 11: MOCNESS - Sampling scheme

net/sample #	sampling layer
1	surface - 10 mab
2	15 mab
3	15 mab
4	15-50 mab
5	50 mab
6	50 mab
7	50-100 mab
8	100 mab
9	100 mab

During *Discovery* 226, a total of 6 MOCNESS hauls were conducted (see Fig. 8). A first sampling series of 3 hauls (Stations 13077#26-34, 13077#36-44, 13077#47-55) was carried out from 19-21 March. All hauls were successful except for the loss of two codend buckets. Haul 4 (Station 13077#73-75) had to be terminated after the second net was closed because the signal was lost due to an interruption in the conducting swivel. During haul 5 (Station 13077#78-86), no net response, indicating the proper net closure, was received, but after recovery all nets were closed,

and the gear appeared to have worked properly. Haul 6 (Station 13078#38-46) was completely successful.

The samples were preserved in formalin immediately. Compared to samples from cruise Meteor 36-6 in October 1996, the plankton abundance appeared to be higher. Also, there were some indications of qualitative differences between the 15 mab stratum and the higher layers.

Scavenging amphipods

Scavenging amphipods were captured by means of a free-fall baited trap set (Christiansen, 1996). The set carried 10 traps from 0-500 mab (Fig. #). The traps have an entrance diameter of 45 mm. Each trap was baited with two mackerel. During deployment 3 and 4, the bait was wrapped in gauze netting to prevent the amphipods from feeding on the bait.

A total of 4 trap set deployments were conducted (Stations 13077#72, 13077#97, 13078#5, 13078#12) (see Fig. 6, VET). The bottom time of each deployment was between 20 and 36 h. All 4 deployments were completely successful.

The catches displayed a pronounced vertical distribution pattern. The bottom traps contained large numbers of small amphipods, most of them *Paralicella* spp, but also several other small species and juveniles of *Eurythenes gryllus*. In the pelagic traps, only *Eurythenes gryllus* were captured, with maximum catch rates between 8 and 30 mab, a minimum between 100 and 300 mab, and a second, smaller maximum at 400-500 mab.

Specimens from hauls 1, 2, and 4 were preserved in formalin for the analysis of composition, distribution, and gut contents. Part of the catch from haul 3 was frozen for the analysis of stable isotopes (task 71) and RNA/DNA ratios.

Literature

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BERND CHRISTIANSEN

NIOZ lander and associated observations

Introduction

Between September 1996 and February 1997 all effort was put in the construction of a new lander to replace the one which was lost during *Discovery* cruise 222. Due to the financial support of the institute and an already running program for the construction of a long-term lander, we managed to have a prototype which could be tested in deep water during *Discovery* cruise 226.

During cruise 226, the new NIOZ lander was deployed 5 times (see Fig. 6). Except for minor failures these deployments were very successful.

The lander was equipped with two respiration chambers to measure the in-situ sediment oxygen consumption, two 2-litre niskin bottles, a technicap sediment trap and two bottom grabs, three amphipod traps and a video unit to follow the decay of bait in time.

Oxygen consumption.

The sediment oxygen consumption was determined from the change in oxygen concentration between start and end of each in-situ lander incubation. Winkler titration of bottom water samples taken by CTD or multicore showed that the near bottom concentration was on average 236.4 µmol/l.

The duration of each lander deployment varied between 56 and 86 hours. The (preliminary) estimated oxygen consumption for these deployments varied between 15 and 21 umol/m2.hr. This consumption rate compares well to the estimates obtained last year during cruise 222.

The sediment traps on the lander yielded insignificant amounts of material, even though some of the deployments lasted for more than 3 days. This strongly contrasted to what was found in September 1996. The lander sediment trap results are corroborated by the results of a 12 day deployment of a technicap trap. The pigment

composition of this material will be compared with the pigment composition in sediment cores, bottom water and the composition of the deep water chlorophyll maximum.

The technicap sediment trap is still deployed at its site in the northern part of the area. 12 weekly samples will be collected between April 14th and July 7th. In this way we hope to determine the exact timing of the phytodetritus drop in the area.

Downcore pigment distribution

Multicores from 9 stations were sliced to determine the pigment depth distribution. From some other cores only the top mm was extracted. In addition to this core slicing gut contents of 6 *O. mutabilis* and 6 *P. longicauda* were sampled.

Oxygen profiles

From 10 stations sediment oxygen depth profiles were determined. Usually the first profile was made within 20 minutes after the core had come aboard. It appeared that the cores had warmed considerably. Several times a temperature of 9.5 to 9.7 °C was measured in the centre of a core even at a depth of 10 cm. Up to now no detailed analyses has been made of the cores.

To enable the calculation of oxygen fluxes from the pore water profiles, sediment samples were frozen to determine their water content. In addition, resistivity profiles for 7 multicore stations were determined.

Amphipod traps

The small traps mounted at three heights on the lander frame had a variable success rate. 14 amphipod species were caught. From three lander stations specimens were frozen in liquid N2 for later analyses of their RNA/DNA ratio.

ROB WITBAARD, JACOB VAN DER WEELE, MARTIN LAAN

Solute fluxes across the sediment - water interface.

(BENGAL tasks 32,34-35 and 75;)

Benthic fluxes (task 32)

Solute fluxes across the sediment -water interface were measured on samples taken *in situ* with the NIOZ lander at four different stations (13077#35,#71,#99 and

13078#19). Samples were taken from the glass oxygen ampoules with the 60ml syringes of the BOLAS chamber and the 35ml ones of the ALBEX chamber. In each case the salinity of the samples was measured to calculate the degree of dilution by the MQ water with which the ampoules had been filled during deployment. Different benthic fluxes measured on-board were Σ CO_2, alkalinity, DOC (dissolved organic carbon), total carbohydrates $(CH_2O)_n$ and monosaccarides. Samples were also collected and stored frozen to be taken back for analysis in Sweden for nutrients and oligosaccarides. One flux-series was also taken (Stn 13078#19) for Christophe Rabouille, Gif sur Yvette, France, for high precision determination of Ca (task 35). For reference samples, bottom water from four different casts with the CTD were taken and analysed for the same parameters as mentioned above.

Pore water profiles (task 34).

Pore water profiles for ΣCO_2, alkalinity, DOC, $(CH_2O)_n$ and monosaccarides were obtained on-board from four different multicore stations (13077#25,#58,#90 and 13078#10) As for the benthic fluxes, pore water samples were taken for later analysis of nutrients and oligosaccarides. Two complete profiles (solid phase) from one station (13077#90) were taken for Olivier Ragueneau, I.U.E.M., Brest, France (task 75). Also two complete sliced cores (solid phase) were taken (13078#10) and stored frozen for analysing Thorium in Sweden and one whole core was taken (13078#7) for the same purpose. A further core (solid phase) was saved for C/N analysis in Sweden.

Experiment - addition of C^{13} labelled algae

Eight multicores (4 with addition of C^{13} labelled algae and 4 controls) were taken from station 13077#58, for on-deck incubation during 18 days in the walk-in freezer. 20 mmol C^{13} per m^2 (approximately equivalent to 10 days of algal deposition from the spring bloom) were added to each of the four incubation cores. Four control cores were also taken from the same cast. The cores were subsampled on 8 different occasins and refill water added. Each sample was analysed for the same parameters as for fluxes and pore water above. Oxygen sediment profiles were run by the Dutch group on four (2 incubations and 2 control) cores.

Flux samples were obtained with a autonomous benthic lander (from NIOZ) with two chambers. Incubation times differed between 55 and 76 h between the four

different deployments. Five samples were obtained from one chamber (ALBEX) and six samples from the other chamber (BOLAS) per deployment. Each sample was filtered through disposable sterile cellulose acetate filters (0.45 mm) and stored refrigerated until analysis. Salinity measurements were carried out by using an Autosal (model 8400A). Pore water was obtained by slicing 8 cores per station into the following depth intervals: 0-5mm, 5-10, 10-20, 20-30, 30-40, 40-50, 50-65, 65-80, 80-100, 100-120, 120-140, 140-160. Each subsample was centrifuged at 2500 rpm for 30 min, the pore water removed and pooled together with other subsamples from the same depth interval. The remaining sediment were frozen. Each pooled pore water sample was filtered through disposable sterile cellulose acetate filters (0.45 mm) and stored refrigerated until analysis. The on-deck incubation experiment with ^{13}C labelled algae was performed at 2°C, in the walk-in freezer. 15 ml of subsample was taken with pipette from each core and pooled into one large 60ml subsample and filtered as above, for the incubation and control respectively. CTD bottom water was used as refill water and for the oxygen profile in the sediment a resistivity probe was used (see cruise report from NIOZ).

Concentrations of alkalinity and total carbonate were determined on-board by potentiometric determination of alkalinity and colorometric determination of ΣCO_2 respectively. DOC was measured on-board by high temperature catalytic oxidation (HTCO) using a SHIMADZU TOC-5000 total C analyser after acid treatment to remove dissolved inorganic carbon. Total carbohydrates (dissolved and particulate) were measured using MTBH analysis and for free dissolved monosaccarides high pressure anion exchange liquid chromatography was used together with a pulsed amperiometric detector.

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Ornithology

Standard ten-minute bird observations were made from the bridge throughout the cruise as and when other commitments allowed. Casual sightings were recorded as appropriate. In all, 172 standard observations were carried out, 14 during passages to and from the work site and 158 at the European Community Station. The EC Station

was occupied for 25 days, giving an average of 6.3 observations per day, somewhat short of the target of 8-9/day, and 26 casual sightings were recorded.

Weather during the cruise was remarkably good. Winds were light throughout, never reaching gale force (34knots = 17.4m/sec) during any observation, and predominantly from a southerly quarter (45%) with some westerlies (26%) and easterlies (21%). Pressure remained high for much of the cruise, and visibility was good with occasional mist and fog patches, particularly on 25 March.

