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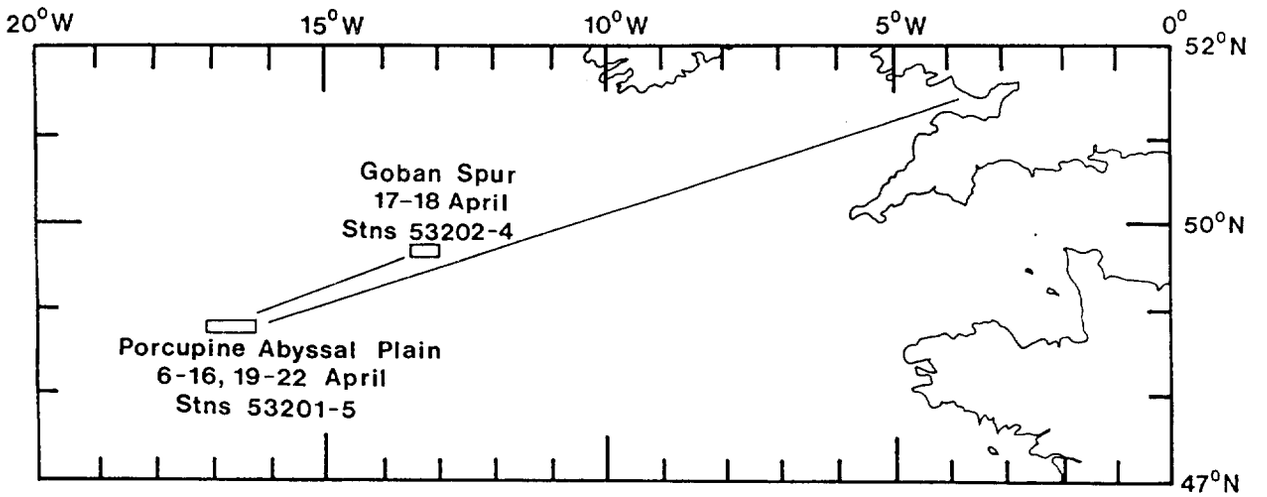
RRS *Challenger* Cruise 111

29 Mar - 25 Apr 1994

Benthic biology of the Porcupine Abyssal Plain (48°50'N 16°30'W)

Cruise Report No 243 1994



INSTITUTE OF OCEANOGRAPHIC SCIENCES

DEACON LABORATORY

CRUISE REPORT NO. 243

RRS *CHALLENGER* CRUISE 111
29 MAR - 25 APR 1994

Benthic biology of the Porcupine Abyssal Plain (48°50'N 16°30'W)

Principal Scientist
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ABSTRACT

The cruise had the principal objective of obtaining a complete suite of benthic samples, from bacteria to megafauna, for comparison with previous samples obtained from this site and, particularly, with samples expected from *Challenger* cruise 113 after the seasonal deposition of phytodetritus.

Supplementary objectives included the recovery of a long-term Bathysnap which had been deployed in September 1992, the first significant use of the WASP system at this locality and, time permitting, a visit to the Goban Spur to collect xenophyophores recorded during previous phototransects.

Despite some bad weather and gear problems, particularly the almost total failure of the epibenthic sledge, a good set of samples was obtained, satisfying almost all requirements of our MAST II partners. In addition, the long-term Bathysnap was recovered successfully and proved to have an extremely impressive and valuable record, including the whole of the 1993 phytodetritus deposition.

KEYWORDS

AUDOS
BACTERIA
BATHYSNACK
BATHYSNAP
BENTHIC COMMUNITIES
BIOGEOCHEMISTRY
BIOLOGY
BOX CORER
CHALLENGER/RRS - cruise(1994)(111)
DEMAR
DETRITUS
EPIBENTHIC SLEDGE
GOBAN SPUR
MACROFAUNA
MEGAFAUNA
MEIOFAUNA
MULTICORER
OTTER TRAWL
PHOTOGRAPHY
PORCUPINE ABYSSAL PLAIN
WASP

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ITINERARY

Depart Barry Tuesday 29 March 1994

Dock Barry Monday 25 April 1994

OBJECTIVES

Principal objective

To obtain a suite of benthic samples from the Porcupine Abyssal Plain (C. 48^{O} 50' N 16^{O} 30' W) as part of the IOSDL 'DEEPSEAS' programme and wider CEC MAST II funded project (contract MAS2-CT92-0033) for comparison with previous cruises to this site (RRS *Discovery* 185, RRS *Challenger* 79) and other NE Atlantic sites (Madeira Abyssal Plain, RRS *Discovery* 194; Cape Verde Abyssal Plain, RRS *Discovery* 204).

Supplementary objectives

To recover a Bathysnap (time-lapse camera and current meter) from the main study site, originally deployed from RRS *Charles Darwin* in September 1992. Time permitting, to visit a site on the Goban Spur to follow up a photosledge transect carried out during RRS *Challenger* 94, which revealed abundant populations of the xenophyophore *Syringammina* sp..

NARRATIVE

Challenger sailed from Barry at 1700 GMT on Tuesday 29 March 1994, one tide later than planned as a result of a propulsion failure at the completion of the preceding cruise. Course was set for the centre of the main study area. Heavy weather was encountered almost immediately and only slow or no progress was made for a number of days. *Challenger* crossed 12^{0} W on the morning of Sunday 3 April much to the relief of many aboard. Relief turned to anxiety as the ship's reverse osmosis unit failed the following day. Some initial plans were made for a port call in Ireland to replenish water supplies. These plans were set aside in the hope that a replacement unit could be put aboard RRS *Charles Darwin* for her impending cruise and that a rendezvous at sea could be arranged later.

Deployment of the PES fish on the afternoon of Wednesday 6 signalled the beginning of the science programme that evening with an otter trawl (OTSB14, 53201#1). Recovery the following morning proved difficult as the sweeps had twisted together almost locking the trawl doors. Both doors were eventually recovered on one block and the net brought aboard. The catch was rather poor, but in composition much as expected from previous cruises.

Vertical wire work got underway with a water bottle drop coupled with a wire test of two acoustic releases (53201#2). Twelve litres of water were successfully collected 26 mab (metres above bottom) for microbiological work, although only one of the two releases operated correctly. The working release was immediately employed in the first mooring deployment (AUDOS, 53201#3). Initial, rather optimistic, use of fine wire to secure the AUDOS ballast resulted in two ballast releases on deck but the third time was lucky. This luck did not hold for the first deployment of the multicorer (53201#4) as it recovered only eight cores, all with cloudy overlying water. The coarse mesh IOS epibenthic sledge (BN1.5/C) was then fished overnight (53201#5).

On recovery the following morning (Fri 8), the sledge's weak link was found to have parted. The cutting blade of the sledge was dented, suggesting contact with a solid object, and the net was torn along its entire length and part of the canvas collar ripped indicating very substantial strain on the net. Needless to say there was no catch.

Challenger then made for the AUDOS position. The wind was gusting to 40 knots at this time and so the release of the mooring was postponed. The ship remained hove to until dawn the following day (Sat 9), when AUDOS was eventually released and successfully recovered. The multicorer was then deployed twice in succession as the first drop (53201#6) produced nothing but water samples. The second drop (53201#7) did recover eleven cores, but all were less than perfect.

The long-term Bathysnap (52916), laid by *Charles Darwin* in September 1992, was then released at 1655/9. Initial relief at the successful release of this 19 month-old mooring turned to concern as it became apparent that it was ascending rather slowly, about 50 m/min. Concern increased as no radio beacon signals could be detected after the calculated time of surfacing. Fortunately the acoustic beacon was working, and

following an hour-long square search the mooring was eventually sighted by the Captain at 1955 : after sunset. The reason for the problems soon became apparent, only the main buoyancy package and lazy-line float were visible at the surface; the dahn buoy had gone, taking 50 kg of buoyancy and the radio beacon with it. With a sterling effort from the crew, what was left of the mooring was successfully recovered. The reason for the loss appears to have been an inappropriate electrolytic couple between the chain and shackle securing the dahn buoy to the main mooring line. It is gratifying to report that the film recovered from the camera is perfect and of great scientific importance; all involved should take a bow.

Following this excitement a rather routine sledge (BN1.5/C, 53201#8) was fished overnight. A small, but apparently appropriate catch was recovered the following morning (Sun 10). The day was spent coring. Firstly, a multicore (53201#9) that produced eleven fairly good cores, then a box core (53201#10) that failed completely, followed by another multicore (53201#11) that proved to be the best yet, collecting twelve good cores.

In an establishing pattern, this success was followed by a failure. An otter trawl (OTSB14, 53201#12) was deployed next. This deployment was halted almost immediately as the sweeps began to tangle as soon as they were connected in to the main warp. Swivels were then added to the inboard end of each sweep and the deployment continued. This effort proved to be in vain. On recovery the following morning (Mon 11), the sweeps were completely twisted and the doors locked together; there was essentially no catch.

Continuing the pattern, the remainder of the day was a success. A smooth deployment of AUDOS (53201#13), followed by a completely successfully multicore (53201#14) and combined water bottle drop and acoustic release wire test (53201#15) filled the daylight hours. The first deployment of the IOSDL Wide-Angle Seabed Photography camera system (WASP, 53201#16) was made overnight, all indications suggesting a very successful run.

Tuesday 12 began with the recovery of AUDOS. A multicore (53201#17) followed, producing twelve cores, but almost all were disturbed. The DEMAR amphipod trap was then deployed (53201#18) with one of the releases tested the previous day. This was the first use (by IOS Benthos) of the Billing's triple floats and the redesigned dahn buoy, incorporating a 6 m mast. The mooring was deployed buoyancy first and eventually set loose using Aberdeen Univerity's release hook; everything worked well and deployment took only 7 minutes. This success did not extend to the following deployment of the box core (53201#19), which again failed to produce a sample. Unfortunately the same was true of an epibenthic sledge fished overnight (BN1.5/C, 53201#20).

On recovery of the sledge the following morning (Wed 13) the net was again found to be torn, consequently there was no catch. The following daylight operations proved to be much more successful. DEMAR was recovered and AUDOS deployed (53201#21) without incident. A multicore (53201#22) produced twelve good cores, and even the box core (53201#23) managed to collect a sample. During the box core

deployment, clear evidence of warp activation was visible on the acoustic traces (as a small jump on pull-out), suggesting that previous failures were the result of pre-triggering in the water column or bad first contacts.

A trawl was planned for the overnight period. Old 50 m sweeps were used, the new 100 m lengths having been destroyed on the previous tows. As additional insurance four swivels were added to the rig, one either end of each sweep. The subsequent deployment (OTSB14, 53201#24) was successful, returning a good catch to the deck the following morning (Thur 14).

Successes continued through the day. AUDOS was recovered and DEMAR deployed (53201#25) without event. The box core (53201#26) collected another sample, and the multicore (53201#27) another twelve good cores. The otter trawl was deployed (53201#28) overnight in the same configuration as the previous successful haul.

The trawl produced another good catch just after breakfast the following day (Fri 15). And again the box core (53201#29) collected a sample, though in the process the pivot pin on the warp activation trigger was sheared through. This was quickly repaired by the ship's engineers. AUDOS was then deployed (53201#30) and DEMAR recovered in routine fashion. The following multicore (53201#31) produced twelve perfect cores. Having repaired one of the two nets torn on previous tows the sledge was deployed overnight (BN1.5/C, 53201#32). Unfortunately, but to no-ones great surprise by this time, the sledge net was found to be torn and to contain no catch on recovery the following morning (Sat 16).

With freshwater now coming in fits and starts, and in a variety of colours, it was time to complete operations and prepare for the steam to a rendezvous with *Charles Darwin*. AUDOS was recovered and a Bathysnack (baited Bathysnap) deployed (53201#34) to work the site in our absence. A quick water bottle dip to 150 m for a microbiological sample (53201#35) filled the last few minutes before departure time.

