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RRS CHALLENGER

CRUISE 6A/85

13 - 28 JUNE 1985

BENTHIC BIOLOGY OF THE PORCUPINE SEABIGHT

CRUISE REPORT NO. 178

1986

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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WORMLEY

RRS CHALLENGER
Cruise 6A/85
(IOS Cruise 522)
13 - 28 June 1985

Benthic biology of the Porcupine Seabight

Principal Scientist

M.H. Thurston

CRUISE REPORT NO. 178

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ITINERARY

Depart Falmouth 0720GMT 13 June 1985
Arrive Falmouth 0700GMT 28 June 1985

SCIENTIFIC PERSONNEL

D.S.M. Billett	IOS Wormley
N.G. Cartwright	" "
E.P. Collins	" "
A.J. Gooday	" "
R. Harvey	SMBA, Dunstaffnage
R.S. Lampitt	IOS Wormley
A. Muirhead	University College, Swansea
G.R.J. Phillips	IOS Wormley
R.C.T. Raine	University College, Galway
D. Roberts	Queens University, Belfast
K.H. Scrimshaw	IOS Wormley
M.H. Thurston	" " (Principal Scientist)

SHIPS PERSONNEL

P. MacDermott	Master
S. Jackson	Chief Officer
M. Putman	Second Officer
R. Chamberlain	Third Officer
C. Harman	Chief Engineer
1. Shufflebotham	Second Engineer
B. Entwhistle	Third Engineer
A. Thomas	Fourth Engineer
M. Trevaskis	C.P.O.
S. Coppin	Seaman
A. Dalby	"
R. Freeman	"
M. McElwee	"
M. Owen	"
P. Belchamber	Chief Cook
S. Jenkinson	Second Cook
J. McKeown	Second Steward
J. Bundzeineks	Steward
W. Office	Steward
C. Bridge	Motorman
J. O'Brien	Motorman
A. Smale	Motorman

PREAMBLE

Both legs of Challenger Cruise 6/85 had been planned as the British contribution to the Anglo-French Diving Campaign "CYAPORC". Challenger was seen as having two functions. Firstly, she was to support, the submersible Cyana and mother ship Le Suroit, providing laboratory and personnel accommodation for British teams of geologists, biologists and physiologists concerned with experimental and observational work. Although attendance on Cyana and Le Suroit would impose considerable restraints on the freedom of movement of Challenger, a sampling programme independent of the diving operations was planned. About half of the available working time would be devoted to diving support and half to the independent programme of biological and geological sampling.

Five weeks prior to the start of the cruise news was received to the effect that Cyana had failed safety checks and that the Diving Campaign could no longer take place. As a result, changes were made at the last minute to programme and personnel. Geological and physiological inputs to the first leg of the month-long cruise 6 were cancelled and a programme based solely on the IOS Benthic Ecosystems Group and collaborators was instigated.

OBJECTIVES

1. To obtain values for the sediment community oxygen consumption using cores obtained by, and incubated in, the SMBA multiple corer, at depths of 2000m and 4800m.

2. To obtain a series of SMBA multiple corer samples within the depth range 1300-4800m for chemical and biological studies of phytodetritus.

3. To obtain a series of SMBA multiple corer samples within the depth range 500-4800m for diversity and in-sediment distribution of foraminiferans, xenophyophores, komokiaceans and other meiofaunal taxa.

4. To obtain a series of USNEL box corer samples, for macrofaunal biomass studies, between 500 and 4800m.

5. To obtain a series of epibenthic sledge hauls in continuation of investigations of mega- and macrofaunal distributions and diversity. These samples to be taken in the depth range 500-4800m.

6. To conduct a phototransect between 800m and 1600m in the northwestern area of the Porcupine Seabight to elucidate further the limits and structure of the Pheronema population.

7. From epibenthic sledge samples, to obtain a comprehensive collection of holothurian tentacles for studies of the functional morphology of these organs.

8. From epibenthic sledge samples, to obtain a comprehensive collection of holothurian gonads to further the study of aspects of the reproductive cycle.

9. To deploy Bathysnap in order to obtain information on the decay rate of holothurian faceal casts.

10. To make test deployments of a new mark/recapture amphipod trap designed for operation by submersible.

11. To investigate the proposed Anglo-French Diving Campaign site at 49°25'N, 12°55'W on the Goban Spu

NARRATIVE

Some of the fuel delivered to the ship was of the wrong grade, being too viscous. In order to overcome this problem, the use of heating coils will be necessary throughout the voyage. These coils require extra water so it was necessary to top up all water tanks. This task was completed at the first opportunity on Thursday morning and Challenger sailed at 0720GMT/13.

The PES fish was streamed at 0715/14 and echosounding commenced beyond the shelf break. Light, mostly northwesterly winds were experienced during passage to the Seabight.

A position close to 51°N, 13°W in about 2050m of water was planned to be a major work site during the cruise. This position was reached at 2012/14 when a wire test of electronics and buoyancy spheres was carried out. Station 52201 commenced with a box corer deployment starting at 2223/14. As a preliminary to the first benthic community oxygen demand deployment, two multiple corer drops were made to provide baseline data. Both were successful, the first providing eleven cores and the second a full complement of twelve. The long deployment (52201#4) commenced at 0437/15. The corer penetrated the bottom at 0513 and then was raised 60m at which depth it was held for eighteen hours. Ten intact cores were present when the corer was recovered at 2348/15.

During the long hang, the work boat was deployed in order to test radio direction finding equipment purchased to aid location at the surface of free-fall instrument packages. The trials were disappointing. At a little more than one mile, the signal was lost altogether, and transmitter and receiver needed to be appreciably closer than this to achieve any sensible direction finding capability.

The vessel now moved to the north, into shallower water, where another box corer sample was taken (Stn 52202#1) in 1360m of water. The corer with a good intact core was recovered at 0418/16.

Soundings in the region of 1500m on 13°W were sought for the first deployment on this cruise of the epibenthic sledge. This haul (52203#1) which sampled at 1531-1541m was completed at 0710/16. The catch provided good quantities of holothurians which in turn provided material for tentacle and gonad studies.

A sledge sample from within the Pheronema (sponge) patch was required, so Challenger made soundings of about 1300m and the sledge was deployed again (52204#1). Recovery was achieved at 1159/16, providing easily handleable catches from close to the lower depth limit of these sponges.

Three multiple corer drops (52205#1-#3) were made close to the previous sledge run to augment the material already available for meiofaunal and phytodetritus studies at this depth. Each haul produced at least ten good cores. The cores were not as long as might have been expected, but were

quite long enough.

On completion of Stn 52205, Challenger proceeded towards the northwest and a box corer drop was made at 986m (Stn 52206#1). On recovery at 1916/16, it was found that most of the supernatant water had been lost, and that one of the vent doors had failed to close. The door problem had been caused by a displaced spring, a failure that was remedied prior to redeployment. The second haul was successful despite a rather lumpy sea, and was completed at 2047/16.