Hardly any birds were seen during the passage legs, the only sighting of any consequence being that of a yellow-legged herring gull (*Larus micahellis*) at 44°45'N 12°00'W on 9 April.

At the EC Station (48°50'N 16°30'W) 8 seabirds species were recorded at 82 of 158 standard observations (52%). Kittiwakes (*Rissa tridactyla)* were seen most frequently (50 observations, 32%) and in greatest numbers (up to 22 individuals). Other species included fulmar (*Fulmarus glacialis,* 18 observations, 11%), great skua (*Catharacta skua skua,*14, 9%), Manx shearwater (*Puffinus puffinus*, 10, 6%), lesser black-backed gull (*Larus fuscus graellsii*, 10, 6%) and gannet (*Sula bassana*, 6, 4%). Singles of Leach's storm petrel (*Oceanodroma leucorhoa*) and puffin (*Fratercula arctica*) were each recorded once.

Seabirds were seen more frequently and in greater numbers towards the end of the cruise - kittiwakes were seen at only 7 of 68 observations during the first ten days at the EC Station, and 17 of 18 sightings of fulmars were made during the last 11 days. This pattern suggests some sort of movement into the area, but whether this is a seasonal drift eastwards towards breeding colonies, or a gradual aggregation of individuals around the ship, is unclear.

One Leach's storm petrel found on board on 7 April was ringed prior to release.

A few non-seabirds were seen during the cruise, usually during or after periods of SE wind. No corpses were found on the ship, but the chances of survival of most of these individuals must be very poor, an exception perhaps being the dunlin (*Calidris*

alpina) seen feeding on the poop before the deck was washed down after the last otter trawl haul.

MIKE THURSTON

Loss of the Goteborg lander.

The Goteborg lander was safely deployed 14.3.97, 23.47 hrs GMT, Stn no 13077#5, Posn 48°55.9'N and 16°35.6'W. Release mechanisms, VHF-radio, ARGOS and flasher were tested several times each on deck before deployment and all were working well without any problems. Contact was made with the lander during its descent and it was followed down to 750m depth before switching the deck unit of the MORS system off and continuing to another station. Descent rate was 35 m/min which is the normal descent speed for this lander. The incubation was due to start 04.00 h on 15.3.97 and last for 60 h in total. The release of the lander was planned to take place 17.3.97, 10.00 h but no contact could be made with it. Continuous trials to release the lander were made with both of the acoustic releases until next morning, but without any success. The search pattern used was an expanding square around the deployment site trying to cover "dead" angles between the ship and the lander. During the search a longer sweep were done north of the deployment site in case the lander was drifting with the bottom current (which is well known to have a northerly direction and a maximum speed of 0.5 knots at this location). During the rest of the week attempts were made to release the lander when there was available ship time for doing so in the area of deployment and north of it, but still without any result. In total, approximately 20 h of ship time were spent searching for the Goteborg lander.

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ACKNOWLEDGEMENTS

Discovery cruise 226 was a pleasant and fruitful cruise blessed with good weather and, apart from some unfortunate gear failures, and particularly the loss of the Goteborg lander, with successful science. None of this would have been possible without the willing and hard-working co-operation of Captain Mike Harding and his crew, and the RVS technicians. They all deserve the thanks of the PS on behalf of all the scientists.

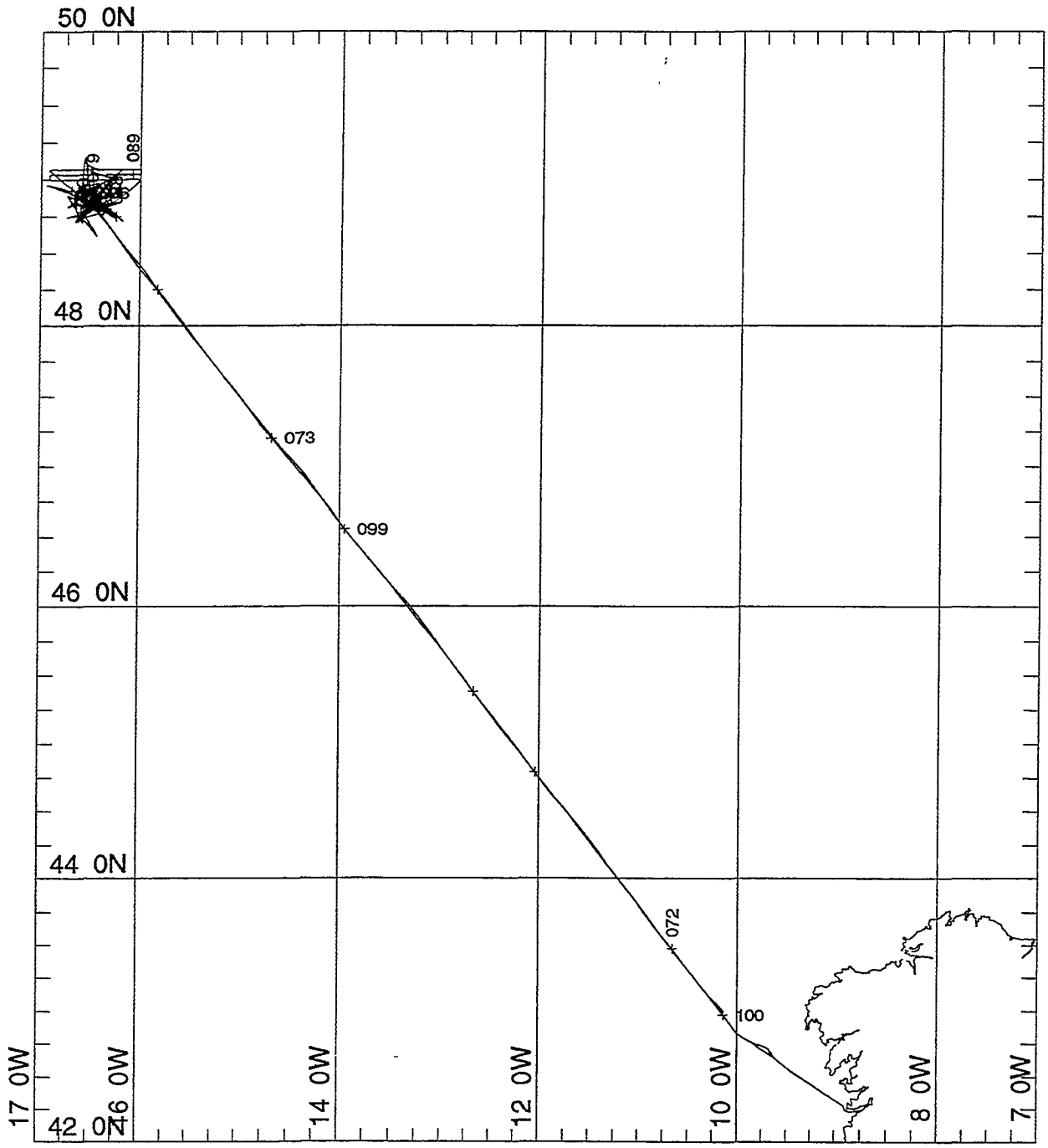

Fig. 1. Track chart between Vigo and the main work area. Chart marked with Julian day numbers.

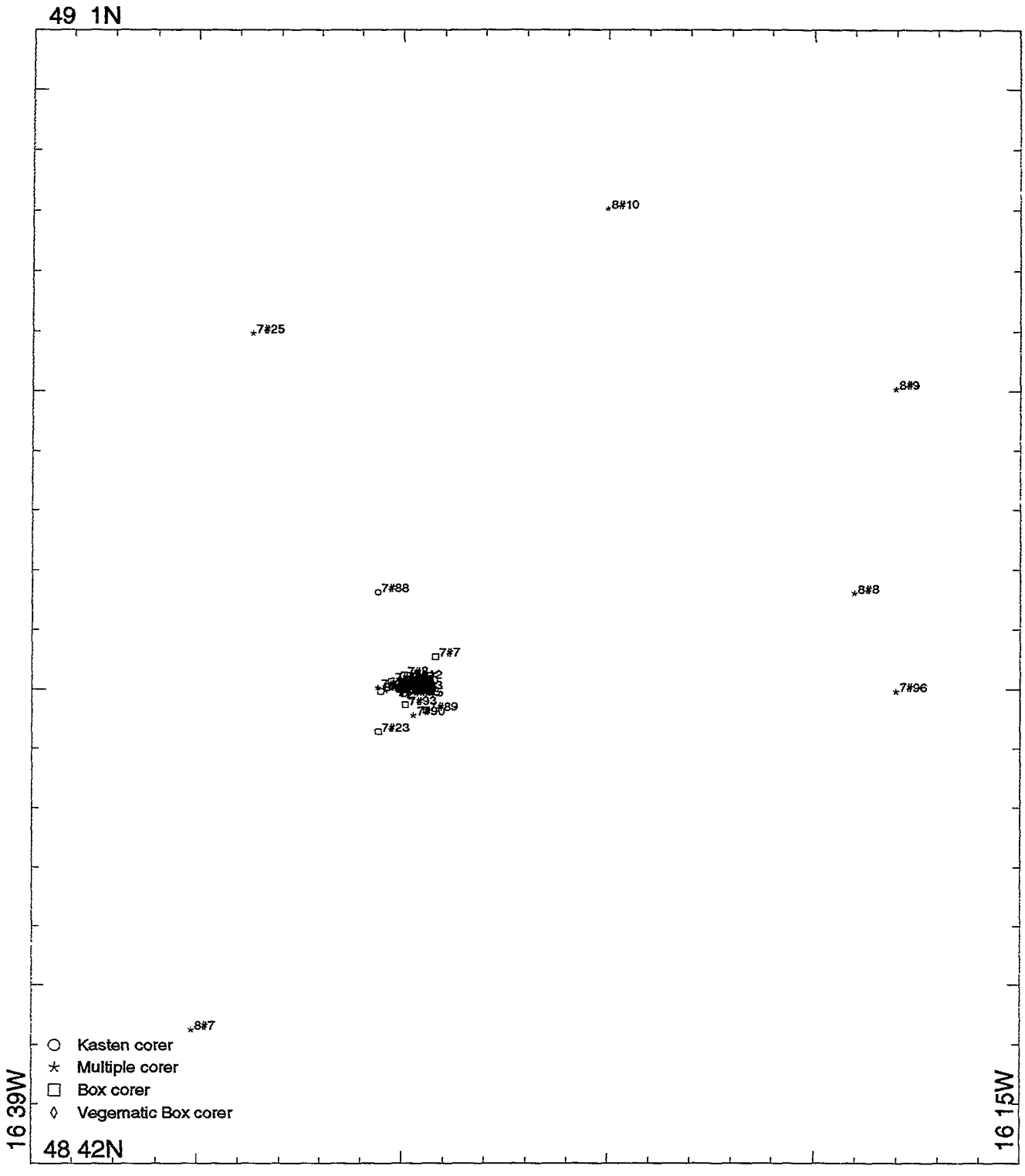

Fig. 2 Coring positions. For details of those in the central area see Fig. 3.