Challenger set course for the Goban Spur. Passage was delayed by a stop for engine failure and subsequent operation at reduced speed. By 1030 Sunday 17, *Challenger* was holding off *Darwin* while the IOS midwater group aboard *Darwin* completed an RMT haul. After one or two false starts *Darwin*'s RIB eventually made the crossing to *Challenger*. The replacement reverse osmosis unit (and a number of other items) was received and a spare monitor battery pack and the remnants of the long-term Bathysnap's dahn buoy sent back to *Darwin*.

In the time require to fit and confirm operation of the reverse osmosis unit, the cruise's subsidiary objective of "visiting a site on the Goban Spur to follow up a photosledge transect carried out during RRS *Challenger* 94, which revealed abundant populations of the xenophyophore *Syringammina* sp." was adopted. In addition, one deployment each of AUDOS and DEMAR were planned.

Challenger sailed for the Goban Spur work area at 1130, arriving at the start point of an echo-sounding transect at 1511, following a one hour stop for further engine repairs. The echo-sounding run complete, *Challenger* proceeded to a '2500 m' station where AUDOS was deployed (53202#1) and then to a '2000 m' station where DEMAR was deployed (53203#1). *Challenger* then returned to the main

'*Syringammina*' site, completing a second echo-sounding transect *en route*. After compiling the echo-sounding data to select an appropriate track, WASP was deployed (53204#1) overnight.

After recovering WASP the following morning (Mon 18), the box core was deployed four times in succession at the '*Syringammina*' site. The first core (53204#2) was disturbed and discarded, the second (53204#3) reasonable and the third and fourth (53204#4,5) good. None of the cores collected the hoped for specimen of *Syringammina* sp.. This work completed, DEMAR and AUDOS were recovered and at 2030 *Challenger* set course for the main work site on the Porcupine Abyssal Plain.

Challenger proceeded directly to the Bathysnack position, arriving 0950 Tuesday 19. Bathysnack was recovered, sustaining minor damage to the camera's bulkhead connector as it was brought over the stern. AUDOS was then deployed (53205#1) followed by the box core (53205#2), which recovered a good deep core. The otter trawl was fished overnight (OTSB14, 53205#3).

A good trawl catch was recovered the following morning (Wed 20). AUDOS was recovered and DEMAR deployed (53205#4) without incident. The following deployment of the multicore (53205#5) was a disappointment, producing only eleven very disturbed cores. Consequently the multicore was redeployed (53205#6) immediately, and fortunately collected twelve good cores. This luck did not hold; an inopportune swell train 'bounced' the following box core deployment (53205#7) resulting in no sample. To squeeze in a last drop, AUDOS was deployed in darkness for the first time during the cruise, this presented no problems. Subsequent overnight WASP operations were problematic. The first deployment (53205#9) was aborted after 30 minutes on the bottom when all telemetry ceased abruptly. A second attempt (53205#10) after some investigations, fared no better - lasting less than 20 minutes on the bottom.

Following the WASP failures, Thursday 21 started with an early morning multicore (53205#11). Despite the spooling gear jamming at a most unfortunate moment, this deployment produced twelve good cores. DEMAR was then recovered and the water bottles deployed (53205#12) for a deep (10 mab) microbiology sample. After recovering AUDOS, insufficient time remained for an overnight tow and two or more multicore drops were planned instead. In the event, the ship's necessity to stream the main warp to correct the spooling gear took up the first available multicore slot. The multicore was then deployed (53205#13) but returned with water samples only. This failure clearly resulted from the heavy swell and worsening weather conditions, and prompted the cancellation of any further multicore deployments.

The final act was the deployment of a Bathysnap on Friday 22. Those struggling to construct the mooring on the afterdeck took several wettings from waves over the stern. When Bathysnap was finally set loose at 0840 there was a distinct feeling of 'just in the nick of time' as the weather closed further. Bathysnap was watched acoustically to the bottom, at which point the PES fish was recovered, signalling the end of scientific operations.

Challenger set course for Barry at 1030, arriving for the morning tide of Monday 25 April 1994.

Conclusion

Many events are not recorded in the narrative above, mainly because they have little bearing on the scientific conduct of the cruise. One series of occurrences should, however, be noted here. The cooled container lab put aboard for the cruise failed continually and eventually terminally despite the unstinting and strenuous efforts of the ship's engineers; I thank them for all their work, and trust that this situation will not arise again.

Despite the weather, and its contribution to many of the gear failures, this cruise was successful. A good proportion of the planned work was completed, and all those aboard together with a number who stayed ashore have been provided with sufficient material to ensure that good science will come from our endeavours at sea. For this success, not to mention a pleasant time aboard, and on behalf of the scientific party, I would like to thank the Master and all of the crew. I would also like to thank all those at RVS base and at IOSDL for their invaluable help with the unsung side of the cruise.

GEAR REPORTS

Acoustic command and monitoring system

The shipborne system, located in the plot, comprised a waterfall display, 10KHz Mk4 Deck command unit and a PES beam steering unit wired into the PES junction box. A secondary waterfall display was also positioned in the main laboratory. This equipment was used to control and monitor mooring, multicore, box core, WASP, epibenthic sledge and OTSB operations. No problems were encountered in the operation of this equipment.

All coring operations were monitored by a 10KHz beacon attached to the warp 50 metres above the corer. The waterfall display showed clear bottom approaches indicated by the beacon's acoustic seabed reflection. On one occasion the beacon failed during deployment, caused by components coming loose inside the pressure case; however, the core was successfully completed by cautious lowering to the seabed based on previously recorded mwo on contact and use of the recording tension meter.

DE

Multiple corer

Summary of useful deployments

Station	Position		Depth (m)
53201#4	48° 51.4' N	16° 30.7' W	4846
53201#7	48° 51.5' N	16° 30.5' W	4842
53201#9	48° 51.8' N	16° 29.7' W	4845
53201#11	48° 51.6' N	16° 29.9' W	4847
53201#14	48° 51.5' N	16° 29.6' W	4844
53201#17	48° 51.1' N	16° 29.6' W	4846
53201#22	48° 51.1' N	16° 29.6' W	4844
53201#27	48° 51.5' N	16° 29.8' W	4845
53201#31	48° 51.7' N	16° 29.9' W	4845
53205#5	48° 51.1' N	16° 29.7' W	4844
53205#6	48° 51.0' N	16° 29.9' W	4844
53205#11	48° 51.4' N	16° 29.6' W	4844

The multiple corer was deployed 14 times at the Porcupine Abyssal Plain site with varying degrees of success (see table 1). Ten deployments each yielded 11 or more cores, although some of these were more-or-less disturbed and overlain by cloudy water. One deployment (53201#4) returned only 8 cores, another set of cores (53205#5) was virtually unusable because of disturbance and two deployments (53201#6, 53205#13) failed completely. Most of the failures could be attributed to unfavourable sea conditions, particularly the heavy swell experienced at the beginning and end of the cruise. The winch speeds used to land the corer on the seafloor and to lift it off (30-40 $mmin^{-1}$ and 20-25 $mmin^{-1}$ respectively) were faster than those used on previous cruises because of the difficulties involved in operating the winch on "half a notch". However, since this procedure resulted in several perfect core sets, it was probably not responsible for the sometimes poor performance of the corer.

AJG

Box corer

Summary of useful deployments

Station	Position		Depth (m)
53201#23	48° 51.2' N	16° 29.8' W	4846
53201#26	48° 51.0' N	16° 29.6' W	4844
53201#29	48° 51.4' N	16° 29.6' W	4844
53205#2	48° 51.0' N	16° 30.7' W	4845

The box core was deployed eight times with 50% success rate. The failures were probably a mix of pre-triggers in the water column and bad first bottom contacts. In both cases these are attributable to the marginal weather conditions for box core operations. The neoprene spade seal was damaged or rucked up on two occasions. Eventually use of the corer without the seal in place demonstrated that at this site, where there is a consolidated clay-like layer in the sediment, it is not necessary for good core retention. The pivot

pin of the warp activation trigger was sheared through on an otherwise successful deployment (53201#29), there was no obvious reason for this.

MHT, BJB

Water bottles

Summary of useful deployments

Station	Position		Samples
53201#2	48° 46.9' N	17° 04.9' W	26 mab
53201#15	48° 53.9' N	16° 31.0' W	1, 15, 31 mab, 4000, 2000, 1000, 500, 10 m
53201#35	48° 54.0' N	16° 20.4' W	150 m
53205#12	48° 53.2' N	16° 30.8' W	nominal 10 mab

The rosette sampler generally performed well, with only a few misfires or incomplete bottle closures, neither of which had particular impact on the science.

AJ, DE

Epibenthic sledge

Summary of useful deployments

Station	Position		Depth (m)
53201#8	48° 52.9' N	16° 28.6' W	4846
	48° 54.4' N	16° 32.9' W	4850

This was an almost total disaster. The coarse-net sledge was deployed on four occasions. Only one of these, the second deployment (#8), obtained a sample, a small one not comparable with previous sledge hauls from this site; clearly the gear had not fished effectively. On each of the other three hauls the net was ripped its full length on, or close to, one of the side seams, once on the starboard side and twice on the port side. We have no clear idea why.

On the first occasion (#5) it was put down to weather since the haul was conducted during a heavy swell, but the other two hauls were carried out in moderate weather. In each case the gear at first appeared to behave normally, indeed rather well. It was firmly ensconced on the bottom with less than 10 km mwo, and gave good traces for several smooth and rapid odometer traverses (though on one occasion only three). Suddenly, in each case, the tension increased rapidly and the traces became markedly wavy, suggesting that the gear was surging, possibly in phase with the swell. Lift off was difficult and, in the best documented case (#32), was immediately preceded by a sudden decrease in tension, presumably as the net split. We can only surmise that the net on each of these hauls became filled with mud and eventually gave way. We do not know why this should happen now, and particularly with the coarse net which has previously taken very clean

catches at this site. Unfortunately, the photographs tell us almost nothing, the vast majority being obscured by mud.

We had no further coarse nets and had already put considerable personal (MHT) and project (LRP4) investment in mending one of the ripped nets. A somewhat cavalier decision to try a fine mesh haul was precluded by lack of time, so we have no idea whether the result would have been better or worse!

ALR

Otter trawl

Summary of useful deployments

Station	Position		Depth (m)
53201#1	48° 51.5' N	16° 41.2' W	4834
	48° 46.5' N	16° 51.2' W	4836
53201#24	48° 53.7' N	16° 36.8' W	4846
	48° 51.7' N	16° 19.6' W	4843
53201#28	48° 55.5' N	17° 00.1' W	4846
	48° 52.2' N	16° 51.9' W	4845
53205#3	48° 54.6' N	16° 47.4' W	4838
	48° 50.3' N	16° 35.9' W	4850

Five trawling operations were carried out on the Porcupine Abyssal Plain. Neither of the first two operations were successful, causing a loss of over 24 hours shiptime. On both occasions the new 100 m sweeps, connecting the doors to the main warp swivel, were severely twisted together over their entire length (and unlaid in part). In so doing, they had locked the doors tightly together to close the net and complicate final recovery. On the second deployment, swivels were let into each sweep at the junction with the main warp. Nevertheless, twists appeared as soon as the sweeps were transferred from the auxiliary pennants to the main warp. They were taken out by temporarily re-connecting to the pennants and shooting was continued apparently normally. Yet the problem was not solved, as twisting must have continued and locked the doors to close the trawl before it reached the bottom. It was recovered completely empty, despite acoustic indication of bottom contact for three hours. The remaining three tows were fished successfully with 50 m sweeps supplied for a former cruise, but swivels were incorporated at both the main warp and door intersections as a precaution. (Note: In the early years, swivels were connected to either ends of these sweeps, but were proved to be unnecessary with the old 6 x 18 construction 13 mm main warp wire provided for the sweeps.)

NRM

WASP

Summary of useful deployments

Station	Position		Depth (m)
53201#16	48° 49.9' N	16° 36.4' W	4847
	48° 49.5' N	16° 40.2' W	
53205#9	48° 51.7' N	16° 31.8' W	4847
	48° 51.6' N	16° 31.5' W	
53205#10	48° 51.2' N	16° 30.5' W	4847
	48° 51.3' N	16° 30.3' W	

WASP was deployed on three occasions, providing over 1000 colour photographs in total. Each has an associated record of time, altitude and pressure, as logged aboard the vehicle and subsequently down-loaded to a PC for use with commercial software.

