SOUTHAMPTON OCEANOGRAPHY CENTRE

CRUISE REPORT No. 30

RRS *CHALLENGER* CRUISE 142
19 APR - 19 MAY 1999

Temporal and spatial variability of benthic communities on the Porcupine Abyssal Plain and in the Porcupine Seabight

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2000

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ABSTRACT

RRS *Challenger* Cruise 142 aimed to study 1) long-term change in abyssal benthic communities (4850m, Porcupine Abyssal Plain) and 2) coral communities on carbonate mounds (c. 800m, Porcupine Seabight).

Sampling on the first leg was focussed at a central locality 48°50'N, 16°30'W) on the Porcupine Abyssal Plain. This locality had been sampled on 9 separate cruises over a 9-year period (1989-1998). A radical change in the composition of the benthic fauna had occurred in recent years and this cruise aimed to follow further long-term change in the benthic fauna and sediment biogeochemistry. In addition, in order to set the results from this central locality in a basin-wide context, further sampling was undertaken across the Porcupine Abyssal Plain.

Sampling on the second leg concentrated on the giant carbonate mounds discovered in recent years on the eastern and northern flanks of the Porcupine Seabight. The mounds had well-developed coral communities. Samples and video of the coral were collected. Other seabed features also noted in sidescan sonar records on previous cruises were imaged as well.

KEYWORDS

BENGAL, BENTHIC COMMUNITIES, BOTTOM PHOTOGRAPHY, CARBONATE DEPOSITS, *CHALLENGER*, CORAL, CORERS, CRUISE 142 1999, DREDGE, EPIBENTHIC SLEDGE, GEOCHEMISTRY, HOLOTHURIANS, LANDERS, MEGAFAUNA, MICROBIOLOGY, NORTHEAST ATLANTIC, PHOTOSLEDGE, PORCUPINE ABYSSAL PLAIN, PORCUPINE SEABIGHT, TIME SERIES, TRAWLS, VIDEOTAPE

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Sail Southampton	(Leg 1)	2100A Monday 19 April
Arrive Galway		0830Z Thursday 6 May
Sail Galway	(Leg 2)	0830Z Friday 7 May
Arrive Glasgow		0900A Wednesday 19 May

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OLDFIELD, Philip T.	2nd Officer
HOLMES, John C.	3rd Officer
ADAMS, Andrew P.	Chief Engineer
CROSBIE, Jim R.	2nd Engineer
HEALY, Andrew	3rd Engineer
PHILLIPS, Clive J.	3rd Engineer
BENNETT, Peter R.	Chief Petty Officer (Deck) - Bosun
THOMSON, Iain N.M.	Petty Officer (Deck) - Bosun's Mate
HEBSON, Harry	Rating SG1A
CRABB, Garry	Rating SG1A
MOORE, Michael S.	Rating SG1A
DICKINSON, Robert	Rating SG1A
DANE, J. Paul	Senior Catering Manager
LYNCH, Peter A.	Chef
STEPHEN, R. Michael	Steward
DILLON, Carol V. A.	Steward
SMYTH, John G.	Motor Man

INTRODUCTION

During the European project BENGAL (High-resolution temporal and spatial study of the BENthic biology and Geochemistry of a north-eastern Atlantic abyssal Locality.) (MAST III, January 1996 to January 1999) a significant change was detected in the abundance and dominance of the megafauna. During the period of the BENGAL project the abundance of the megafauna was some three times greater than samples taken at the same locality between 1989 and 1994. Significant increases in abundance occurred in the actiniarians, polychaetes, ascidians, ophiuroids and holothurians. In particular, one species of holothurian, *Amperima rosea*, increased from about 2 to about 6000 individuals per hectare. This remarkable change became known as "The *Amperima* Event" and appeared to be related to inter-annual variability in the deposition of phytodetritus. RRS *Challenger* Cruise 142 was planned to follow the development of the "*Amperima* Event" at the BENGAL locality and to assess whether it was representative of the Porcupine Abyssal Plain as a whole or whether it was restricted to a small area only.