Passage towards the 500m station (52207#1) was interrupted by a boiler tube failure and the necessity to switch to the other boiler. By the time the required position had been reached, sea conditions raised by a stiff westerly wind were such that neither the box corer nor the multiple corer would stand much chance of obtaining samples. The ship was hove to on station at 0315/17 and remained so for five hours during which wind and sea moderated. At 0810/17 the multiple corer was deployed at 51°32'N, 13°53'W. This and the subsequent dip were both successful, each obtaining twelve cores. This station was completed by a box corer drop that was all too successful. Penetration almost to the full depth of the box was achieved, and the sample took nine hours to sieve out.

A phototransect, using the epibenthic sledge in the photographic mode, i.e. without the three benthic nets, was planned. The intention of this transect was to elucidate further the faunal boundaries, both horizontal and vertical, at depths of 800-1600m, in the northwestern area of the Seabight. With Force 4 winds from the WNW, the transect had to be worked from the deep end upwards. This was unfortunate, as it involved more steaming time than would have the reverse course. The first sledge haul (52208#1) was shot at 1520/17 and reached bottom at a depth of 1585m. After $3\frac{1}{2}$ hours on the bottom, various of the monitor traces began to behave oddly, and the gear was recovered. The shallowest depth fished was 1349m. The second haul (52209#1) arrived on the bottom at 2249/17 in 1433m of water. despite having changed monitors for the second haul, similar irregularities became apparent in the monitor traces, leaving no alternative but to recover the sledge. Hauling started at 0504/18 in 1033m depth. The sledge was recovered at 0550/18. The third haul (52210#1) was deployed at 0651/18 and bottomed at a depth of 1058m. A gradual wind

change during the haul resulted in more leeway than was desirable and the necessity to terminate the haul at 861m depth. The sledge was back inboard by 1241/18.

On completion of the phototransect Challenger headed south and east into deeper water. The nets were reattached to the sledge, and a conventional haul started at 1538/18 (Stn. 52211#1). This was the last station which had been planned prior to our return to the 2000m station occupied at the beginning of the cruise. Although some time had been lost, most of the hauls written in the original plan were completed.

Work at 2000m (Stn 52212) on this visit, was to consist entirely of multiple corer casts. Although the wind was not particularly strong, an awkwardly short sea and underlying swell made Challenger rather lively. As a result no cores were obtained from the first drop, shot at 2007/18 and only seven in each of the next two. Sea conditions were improving gradually, and although far from perfect, proved far less of a nuisance than a few hours previously. Ten cores were obtained from the fourth deployment. This deployment was marred by the loss of a core retention arm, presumably at pull-out. The arm fractured at the junction of the plunger rod and the square-section rod guide. Unfortunately no spares were available, so all subsequent hauls were made with only eleven funcitonal tubes. Deployment five was delayed for three hours while slack turns were removed from the main winch drum. The highly twisted state of the outboard end of the warp was such that it was necessary to pay out some hundreds of metres and stream it astern. Although the weather forecast was not good, the improved 'striking rate' - ten cores each from #4 and #5 - gave sufficient encouragement to go for the second 18 hour respirometry hang. Accordingly, 52212#6 commenced at 0853/19. Winds remained moderate and variable during the day, but backed southerly and started to rise after sunset. The hang was terminated after 15 hours 20 minutes in the hope that one last multiple corer drop could be completed before conditions became too bad. The early termination of #6 was a calculated risk, although the results obtained from the first hang suggested that the full 18 hours was not necessary to produce significant results. Only seven intact cores were obtained but subsequent titrations showed the decision to be the correct one. The last drop, #7, was completed in marginal and deteriorating conditions at 0335/20, whereupon course was set to the south.

The epibenthic sledge is a more robust piece of gear than either the box corer or multiple corer in terms of deployment and recovery, and ability to take samples in poor weather conditions. On arrival at 50°35'N, 13°02'W, conditions were such that successful sampling with the box corer was unlikley, so the sledge was deployed. A successful haul was completed at 1137/20.

Weather conditions were such that the chances of successful deployments with either of the corers were poor. Accordingly Challenger headed for the deep transponder station (49°50'N, 14°10'W) in 4080m of water. The sledge was shot at 2225/20 in strongish westerly winds. Three hours later, soon after the net reached the bottom, it became apparent that the wind had veered and was rising rapidly. The haul was aborted at 0154/21 and brought to the surface as quickly as possible. Wind speed had risen to 40 knots and the ship was beginning to pitch heavily. Four people with considerable experience at handling the sledge together with the Mate and seamen of the night watch brought the sledge inboard with remarkably little trouble at 0440/21. Despite the ease with which the sledge was recovered, we must consider ourselves lucky - working in such conditions could never become routine.

Winds continued at Force 8 to 9 for most of the day - Midsummers Day, incidentally - and only began to drop after sunset. 'Flaming June' is taking on other connotations! Challenger made slow progress into the wind and sea, and during the 0400-0800 watch on 22 June, was able to steer for the position of the proposed 4500m station (52215#1). The sledge was shot at 0731/22 and recovered at 1232/22.

By now, much time had been lost, and it was clear that an appreciable number of planned hauls would have to abandoned. Although the weather forecasts were not good it was considered imperative to attempt sampling at 4800m. Accordingly, Challenger headed towards a position of 48°50'N, 16°30'W, arriving at 2200/22. The initial attempt at wire-testing the Cyana amphipod trap and buoyancy spheres was aborted with barely 100m of wire out when it became obvious that more weight was required on the rig. The second, successful, test ended at 0314/23.

The box corer was deployed at 0357/23. Loss of pinger signals when near the bottom resulted in an excess of wire being paid out. As a result recovery was hindered by a loop of main warp round the pinger bracket. No sample was obtained.

During the morning we learnt of the disaster which overtook the Air India Flight 182. The crash position, 51°02'N, 12°46'W, is less than ten miles east of station 52212. Currently we are two hundred miles from the crash so there is no question of our joining the search for bodies and wreckage.

All systems on the amphipod trap had functioned satisfactorily on the wire test, so now we came to the moment of truth - a free fall deployment (52216#2). As we have no submersible, we cannot go through the whole experimental procedure. On this deployment only trap 1 was baited. The trap rig was released at 09ed. The
trap rig was released at 0912/23 and reached the bottom in 4805m of water in just 100 minutes. In order to achieve two deployments at this station, the first drop had to be a short one. Ballast was dropped at 1528/23. The ascent rate was slow, allowing plenty of tracking time. As a consequence the rig surfaced barely 100m away from the ship and was inboard at 1842/23, less than twenty minutes after reaching the surface.

Once the trap had been got away the multiple corer was deployed; going out at 0940/23 and being recovered at 1218/23. A second drop (52216#4) was completed before the amphipod trap was released. Eight and ten cores were recovered but a core arm was lost during the second drop.

Although not totally suitable the present weather and the forecast suggested that a multiple corer haul should be attempted sooner rather than later. The amphipod trap was turned round as quickly as posisble and redeployed at 2025/23. The multiple corer followed at 2046/23 (52216#6). During the eighteen hour hang, the wind dropped and turned light and variable. Recovery was effected at 1733/24. The investment of time in a hang of this nature is considerable, and there is always a worry that few or even no cores at all will have survived more than eighteen hours of continuous motion. Once again we experienced that moment of euphoria and relief - this time there were ten intact cores.