Following two successful deployments (the second being on the Goban Spur), the third deployment required a premature recovery after obtaining only 100 photographs, as a result of acoustic telemetry failure. With limited time available basic system checks did not reveal the problem, which was made more difficult to locate as everything operated correctly on deck. The system was redeployed with a combined replacement acoustic transducer and pulse power amplifier. However, after approximately 2 hours, that included lowering the system to the seabed and taking 30 photographs, the fault recurred. The system was recovered, and was bench tested the following day without the fault recurring.

Moorings

A total of 13 deployments and recoveries were successfully completed during this cruise. These comprised of 6 AUDOS (plus one at Goban Spur), 3 Demar (plus one at Goban Spur), 1 Bathysnap and 1 Bathysnack. All were equipped with a single IOS CR200 acoustic release operating twin retractors except in the case of Bathysnap and Bathysnack which were fitted with twin pyros.

DE, AJ

Bathysnap & Bathysnack

The long-term Bathysnap (52916), originally deployed by RRS *Charles Darwin* in September 1992, was released at 1655z 9-IV-94, and eventually recovered with some difficulty (see narrative). The dahn buoy, comprising buoyancy, mast, flag, radio beacon, and strobe, was missing; presumably the result of an inappropriate electrolytic couple between the securing chain and shackle. The recording current meter had also sustained some damage, probably not during recovery; the rotor was missing, the rotor guard askew with some retaining screws loose. On recovery the flash was seen to fire at 2235z 9-IV-94. Subsequent examination of the camera indicated that an appropriate quantity of film had run through; the developed film confirmed completely successful camera operation.

One Bathysnack deployment was completed (53201#34). It was operated in standard fashion with mackerel bait. The mooring utilised the new Billing's triple floats and 6 m pole which all seemed to work well. On recovery the camera was found to have jammed with several turns of film around the drive sprocket. This probably resulted from insufficient back-tension from the take-up spool, caused by excessive slippage in the clutch. Some 8-9 m of film were recovered and subsequent development showed otherwise correct operation and did capture the first arrivals of scavenging animals.

A 'medium-term' Bathysnap was deployed (53205#14; 4844 m; 48° 51.73' N 16° 30.25' W; CR 2436 234-243 239-70 secs 314-324 P1.10) with the intention of pick-up during RRS *Challenger* cruise 113 in July 1994. From top to bottom the mooring comprises: a single Billing's triple float, 10 m of polyprop, the dahn buoy (one triple float, 10 kg ballast, 6 m mast, orange flag, Novatec radio beacon - 160. 725 Mhz), 20 m kevlar, a triple-triple buoyancy pack with swivels top and bottom, 50 m kevlar, standard Bathysnap rig. The frame was fitted with three blocks of wood for colonisation / boring; these should be preserved and returned to Robin Harvey (DML) on recovery. **IMPORTANT NOTE** the camera is MK5, i.e. not light tight, also **RECORD APERTURE SETTING AND PRESENCE OF COLOUR CORRECTION FILTER ON OR BEHIND LENS** as subsequent development of the Kodak 5297 film may require adjustment.

BJB, ALR, DE

DEMAR

Summary of useful deployments

Station	Position		Depth (m)	Duration
53201#18	48° 47.0' N	16° 34.2' W	4846	14:57
53201#25	48° 49.1' N	16° 31.0' W	4844	26:10
53205#4	48° 51.2' N	16° 26.4' W	4844	22:44

Amphipods were trapped using DEMAR, the free-fall de-rated mark and recapture system, as used on previous cruises. Buoyancy consisted of five Billings triple units, one as a lazy line float, one as the basis of a dahn buoy, and three mounted together coaxially as the main buoyancy. The main buoyancy was separated from the dahn buoy and the trap by 20 m and 50 m of 10 mm braid-line strops respectively. The lazy line was 10 m of 20 mm polypropylene. The dahn buoy, with a 6 m mast projecting 3 m above the surface, carried a flag and a radio beacon. The trap was ballasted with a 135 kg weight. Release was achieved using retractors.

Deployment was carried out buoyancy first, with just sufficient way on the ship to stream the rig astern. The trap was cut lose using a release hook. Sea and weather conditions were not testing, but this method gave quick (7-8 minute) and safe deployments.

The rig was deployed on four occasions, three times on the abyssal plain and once on the Goban Spur. Descent rates for the two deployments for which the gear was monitored to the bottom were 0.85 and 0.88 $msec^{-1}$. Ascent rates for the four deployments were consistent and in the range 0.59 to 0.63 $msec^{-1}$.

MHT

AUDOS

Summary of useful deployments

Station	Position		Depth (m)	Duration
53201#3	48° 47.6' N	16° 20.5' W	4837	36:30
53201#13	48° 57.9' N	16° 37.5' W	4845	16:42
53201#21	48° 50.0' N	16° 23.1' W	4844	19:45
53201#30	48° 52.2' N	16° 25.4' W	4844	20:10
53205#1	48° 52.9' N	16° 24.1' W	4845	17:10
53205#8	48° 52.0' N	16° 32.1' W	4846	18:16

AUDOS is a free-fall pop-up vehicle designed for photography of deep-sea scavenging fishes. The vehicle is also equipped for the acoustic tracking of such fish *in situ*. The AUDOS vehicle functioned very well throughout the cruise, making six successful deployments (plus one on the Goban Spur). Vehicle sub-system reports as follows:

1. TRATEX (Transponding Acoustic Tracking Experiment) is the central command unit of the vehicle and oversees the functioning of both the tracking experiment and the camera system. It is also responsible for logging any tracking data. This functioned extremely well during all deployments with no faults encountered at any time.

2. The Scanning Hydrophone on the vehicle is responsible for sending acoustic interrogating pulses to any CAT's (Code Activated Transponders) ingested by fishes and receiving returning CAT signals. As with TRATEX no problems were encountered.

3. The camera and flash system, Camera Alive Marine Equipment Limited model CAMEL CI 800. The camera worked very well during all deployments and more than 10 hours of Kodak Ektachrome 200 Professional were exposed per deployment. Ship-board development (E-6 process) of short test strips (c. 1 m) confirmed camera operation.

4. The Valeport current meter did not flood, as had occurred with earlier models. It appears to have worked well, as it did during the last cruise involving the system.

5. The Acoustic release (CR200, twin retractors), supplied and maintained by the Institute of Oceanographic Sciences, used on the vehicle was 100% reliable and the backup magnesium links used in the rig were never called into play.

The only problem encountered was the dropping of ballast while still inboard during the first deployment. The wire used in the ballast rigging had held but the nicopress crimps supplied were of the

wrong size and probably the wrong material. This was overcome by rigging the ballast with lengths of large chain-links shackled together; no further problems were encountered.

AS, SA

SAMPLES AND SCIENTIFIC OBSERVATIONS

Water Bottle samples

Samples were taken from four hauls, three for bacterial filtration and DNA extraction and one for biomass through the water column.

53201#2	12 litres from 4790m for DNA extraction
53201#15	Samples from 10m, 500m, 1000m, 2000m, 4000m, 31mab, 15mab and 7mab for biomass determination by fluorescence microscopy
53201#35	16 litres from 150m for DNA extraction
53205#12	14 litres from 4750m for DNA extraction

Bacterial activity was investigated by observing the incorporation of radiolabelled compounds by samples incubated at both surface (1 atm) and seabed (480 atm) pressures. All incubations (with one exception) were carried out at the near-bottom temperature of 2.5^{o}C and were for intervals up to approximately 24 hrs. Bacterial DNA production was followed by the incorporation of [methyl-^{3}H] thymidine, and protein production by the incorporation of L-[4,5 -^{3}H] leucine. Incorporated radioactivity was assessed on board by means of the Ryan Institute's scintillation counter.

Multiple core samples

The cores recovered were similar to those taken from the PAP site during earlier cruises (*Discovery* 184, *Challenger* 79). They were typically 260-350 mm long with a distinct colour discontinuity about 240 mm below the surface. The lower layer was very sticky and formed a plug which helped to retain the core within the tube.

Cores were used for a variety of purposes (see table 2). Seven sets were sampled for meiofaunal, bacterial and chemical studies according to a more or less standard protocol (ND, DE, TF, AJG). Two were used to study microbiological influences on sediment geochemistry (DB). Five cores from one deployment were homogenised to investigate the relation between chemical parameters and metazoan meiofauna (DB, ND, TF). One complete set of core-tops (0-1 cm) were taken for use in a study of small-scale variability among foraminiferal populations (AJG). Several samples were used for a foraminiferal incubation experiment and associated electron microscopy (AJG).

AJG

Foraminiferal diets

The intention was to conduct a series of incubation experiments during this cruise to investigate the ingestion of food particles by meiofaunal foraminifera. Unfortunately, these plans had to be revised because of problems with the recently modified IOSDL pressure vessels. At 2^{o}C it proved impossible to screw down the new end caps completely, although they fitted well at room temperature.

A single three day incubation was carried out as follows. About 5 ml of surface sediment from multiple corer deployment 53201#14 was pipetted into each of three plastic bags. The first bag was topped up with core-top water (unfed incubation), the second with about 20 ml of mixed algae (*Emiliani huxleyi*, *Chlorella* sp., *Tetraselmis* sp.) and the third with core-top water and 50 ml of a suspension of 1mm diameter fluorescent microspheres (10^{10} spheres ml^{-1}). The bags were heat sealed, care being taken to eliminate air, and placed in a UCG pressure vessel maintained at 450 atm and about 2^{o}C in the cold container. After three days the experiment was terminated and the samples fixed immediately in 5 % (final concentration) cacodylate-buffered gluteraldehyde. An unincubated control sample of surficial sediment from the same sample was fixed in the same way.

To compensate for the lack of incubated material, additional sediment samples were fixed in gluteraldehyde to study food items contained in the protoplasm of infaunal and epifaunal taxa. Samples were taken from the surfaces and from various deeper layers (3-4cm, 4-5cm, 7-8cm, 9-10cm) of two disturbed cores (53205#5).

AJG

Sediment chemistry

In all, 6 pairs of sediment cores from 6 different multicorer deployments were taken for chemical analysis. Of these 12 cores, one had to be discarded due to excessive disturbance of the surface sediment. These cores were sectioned at the following depth intervals: 0-5 mm, 5-10 mm, 10-20 mm, 20-30 mm, 30-40 mm, 40-60 mm, 60-80 mm and 80-100 mm. Time restraints and a lack of oil for the vacuum pump meant that it was not possible to freeze-dry samples on board ship.

In addition to the routine sampling of sediments described above, two special experiments were conducted on cores collected during this cruise. The first, an homogenisation experiment, was carried out on cores from a single multicorer deployment. This involved sectioning 5 of the cores at 1 cm intervals down to 5 cm, and homogenising each section using a rotamixer. Samples were split approximately 50:50 between Liverpool and NHM, with Galway taking 1 ml of sediment for bacterial analysis. Samples for chemical analysis were frozen at -70^{o}C. The remaining 2 cores, intended solely for chemical analysis, were routinely sectioned and frozen as described above.

The second experiment, conducted jointly with Galway, involved incubation of surface sediments in order to investigate the effects of microbial activity on surface sediment chemistry. The top 1 cm sections

from all 12 cores from a single multicorer deployment were pooled, homogenised and about 25ml placed in separate plastic bags to be incubated at 480 atm and 4°C. Incubations were carried out for the following time intervals: 0, 12, 24, 48 and 96 hours along with a control (96 hours) to which formalin had been added. At the end of each of the incubation periods, 1 ml of sediment was taken by Galway, the bag resealed and placed in the -70°C freezer. The above was repeated on samples from the same homogenised sediment, this time incubating the sediment at 1 atm as a check for the influence of non-barophilic bacteria.