Biogeochemical studies of surface sediments during the BENGAL study had indicated also that the *Amperima* Event had had a significant effect on the way in which organic matter was recycled at the sediment-water interface. While significant seasonal flux of phytodetritus was evident in sediment trap samples during July and August in 1997 and 1998, in neither year did the phytodetritus gather on the seabed, as in previous years. In addition, little fresh organic matter was mixed into the sediment, as shown by phytopigment and lipid analyses. Significant inter-annual differences in the organic composition of the sediment were noted. Therefore, RRS *Challenger* Cruise 142 aimed to continue studies into interannual differences in the early diagenesis of organic matter in surficial sediments.

Temporal changes had also been noted in the composition of the macrofauna and foraminiferan meiofauna at the BENGAL locality. The changes may have been related to the "*Amperima* Event". RRS *Challenger* Cruise 142 planned to assess what further changes had occurred in these components of the benthic community. However, while multicorer samples could be taken for meiofauna, it was not possible to use the box corer from RRS *Challenger* because the coring wire on the ship had been damaged on a previous cruise. Fortunately, RRS *Discovery* was scheduled to undertake a training cruise in the area at almost the same time. Consequently, the box-coring programme was undertaken on that ship. RRS *Discovery* arrived at the BENGAL locality just as RRS *Challenger* was completing its work at the site.

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The discovery of long-term change at abyssal depths raised questions whether similar changes might occur at bathyal depths. Consequently, the cruise planned to sample a particular locality in the Porcupine Seabight (1350m) that had been sampled in detail previously in the 1980s for foraminiferan meiofauna. In addition trawling was planned for a variety of depths between 800 and 2700m to see whether the megafauna showed any significant differences over a similar period. Owing to the time lost at the start of the cruise because of 1) problems with the ship's ventilation fan and 2) the weather (see Cruise Narrative) this aim was only partially realised. However, several trawl and epibenthic sledge samples were taken for a variety of other studies including taxonomy and population biology.

An additional requirement of the cruise was to study the recently discovered carbonate mounds on the eastern and northern slopes of the Porcupine Seabight. Sidescan and echo sounding surveys had detected large mounds some 100 to 200m high and 1km in diameter, but as yet the faunal communities had been little studied. RRS *Challenger* Cruise 142 aimed to image and sample the fauna from a number of mounds. A number of other seabed features had also been identified on the slopes of the Seabight by sidescan sonar and a secondary aim of the cruise was to image these features using WASP and the epibenthic sledge.

SPECIFIC AIMS

1. To determine whether the "*Amperima* Event" had persisted into 1999 at the BENGAL locality.

2. To determine whether the "*Amperima* Event" was characteristic of a wide area of the Porcupine Abyssal Plain.

3. To determine long-term changes in sediment geochemistry at the BENGAL locality (University of Liverpool)

4. To determine the nature of long-term change in meiofauna communities at the BENGAL locality.

5. To determine the nature and distribution of faunal communities on carbonate mounds in the Porcupine Seabight.

6. To determine whether long-term change had occurred in the foraminiferan meiofauna at a specific locality (1350m) in the Porcupine Seabight.

7. To image seabed features in the Porcupine Seabight.

8. To sample key species for molecular biology studies (taxonomy and population biology).

9. To sample the microbiological communities on the Porcupine Abyssal Plain (National University of Ireland, Galway).

10. To measure fluxes *in situ* of oxygen and dissolved organic carbon across the sediment-water interface using a lander (University of Goteborg).

11. To recover and deploy a Bathysnap lander at the BENGAL locality.

12. To sample benthic fauna in the Porcupine Seabight between 800 and 2700m.

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NARRATIVE

Friday 16 April

The scientific party joined the ship during the day and made ready to leave port at 0900A the following morning. A safety briefing was held for all scientific personnel at 1500A. Late on the Friday evening, however, the ship's ventilation fan fell apart in spectacular fashion and all air supply/heating to the cabins stopped. The time of sailing was delayed until a suitable replacement part could be found

Saturday 17 April

Efforts were made during the morning to find replacement parts, or a replacement unit, for the ventilation system in order for the vessel to leave port that day. This proved impossible and the departure date was put back to Monday 19 April.