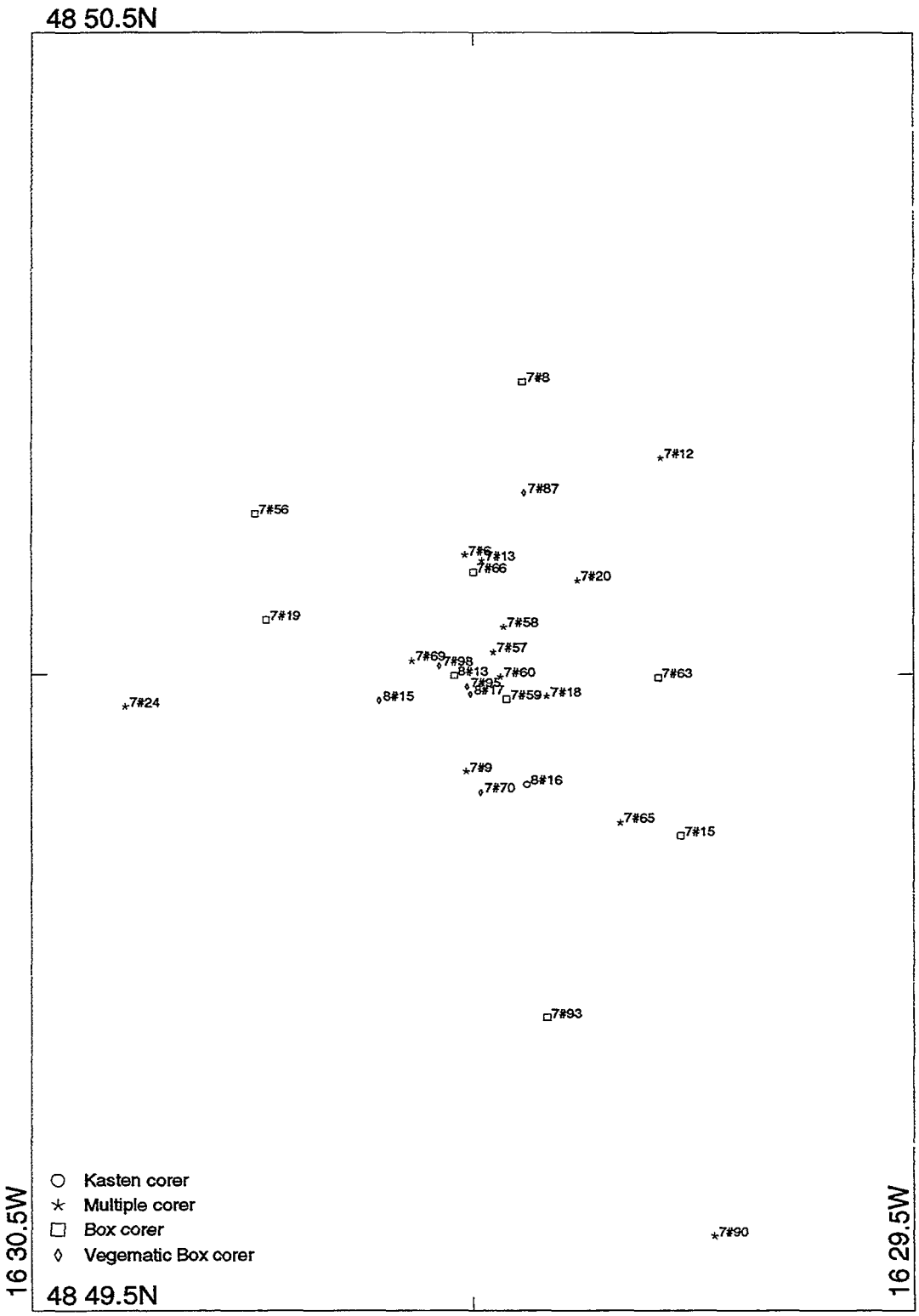

Fig. 3 Coring positions within central area.

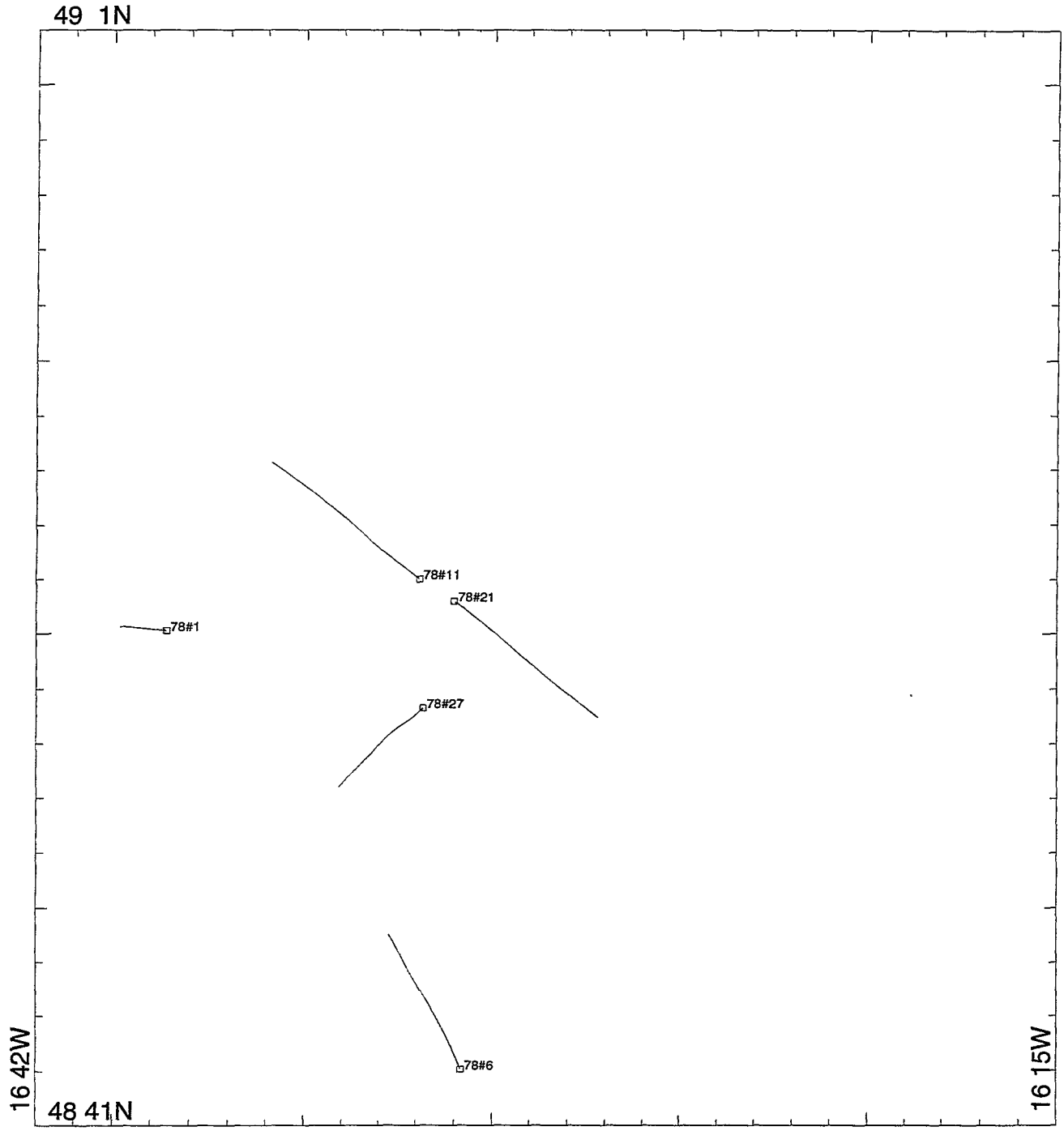

Fig. 4 Chalut à perche bottom tracks.