The first time this experiment was attempted, a shortage of working pressure vessels meant that the vessel employed for the incubations was overfull. This resulted in the bags containing the sediment bursting and samples becoming contaminated. The experiment was repeated and, with more space available in the only remaining fully-working pressure vessel, worked successfully.

DB

Sediment microbiology

Bacterial activity experiments were carried out on three multiple core samples from three different drops and on sediment contact water from a further two drops.

Station	Experiment
53201#4	Thymidine & leucine on sediment sections 0-2, 3-5, 5-10 cm
53201#11	Thymidine on sediment contact water
53201#14	Thymidine on sediment sections 0-1, 1-2, 2-3, 3-4, 4-5 cm
53201#22	Thymidine & leucine on sediment sections 0-2, 3-5, 5-10 cm
53201#31	Thymidine on sediment contact water (isotope dilution experiment)

Preliminary results in terms of volumetric uptake rates showed bacterial activity of a similar level to that found at the EUMELI oligotrophic site (21° N 31° W) during RRS *Discovery* cruise 204. These will be reworked on-shore and subjected to a more rigourous statistical analysis.

Sediment DNA samples were taken from four cores:

Station	Sections (cm)
53201#7	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, 9-10
53201#9	0-1, 1-2, 2-3, 3-4, 4-5, 5-7, 7-9, 9-11
53201#11	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, 9-10
53201#22	0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, 9-10

All sections were stored at -20°C. Subsamples from each section were taken for biomass determination. One additional core was taken for Biological Oxygen Demand work (53201#17, core 3).

DE

Metazoan meiofauna

Metazoan taxa (Gent)

A total of thirteen cores were taken from seven deployments of the multiple corer (two cores from individual drops with the exception of #4). Some cores showed detectable resuspension of surface sediment

in the overlying water column. Therefore, the surface water was removed by syringe and preserved in formalin as a separate sample The cores were sectioned in 1 cm horizons to a depth of 5 cm. The samples were then fixed in 10 % formalin and will be returned to IOS and stored until collected by Gent. In addition, a further core from each of the seven deployments was taken and sectioned as for the metazoan taxa samples. This material was placed in plastic bags and frozen at -20^{o}C and will subsequently be used for chemical analysis by Gent.

TF, ND

Nematode Studies (NHM)

A total of seven cores were taken from seven deployments of the multiple corer. Some cores showed detectable resuspension of surface sediment in the overlying water column. Therefore, the surface water was removed by syringe and preserved as a separate sample. The cores were sectioned in 1 cm horizons to a depth of 5 cm, and then in 5cm sections to a depth of 15 cm. The samples were then fixed in 10 % formalin and will be returned to IOS and stored until collected by NHM.

An additional core containing a distinct burrow structure was taken from drop 53201#11 and sectioned similarly. The burrow structure remained detectable within the sediment to a depth of approximately 7 cm, but deviated towards the side of the core over this distance and may not have been sampled fully.

On deployment #14 a series of five cores were taken to provide samples for collaborative research between NHM, LUDO and Galway. The cores were sectioned in 1 cm horizons to a depth of 5 cm. The material from each section was then homogenised with some additional artificial seawater to a slurry-like consistency. This material was then divided between NHM and LUDO for subsequent nematode abundance and sediment chemistry analysis respectively. A 1 ml sample of the material was taken by Galway for sediment microbiology analysis. This experiment was somewhat affected by technical problems particularly in the handling and accurate division of the homogenised material and further refinement of the technique will be undertaken by NHM before the protocol is repeated at sea.

TF, ND

Box core samples

The four useful cores collected from the abyssal site were treated according to the protocol adopted on previous cruises. The supernatant water was drained or siphoned off, and the core surface described and photographed, paying particular attention to organisms and biogenic structures. Any visible macrofaunal metazoans were removed and foraminiferans, komoki and xenophyophores picked off for separate fixation. A 57 mm diameter subcore was taken for sedimentological analysis. The main core was subsampled in six layers (0-1, 1-3, 3-5, 5-10, 10-15 and 15-20 cm). The uppermost four layers were sieved out at 1000, 500, 300 and 250 mm, and the two deeper layers at 1000 and 500 mm only. Material from deeper than 20 cm was discarded.

The abyssal plain cores were all similar in structure, and conformed closely to the pattern seen in cores obtained on previous cruises to the area. The cores were deep, ranging from 44 to 49.5 cm. Surfaces were a uniform pale warm beigy-brown in colour, showing varying degrees of biogenic activity in the form of tubes and burrows, but no trails. Protists were present in some numbers on all core surfaces, with *Rhizammina* particularly obvious. Superficial layers of all cores were extremely soft, the top 2-3 cm being unable to support the weight of a subcore tube. Generally, firmness increased more-or-less regularly and colour darkened and became richer with increasing depth down to a variably well-defined greyer layer 3-4 cm thick. The bottom of this layer represents the redox level, and occurred at or about a depth of 25 cm. Underlying sediment was much paler in colour, and was separated by a sharp boundary. Sieved residues were very small, with little sign of obvious macrofauna.

MHT

Large agglutinated rhizopods

The most common foraminiferal species occurring on box cores and multiple cores was *Rhizammina algaeformis*, as noted previously during RRS *Discovery* cruise 184 and RRS *Challenger* cruise 79. In addition, a few obvious komokiacean mudballs (*Lana, Edgertonia*) were preserved. There was, however, a virtual absence of xenophyophores on the 13000 cm^2 of sediment surface (4 box cores, 125 multiple cores) sampled during this cruise. A single possible small specimen occurred on box core 53201#26. This compares with the 10 xenophyophores found on 9 box cores and 153 multicores (1 specimen per 2600 cm^2) during *Discovery* 184 and the 11 specimens found on 7 box cores and 148 multiple cores (1 specimen per 1900 cm^{-2}) during *Challenger* 79. Several of the *Challenger* 79 specimens were associated with phytodetritus. Moreover, rapid episodic growth has recently been observed in three specimens of *Reticulammina labyrinthica* on the Madeira Abyssal Plain. It remains to be established whether or not these density differences are statistically significant. However, if they are, then it is conceivable that xenophyophores develop rapidly at the PAP site following the spring bloom and the delivery of phytodetritus to the seafloor.

AJG

Epibenthic sledge

The solitary, rather poor sample was preserved in the normal way.

ALR

Otter trawl

Fish

Semi-quantitatively, three of the five OTSB operations were successful. Twisting of the sweep wires locked the doors and closed the net on the first two operations. A sample was recovered from the first tow, though this could only be considered a qualitative collection. Altogether 58 fish were taken, weighing a total of

50.1 kg. The three good tows covered a distance of 23.6 miles on the sea-floor. These yielded relative densities in the range 0.10-0.14 fish per 1000 m^2 and relative biomass of 0.08-0.15 kg per 1000 m^2.

Overall seven species were sampled, representing the families Synaphobranchidae (1 species), Alepocephalidae (2), Synodontidae (1) and Macrouridae (3). The most abundant species, to be expected in these soundings, was *Coryphaenoides (Nematonurus) armatus* (19 individuals), followed by *C. (Chalinura) leptolepis* (16) and *Histiobranchus bathybius* (11). Of interest was the small size of the *Bathysaurus mollis* (Synodontidae) caught, at only 229 mm standard length, as well as a particularly large and undamaged specimen of the pelagic eel, *Saccopharynx*, which occur only infrequently in any catches.

In addition to the routine samples taken from the specimens for ichthyological purposes, liver tissue was taken for Jez Brooks (Southampton University, for stress physiology studies) and intestinal tracts retained for Rod Bray (NHM, for parasitological investigations of *C. (N.) armatus*).

NRM

Sampling of fish tissues was also undertaken by the Aberdeen group. Samples of muscle, liver, heart and brain were taken from a dozen *C.(N.)armatus*, two *Histiobranchus bathybius* and two *Conocara salmonea*, these were placed in cryotubes and frozen at -70^{o}C to be transported to Aberdeen in liquid nitrogen. Once in Aberdeen the samples will undergo analysis in the Department of Zoology, University of Aberdeen, with particular interest in biochemical correlates of growth.

AS, SA

Invertebrate megabenthos

The catches of three otter trawls and one coarse-mesh epibenthic sledge haul have provided megafauna. For the present exercise, these catches have been sieved on 20 mm and 4 mm meshes. Material retained on the 20 mm mesh has been regarded as megafauna, and that passing the 20 mm mesh but retained on the 4 mm screen as larger macrofauna. The latter was fixed *in toto* for subsequent sorting.

Because of the widely varying shape and consistency of the organisms obtained, sieving is an imperfect means of separating large and small individuals. As a consequence, some arbitrary decisions have been made. For instance, all holothurians are considered to be megafaunal, i.e. greater than 20 mm, although smaller individuals have a diameter of less than this. In contrast, all annelids have been relegated to the larger macrofauna, i.e. less than 20 mm, despite some specimens being nearly twice this length.

Holothurians comprised between 90 and 95% of megafaunal biomass the most important species in terms of biomass, and probably numerically also, was *Oneirophanta.* Other important species were *Pseudostichopus* and *Psychropotes* with lesser numbers of *Amperima, Benthodytes, Deima, Mesothuria, Molpadia, Paroriza* and *Peniagone* among others. Holothurians apart, actiniarians and asteroids were of importance. Among the former, a species of *Sicyonis* attached to worm tubes and sponge spicules was common. The most abundant asteroids were *Hyphalaster* and *Styracaster.* Both expected species of the

anomuran *Munidopsis, crassa* and *parfaiti* occurred in all catches, but the natantian decapod *Plesiopenaeus* was rare. Echiuran worms were present in all catches. Being burrowing forms, these organisms are likely to be under-collected, so it was of interest to see their characteristic 'star' burrow feeding traces on the short tail of a WASP film processed to check camera function. Polynoid annelids were present in some numbers in all catches, but as noted above, they are considered as large macrofauna rather than megafauna. Of note, but contributing little to the overall biomass, was a single large *Eurythenes gryllus*. Net-caught examples of this necrophagous amphipod are extremely rare, although the species has been taken widely and abundantly in baited traps on and above the abyssal seafloor. Other taxa present in small numbers were sponges, the pennatulacean *Umbellula*, sipunculid worms, cirripedes, the large pycnogonid *Colossendeis*, gastropods, bivalves, cephalopods, the inevitable ophiuroid *Ophiomusium*, and the stalked tunicate *Culeolus*.

Subjective impressions suggest that the megafauna as sampled on this cruise is not different in quantity or taxonomic composition from that found on previous visits to this site at different seasons of the year.

MHT, BJB, AJG, ALR

Actiniaria (Paul Tyler / Sarah Bronsdon, SUDO). A total of 48 epizoic anemones, *Kadosactis commensalis,* were collected from 18 *Paroriza prouhoi*, and a further 4 from 2 specimens of *Pseudostichopus* sp. The material was frozen at -70^{o}C and will be used for enzyme electrophoresis to investigate the possibility of a genetic relationship between the anemones in multiple infestations. Five specimens of the free-living *Sicyonis* sp, one weighing about 300 gm), were frozen at -70^{o}C.

Holothurian demography and physiology (Lawrence Hawkins, SUDO). A series of displacement volumes and weights were determined for a range of sizes in *Oneirophanta*, *Psychropotes* and *Pseudostichopus* but, as expected, the use of a spring balance at sea produced very questionable weight data. A request for coelomic fluid from *Peniagone* and *Paelopatides* could not be fulfilled. Only one specimen of *Paelopatides* and a small number of *Peniagone* were taken. All were in poor condition and attempts to remove fluid failed. It was also impossible to obtain coelomic fluid from the considerable numbers of *Amperima* taken, but good samples were obtained from 4 *Deima* and 5 *Pseudostichopus* and frozen at -20^{o}C.

ALR

Holothurian sampling

For gut content analysis the holothurians *Oneirophanta mutabilis*, *Pseudostichopus atlanticus* and *Psychropotes longicauda* were obtained from Otter trawl (OTSB) and epibenthic sledge catches. Gut content samples were taken from the oesophagus, anterior intestine, posterior intestine, and the cloaca. Material obtained is summarised below:

Haul 53201#1. Fifteen *Pseudostichopus* sp. were dissected and gut contents collected for bacterial counts and C/N analysis. Gut wall and gut contents were also collected for cellulase analysis. Gut contents were collected for bacterial probe work.