Light winds and low sea state gave better working conditions than had been experienced so far. For the first time during the cruise we were able to launch gear without needing handling lines. A successful box corer drop was made (52216#7), followed by an epibenthic sledge haul ending at 0726/25. The sledge deployment was delayed when the main warp escaped from the spooling sheave yet again.

The amphipod trap was released at 0911/25 and was inboard only sixteen minutes after reaching the surface. With over fifty hours steaming to Falmouth from the present position and another station to be worked, time was running out rapidly. A final multiple corer drop (52216#9) was completed at 1401/25, whereupon the ships head was turned towards the Goban Spur on the south side of the Seabight.

A station at 1500m on the Goban Spur had been planned as a dive site for Cyana although biologically there were some doubts as to its suitability. Should the Anglo-French Diving Campaign be resurrected, more information about this potential dive site would be valuable.

The principal scientist managed to get his timing right at last: arrival on station at 49°25'N, 12°55'W allowed a comfortable breakfast before turning aft to work gear. Bathysnap (52217#1) and the amphipod trap (52217#2) were deployed in quick succession, the former to be recovered on some later cruise, and the latter as the last act of the present one. Challenger then steamed off a short distance and the epibenthic sledge was put into the water at 0919/26. This was followed by two multiple corer drops (52218#2-3). The amphipod trap was released at 1540/26, surfaced at 1616/26 and was inboard only thirteen minutes later. A course towards Falmouth was set at 1630/26.

Light northwesterly breezes and a low following swell allowed Challenger to make a good speed and gave a very comfortable ride. On June 27 we experienced the excitement of a rendevous at sea. RVS, Barry have two box corers, one old and one new, but only one box cradle. Although the box of the corer can be made accessible for removal of the sample without a cradle, it is much more difficult, and in any sort of a sea, a potentially hazardous operation. Dr. Richard Warwick of IMER sailed from Falmouth on

June 26 on the Frederick Russell with the intention of box coring in the Seabight. We were able to transfer the box corer cradle to Dr. Warwick via the inflatable from the Frederick Russell at 0830/27. This transfer completed we resumed passage towards Falmouth. The pilot was taken aboard at 0615/28, and Challenger berthed at 0700/28.

All of the objectives of the cruise were attained to a large degree. The weather was less kind than might have been expected for the time of year. As a consequence time was lost, and the programmes proposed for epibenthic sledge, box corer, multiple corer and amphipod trap all suffered to a greater or lesser extent, with two or more hauls not being attempted. This failing aside, the cruise was a considerable success. The scientific party worked hard and long, and I am grateful to them for their efforts. However, all this work would have been of little avail had it not been for the unstinting help given to us by Captain MacDermott and his crew. Our thanks to them all.

Michael H. Thurston
28 June 1985

MONITORING SYSTEMS

SHIPS SYSTEMS

10kHz Precision Echo Sounder system. The hull and towed fish transducers were both in good contion. The deck unit was poor but usable - all electronic cards showed considerable evidence of corrosion resulting from prolonged exposure to sea air. The best system performance was achieved by transmitting on hull transducers and receiving on the fish 8 elements through the IOS command system deck unit into the auxillary (marking amplifier) input. All monitoring work was carried out through this command system deck unit. With standard technique, echo sounding below 2000m was difficult with any combination of the available receiver and filter cards. The IOS PES deck unit had been dropped and damaged during loading but was carried to provide otherwise unobtainable spares.

Main winch monitors. All monitors performed well apart from some

disparities in metres of wire out readings and the usual ink problems with the Servoscribe.

IOS SYSTEMS

10 kHz wire mounted acoustic beacons. Acoustic beacons were used with all SMBA multiple corer and box corer deployments. Good bottom echos were achieved on all deployments including the deepest at 4800m, but the age of one unit was exposed by rough treatment. A wire clamp assembly was damaged when caught in a bight of the main warp during a box corer deployment in somewhat inauspicious weather conditions.

Benthic sled monitors. Both units contained completely new electronics and worked well throughout the cruise. All three rechargeable battery packs gave problems. The two oldest had to be combined because 19 of the 54 cells had failed, as had three of the newer pack.

Bathysnap releases. Two units were overhauled completely and wire tested to cover the proposed Bathysnap deployment. Both performed successfully and unit CR 2381 was laid with the bathysnap rig in about 1500m on the Goban Spur. Its operation characteristics are - Period 094 - location and time-out mode 314 to 427, release bandwidth 235 to 247 fired two puffers on wire test at 1900m with 9 ten second bursts of 241Hz.

'Novatech' radio location system. This was tested during one of the long multicorer 'hangs'. The directional trials were later found to be invalid due to a wrongly spaced antenna system which gave no obvious directional properties. A more serious limitation would seem to be that of sensitivity i.e. obtainable range, on which the wrong antenna spacing would have relatively little effect. The range limit appears to be under one nautical mile which offers no advantage over other location techniques available to us.

Amphipod trap control acoustics. This acoustic control unit was produced by modifying and considerably adding to a standard shallow water command release 200 sea unit for trials in the lochs around SMBA Oban. The unit was first modified to a deep ocean and two year life cycle capability as is normal for deep deployments. The pump switching requirement was in addition

to the release function. To retain the security of the release operation the pump operation had to be on the 'location' channel. In order to be controllable and to cope with the problems of the acoustic environment, a fairly long time sequence was used. A single pump command occupies four and a half minutes from initial reception. During the trials this led to considerable confusion among untutored operators. The pump battery voltage and flow meter were monitored using a pulse represention of a seven bit binary code. The pump and flowmeter had not been tested in deep ocean before so a preliminary wire test was carried out to 4500m. In addition this was used to confirm the operating sequences, check the monitor circuits and test the recovery circuits. All tests were successful as were two deployments to 4800m and one to 1500m. The binary monitoring signals will be a very useful technique for the future. The first deployment was slightly marred by the package not lifting off the sea-bed until one minute after release activation - it should be instantaneous. This has occurred before with other rigs and most likely causes eliminated. In this case it is possible that stiffness and friction in the PVC moving parts in the retractor was the cause. For the two subsequent deployments the suspect areas were heavily greased and instantaneous lift off was achieved each time.

G.R.J. Phillips

MULTIPLE CORER

With the exception of relatively minor problems detailed below, the corer performed well, collecting a total of 205 cores during 21 deployments. On one occasion (52212#1) the corer apparently reached the bottom (as indicated by the tension meter), but failed to collect a sample. In all probability, this failure was due either to the heavy swell or to the fact that the wire was streamed well to the port side during the drop. Otherwise, the number of cores obtained ranged from 7-12. Those taken at 2000m (52201, 52212) 1400m (52205), and 1500m (52218) were generally rather short. Longer cores (25-36cm) were taken at 4800m (52218) in soft, reddish-brown clay and in silty sand at 500m (52207). Three incubation experiments, during which the gear was suspended at around 50m above the seafloor for up to 18hrs, were performed successfully at 52201#4 (2052m), 52212#6 (2043m) and 52216#6 (4841m).