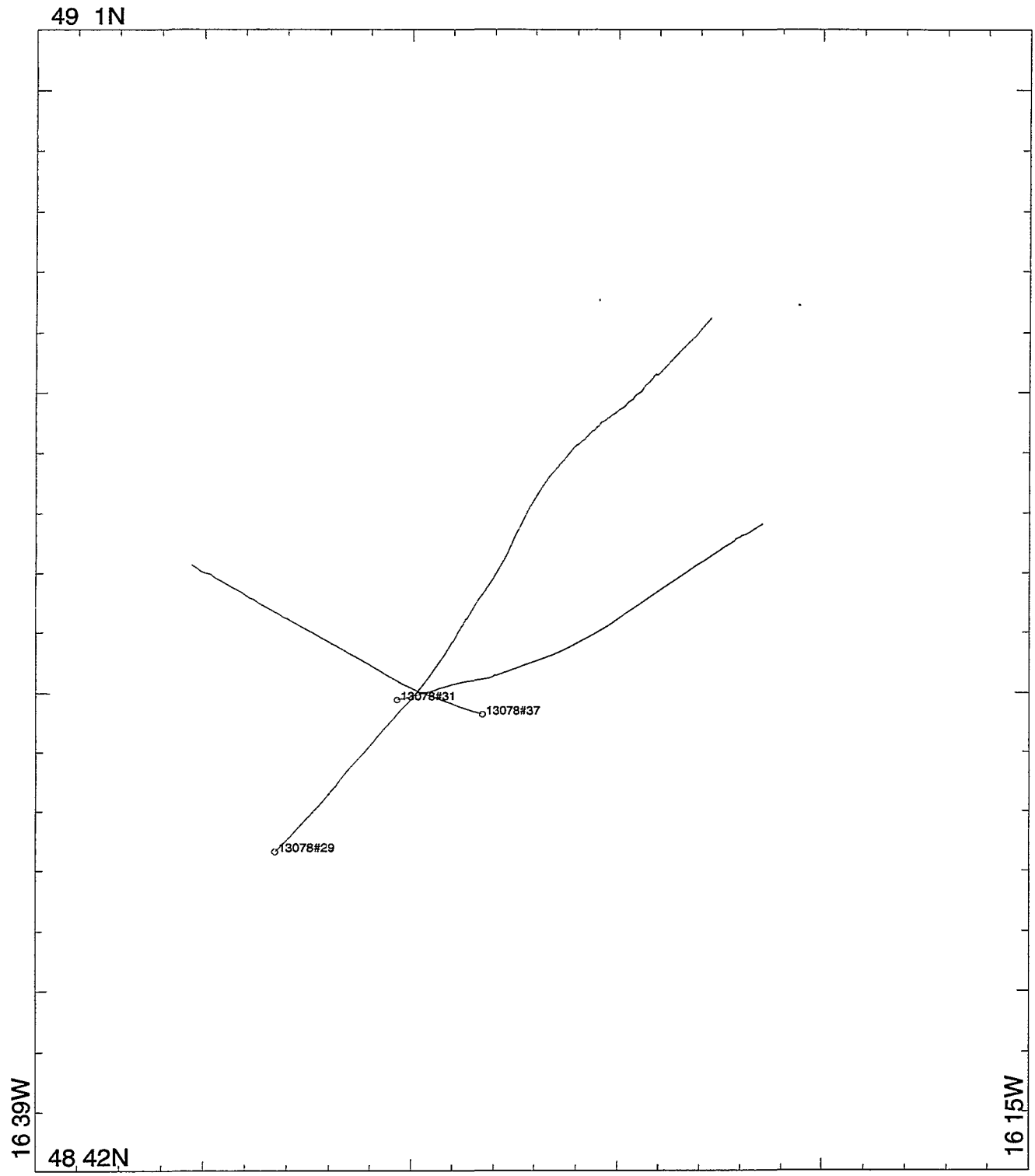

Fig. 5. Semi-balloon otter trawl (OTSB) bottom tracks

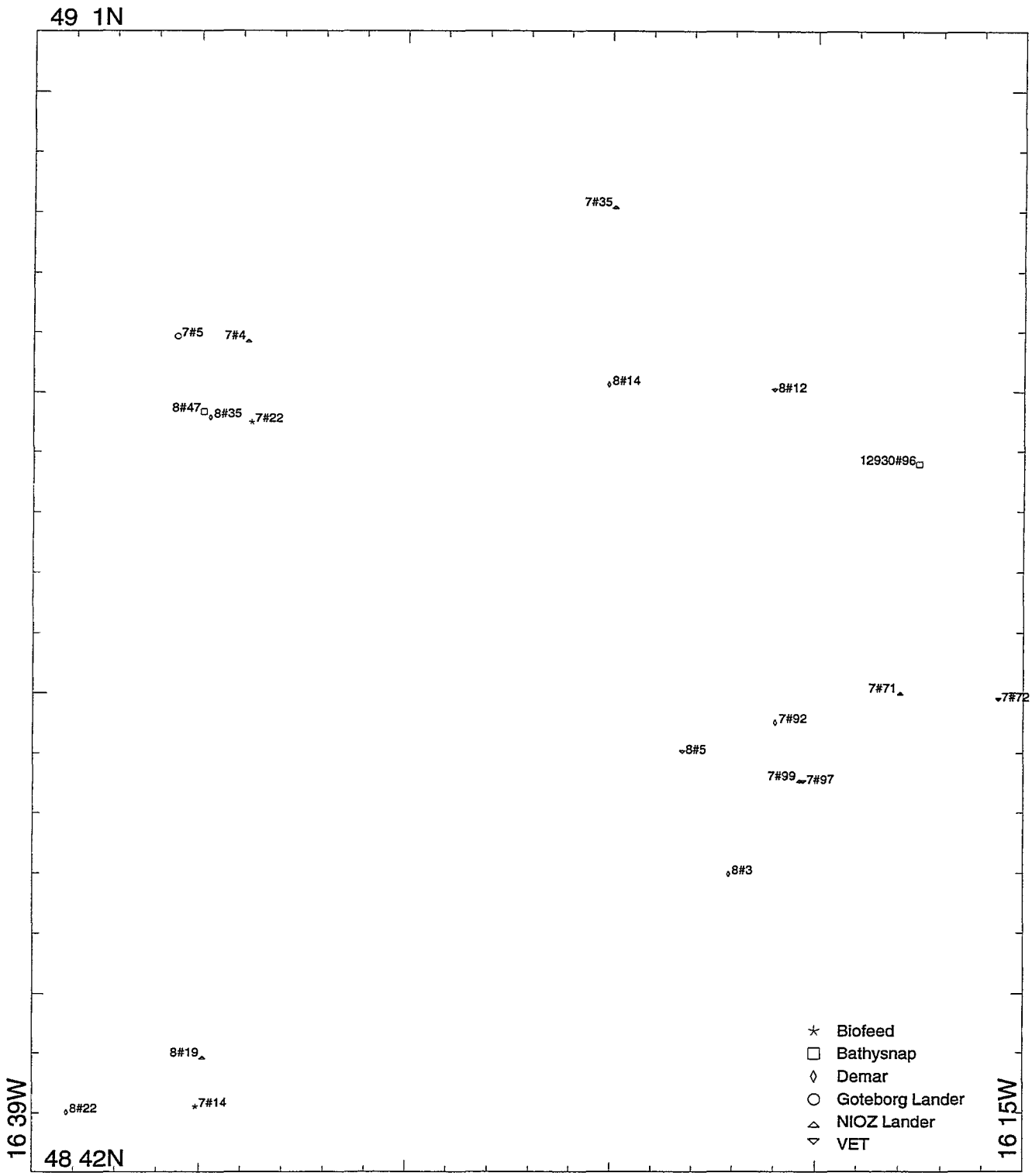

Fig. 6 Deployed gear positions (see also Fig. 7).

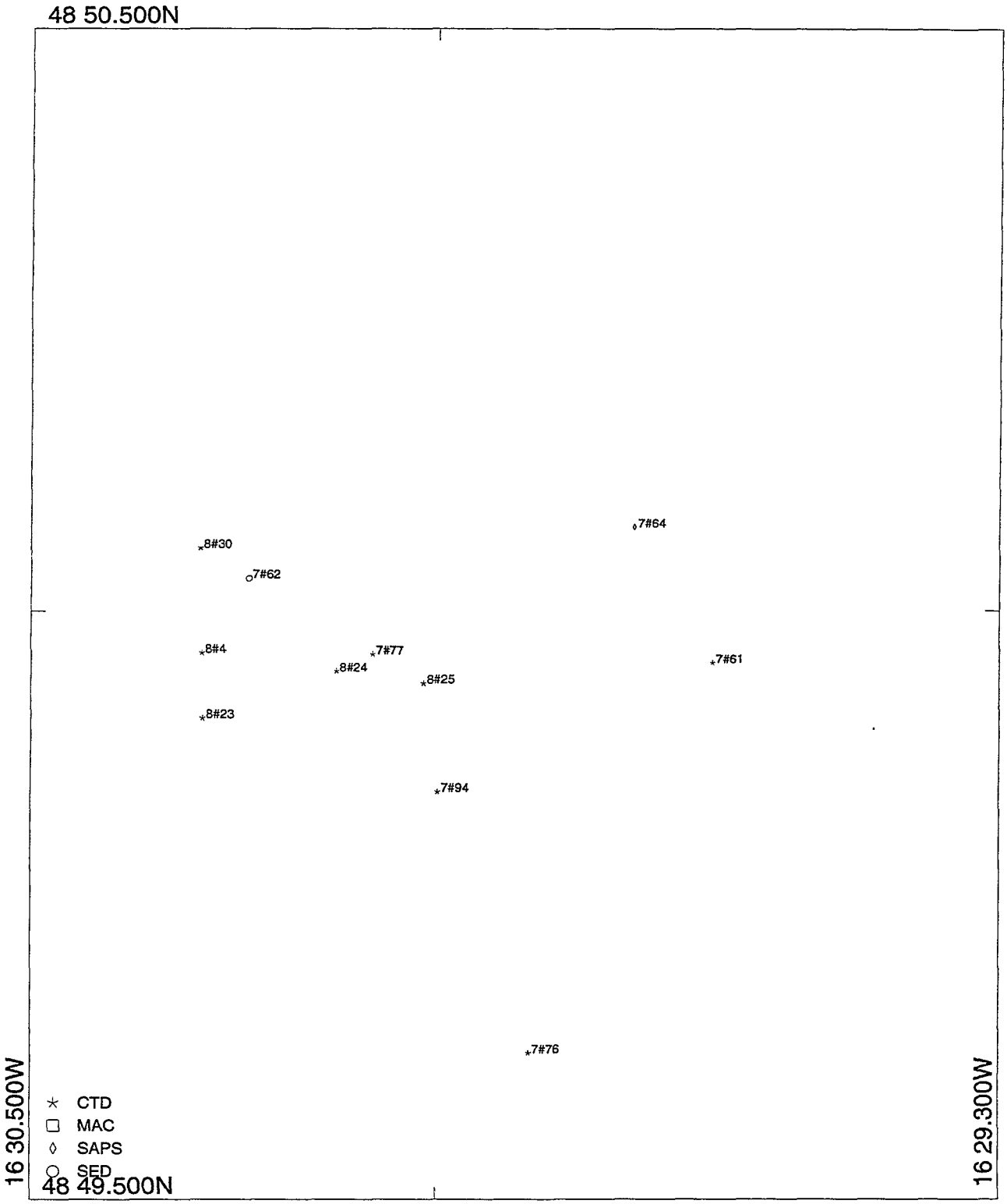

Fig. 7 CTD, MAC, SAPS and sediment trap mooring positions.