Haul 53201#8. Nine *Oneirophanta mutabilis* were dissected and gut contents collected for bacterial counts and C/N analysis.

Haul 53201#24. Six *Oneirophanta mutabilis* were dissected and gut contents collected for bacterial counts and C/N analysis. Gut wall and gut contents were collected for cellulase analysis. Gut contents and tentacles were collected for bacterial probe work. Six *Psychropotes longicauda* were dissected and gut contents were collected for bacterial counts and C/N analysis.

Haul 53201#28. Nine *Psychropotes longicauda* were dissected and gut contents collected for bacterial counts and C/N analysis. Gut wall and gut contents were collected for cellulase analysis.

For chemical analysis of gut contents a separate set of individuals were sampled and the gut contents pooled for each region of the gut. Subsamples were taken for bacterial counts and C/N analysis.

BM

Gut contents were taken from three deep-sea holothurians, namely *Oneirophanta mutabilis*, *Pseudostichopus atlanticus* and *Psychropotes longicauda*. For each species, samples were taken from four sections of the gut i.e. the oesophagus/stomach, the anterior intestine, posterior intestine and the rectum/cloaca. Samples from the same gut region of the same species were pooled and homogenised. From each pool of material QUB took subsamples for bacterial counts and C/N analysis. The remaining pooled material was frozen at -70^{o}C.

Dissected remains of all three species were retained for natural product work. Two specimens of the asteroid *Hyphalaster*, which were bloated with ingested sediment were also dissected, with samples again frozen at -70^{o}C. In addition to the dissections six specimens of *Oneirophanta mutabilis* and two very large specimens of another holothurian *Paroriza* were frozen whole for future dissection.

DB

Bacterial activity experiments (using Thymidine) were carried out on three gut regions of *Psychropotes longicauda* taken from OTSB haul 53205#3.

Gut samples and tentacles from *Pseudostichopus atlanticus*, *Oneirophanta mutabilis* and *Psychropotes longicauda* were taken for bacterial DNA probe, bacterial numbers and C/N analysis:

53201#1 *Pseudostichopus* guts
53201#24 *Oneirophanta* guts and tentacles
53205#3 *Psychropotes* guts. *Pseudostichopus* and *Psychropotes* tentacles

DE

Moorings

Bathysnack and Bathysnap

Only one Bathysnack deployment was made (53201#34). Unfortunately the camera was found to have jammed and only 8-9 m of film were recovered. Subsequent development ashore showed that the first arrivals of scavenging fish had nevertheless been recorded. A long-term Bathysnap was deployed (53205#14) for recovery during RRS *Challenger* cruise 113, after hopefully recording the arrival of phytodetritus.

BJB, ALR, MHT

DEMAR

Without detailed analysis, catches from the three PAP deployments appear very similar. Each contained of the order of 500 amphipods. Most were *Paralicella* spp., but in each case about 10% of the specimens were *Eurythenes gryllus*. In addition, a few specimens of *Orchomene* sp. were present. All of the *E. gryllus* were small, none exceeding 22 mm in length. Twenty specimens from each of two hauls were measured and they fell into two size classes with means of 14.9 mm (n=22) and 20.6 mm (n=18).

Bottom duration varied from 14.95 to 26.17 h. The longest duration was for 53201#25, the deployment in which direct access to the bait was precluded. The number of individuals caught during this deployment appears to be about the same as that for the other two PAP deployments. It appears, therefore, that the feeding activity of amphipods enhances the attractiveness of the bait, presumably by increasing the rate of release of attractive molecules into the water

The results from these three hauls taken together with the single haul from the Goban Spur (see below) provide two surprises. First and foremost, the presence of *E. gryllus* at 2050 m (at the Goban Spur) was totally unexpected. The species is regarded as a coldwater stenotherm confined to water temperatures of less than 2-3^{o}C, and has not been recorded before at such a shallow depth in the Atlantic Ocean. Secondly, catches of this species from the three PAP hauls contained no animals longer than 22 mm. This contrasts with previous sampling at the same site which yielded specimens in the 40-50 mm size bracket, albeit at a different time of year. Although intuitively unlikely, this may be an indication of some sort of seasonality, either in breeding or in horizontal or vertical migration

MHT

AUDOS

Examination of the short test film strips developed aboard showed the presence of Macrourids (namely *Coryphaenoides* (*Nematonurus*) *armatus*) of which up to 6 were seen in a single frame. This agrees with previous findings that in the North Atlantic *C.*(*N.*) *armatus* is the dominant species below 2225 m. The film also showed the presence of deep-sea eels, probably *Histiobranchus bathybius*, with two individuals seen in one test strip. The photographic data will be used to give estimates of initial arrival rate, and mean staying

time at the bait. A reference scale suspended in view of the camera will also allow calculation of fish length frequencies.

Each deployment carried three ingestible code activated transponders wrapped in bait (5 deployments with Mackerel and 1 with squid). There is a general ecological interest in the response of organisms to a patchy food source. Tracking of fish in the deep-sea environment should contribute toward the knowledge of such behaviour. Brief onboard analysis of the tracking data suggests that over the six deployments about 7 fish tracks have been recorded by TRATEX. Possible further tracking data may be found with closer inspection of the data once ashore.

Station.	Depth (m)	Bait	Tracks	Comments
53201#3	4837	Mackerel	2	poss 3rd track
53201#13	4844	Mackerel		
53201#21	4844	Mackerel		
53201#30	4844	Mackerel		
53205#1	4845	Squid	1	
53205#8	4846	Mackerel	2	

This cruise was designed to gather biological data before the arrival of phytodetritus on the seafloor. The photographic and tracking data successfully obtained will be invaluable for comparison with similar work due to take place on RRS *Challenger* cruise 113. This will provide the opportunity to assess the influence of food availability on the behaviour of deep-sea fishes. The data will also be compared with that already gathered from the Pacific in an area with a different trophic status and also with other work planned for the Pacific.

AS, SA

REPORT OF GOBAN SPUR OPERATIONS

Moorings

Two moorings were successfully deployed and recovered during the period spent on the Goban Spur:

Gear	Station	Position		Depth (m)	Duration
AUDOS	53202#1	49° 45.9' N	13° 27.8' W	2672	24:13
DEMAR	53203#1	49° 43.4' N	13° 17.4' W	2048	20:38

AUDOS

The Goban Spur deployment (53202#1) was made at 2672 m where an interesting fish fauna was observed by AUDOS during RRS *Challenger* cruise 94. The test strip developed from the Goban Spur deployment, in which squid (*Loligo forbesii*) was used as bait for the first time with this rig, showed

Coryphaenoides (*Nematonurus*) *armatus* (3), *Antimora rostrata* (2) and an Ophidioid (*Spectrunculus grandis* ?).

AS, SA

DEMAR

The single deployment at 2048 m on the Goban Spur produced a much larger catch than at the PAP site - probably in excess of 2000 specimens - dominated by a species of *Hirondellea*. Also present were 100+ *E. gryllus* ranging up to 42 mm total length. This species is regarded as a coldwater stenotherm confined to water temperatures of less than 2-3^{o}C, and has not been recorded before at such a shallow depth in the Atlantic Ocean. (See also DEMAR observations from the main work site, above).

MHT

Echo-sounding

Two parallel echo-sounding transects (E1-E2, E3-E4) were completed in the region of a previous sledge deployment (RRS *Challenger* cruise 94) that had revealed significant populations of the xenophyophore *Syringammina* sp.. Data from the earlier cruise had suggested a possible relationship between xenophyophore density and comparatively small changes in topography. The bathymetric profiles obtained from the transects were used to guide subsequent WASP and box core operations.

BB

WASP

WASP was deployed (53204#1) along, approximately, the E1-E2 transect track, in a region of appropriate topography. WASP appeared to work well for a four hour period on the bottom, but on hauling at the end of the run all acoustic signals were lost. An appropriate quantity of film had run through the camera and test development of a short strip indicated correct operation.

DE, ALR, BB

Box core

The box core was deployed four times in the hope of recovering a specimen of the xenophyophore *Syringammina* sp.. Three deployments (53204#2, 3, 4) were made in a region of appropriate topography close to the E1-E2 transect track. The first was rather disturbed and discarded, the second and third were better, but contained no xenophyophores; the 0-10 cm sediment layer was removed from each and sieved over a 500 mm mesh and retained. The fourth deployment (53204#5) was made in a region of appropriate topography close to the E3-E4 transect track. No xenophyophore was caught and the sediment treated as above.

BB, MHT

ORNITHOLOGY

Ten-minute observations were undertaken during daylight hours throughout the cruise as and when other duties permitted. The ideal of eight observations per day was achieved only rarely. Excluding the first three days of the cruise, 125 observations were made in 24 days (range 2-10, mean 5.2). Casual sightings were recorded where appropriate.

Barry to 48°50'N 16°30'W (29 March-6 April, 24 observations)

Continuous gales from SW, W and NW account for the unprecedentedly long duration of this passage. Most observations were made during the latter part of the period. Eight species of seabird were recorded over the continental shelf, but only five beyond the shelf break. Fulmars (*Fulmarus glacialis*) and lesser black-backed gulls (*Larus fuscus graellsii*) were seen most frequently, with numbers of both species peaking over the outer shelf immediately prior to the night crossing of the shelf break. Over deeper water kittiwakes (*Rissa tridactyla*) and fulmars were recorded most frequently and in greatest numbers. Small numbers of great skuas (*Catharacta s. skua*) and Manx shearwaters (*Puffinus p. puffinus*) occurred in the Porcupine Seabight.

Porcupine Abyssal Plain, 48°50'N 16°30'W (7-16, 19-22 April, 14 days, 76 observations)

Winds during these periods were mostly light to moderate, from the W and NW initially, then from the NE and E during five days of high pressure, and finally variable but always with an element of north. Eleven species of seabird were recorded, but only kittiwakes were seen at more than half the observations. Some at least of these were repeat sightings of individuals which remained in the vicinity of the vessel for part or all of a day. Manx shearwaters, fulmars, lesser black-backed gulls and gannets were seen at 12-28% of observations. Trends noted were the increase in abundance and frequency of occurrence of fulmars in the second period, and the near total absence of adults among the gannets seen. Two little auks (*Plautus alle*) were sighted on 8 April.

Goban Spur (17-18 April, 2 days, 11 observations)

Light to moderate northerly winds prevailed during this period. Six species of seabird were seen, all previously recorded further west, but none were recorded at more than five observations. A flock of gannets around the ship on 18 April was multi-age in structure with a bias towards adults and fourth year birds, but also included one first year individual.

48°50'N 16°30'W to Barry (22-24 April, 3 days, 15 observations)

The passage started with strong easterly winds and finished with strong westerlies. Fulmars, gannets, lesser black-backed gulls and kittiwakes were present for at least half of the observations made. In the Celtic Sea, gannets were relatively abundant, and in many cases their flight tracks could be projected back to or

towards the major breeding colonies on Great Saltee or Grassholm. The vessel ran through a large feeding aggregation of Manx shearwaters some 30 nm west of Lundy.

In all, thirteen species of seabird were recorded during the cruise. Fulmar, Manx shearwater, gannet, great skua, lesser black-backed gull and kittiwake occurred fairly regularly, having been seen on most days of the cruise. However, the remaining seven species were not common, being recorded at most three times each. Despite the time of year, and perhaps because of the complete absence of S or SE winds, records of terrestrial passage migrants were very few. Overall, the cruise was unexceptional for birds, presenting a fairly typical picture of spring in the eastern North Atlantic Ocean.