A number of minor problems dogged the corer on this cruise. The special spanner used for tightening the large coring head bolt was missing and hence the head repeatedly became loose. This was a particular nuisance because the bolt invariably shifted and had to be relocated, a process which involved lifting the head with the crane in order to take the weight off the bolt. Oxygen measurements from the tube in position 5 were consistently higher than normal and this tube also often failed to hold its sample. It would appear therefore, that the top valve no longer seals properly. Several of the bolts which attach the core catcher units to the tube rings have either lost their thread or disappeared completely. This necessitated some first aid repairs using insulating tape. One complete core catcher was lost during a deployment and another was rendered useless when the upper rod snapped off on deck.

MULTIPLE CORER STATIONS

Station	Depth (m)	No of cores	Core height (cm)
52201#2	2052	12	18-20
52201#3	2049	12	16-21
52201#4	2052	10	11-15
52205#1	1388	12	no data
52205#2	1420	12	17-21
52205#3	1374	10	no data
52207#1	498	12	26-34
52207#2	491	12	24-37
52212#1	2041	No sample	-
52212#2	2043	7	8-11
52212#3	2049	8	8-11
52212#4	2057	10	15-18
52212#5	2053	10	no data
52212#6	2043	7	no data
52212#7	2046	11	10-19
52216#3	4840	8	15-26
52216#4	4841	10	20-30
52216#6	4841	10	21-36
52216#9	4837	10	24-31
52218#2	1432	11	no data
52218#3	1427	11	16-18

A.J. Gooday

SPADE BOX CORER

Seven deployments were made with the USNEL-type 0.25m² spade box corer. Cores were obtained from 500, 1000, 1350, 2000 and 4800m. Successful sampling at 1000 and 4800m was attained only at the second attempt. Poor sea conditions prevented a full transect being worked and may well have been responsible for the initial failures at 1000 and 4800m, probably causing premature triggering of the release mechanism.

At the 500m station the corer penetrated to a record depth of 53cm in silty sand. At the other stations, the cores showed a typical two layered structure with light brown surface layer around 10cm thick overlying a denser grey ooze as seen at stations in the Rockall Trough. An excellent core of sediment with a surprisingly uniform structure was obtained at 4800m. Despite the presence of numerous burrows in this core, on washing there appeared to be very little in the way of macrofauna.

These initial cores from this area will permit estimates of biomass and in addition provide specimens of fauna not captured in numbers with other samplers.

This record of successful deployments was not achieved without some problems. These were overcome by a combination of IOS and ship-side technical support and good fortune. Anti-seize-grease to facilitate dismantling the corer for core extraction had been requested, but none was provided. Fortunately some was located on board. Recovery poles and lines were requested but these too did not arrive. Eventually two were located on board, and refurbished by ship-side staff. No spare parts were sent with the corer. The following items are prone to failure, damage and/or loss and should be duplicated.

(a) all of the nuts, bolts and washers which have to be removed.
Four bolts securing the box locating bar to the corer.
Four bolts securing the removable front section of the box.
Twelve bolts securing the front of the box to the remainder.
Ten bolts securing the sliding drain panel to the box.

(b) The springs which close the four vent flaps subsequent to sampling.

(c) The stainless steel wires linking the vent flaps with the triggering mechanism.

The vent flap linkages failed during the fourth deployment and had to be replaced. No suitable material was available and the welding rods used were not satisfactory, requiring attention after every subsequent deployment. An alternative method for flap closure would be advantageous and devised, would eliminate the weakest point in the whole system. On this cruise the users were biologists not engineers and without the fortuitous presence of IOS technical expertise the fourth deployment would have been the final one.

On return to RVS the corer needs a thorough overhaul. Attention to the points listed above is necessary. In addition, the gimbal system via which the corer descends through the frame is misaligned as some of the recessed retaining bolts were loose.

R. Harvey, A. Muirhead

EPIBENTHIC SLEDGE

The epibenthic sledge was deployed on eleven occasions, eight times in the triple net mode and three times as a photosledge fitted with the suprabenthic net only.

The sledge was launched with the ship head to wind and steaming at 2.0-2.5 knots. The lower speed was sufficient in low sea states, but any deterioration in conditions demanded a commensurate rise in speed. A speed of 2.5 knots was necessary in order to maintain a sensible scope to depth ratio during the initial period of paying out. Depending on conditions, ship speed was reduced at some time during paying out so that when the net was within about 200m of the bottom, the speed over the ground was 1.5 knots. This put the net on the bottom with a scope to depth ratio of 1.4-1.8. On most hauls an extra 50m of wire paid out resulted in a stable

haul with a near continuous series of photographs.

The three photosledge runs were in the form of a transect designed to increase our knowledge of faunal boundaries and densities in and around the Pheronema ground in the north western part of the Seabight. A good overlap was achieved between successive hauls, and the total depth range covered was 861-1585m. Photographs were taken at 30 second intervals, which, at a trawling speed of 1.5 knots, resulted in a frame separation of about 25m.

D.S.M. Billett, M.H. Thurston

AMPHIPOD TRAP

The 'mark and recapture' experiments, for which the trap system was designed, depended for some critical manipulations on the submersible Cyana. Cyana was not available, having failed safety checks, so the experiments could not be attempted. The opportunity was taken, however, to use the module as a straightforward amphipod trap, and to test those systems not dependent on Cyana.

The rig comprises a rectangular frame about 1.0m long, 0.8m wide and 0.8m high, and made of aluminium alloy tube. Within the frame are located two traps, a pump, a 20 l collapsible reservoir to contain a vital stain, a power pack, and an acoustic command release system.

The small centrifugal pump draws ambient seawater through chopped fish in a bait container and delivers the odour laden water to Trap No. 1. The pump, which is designed to deliver approximately 2 litres/min of sea water, is driven by a small pressure balanced d.c. motor operating with a supply voltage in the range of 8.5V to 9.5V. The electrical supply to the motor is derived from a pressure balanced lead-acid battery power pack. A small flowmeter is used to monitor the pump delivery. Trap No. 2 has a bait container inside it.

The rig is designed for free fall descent to the ocean floor, while its return to the surface is achieved through jettisoning a rigid planar ballast mass by the release system. The acoustic system is also used to monitor motor supply voltage and pump seawater flowrate.

The complete rig was wire-tested to 4500m prior to three free-fall deployments, two to 4800m and one to 1480m. Trap No. 1 was baited for the first 4800m deployment and Trap No. 2 for the second. Time precluded more than a single deployment at the shallow site, so both traps were baited for this drop.

Despite operating at a maximum of twice the original design depth, the rig structure, materials and ancillaries operated satisfactorily and reliably for deployment periods totalling 39 hours at 4800m and 7 hours at 1480m.

After the initial deployment, the ballast weight was increased by 17kg and the number of 16" buoyancy spheres increased from five to six in order to achieve more satisfactory descent and ascent rates.