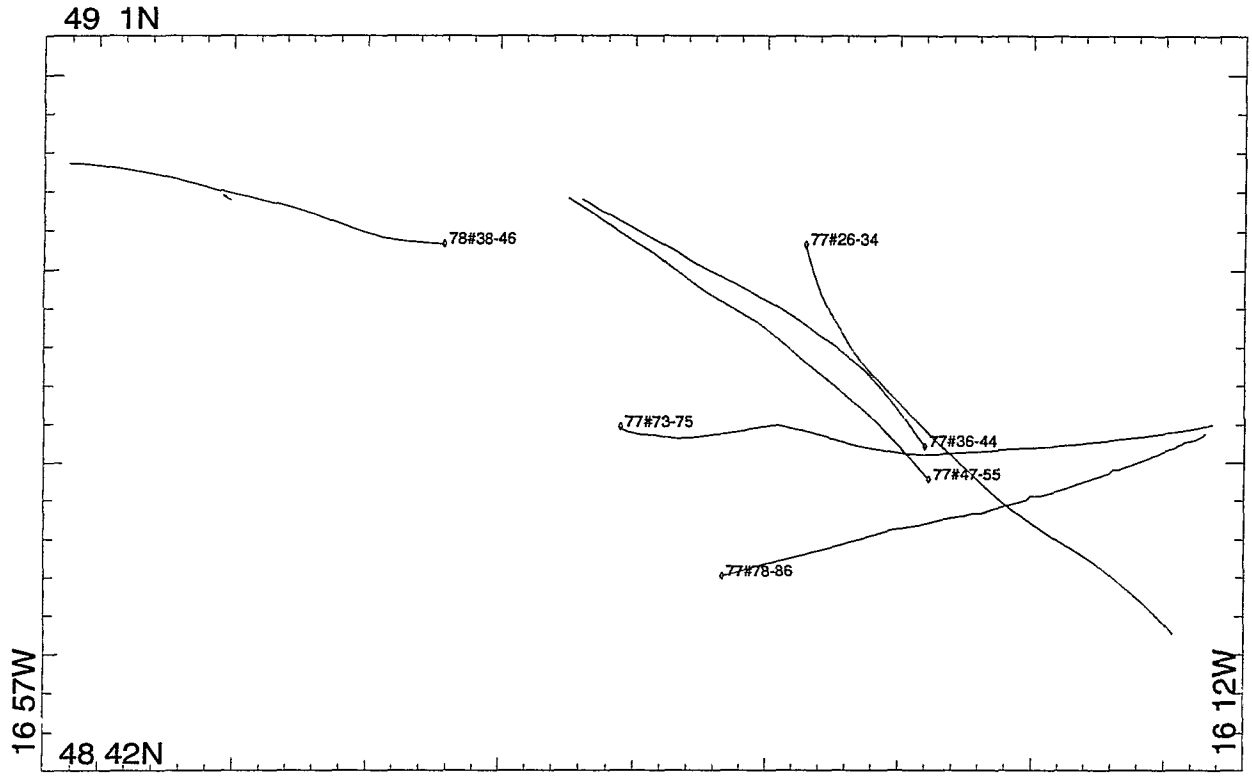

Fig. 8 MOCNESS fishing tracks.

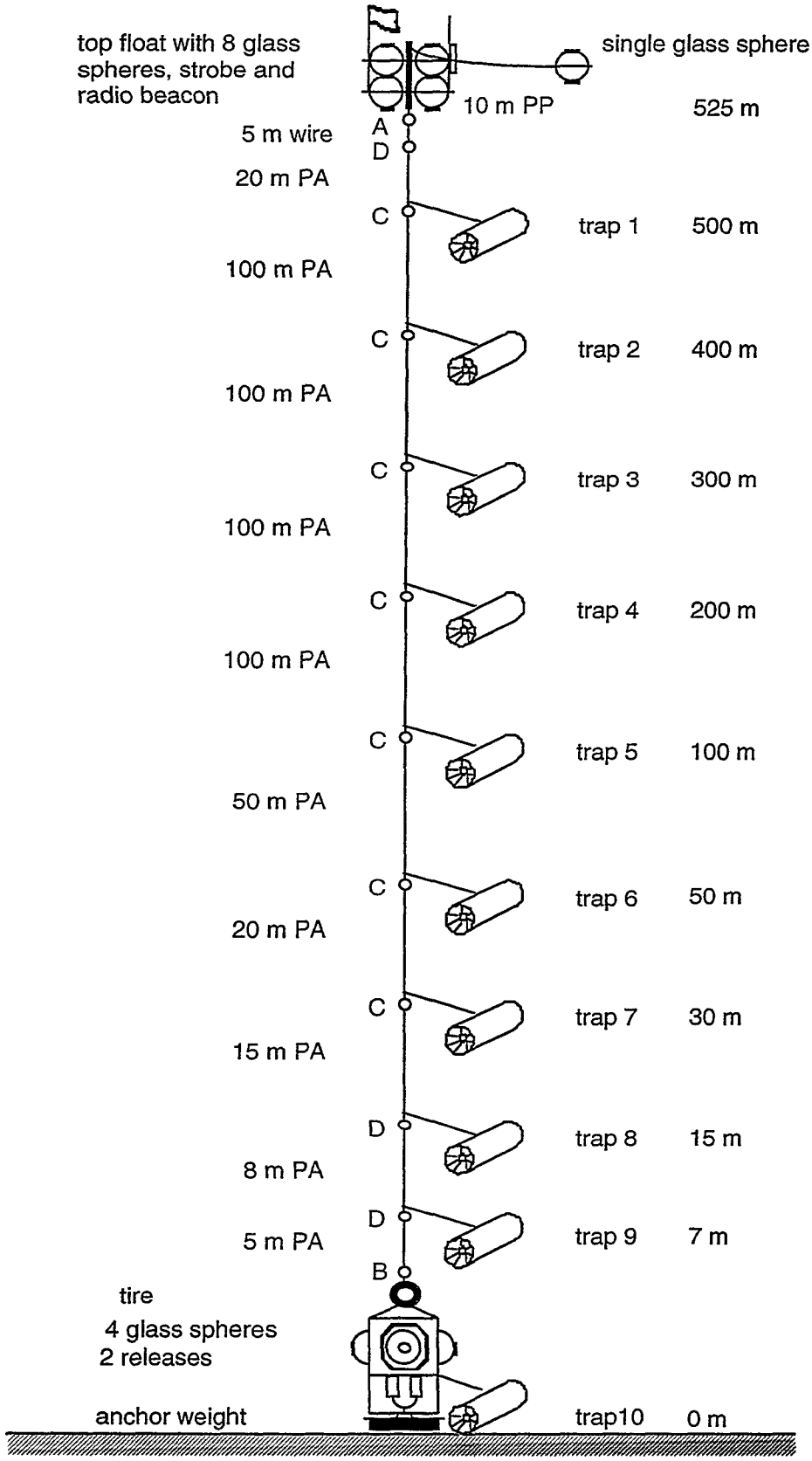

Fig. 9: Arrangement of amphipod trap set

GEAR USED ON DISCOVERY CRUISE 226

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
DEMAR	Baited free-fall benthic amphipod trap
GOTEBORGL	Goteborg multifunction lander system
KASTEN	Kasten corer with 1m square section core tube 10cm on a side
MAC	Module Autonome de Colonisation: long-term enrichment and recolonisation experiment
MLT CORER	Multiple corer, Barnett pattern, using 12 57mm i.d. core tubes
MOCNESS 1	Nine-net, 1m^2 opening and closing plankton net system
MS	Multi-sampler: water bottle rosette mounted on CTD frame
MSP	Marine snow profiler: marine snow camera mounted on CTD frame
NIOZL	NIOZ multifunction lander system
OTSB14	Semi-balloon otter trawl with 14m headline. effective fishing width 8.6m
SAP	Stand-alone pump
SED TRAP	Sediment trap array. SOC version with three carousel traps at 1000m, 3000m and 100mab: NIOZ version with one carousel trap 10mab
VEGBOXC	Spade box corer (0.25m^2), modified USNEL type, fitted with vegematic box.
VET	Vertical amphipod trap rig with 10 cylindrical double-funnel traps at 0, 8,15, 30, 50, 100, 200, 300, 400 and 500mab
WASP	Wide Angle Survey Photography instrument