MHT

TABLE 1

Multiple corer deployments on the Porcupine Abyssal Plain

Deployment	Station	Usable cores	Length (mm)	Comments
1	53201#4	8	310-355	Cloudy water, disturbed cores
2	53201#6	0	---	Complete failure
3	53201#7	11	260-350	Water cloudy, cores somewhat disturbed
4	53201#9	11	280-350	Water slightly cloudy, cores good
5	53201#11	12	300-320	Water clear, cores good, 1 core lost on deck
6	53201#14	12	N/A	Water clear, cores good
7	53201#17	12	290-330	Water cloudy, cores more-or-less disturbed
8	53201#22	12	270-320	Water mostly clear, cores good
9	53201#27	12	290-330, 160	Water clear, cores good
10	53201#31	12	290-345	Water clear, cores good
11	53205#5	(11)	260-360	Cores very disturbed and virtually useless
12	53205#6	11	300-320	Water mostly clear, cores good
13	53205#11	12	290-310	Water slightly cloudy, cores good
14	53205#13	0	---	Complete failure

TABLE 2

Fate of multiple corer samples from the Porcupine Abyssal Plain

[Note that some cores were used for more than one purpose]

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
53201#4	1	1	1	2	0	0	0	1	1	2	0	2	0	0
53201#6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53201#7	1	2	1	2	2	0	0	0	1	0	0	2	0	0
53201#9	1	2	1	2	2	0	0	0	1	0	0	0	0	0
53201#11	2	2	1	5	0	0	0	0	1	5	0	0	0	0
53201#14	0	0	0	1	0	3	0	1	0	0	0	2	5	0
53201#17	1	2	1	3	2	0	0	0	0	0	1	2	0	0
53201#22	1	2	1	3	1	0	0	1	1	0	0	2	0	0
53201#27	0	0	0	12	0	0	0	0	0	0	0	0	0	0
53201#31	0	0	0	0	0	0	0	0	0	8	0	0	0	12
53205#5	0	0	0	0	0	0	2	0	0	0	0	0	0	0
53205#6	1	2	1	3	2	0	1	0	0	0	0	2	0	0
53205#11	0	0	0	0	0	0	0	0	0	0	0	0	0	12
53205#13	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A Nematode studies (NHM)
B Metazoan meiofauna studies (Gent)
C Sediment chemistry (Gent)
D Complete cores for foraminiferal studies (IOSDL)
E Syringe subcores for foraminiferal studies (IOSDL)
F Foraminiferal incubation (IOSDL)
G Fixed for electron microscopy (IOSDL)
H Thymidine and leucine activity (Galway)
I DNA studies (Galway)
J Topwater for microbiology (Galway)
K Biological oxygen demand (Galway)
L Sediment chemistry (LUDO)
M Homogenisation (LUDO, NHM, Galway)
N Microbial incubations (LUDO, Galway)

GEAR ABBREVIATIONS USED IN STATION LIST

WASP	Wide angle survey photographic instrument
MLT CORER	Multiple corer
DEMAR	Bottom amphipod trap
BOX CORER	Spade box corer
BN1.5/C	Epibenthic sledge, coarse mesh
AUDOS	Aberdeen University Deep Ocean Submersible
OTSB14	Semi-balloon otter trawl
MS	Multisampler with 5 litre water bottle
BSNAP	Bathysnap, pop-up camera system
BSNACK	Bathysnack, baited pop-up camera system

STN.	DATE 1994	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
53201 # 1	6/ 4 7/ 4	48 51.5N 48 46.5N	16 41.2W 16 51.2W	OTSB14	4834-4836	2335-0315	DOORS LOCKED, POOR (SEMI-QUANT) CATCH Tow dist. 15.347 km.	
53201 # 2	7/ 4	48 46.9N	17 4.9W	MS	4797-4797	1107-	12 LITRES, 26 MAB, AND WIRE TEST	
53201 # 3	7/ 4 9/ 4	48 47.6N	16 20.5W	AUDOS	4837-4837	1733-0603	DESCENT 0.8M/S, ASCENT 0.8M/S	
53201 # 4	7/ 4	48 51.4N	16 30.7W	MLT.CORER	4845-4845	1922-	8/12 RATHER DISTURBED	
53201 # 5	8/ 4	48 55.8N 48 56.2N	16 43.5W 16 49.1W	BN1.5/C	4846-4849	0428-0754	HARD CONTACT, WEAK LINK PARTED, NET RIP Tow dist. 6.877 km.	
53201 # 6	9/ 4	48 51.3N	16 30.3W	MLT.CORER	4845-4845	1105-	COMPLETE FAILURE	
53201 # 7	9/ 4	48 51.5N	16 30.5W	MLT.CORER	4837-4837	1414-	11/12 RATHER DISTURBED	
52916 # 1	9/ 4	48 56.1N	16 22.6W	BSNAP	4844-4844	1655-	DEPLOYED 1546 8/9/1992. DHAN BUOY LOST	
53201 # 8	10/ 4	48 52.9N 48 54.4N	16 28.6W 16 32.9W	BN1.5/C	4846-4850	0117-0253	SMALL CATCH Tow dist. 5.941 km.	
53201 # 9	10/ 4	48 51.8N	16 29.7W	MLT.CORER	4845-4845	0950-	11/12 GOODISH	
53201 #10	10/ 4	48 51.4N	16 29.3W	BOX CORER	4845-4845	1350-	NO SAMPLE	
53201 #11	10/ 4	48 51.6N	16 29.9W	MLT.CORER	4847-4847	1713-	12/12 GOOD	

STN.	DATE 1994	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
53201 #12	11/ 4	48 56.6N 48 54.0N	16 21.5W 16 39.7W	OTSB14	4843-4850	0050-0450	DOORS LOCKED, NO SAMPLE Tow dist. 22.751 km.	
53201 #13	11/ 4 12/ 4	48 57.9N	16 37.5W	AUDOS	4845-4845	1234-0516	DESCENT 0.67 M/S, ASCENT 0.93 M/S	
53201 #14	11/ 4	48 51.5N	16 29.6W	MLT.CORER	4844-4844	1319-	12/12 PERFECT	
53201 #15	11/ 4	48 53.9N	16 31.0W	MS	10-4837	1641-1827	SAMPLES @ VARIOUS DEPTHS	
53201 #16	11/ 4 12/ 4	48 49.9N 48 49.5N	16 36.4W 16 40.2W	WASP	4847-4847	2101-0115	GOOD, C. 900 PHOTOS Tow dist. 4.707 km.	
53201 #17	12/ 4	48 51.1N	16 29.6W	MLT.CORER	4846-4846	0938-	12/12 ALL DISTURBED BAR NO. 7	
53201 #18	12/ 4 13/ 4	48 47.0N	16 34.2W	DEMAR	4846-4846	1411-0508	DESCENT 0.85 M/S, ASCENT 0.59 M/S	
53201 #19	12/ 4	48 51.5N	16 29.1W	BOX CORER	4846-4846	1616-	FAILURE	
53201 #20	12/ 4 13/ 4	48 50.5N 48 52.2N	16 28.7W 16 24.3W	BN1.5/C	4845-4847	2204-0007	NET TORN, NO CATCH Tow dist. 6.232 km.	
53201 #21	13/ 4 14/ 4	48 50.0N	16 23.1W	AUDOS	4844-4844	1129-0714	DESCENT 0.78 M/S, ASCENT 0.99 M/S	
53201 #22	13/ 4	48 51.1N	16 29.6W	MLT.CORER	4844-4844	1203-	12/12 GOOD	

STN.	DATE 1994	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
53201 #23	13/ 4	48 51.2N	16 29.8W	BOX CORER	4846-4846	1506-	A CORE, STANDARD IOS PROTOCOL	
53201 #24	13/ 4 14/ 4	48 53.7N 48 51.7N	16 36.8W 16 19.6W	OTSB14	4843-4846	2247-0256	LOTS OF SWIVELS; A CATCH Tow dist. 21.346 km.	
53201 #25	14/ 4 15/ 4	48 49.1N	16 31.0W	DEMAR	4844-4844	1215-1425	DESCENT 0.62 M/S, ASCENT 0.62 M/S	
53201 #26	14/ 4	48 51.0N	16 29.6W	BOX CORER	4844-4844	1351-	A CORE	
53201 #27	14/ 4	48 51.5N	16 29.8W	MLT.CORER	4845-4845	1657-	12/12 GOOD	
53201 #28	15/ 4	48 55.5N 48 52.2N	17 0.1W 16 51.9W	OTSB14	4845-4846	0200-0410	FAIR CATCH Tow dist. 11.742 km.	
53201 #29	15/ 4	48 51.4N	16 29.6W	BOX CORER	4844-4844	1059-	A CORE, WARP ACTIVATION RELEASE TRIGGER	
53201 #30	15/ 4 16/ 4	48 52.2N	16 25.4W	AUDOS	4844-4844	1512-1122	DESCENT 0.83 M/S, ASCENT 0.91 M/S	
53201 #31	15/ 4	48 51.7N	16 29.9W	MLT.CORER	4845-4845	1921-	12/12 PERFECT	
53201 #32	16/ 4	48 51.0N 48 55.7N	16 28.2W 16 23.5W	BN1.5/C	4843-4846	0141-0445	NET TORN, NO CATCH Tow dist. 10.431 km.	
53201 #33	16/ 4	48 51.1N	16 29.7W	BOX CORER	4845-4845	0936-0949	NO SAMPLE, PROBABLE PRE-TRIGGER	

STN.	DATE 1994	POSITION LAT.	LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
53201 #34	16/ 4 19/ 4	48 53.3N	16 19.6W	BSNACK	4842-4842	1607-0951	FILM JAM; 8-9 M RUN	
53201 #35	16/ 4	48 54.0N	16 20.4W	MS	150- 150	1622-		
53202 # 1	17/ 4 18/ 4	49 45.9N	13 27.8W	AUDOS	2672-2672	1828-1841	SQUID BAITED; DESCENT 0.94 M/S, ASCENT	
53203 # 1	17/ 4 18/ 4	49 43.4N	13 17.4W	DEMAR	2048-2048	1954-1632	DESCENT 0.88 M/S, ASCENT 0.59 M/S	
53204 # 1	17/ 4 18/ 4	49 36.5N 49 37.2N	13 7.6W 13 12.0W	WASP	1720-1734	2332-0335	GOOD RUN Tow dist. 5.455 km.	
53204 # 2	18/ 4	49 36.4N	13 8.2W	BOX CORER	1720-1720	0550-	DISTURBED, NOT SIEVED	
53204 # 3	18/ 4	49 36.3N	13 8.5W	BOX CORER	1723-1723	0829-	OK, 0-10 CM ON 500 UM SIEVE ONLY	
53204 # 4	18/ 4	49 36.1N	13 8.2W	BOX CORER	1729-1729	1131-	GOOD, 0-10 CM ON 500 UM SIEVE ONLY	
53204 # 5	18/ 4	49 38.5N	13 8.4W	BOX CORER	1786-1786	1425-	GOOD, 0-10 CM ON 500 UM SIEVE ONLY	
53205 # 1	19/ 4 20/ 4	48 52.9N	16 24.1W	AUDOS	4845-4845	1423-0733	DESCENT 0.73 M/S, ASCENT 0.99 M/S	
53205 # 2	19/ 4	48 51.0N	16 30.7W	BOX CORER	4845-4845	1508-	GOOD DEEP CORE	

STN.	DATE 1994	POSITION LAT.	LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
53205 # 3	19/ 4 20/ 4	48 54.6N 48 50.3N	16 47.4W 16 35.9W	OTSB14	4839-4850	2350-0305	GOOD CATCH Tow dist. 16.166 km.	
53205 # 4	20/ 4 21/ 4	48 51.2N	16 26.4W	DEMAR	4844-4844	1129-1013	DESCENT 1.07 M/S, ASCENT 0.63 M/S	
53205 # 5	20/ 4	48 51.1N	16 29.7W	MLT.CORER	4844-4844	1251-	11/12 VERY DISTURBED	
53205 # 6	20/ 4	48 51.0N	16 29.9W	MLT.CORER	4844-4844	1612-	12/12 GOOD	
53205 # 7	20/ 4	48 51.6N	16 29.8W	BOX CORER	4845-4845	1944-	NO SAMPLE	
53205 # 8	20/ 4 21/ 4	48 52.0N	16 32.1W	AUDOS	4846-4846	2309-1725	DESCENT 0.81 M/S, ASCENT 0.98 M/S	
53205 # 9	21/ 4	48 51.7N 48 51.6N	16 31.8W 16 31.5W	WASP	4847-4847	0001-0031	ABORTED, TRACES LOST AFTER 30 MINS Tow dist. 0.413 km.	
53205 #10	21/ 4	48 51.2N 48 51.3N	16 30.5W 16 30.3W	WASP	4847-4847	0336-0351	ABORTED, TRACES LOST Tow dist. 0.308 km.	
53205 #11	21/ 4	48 51.4N	16 29.6W	MLT.CORER	4844-4844	0747-	12/12 GOOD	
53205 #12	21/ 4	48 53.2N	16 30.8W	MS	4800-4800	1549-	SAMPLE 44 MAB	
53205 #13	22/ 4	48 51.0N	16 29.5W	MLT.CORER	4845-4845	0143-	COMPLETE FAILURE	
53205 #14	22/ 4	48 51.7N	16 30.2W	BSNAP	4844-4844	1013-	PICK UP CR 113?	