Modifications advisable prior to use of the system on future cruises include lowering Trap No. 1 within the framework, strengthening some of the peripherals of and facilitating access to the catch of Trap No. 2, and improving the ballast attachment arrangements.

Although modifications are required, about 2000 amphipods were captured during the three deployments, showing that the basic concept of the system is good.

K.H. Scrimshaw

BATHYSNAP

A Mk V Bathysnap was deployed at a depth of 1476m on the Goban Spur to monitor the rates of deposition and disintegration of holothurian faecal masses. It is hoped to recover the rig during Discovery Cruise 158 in April 1986.

High levels of corrosion experienced with the earlier Mk V aluminium frame will not recur as the frame used on this cruise was manufactured from rigid PVC.

The camera used was a new Mk 4 model loaded with thin based film and set

with a frame interval of about 8.5 hours.

R.S. Lampitt

UNDERWATER CAMERAS

IOS cameras were operated on eight epibenthic sledge hauls and three photosledge runs. No problems were encountered with the equipment which produced a total in excess of 2500 photographs.

The latest type of Mk4A half frame camera with a completely redesigned control system, and the high capacity Mk 5 prototype unit were tested for the first time under operational conditions. Encouraging results were obtained in both instances and the new equipment operated in a satisfactory manner.

Prior to the cruise all flash units were tested and adjusted where necessary to gain a controlled level output equivalent to f 11 with 400ASA film. This produced a high degree of uniformity in the density of negatives produced throughout the cruise.

A completely new Mk 4 camera and flash system modified for long term elapsed time photography were incorporated on the Bathysnap deployed at Stn 52217#1.

Station	Gear	Camera	Number of frames		Remarks
			Total	Useful	
52203#1	BN1.5/3M	Std Mk4	96	81	
52204#1	BN1.5/3M	Std Mk4	68	44	
52208#1	BN1.5/P	New Mk4	c500		)Films returned to
52209#1	BN1.5/P	New Mk4	c800		)laboratory for commer-
52210#1	BN1.5/P	New Mk4	c600		)cial processing
52211#1	BN1.5/3M	Std Mk4	124		Camera partly obscured by hung-up suprabenthic net
52213#1	BN1.5/3M	Std Mk4	114	77	
52214#1	BN1.5/3M	Std Mk4	220	120	
52215#1	BN1.5/3M	Std Mk4	311	234	
52216#8	BN1.5/3M	New Mk4	304	214	
52217#1	Bathysnap	New Mk4			Recovery planned during future cruise
52218#1	BN1.5/3M	Mk5	140	104	

E.P. Collins

ENGINEERING

Almost inevitably on a cruise of this nature, mechanical problems arose with some of the gear. Of greatest significance was the failure of the vent flap linkage on the fourth deployment of the box corer. Repairs were effected, but as no suitable material was available on the ship, attention or repairs were required after each subsequent haul. Priority consideration should be given to redesigning the flap release mechanism and linakge in order to obviate this problem in the future.

The SMBA multiple corer has been in service for a number of years and is beginning to experience mechanical failures in some components. Some repairs were carried out on board, but others were beyond the facilities available. Fortunately, none of the problems encountered wre sufficient to endanger the work programme.

An aerial for the W.S. Oceans HFR-3 Direction Finding Receiver was erected. Minor maintenance was carried out on various other scientific equipment.

Workshop facilities on the ship are inadequate for the requirements of servicing and maintaining prototype equipment at sea. Such a facility should comprise - a workbench, vice, electrical power, bench drill and adequate lighting as an absolute minimum.

K.H. Scrimshaw

PHYTODETRITUS SAMPLING

The SMBA multiple corer was used to examine the distribution of phytodetritus and to collect samples when present. Due to spatial and short term temporal variations in the quantity of detritus at any one position, consecutive deployments of the corer usually provided very different quantities of material. As in previous years there was no evidence of detritus at 500m. Material was present, however, in varying quantities at 1400m and below. Layers of detritus up to 4mm and 3mm thick were found at 1400m and 2000m respectively. At 4800m an indication of

phytodetritus was seen on one set of cores only, in a layer usually much less than 1mm thick. Microscopic examinations will be required to confirm the presence of phytodetritus as the quantity is so small.

The phytodetritus collected was preserved in various ways for analysis of the phytoplankton species composition, microbiota, chloropigment, mineralogy, carbohydrate, lipids, fatty acids, sterols, organic carbon and nitrogen but as most of these analyses rely on large amounts of material they will be restricted to that collected at the 1400m stations.

Phytodetritus was present at Stn 52218 (1450m) on the Goban Spur. The epibenthic sledge haul at this station provided specimens of the holothurians Paroriza pallens and Benthgone rosea. Guts from these animals were preserved. Analyses will be carried out to examine the degradation of phytodetritus as it passes through the gut.

R.S. Lampitt, D.S.M. Billett

RESPIROMETRY

A principal objective of this cruise was to continue the IOS/Galway programme of seasonal measurements of sediment respiration (sediment community oxygen consumption, SCOC) at the 2000m station in the Porcupine Seabight. The suspended core technique utilising the SMBA multiple corer, as used on previous cruises, was employed to obtain two measurements of SCOC (Stations 52201#4 and 52212#6). Incubations of 18 hours were aimed for, but that on the second deployment had to be terminated 2hrs 40 minutes early due to deteriorating weather conditions. Results may be summarised as follows:

Station	No. cores	Mean core SCOC ($mgO_2m^{-2}day^{-1}$)	Between core standard deviation ($mgO_2m^{-2}day^{-1}$)
52201#4	9	62.9	11.5
52212#6	6	66.5	6.2

The decision to sample at the 4800m station on the Porcupine Abyssal Plain was guided in part by the wish to compare results with those of the Galway experiments on previous SMBA Challenger cruises in 1980 and 1981. Sampling time allowed for one 18 hour in situ measurement (52216#6) which resulted in a mean core SCOC of $20mgO_2m^{-2}day^{-1}$ (between core standard deviation $5.9mgO_2m^{-2}day^{-1}$) from 9 good cores.

An extra drop with the multiple corer at the 2000m station (52212#7) was fortuitious in that it allowed cores to be incubated "on deck" at 4°C in the constant temperature room. On this occasion, an 18 hour incubation revealed an apparent SCOC of $104mgO_2m^{-2}day^{-1}$ (11 cores; s.d. = $18mgO_2m^{-2}day^{-1}$), surprisingly only 65% higher than the in situ result. The importance of this type of experiment was considered sufficiently high to undertake a repeat at the 4800m station (52216#9). Seven cores from this series were incubated in the constant temperature room, and when analysed after 21 hours incubation, showed an apparent SCOC of $32mgO_2m^{-2}day^{-1}$ (s.d. = $6mgO_2m^{-2}day^{-1}$). The significance of these results can be assessed only after further experimentation with the polycarbonate core tubes.

Throughout the study programme, extra water samples were taken from the incubated cores for the measurement of the flux of dissolved organic carbon (DOC) and inorganic nutrients across the sediment surface.