STN	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
12930 # 5	1/ 9 14/ 3	48 55.63N	16 32.40W	MAC	4838-4838	0910-1230	Surface c1440	4843
12930 #35	6/ 9 19/ 3	49 0.47N	16 17.96W	SED TRAP	1000-4741	1412-1423	Traps 1 and 2 sampled, trap 3 failed	4846
12930 #96	21/ 9 15/ 3	48 53.74N	16 17.96W	BSNAP	4838-4838	2042-1036	Camera flooded	4838
13077 # 1	14/ 3	48 56.57N	16 30.87W	MAC	4843-4843	1340-		4843
13077 # 2	14/ 3	48 56.07N 48 56.94N	16 33.89W 16 33.10W	CTD MS	0-4817	1615-2023	5 bottles fired, depths dubious	4827
13077 # 3	14/ 3	48 55.60N	16 32.19W	MAC	4843-4843	2236-		4843
13077 # 4	14/ 3 18/ 3	48 55.82N	16 35.25W	NIOZL	4844-4844	2316-0700		4844
13077 # 5	15/ 3	48 55.92N	16 35.55W	GOTEBORGL	4843-4843	0400-	(Launch 2347). Lander lost	4843
13077 # 6	15/ 3	48 50.09N	16 30.01W	MLT.CORER	4843-4843	0311-	12 good cores	4843
13077 # 7	15/ 3	48 50.54N	16 29.19W	BOX CORER	4846-4846	0713-	Bad core, sieved for large macrofauna	4846
13077 # 8	15/ 3	48 50.23N	16 29.94W	BOX CORER	4844-4844	1533-	No core	4844
13077 # 9	15/ 3	48 49.92N	16 30.01W	MLT.CORER	4847-4847	1908-	No cores	4847
13077 #10	15/ 3	48 49.88N 48 49.73N	16 30.46W 16 30.96W	CTD MS	0-1000	2156-2334	12 bottles 1000-50m (2239-2330h)	4847

STN	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13077 #11	16/ 3	48 50.52N 48 50.74N	16 32.77W 16 33.37W	SAP	50-1000	0230-0330	Pumps at 1000m, 100m, 50m	4845
13077 #12	16/ 3	48 50.17N	16 29.79W	MLT.CORER	4846-4846	1100-	11 good cores	4846
13077 #13	16/ 3	48 50.09N	16 29.99W	MLT.CORER	4844-4844	1446-	12 good cores to Biofeed	4844
13077 #14	16/ 3 6/ 4	48 43.11N	16 35.08W	BIOFEED	4844-4844	2005-0536	6 cores enriched, eta bottom estimated	4844
13077 #15	16/ 3	48 49.87N	16 29.77W	BOX CORER	4845-4845	2056-	No core. Pre-triggered?	4845
13077 #16	16/ 3 17/ 3	48 50.18N 48 50.11N	16 30.12W 16 30.83W	CTD MS	0-4830	2258-0302	12 bottles at 10m off bottom (0117-0123h)	4840
13077 #17	17/ 3	48 50.11N 48 50.14N	16 30.83W 16 30.78W	CTD MS	0- 100	0342-0349	7 bottles at 100-3m (0344-0348h)	4847
13077 #18	17/ 3	48 49.98N	16 29.92W	MLT.CORER	4844-4844	0616-	12 moderate cores	4844
13077 #19	17/ 3	48 50.00N	16 30.05W	BOX CORER	4846-4846	0943-	Good core, IOS protocol	4846
13077 #20	17/ 3	48 50.07N	16 29.88W	MLT.CORER	4844-4844	1933-	12 good cores to Biofeed	4844
13077 #21	17/ 3	48 50.02N	16 30.59W	MLT.CORER	4845-4845	2305-	12 good cores to Biofeed	4845
13077 #22	18/ 3	48 54.50N	16 33.76W	BIOFEED	0- 0	0341-	No monitor response. Gear lost	
13077 #23	18/ 3	48 49.28N	16 30.56W	BOX CORER	4844-4844	1222-	Good core, IOS protocol	4844
13077 #24	18/ 3	48 49.97N	16 30.39W	MLT.CORER	4844-4844	1619-	12 good cores	4844

STN	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13077 #25	18/ 3	48 55.96N	16 33.68W	MLT.CORER	4825-4825	2009-	12 good cores inc 4 NIOZ, lander site	4825
13077 #26	19/ 3	48 45.53N 48 49.93N	16 14.70W 16 22.65W	MOCNESS 1	0-4834	0117-0605	Net 1	4845
13077 #27	19/ 3	48 49.93N 48 50.69N	16 22.65W 16 23.80W	MOCNESS 1	4828-4838	0605-0635	Net 2, 6-16mab	4845
13077 #28	19/ 3	48 50.69N 48 51.47N	16 23.80W 16 24.90W	MOCNESS 1	4828-4840	0635-0705	Net 3, 4-16mab	4844
13077 #29	19/ 3	48 51.47N 48 51.88N	16 24.90W 16 25.46W	MOCNESS 1	4794-4827	0705-0721	Net 4, 17-50mab	4846
13077 #30	19/ 3	48 51.88N 48 52.62N	16 25.46W 16 26.43W	MOCNESS 1	4781-4797	0721-0752	Net 5, 47-57mab. Cod end bucket lost	4845
13077 #31	19/ 3	48 52.62N 48 53.39N	16 26.43W 16 27.17W	MOCNESS 1	4784-4804	0752-0822	Net 6, 40-60mab	4846
13077 #32	19/ 3	48 53.39N 48 53.95N	16 27.17W 16 27.64W	MOCNESS 1	4744-4784	0822-0844	Net 7, 60-100mab	4846
13077 #33	19/ 3	48 53.97N 48 54.80N	16 27.65W 16 28.15W	MOCNESS 1	4734-4750	0844-0915	Net 8, 94-110mab	4846
13077 #34	19/ 3	48 54.82N 48 55.70N	16 28.16W 16 28.55W	MOCNESS 1	4714-4749	0915-0945	Net 9, 95-130mab	4845
13077 #35	19/ 3 23/ 3	48 58.10N	16 24.93W	NIOZL	4845-4845	1955-0655	Ascent 47m/min, all systems functioned	4845
13077 #36	19/ 3 20/ 3	48 56.80N 48 54.34N	16 36.94W 16 30.36W	MOCNESS 1	0-4828	2100-0133	Net 1	4846
13077 #37	20/ 3	48 54.34N 48 54.34N	16 30.36W 16 30.36W	MOCNESS 1	4828-4828	0133-0133	Net 2 closed immediately	4846

STN	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13077	20/ 3	48 54.34N	16 30.36W	MOCNESS 1	4824-4833	0133-0204	Net 3, 11-20mab	4849
#38		48 53.87N	16 29.16W					
13077	20/ 3	48 53.87N	16 29.16W	MOCNESS 1	4826-4834	0204-0234	Net 4, 10-18mab	4847
#39		48 53.30N	16 27.99W					
13077	20/ 3	48 53.30N	16 27.99W	MOCNESS 1	4794-4834	0234-0256	Net 5, 10-50mab	4847
#40		48 52.84N	16 27.08W					
13077	20/ 3	48 52.84N	16 27.08W	MOCNESS 1	4789-4799	0256-0327	Net 6, 45-55mab	4847
#41		48 52.16N	16 25.99W					
13077	20/ 3	48 52.17N	16 26.00W	MOCNESS 1	4779-4794	0327-0357	Net 7, 50-65mab	4845
#42		48 51.45N	16 25.13W					
13077	20/ 3	48 51.45N	16 25.13W	MOCNESS 1	4744-4784	0357-0408	Net 8, 60-100mab	4844
#43		48 51.16N	16 24.80W					
13077	20/ 3	48 51.16N	16 24.80W	MOCNESS 1	4734-4744	0408-0437	Net 9, 100-110mab	4843
#44		48 50.46N	16 24.06W					
13077	20/ 3	48 55.03N	16 30.11W	SAP	4845-4845	1500-1700	Free fall rig lost during recovery	4845
#45								
13077	20/ 3	48 54.72N	16 32.15W	SED TRAP	4844-4844	1848-0559	NIOZ rig, eta bottom estimated	4844
#46	4/ 4							
13077	20/ 3	48 56.83N	16 37.44W	MOCNESS 1	0-4836	2255-0313	Net 1	4847
#47	21/ 3	48 54.20N	16 31.75W					
13077	21/ 3	48 54.20N	16 31.75W	MOCNESS 1	4827-4836	0313-0345	Net 2, 10-19mab	4847
#48		48 53.70N	16 30.51W					
13077	21/ 3	48 53.70N	16 30.51W	MOCNESS 1	4829-4836	0345-0415	Net 3, 10-17mab	4848
#49		48 53.12N	16 29.39W					
13077	21/ 3	48 53.11N	16 29.37W	MOCNESS 1	4796-4836	0415-0433	Net 4, 10-50mab	4847
#50		48 52.70N	16 28.68W					