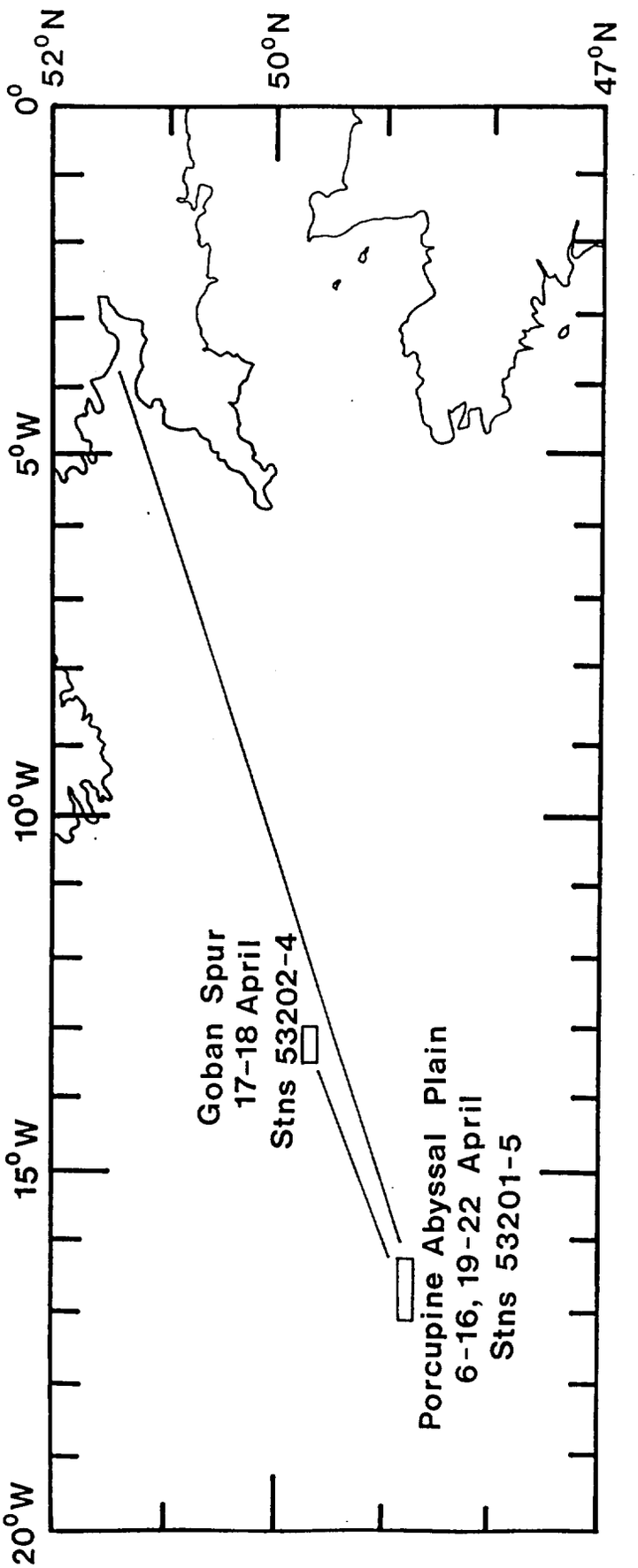

Figure 1. Track chart RRS *Challenger* cruise 111, 29 March - 25 April 1994

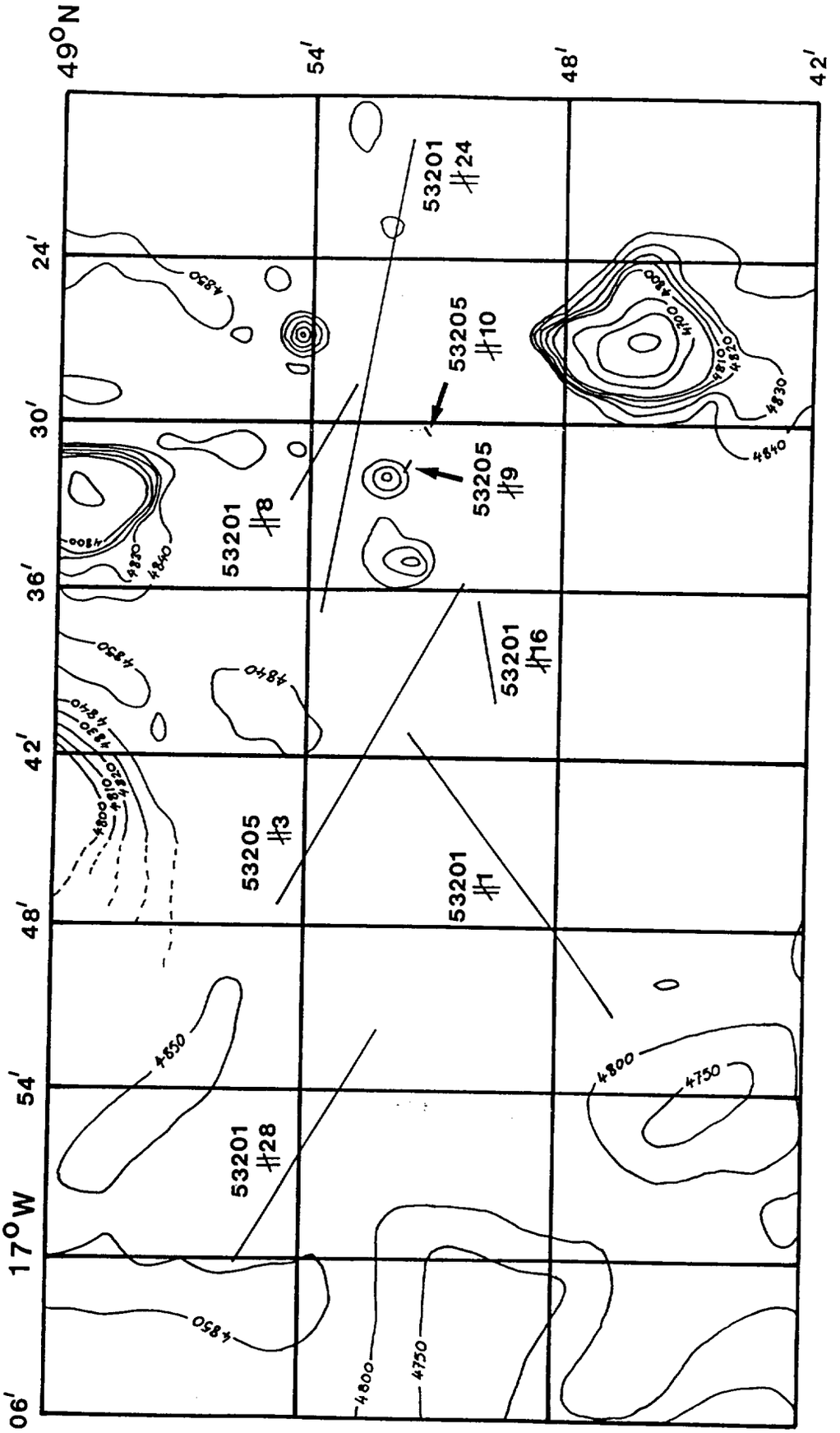

Figure 2. Towed gear tracks (stations 53201 and 53205)

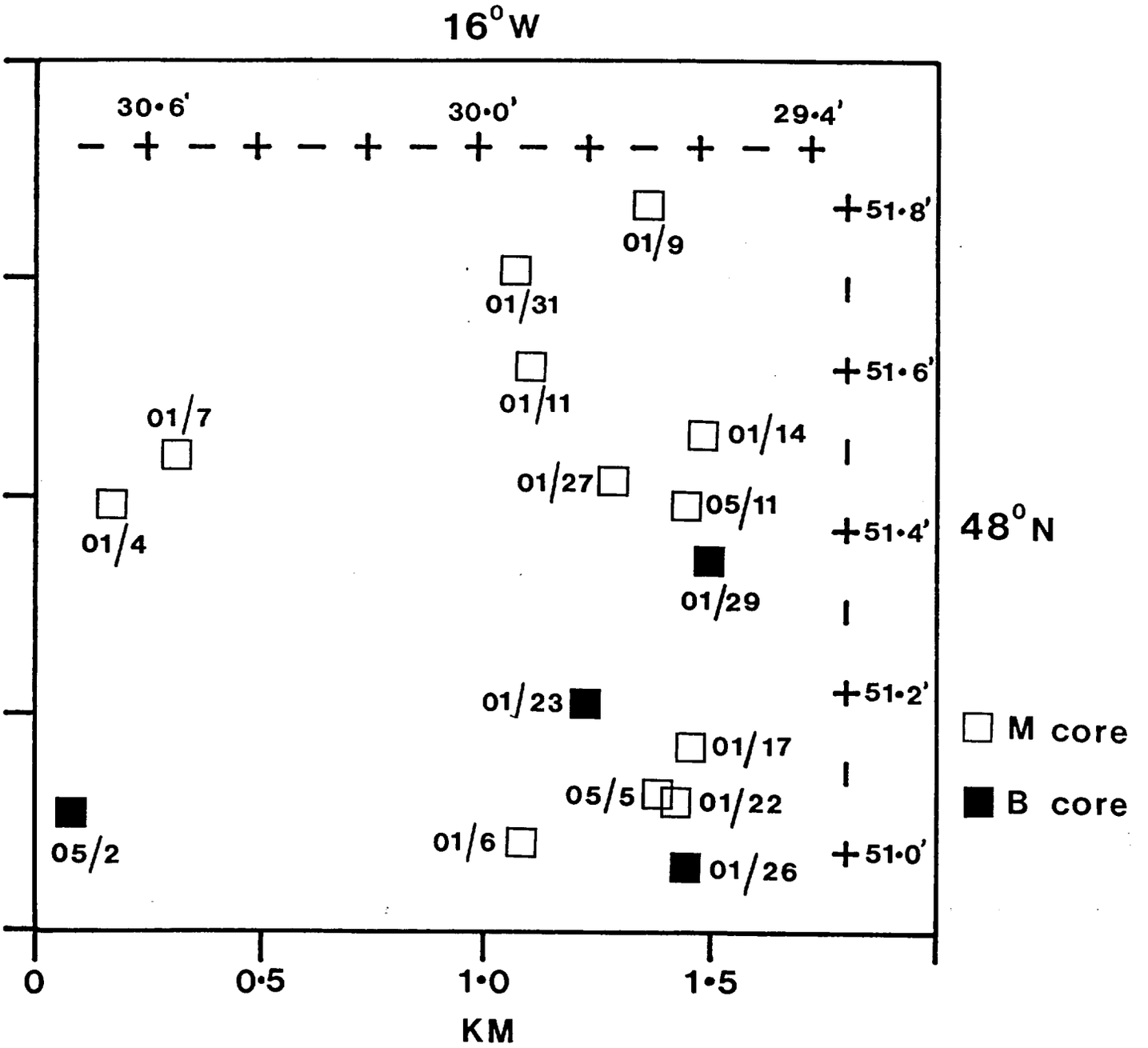

Figure 3. Multicore and box core positions chart (stations 53201 and 53205)