R.C.T. Raine, D.S.M. Billett, R.S. Lampitt

BENTHIC INVERTEBRATES

Two samples were taken from the northwestern part of the Porcupine Seabight at 1530m (52203#1) and 1300m (52204#1). The latter sample was within the Pheronema grayi community previously sampled on earlier cruises. Many fine specimens of the sponge were taken together with its commensals, notably sipunculids and the ophiuroid Ophiactis abyssicola. Other than Pheronema the echinoderms were the most prominent megafauna and included the holothurians Bathyplotes natans, Laetmogone violacea, Paroriza pallens, Ypsilothuria talismani and Echinocucumis hispida, and the asteroid Plutonaster bifrons. Commensal polychaetes (Eunöe laetmogonensis) were found on Laetmogone and Paroriza. This is the first record of such an association for the latter species. The echinoderms were also prominent at

52203#1. The small holothurian Elpidia echinata was particularly abundant, but Benthogone rosea and Mesothuria lactea were the dominant large megafauna. The asteroid Plutonaster bifrons, the irregular echinoid Hemiaster expergitus and the actiniarian Actinoscyphia aurelia were present in addition to the crustacean Parapagurus pilosimanus and its commensal zoanthid Epizoanthus paguriphilus. Although P. pilosimanus (s.l.) has a very wide depth range, this is a very deep record for this association.

A similar catch was obtained at a station on the Goban Spur (52218#1) despite coming from a slightly shallower depth, 1440m. Again the echinoderms dominated the megafauna with Benthogone rosea, Paroriza pallens, Bathyplotes natans and Zoroaster fulgens most prominent. There were numerous solitary corals, Caryophyllia, small pagurids with small commensal zoanthids and a single specimen of the gastropod Troschelia. The catch had large residues of clinker and stones and also contained two very large specimens of Actinoscyphia aurelia as well as other actiniarians.

Two samples were taken in the centre of the Seabight at 1720m (52211#1) and 2410m (52213#1). The megafauna of the former catch was ruled by echinoderms and included the holothurians Benthogone rosea, Paelopatides grisea and Mesothuria lactea, the ophiuroid Ophiomusium lymani, and the asteroid Plutonaster bifrons. The sample contained many tests of the pteropod Diacria which also occurred in the sample from the Goban Spur. The actiniarian Actinoscyphia aurelia was present and another actinarian Phelliactis robusta was found attached to large lumps of coal. The sample from 52213#1 was rather small and was dominated by the asteroids Hymenaster membranaceus, Benthopecten simplex and Pectinaster filholi. The ophiuroid Ophiomusium lymani was also present but otherwise only scaphpods occurred in any number.

Three samples were taken on the Porcupine Abyssal Plain, one at the mouth of the Seabight (52214#1) and two in deeer water further west and south (52215#1 and 52216#8). The sledge at 52214#1 was trawled in rough weather which became progressively worse during the haul. Both weak links on the net bar broke which may have been the cause of the rather poor catch. The sample contained gastropods, scaphapods, actiniarians, the crustacean Munidopsis and the holothurians Deima validum and Benthothuria funebris. The bulk of this sample and that at Stn 52215#1 consisted of clinker. At the latter

station echinoderms were again the dominant element of the fauna and included the holothurians Psychropotes longicauda, Oneirophanta mutabilis and Peniagone diaphana, the asteroids Styracaster sp. and Dytaster sp. and many specimens of the small ophiuroid Ophiocten hastatum. Light relief was provided by a "7-Up" can. The deepest sample, 52216#8, contained a varied catch of holothurians, (Oneirophanta mutabilis, Pseudostichopus atlanticus, Paroriza prouhoi, Psychropotes longicauda and Mesothuria sp.), sipunculids, actiniarians and zoanthids on sponge spicules. The Pseudostichopus and Paroriza both had commensal actiniarians of the genus Sicyopus.

D.S.M. Billett, M.H. Thurston

FORAMINIFERAN STUDIES

The multiple corer was used to sample foraminiferan populations. A number of 20ml syringe subsamples and complete core tops (0-1cm layer) were taken from cores collected at all depths. A special series of 16 core tops (4 from each of 4 separate drops) obtained at 2050m will form the basis for a study of the numerical variabilities of selected foraminiferan species. Several 20ml syringe subcores were shock frozen in liquid N_2 for later sectioning. It is hoped that these samples will yield in situ data on the life habits of foraminiferans and other small organisms which will complement that obtained from impregnated cores. Smaller 5ml syringe subsamples were taken for chloroplastic pigment, protein and ATP analyses.

Attempts were made to impregnate core subsamples in order to study in situ relationships between benthic Foraminifera, other organisms and sediment particles.

Subcores were taken using brass tubes and the samples fixed by drawing formalin through them under vacuum. Two methods of impregnation were used. The first involved drawing propylene oxide through the sample followed by an Epoxy resin mixture [159ml dodecenyl succinic anhydride (DD54), 88ml nadic methyl anhyrdride (NMA), 200ml Epon 812] which was cured for several days at 60°C. The second method used Polyethylene Glycol (PEG) which is a waxy substance and sets with a consistency of talc. Five per cent, 25 per cent and 50 per cent W/W aqueous solutions of PEG were drawn through the

samples before a final impregnation with pure PEG at 60°C for 48 hours.

These methods proved only partly successful since it was difficult for the Epoxy resin and PEG to infiltrate these fine grained sediments, even under vacuum. On the basis of the limited experience gained on this cruise it appears that the Epoxy resin treatment is the more promising.

A.J. Gooday, N.G. Cartwright

NECROPHAGOUS AMPHIPODS

The indifferent weather experienced during part of the cruise reduced the number of deployments from a proposed six to a wire test and three free fall descents. The wire test was done at 4800m in order to check the component systems. Only trap 1 was incorporated in the rig. The bait container for this trap was filled with choped fish, but because the rig was stationary at depth for only a few minutes, no amphipods were taken.

Two free fall deployments were carried out at 4800m. On the first of these odour-laden water was pumped through trap 1 but no bait was added to trap 2. This remained on the bottom for about 4½ hours and caught 28 amphipods. The second deployment was to test trap 2, no bait being added to the chamber on the pump line to trap 1. This deployment lasted for 35 hours and took an estimated 1500 amphipods. The considerable disparity in numbers between the two drops is attributable, probably, to a combination of trap design and deployment duration. Species which figured predominantly in these catches were Eurythenes gryllus, Paralicella tenuipes, P. caperesca and Orchomene spp. At least four other species were taken including a few specimens of the rare and poorly known genus Valettietta.

The final deployment was designed to assess the potential of a site at 1500m on the Goban Spur as a dive site should the Cyana project be reinstated. Time permitted only a single drop so no comparison could be made between the efficiency of each trap in isolation from the other. As the main object was to collect as many specimens as possible both traps were baited. Bottom time was about seven hours. Trap 1 contained ten amphipods, whereas trap 2 had taken over 200 amphipods, about forty isopods

(Cirolana sp) and about forty hagfish (Myxine). Mucus from the latter posed problems, making the trap difficult to clear, and enveloping many of the specimens. A majority of the amphipods taken were Tmetonyx cicada.