STN	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13077 #51	21/ 3	48 52.70N 48 52.10N	16 28.68W 16 27.61W	MOCNESS 1	4791-4799	0433-0504	Net 5, 47-55mab	4845
13077 #52	21/ 3	48 52.10N 48 51.46N	16 27.61W 16 26.51W	MOCNESS 1	4789-4802	0504-0534	Net 6, 44-57mab	4845
13077 #53	21/ 3	48 51.46N 48 50.98N	16 26.51W 16 25.74W	MOCNESS 1	4744-4789	0534-0555	Net 7, 55-100mab	4845
13077 #54	21/ 3	48 50.98N 48 50.27N	16 25.74W 16 24.79W	MOCNESS 1	4738-4747	0555-0626	Net 8, 96-105mab. Cod end bucket lost	4844
13077 #55	21/ 3	48 50.27N 48 49.58N	16 24.79W 16 23.92W	MOCNESS 1	4733-4747	0626-0656	Net 9, 96-110mab	4844
13077 #56	21/ 3	48 50.13N	16 30.25W	BOX CORER	4844-4844	1531-	Bad core, double contact, not sieved	4844
13077 #57	21/ 3	48 50.02N	16 29.98W	MLT.CORER	4844-4844	1926-	12 good cores	4844
13077 #58	21/ 3	48 50.04N	16 29.96W	MLT.CORER	4844-4844	2303-	12 good cores	4844
13077 #59	22/ 3	48 49.98N	16 29.96W	BOX CORER	4845-4845	0243-	Good core, IOS protocol	4845
13077 #60	22/ 3	48 50.00N	16 29.97W	MLT.CORER	4845-4845	0625-	12 good cores	4845
13077 #61	22/ 3	48 49.94N 48 49.99N	16 29.71W 16 30.06W	CTD MS	0-4824	0847-1246	Bottles 4824(dubious)-3300m(OK) (1057-1141h)	4842
13077 #62	22/ 3	49 0.42N	16 18.14W	SED TRAP	1000-4747	1905-	IOS rig for release July 1997	4847
13077 #63	22/ 3	48 50.00N	16 29.79W	BOX CORER	4843-4843	2215-	Excellent core, IOS protocol	4843

STN	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13077 #64	23/ 3	48 50.07N 48 50.00N	16 29.75W 16 29.80W	SAP	1000-3000	0225-0425	Pumps at 1000m and 3000m	4844
13077 #65	23/ 3	48 49.88N	16 29.83W	MLT.CORER	4845-4845	1152-	12 good cores	4845
13077 #66	23/ 3	48 50.08N	16 30.00W	BOX CORER	4846-4846	1538-	Sampled fairy ring, occupant not found	4846
13077 #67	23/ 3 24/ 3	48 50.03N 48 49.84N	16 30.04W 16 30.74W	CTD MS MSP	0-4834	1942-0013	Camera worked, bottles at 10mab dubious	4846
13077 #68	24/ 3	48 49.89N 48 50.05N	16 30.06W 16 30.03W	SAP	4744-4831	0310-0510	Pumps at 100mab and 13mab	4845
13077 #69	24/ 3	48 50.01N	16 30.07W	MLT.CORER	4843-4843	0902-	12 reasonable cores	4843
13077 #70	24/ 3	48 49.91N	16 29.99W	VEGEBOX	4842-4842	1228-	Reasonable core, SAMS protocol	4842
13077 #71	24/ 3 27/ 3	48 50.01N	16 17.97W	NIOZL	4840-4840	1710-1632		4840
13077 #72	24/ 3	48 49.86N	16 15.61W	VET	4348-4848	1817-0715	Hamburg rig	4848
13077 #73	24/ 3	48 50.99N 48 50.33N	16 13.23W 16 21.20W	MOCNESS 1	0-4823	1905-2317	Net 1	4845
13077 #74	24/ 3	48 50.33N 48 50.25N	16 21.20W 16 22.89W	MOCNESS 1	4814-4829	2317-2347	Net 2, 15-30mab	4844
13077 #75	24/ 3 25/ 3	48 50.25N 48 50.93N	16 22.92W 16 35.50W	MOCNESS 1	0-4829	2347-0345	Net 3 oblique, signal lost	4845
13077 #76	25/ 3	48 49.94N 48 49.59N	16 29.91W 16 29.80W	CTD MS MSP	0- 200	0833-0922	Trial of CTD and camera system	4845

STN	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13077 #77	25/ 3	48 49.91N 48 49.99N	16 30.03W 16 30.42W	CTD MS MSP	0-4835	1139-1541	Bottles 4000-4835m. Camera test	4845
13077 #78	25/ 3	48 50.76N 48 48.79N	16 13.51W 16 21.34W	MOCNESS 1	0-4823	1748-2158	Net 1	4845
13077 #79	25/ 3	48 48.79N 48 48.75N	16 21.34W 16 21.54W	MOCNESS 1	4819-4824	2158-2202	Net 2, 20-25mab	4842
13077 #80	25/ 3	48 48.75N 48 48.55N	16 21.54W 16 23.09W	MOCNESS 1	4814-4824	2202-2233	Net 3, 20-30mab	4842
13077 #81	25/ 3	48 48.55N 48 48.35N	16 23.09W 16 24.22W	MOCNESS 1	4784-4814	2233-2255	Net 4, 30-60mab	4843
13077 #82	25/ 3	48 48.36N 48 48.13N	16 24.19W 16 25.80W	MOCNESS 1	4766-4794	2255-2327	Net 5, 50-78mab	4843
13077 #83	25/ 3	48 48.13N 48 47.84N	16 25.83W 16 27.24W	MOCNESS 1	4786-4809	2327-2357	Net 6, 35-58mab	4844
13077 #84	25/ 3 26/ 3	48 47.84N 48 47.61N	16 27.24W 16 28.48W	MOCNESS 1	4744-4789	2357-0021	Net 7, 55-100mab	4842
13077 #85	26/ 3	48 47.61N 48 47.36N	16 28.50W 16 30.00W	MOCNESS 1	4735-4757	0021-0053	Net 8, 87-109mab	4844
13077 #86	26/ 3	48 47.36N 48 47.05N	16 30.03W 16 31.63W	MOCNESS 1	4714-4770	0053-0124	Net 9, 74-120mab	4843
13077 #87	26/ 3	48 50.14N	16 29.94W	VEGEBOX	4844-4844	1432-	Good core, SAMS protocol	4844
13077 #88	26/ 3	48 51.62N	16 30.59W	KASTEN	4844-4844	1829-	Good, top 40cm lost, bomb too heavy	4844

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13077 #89	26/ 3	48 49.63N	16 29.42W	BOX CORER	4844-4844	2319-	Good core, IOS protocol	4844
13077 #90	27/ 3	48 49.56N	16 29.73W	MLT.CORER	4846-4846	0310-	11 reasonable core in heavy swell	4846
13077 #91	27/ 3	48 59.75N 48 59.14N	16 18.38W 16 18.44W	CTD MS MSP	0-4834	1054-1511	Bottles at 4834-5m	4847
13077 #92	27/ 3 28/ 3	48 49.50N	16 20.97W	DEMAR	4844-4844	2018-1649	Slow descent, nominal 24h deployment	4844
13077 #93	27/ 3	48 49.73N	16 29.92W	BOX CORER	4844-4844	2150-	Good core, IOS protocol	4844
13077 #94	27/ 3 28/ 3	48 49.95N 48 49.84N	16 30.02W 16 29.99W	CTD MSP	0- 100	2359-0032	Time series	4844
13077 #95	28/ 3	48 49.99N	16 30.01W	VEGEBOX	4843-4843	0349-	Double contact, core rejected	4843
13077 #96	28/ 3	48 49.96N	16 18.03W	MLT.CORER	4846-4846	0833-	12 good cores, 4 NIOZ tubes	4846
13077 #97	28/ 3 29/ 3	48 48.50N	16 20.31W	VET	4346-4846	1223-0912	Good catch	4844
13077 #98	28/ 3	48 50.01N	16 30.04W	VEGEBOX	4843-4843	1400-		4843
13077 #99	28/ 3 1/ 4	48 48.56N	16 20.40W	NIOZL	4846-4846	1853-0811	All systems functioned	4846

STN	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13078 # 1	29/ 3	48 50.13N 48 50.06N	16 39.86W 16 38.68W	CP	4844-4844	0023-0140	$2m^3$ mud, catch small Tow dist. 1.446 km.	4844
13078 # 2	29/ 3	48 48.23N 48 48.26N	16 20.06W 16 19.98W	CTD MS MSP	0- 100	1152-1212	Time series, bottles at 50m	4839
13078 # 3	29/ 3 31/ 3	48 46.99N	16 22.09W	DEMAR	4842-4842	1539-1435	Descent 34m/min, nominal 48h deployment	4842
13078 # 4	30/ 3	48 50.01N 48 49.99N	16 30.26W 16 30.40W	CTD MS MSP	0- 100	0812-0832	Time series, bottles at 72m and 5m	4845
13078 # 5	30/ 3 31/ 3	48 48.99N	16 23.23W	VET	4346-4846	1102-1148	Good catch	4846
13078 # 6	30/ 3	48 44.55N 48 42.09N	16 32.77W 16 30.86W	CP	4838-4838	1538-1737	Good clean catch Tow dist. 5.129 km.	4838
13078 # 7	30/ 3	48 44.25N	16 35.14W	MLT.CORER	4843-4843	2349-	12 good cores, 4 NIOZ tubes	4843
13078 # 8	31/ 3	48 51.60N	16 19.03W	MLT.CORER	4845-4845	0451-	12 good cores	4845
13078 # 9	31/ 3	48 55.02N	16 18.05W	MLT.CORER	4846-4846	0905-	12 good cores, 4 NIOZ tubes	4846
13078 #10	31/ 3	48 58.02N	16 25.03W	MLT.CORER	4847-4847	1920-	12 good cores, 4 NIOZ tubes	4847
13078 #11	1/ 4	48 53.19N 48 51.05N	16 35.98W 16 31.99W	CP	4844-4844	0104-0333	Big muddy catch Tow dist. 6.291 km.	4844
13078 #12	1/ 4 2/ 4	48 55.01N	16 21.02W	VET	4345-4845	1243-1218	Good catch	4847
13078 #13	1/ 4	48 50.00N	16 30.02W	BOX CORER	4843-4843	1522-	Good core, IOS protocol	4843