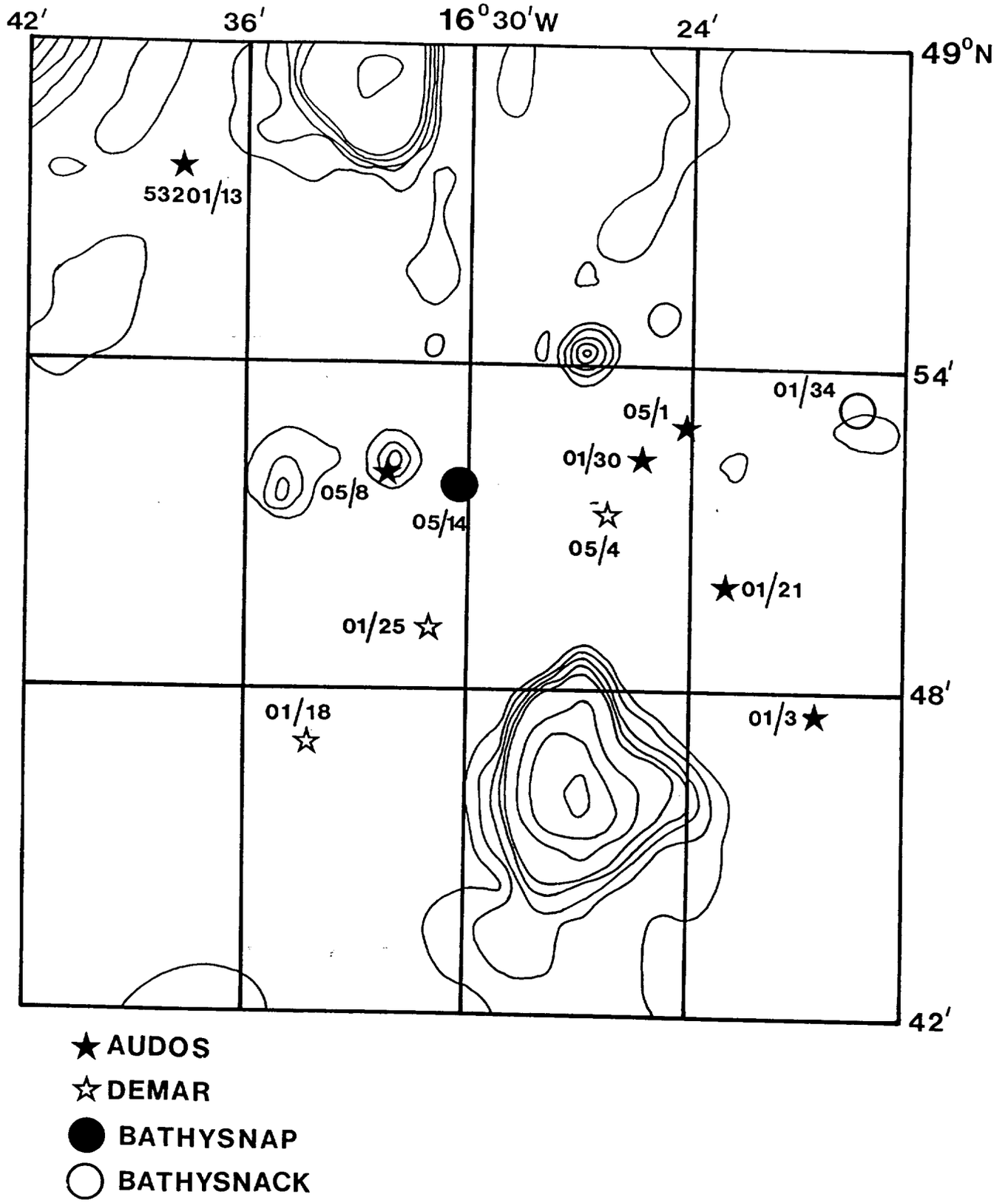

Figure 4. Moorings positions chart (stations 53201 and 53205)

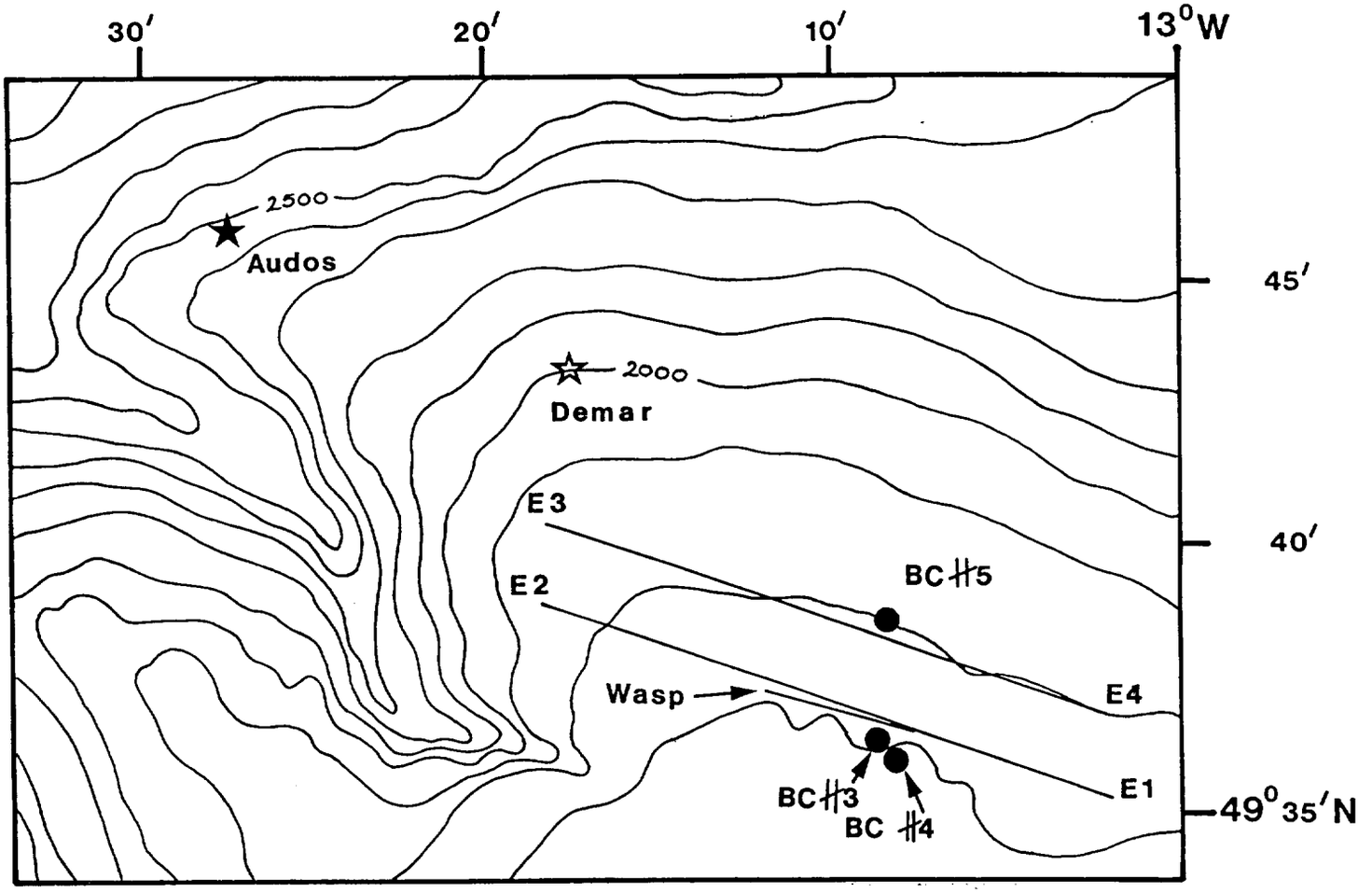

Figure 5. Goban Spur operations chart. E1-E2, E3-E4 - echosounding runs (see fig. 6)

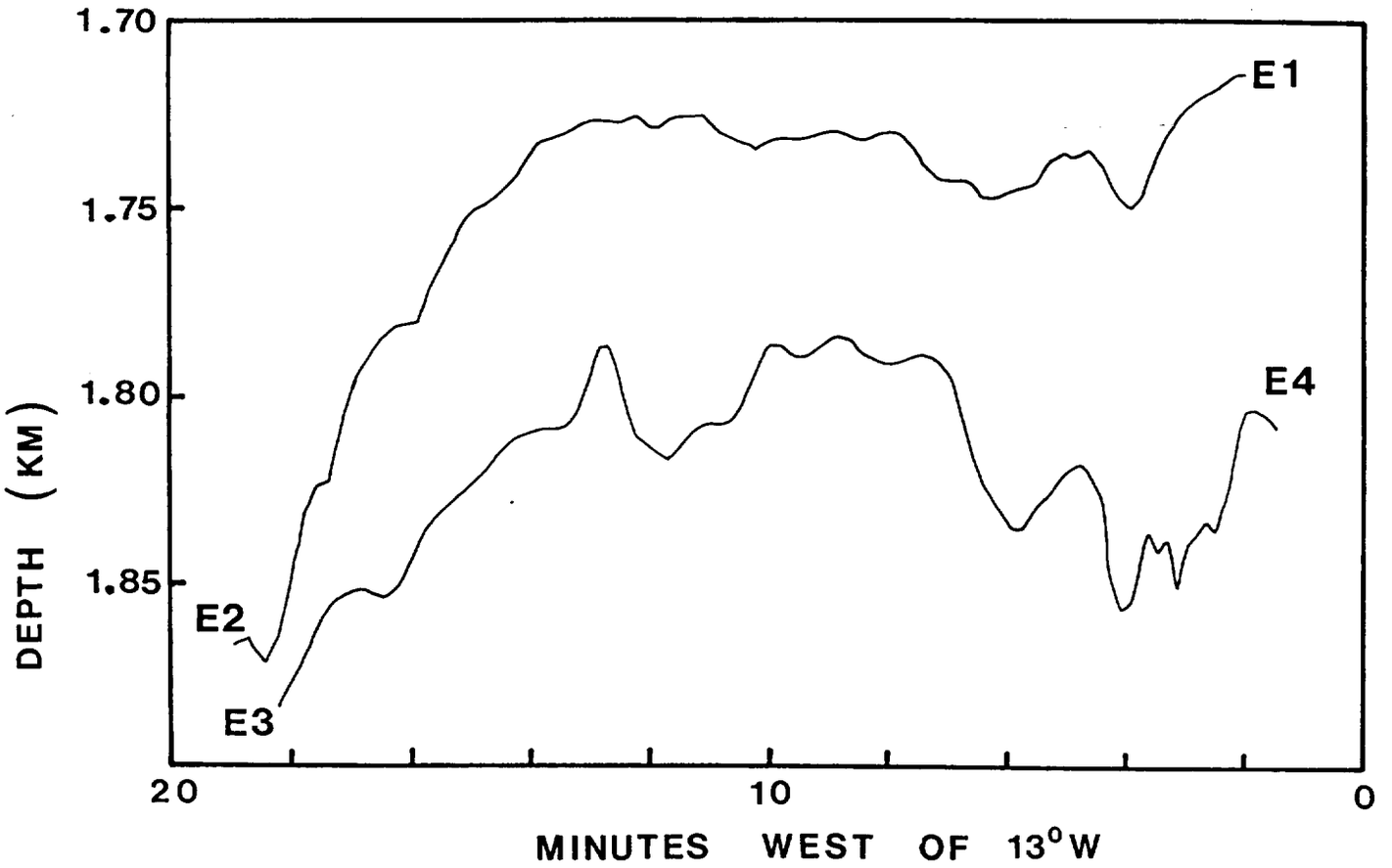

Figure 6. Goban Spur bathymetric profiles