These very preliminary results from limited trials are encouraging, showing clearly the ability of both traps to catch amphipods. A number of design features require some modification, but the general concept and basic design are good.

The species recovered from the deep station fit precisely into the pattern emerging from deep trapping studies in various parts of the world. Much less is known about those species which are facultative necrophages at mid-slope depths. A preliminary assessment of the catch from 1500m indicates that the species composition in the two traps is different. Eight of the ten amphipods taken in trap 1 (entrance 40cm above the sediment) were Orchomene and two were Tmetonyx. Orchomene was present in small numbers in trap 2 (entrance 20cm above the sediment) but was hugely outnumbered by Tmetonyx in the ratio 20:1. Should future work prove this difference to be real, then this is the first indication of fine structure in the vertical partitioning of the epibenthic environment by necrophages at these depths.

M.H. Thurston

FUNCTIONAL ANATOMY OF HOLOTHURIAN TENTACLES

As part of a long term research programme to investigate tentacular functional anatomy of all major holothurian groups it was essential, at some stage, to obtain fresh material from deep sea species. Investigations to date have been restricted to tropical Aspidochirotida and Apoda and temperate Dendrochirotida from shallow waters. These have involved studies of resource partitioning and tentacular surface microarchitecture. Groups yet to be studied from this viewpoint are the orders Elasipoda, Molpadida and Dactylochirotida. Representatives from these three groups were obtained in epibenthic sledge hauls, together with several aspidochirote species. It will be interesting to compare the latter with shallow water aspidochirotes.

Approximately 80 samples including over 200 individual tentacles and representing some 17 species have been fixed for SEM and light microscopy. These are listed below in systematic order although depth data were recorded so that any possible ecological significance from subsequent studies may be assessed. The most significant feature of the material obtained is that it covers all groups not so far studied and, assuming the material has been well preserved, should fill a gap in our present knowledge of holothurian biology.

Species obtained: (kindly identified by D.S.M. Billett)

ELASIPODA: Benthogone rosea, Elpidia echinata, Laetmogone violacea, Deima validum, Psychropotes longicauda, Oneirophanta mutabilis, Peniagone diaphana.
MOLPADIDA: Molpadia sp.
ASPIDOCHIROTIDA: Mesothuria lactea, Paroriza pallens, Paroriza pruohoi, Bathyplotes natans, Paelopatides grisea, Benthothuria funebris, Pseudostichopus atlanticus.
DACTYLOCHIROTIDA: Ypsilothuria talismani, Echinocucumis hispida.

D. Roberts

HOLOTHURIAN REPRODUCTIVE BIOLOGY

Gonads were dissected from both sexes of a majority of the holothurian species taken in epibenthic sledge samples at 1300-4800m. Each gonad was divided into two approximately equal parts. Of these, one is to be used for routine histological examination to determine the degree of development. The second portion was immediately deep frozen and subsequently will be freeze-dried prior to determination of the calorific content of the tissue by microbomb calorimetry.

This pilot study will identify those species likely to yield the most informative long term results. The ultimate aim is to assess that proportion of availabile energy which is put towards reproductive effort in as many species as possible. This will be achieved by relating the rate of uptake of energy from the sediment to the calorific value of gonad material produced within a finite time period. Therefore seasonally

reproducing species are anticipated to be especially useful.

A. Muirhead

ORNITHOLOGY

Standard ten-minute observations were made throughout the cruise as and when other duties allowed, and, in addition, casual sightings of birds were recorded. In all, thirteen species of seabird were seen.

For twelve days (15-26 June inclusive) the ship was beyond the shelf edge, and 66 standard observations were made. Fulmar (Fulmarus glacialis), British storm petrel (Hydrobates pelagicus) and gannet (Sula bassana) were the highest ranking species both in terms of individuals seen and frequency of occurrence. However, numbers were low and sightings sporadic. Less than one hundred individuals of any one species were seen throughout the whole twelve-day period, and no species was recorded at more than one third of the observations. Low bird densities must be attributable in part at least to the season: most adult birds will be at or close to the breeding colonies. Although more birds were seen over the shelf and shelf edge during passage (13-14 and 27-28 June), numbers were still far from high.

The onshore/offshore factor is demonstrated by the pattern of sightings during the period 15-26 June. The first six days were spent in the northwestern part of the Porcupine Seabight, 100-170 nautical miles (185-315km) offshore and the second six days largely southwest of the Seabight, over the abyssal plain, 140-300 nautical miles (260-555km) offshore. Of the total individual sightings for the whole twelve day period, 94% were made during 31 observations in the first six days and only 6% during 35 observations conducted in the second six days. Even if an allowance is made for some probable multiple sightings during the first period, and a day of gale force winds during the second, the disparity remains considerable.