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13078 #14	1/ 4 2/ 4	48 55.12N	16 25.06W	DEMAR	4845-4845	2052-0956	Nominal 12h drop. Large catch	4845
13078 #15	1/ 4	48 49.98N	16 30.11W	VEGEBOX	4844-4844	2202-	Very good core, SAMS protocol	4844
13078 #16	2/ 4	48 49.91N	16 29.94W	KASTEN	4844-4844	0238-	Good core, but missing surface layer	4844
13078 #17	2/ 4	48 49.98N	16 30.00W	VEGEBOX	4843-4843	0654-	Moderate core, SAMS protocol	4843
13078 #18	2/ 4	48 49.96N	16 30.51W	BOX CORER	4843-4843	1738-	Not sieved. Sub cored for CFR, GIP	4843
13078 #19	2/ 4 6/ 4	48 43.94N	16 34.91W	NIOZL	4844-4844	2156-0700		4844
13078 #20	2/ 4	48 46.50N 48 46.60N	16 24.86W 16 25.22W	WASP	0- 0	2133-2208	Monitor flooded, haul aborted Tow dist. 0.480 km.	4844
13078 #21	3/ 4	48 48.48N 48 50.63N	16 27.21W 16 31.07W	CP	4844-4844	0238-0423	Very small catch Tow dist. 6.176 km.	4844
13078 #22	3/ 4	48 43.02N	16 38.18W	DEMAR	4842-4842	1143-1730	Nominal 6h drop. Good catch	4842
13078 #23	3/ 4	48 50.11N 48 49.79N	16 30.20W 16 30.15W	CTD MS	0-4806	1020-1352	Only 3/12 bottles fired	4846
13078 #24	3/ 4	48 49.96N 48 50.06N	16 30.07W 16 30.21W	CTD MS	0- 500	1448-1524	Water at 12 depths,500-4m for Ragueneau	4844
13078 #25	3/ 4	48 49.95N 48 49.91N	16 30.10W 16 30.00W	CTD MS MSP	0- 100	1602-1625	Time series, bottles at 100m and 5m	4844
13078 #26	3/ 4	48 45.82N 48 45.79N	16 36.38W 16 36.23W	CTD MS MSP	0- 100	2003-2021	Time series, bottles at 40m and 5m	4844

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13078	3/ 4	48 47.26N	16 34.01W	CP	4844-4844	2257-0034	Small catch, ? on bottom throughout	4844
#27	4/ 4	48 48.67N	16 31.76W				Tow dist. 3.798 km.	
13078	4/ 4	48 55.25N	16 26.59W	CTD	0- 100	0409-0429	Time series, bottle at 4m	4846
#28		48 55.41N	16 26.63W	MS MSP				
13078	4/ 4	48 56.20N	16 22.77W	OTSB14	4844-4847	1420-2010	Much mud. Large catch	4846
#29		48 47.35N	16 33.23W				Tow dist. 20.800 km.	
13078	5/ 4	48 50.04N	16 30.11W	CTD	0-4826	0052-0445	Bottles at 4826-4775m. Wire tests	4846
#30		48 50.17N	16 30.37W	MS				
13078	5/ 4	48 52.80N	16 21.48W	OTSB14	4844-4850	1120-1601	4 tonnes of mud, small catch, no fish	4847
#31		48 49.88N	16 30.34W				Tow dist. 12.117 km.	
13078	6/ 4	48 54.50N	16 31.46W	SED TRAP	4846-4846	0026-	NIOZ rig, trap 11mab for recovery July	4846
#32								
13078	6/ 4	48 54.53N	16 31.42W	CTD	0-4827	0018-0322	Bottles at 4827 & 4775m	4846
#33		48 54.61N	16 31.53W	MS				
13078	6/ 4	48 52.32N	16 38.88W	OTSB14	0- 600	1217-1545	Winch malfunction, haul aborted	4846
#34		48 49.91N	16 29.03W					
13078	6/ 4	48 54.58N	16 34.76W	DEMAR	4843-4843	2108-0500	Large catch, including fish	4843
#35	8/ 4							
13078	7/ 4	48 54.52N	16 31.15W	CTD	0- 100	0105-0121	Bottles at 100m	4844
#36		48 54.55N	16 31.15W	MS				
13078	7/ 4	48 52.16N	16 35.32W	OTSB14	4842-4844	1002-1154	Clean catch, many fish.	4843
#37		48 49.63N	16 28.30W				Tow dist. 9.781 km.	
13078	7/ 4	48 57.73N	16 56.13W	MOCNESS 1	0-4825	1810-2214	Net 1	4844
#38		48 56.97N	16 50.20W					

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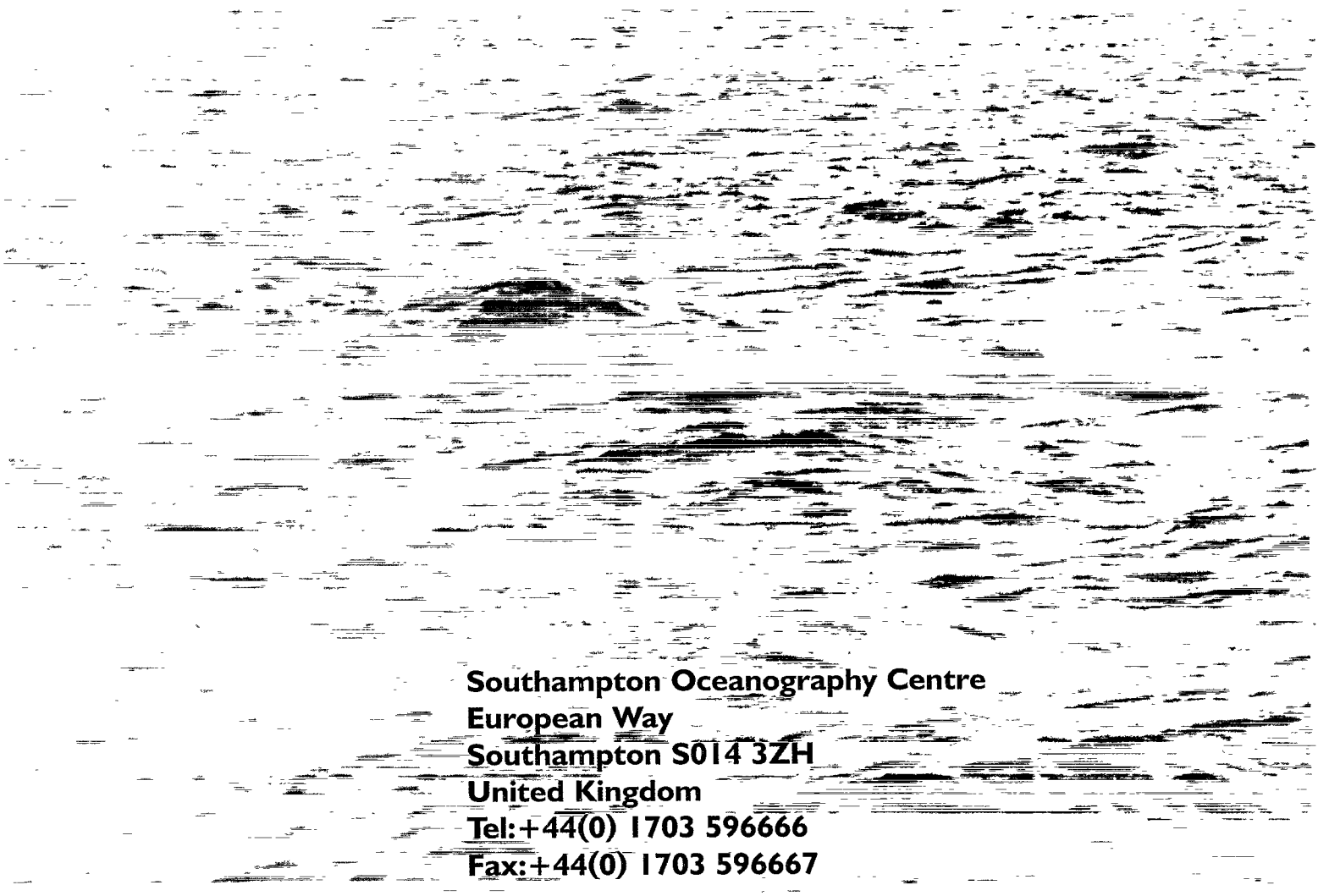
13078	7/ 4	48 56.97N	16 50.20W	MOCNESS 1	4825-4832	2214-2244	Net 2, 12-19mab	4844
#39		48 56.80N	16 49.12W					
13078	7/ 4	48 56.80N	16 49.12W	MOCNESS 1	4828-4832	2244-2315	Net 3, 12-16mab	4845
#40		48 56.60N	16 47.89W					
13078	7/ 4	48 56.60N	16 47.89W	MOCNESS 1	4794-4829	2315-2327	Net 4, 15-50mab	4845
#41		48 56.50N	16 47.38W					
13078	7/ 4	48 56.50N	16 47.38W	MOCNESS 1	4789-4797	2327-2357	Net 5, 47-55mab	4844
#42		48 56.22N	16 46.19W					
13078	7/ 4	48 56.23N	16 46.21W	MOCNESS 1	4788-4796	2357-0029	Net 6, 48-56mab	4844
#43	8/ 4	48 55.93N	16 44.95W					
13078	8/ 4	48 55.93N	16 44.95W	MOCNESS 1	4744-4794	0029-0038	Net 7, 50-100mab	4844
#44		48 55.85N	16 44.57W					
13078	8/ 4	48 55.85N	16 44.57W	MOCNESS 1	4734-4748	0038-0108	Net 8, 96-110mab	4844
#45		48 55.72N	16 43.36W					
13078	8/ 4	48 55.72N	16 43.38W	MOCNESS 1	4727-4740	0108-0138	Net 9, 104-117mab	4844
#46		48 55.67N	16 42.13W					
13078	8/ 4	48 54.68N	16 34.92W	BSNAP	4844-4844	0743-	For recovery in July	4844
#47								



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