M.H. Thurston

STATION LIST

Station	Date (1985)	Gear Position (start) N	W	Gear Postion (end) N	W	Gear	Sampler depth (m corr)	Duration (GMT)	Distance run (m) Odometer	Calculated	Remarks
52201#1	14:6	51°00.22'	12°59.26'			BC	2038	2259			
52201#2	15:6	50°59.59'	12°59.31'			MC	2052	0123			
52201#3	15:6	50°59.56'	12°59.73'			MC	2049	0318			
52201#4	15:6	50°59.41'	13°00.06'			MC	2052	0513			Respirometer hang. Hauled at 2313.
52202#1	16:6	51°27.18'	13°05.48'			BC	1360	0343			
52203#1	16:6	51°25.91'	13°00.60'	51°25.48'	13°00.38'	BN1.5/3M	1521-1531	0610-0629	645	828	
52204#1	16:6	51°37.07'	12°59.96'	51°37.29'	13°00.01'	BN1.5/3M	1295-1310	1112-1127	310	402	
52205#1	16:6	51°36.20'	12°57.36'			MC	1388	1259			
52205#2	16:6	51°36.15'	12°56.35'			MC	1420	1437			
52205#3	16:6	51°37.41'	12°55.74'			MC	1374	1606			
52206#1	16:6	51°40.09'	13°14.77'			BC	988	1855			Sample partially washed out so discarded.
52206#2	16:6	51°40.78'	13°13.90'			BC	999	2019			
52207#1	17:6	51°32.35'	13°53.40'			MC	498	0829			
52207#2	17:6	51°32.30'	13°54.01'			MC	491	0914			
52207#3	17:6	51°32.30'	13°54.39'			BC	485	0958			
52208#1	17:6	51°20.37'	13°00.81'	51°23.61'	13°08.50'	BN1.5/P	1585-1349	1617-2000	5646	10720	
52209#1	17:6	51°21.61'	13°06.01'	51°24.87'	13°22.78'	BN1.5/P	1433-1033	2248-0507	11410	20790	
52210#1	18:6	51°26.13'	13°20.44'	51°31.52'	13°26.73'	BN1.5/P	1058-861	0735-1213	7398	12380	
52211#1	18:6	51°10.57'	13°14.71'	51°09.84'	13°15.15'	BN1.5/3M	1693-1738	1646-1712	617	1416	SBN hung up on frame. Camera obscured for part of haul.
52212#1	18:6	51°00.15'	12°59.58'			MC	2041	2044			Deployed in marginal conditions. No samples.
52212#2	18:6	51°00.12'	12°59.15'			MC	2043	2209			
52212#3	19:6	50°59.93'	12°58.89'			MC	2049	0013			
52212#4	19:6	50°59.87'	12°58.41'			MC	2057	0314			Core retaining arm broken.
52212#5	19:6	50°59.66'	13°01.59'			MC	2053	0737			
52212#6	19:6	50°59.95'	13°03.15'			MC	2043	0930			Respirometry hang. Hauled at 0500 20:6 in deteriorating weather.
52212#7	20:6	50°59.76'	13°01.77'			MC	2046	0258			
52213#1	20:6	50°33.04'	12°59.21'	50°32.41'	12°58.53'	BN1.5/3M	2405-2420	0959-1023	593	1398	
52214#1	21:6	49°51.96'	14°14.77'	49°52.69'	14°19.76'	BN1.5/3M	4075-4050	0055-0240	c.1980	6114	Terminated early due to bad weather. Both net bar weak links broken.
52215#1	22:6	49°30.27'	14°49.02'	49°30.60'	14°51.33'	BN1.5/3M	4561-4565	0914-1025	1528	2842	
52216#1	23:6	48°49.32'	16°30.81'			BC	4838	0525			No sample.
52216#2	23:6	48°50.39'	16°29.51'			AMPHT	4841	1052-1528			Descent rate 0.81m/sec, ascent rate 0.47m/sec
52216#3	23:6	48°50.70'	16°29.25'			MC	4840	1057			
52216#4	23:6	48°50.27'	16°29.35'			MC	4841	1349			
52216#5	23:6	48°50.02'	16°30.42'			AMPHT	4842	2206-0911 25:6			Descent rate 0.80m/sec, ascent rate 0.66m/sec
52216#6	23:6	48°49.81'	16°29.94'			MC	4841	2157			Respirometry hang. Hauled at 1600 24:6.
52216#7	24:6	48°48.88'	16°29.31			BC	4840	2147			
52216#8	25:6	48°47.95'	16°37.59'	48°47.59'	16°39.68'	BN1.5/3M	4803-4832	0333-0436	1767	2642	
52216#9	25:6	48°49.80'	16°31.35'			MC	4837	1238			
52217#1	26:6	49°27.27'	12°55.86'			BSNAP	1476	0745			Recovery planned for Discovery Cr. 158, April 1986.
52217#2	26:6	49°27.96'	12°55.99'			AMPHT	1476	0842			Descent rate 0.77m/sec, ascent rate 0.68m/sec
52218#1	26:6	49°25.40'	12°49.80'	49°26.37'	12°50.27'	BN1.5/3M	1433-1447	1009-1041			
52218#2	26:6	49°25.90'	12°50.35'			MC	1432	1300			
52218#3	26:6	49°25.79'	12°50.20'			MC	1427	1422			

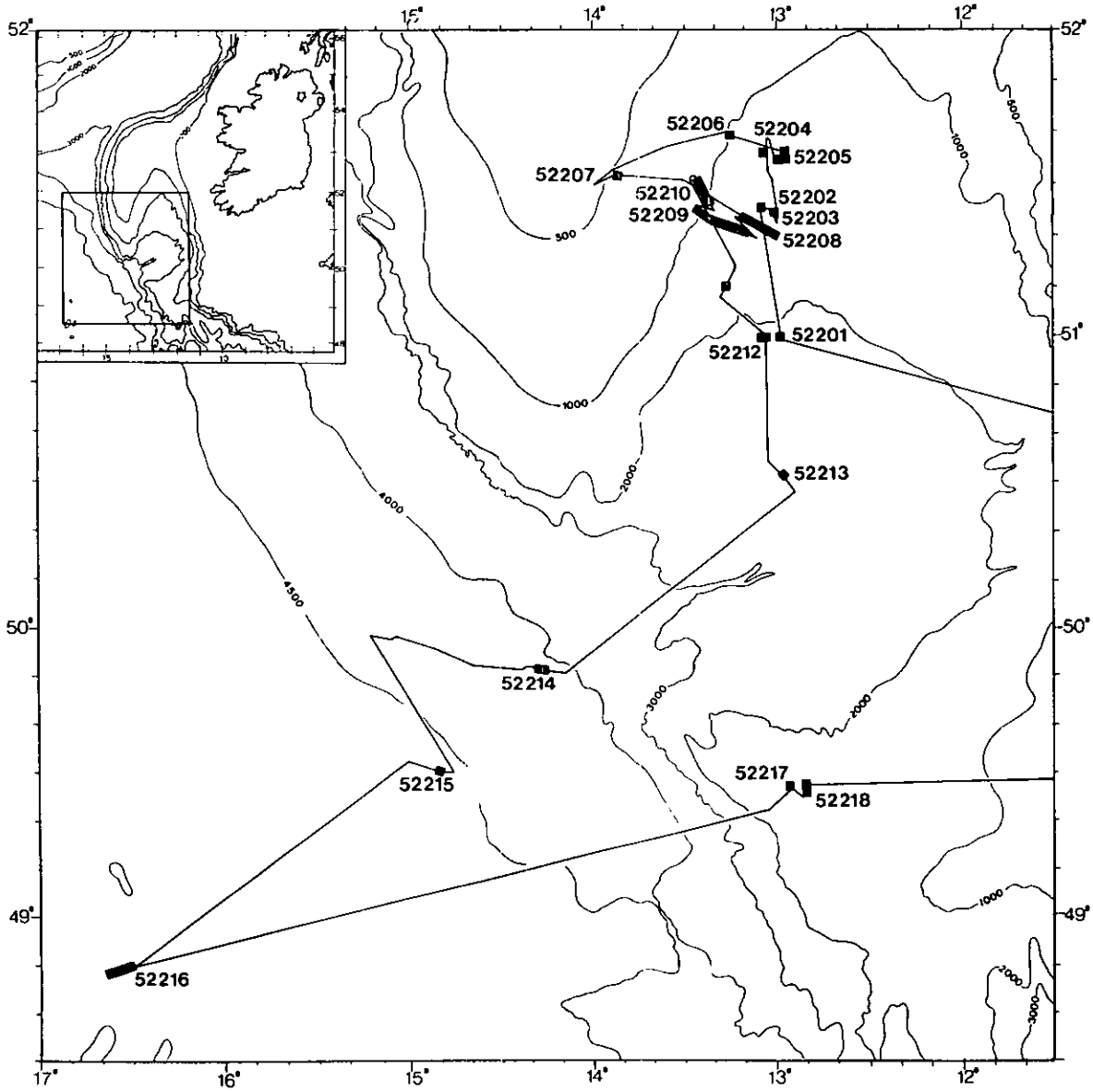

Fig. 1. Track Chart