Monday 19 April

Replacement parts were located during the morning and were transported to the ship from Kent. The ventilation system was repaired by late afternoon and the ship sailed from Southampton, Empress Dock at 2100A. This delay of two and a half days led to the cancellation of some of the intended research work programme.

Tuesday 20 April

The ship made good progress during the day into a fresh breeze and fairly heavy seas, but the weather deteriorated towards the end of the day. A scientific meeting was held at 1500A to discuss the revised cruise plan, but with several members of the scientific party missing, owing to the weather, the meeting was only partially successful. At 1615A there was an emergency stations/boat drill. The clocks were put back one hour to GMT overnight.

Wednesday 21 April

A strong westerly gale all day stopped the ship from progressing much beyond a point south of the Lizard.

Thursday 22 April

Better progress was made towards the shelf break and deep water near Little Sole Bank. The PES fish was deployed at 0915Z. The weather was still unpleasant. A second scientific meeting was held at which all the scientific personnel described what they wished to achieve on the cruise. A revised plan for the cruise was agreed taking into account the delay in starting the cruise and the bad weather.

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Friday 23 April

With the wind decreasing overnight the ship headed for the nearest deep-water site off Little Sole Bank where it was hoped to stream the new main trawling warp. Streaming the wire was a necessary task in order to tension the warp for subsequent operations. However, on arrival at the start point the wind was still too strong to allow the wire streaming to go ahead other than in a NW or SE direction; neither were suitable. It was decided to continue to steam in a west-north-westerly direction. After a further two hours, with the wind and swell still decreasing, the ship altered course to the southwest. After a further 3 hours the last of the abyssal hills in this area had been passed and the main warp was paid out. At 1910Z, and with 13011m of wire out, the main warp was hauled back in. The wire was inboard again at 2310Z.

A wire test was then made at 2330Z of three acoustic releases (two MORS releases for the Goteborg Lander and one MORS OEM unit for Bathysnap) and a 'prototype' Anderaa current meter (Goteborg Lander) using a frame and the CTD wire.

Saturday 24 April

The wire test was completed at 0225Z and the ship then proceeded towards the “BENGAL locality”, the major study area for this cruise. This locality, at 48°50 N 16°30 W, had been sampled on 6 cruises between September 1996 and October 1998 (RRS *Discovery* cruises 222(2), 226, 229, 231 and 237 and RRS *Challenger* cruise 135). A major feature of the BENGAL area during these cruises was the unexpected, long-term temporal variability in the abundance and structure of the benthic megafauna. However, it was unknown whether this was representative of just the BENGAL area, or of the Porcupine Abyssal Plain as a whole. In order to investigate the issue of spatial variability the cruise intended to sample some localities distant from the BENGAL site. One of these areas, with a water depth of about 4800m and a flat seabed suitable for trawling, lay on the new course set for the BENGAL area.

The weather improved steadily during the day, and it was decided to prepare the trawl to sample the seabed some 50nm to the southeast of the BENGAL locality. However, just as the trawl was being rigged, a gale warning was received and it was decided not to risk trawling in an unknown area in such conditions. The ship continued to make passage for the BENGAL site, arriving at 2200Z. The ship hove to waiting for an improvement in the weather.

Sunday 25 April

The state of the weather was assessed again at 0600Z. The wind speed was about 20kts, but a large swell was still running. It appeared that the ship was in the centre of the large depression that had caused the bad weather of the past two days. The ship repositioned and arrived back at the central BENGAL locality at 0830Z whereupon it was decided to wait until the swell showed signs of decreasing. Later in the morning the weather had improved to a small extent and a multicorer deployment was attempted, starting at 1216Z (St. 54901#1). During the coring operation the wind speed increased to about 30kts and veered by about 40 degrees relative to the swell, making sampling conditions very difficult (1357Z). The corer was recovered at 1513Z and while the core tubes had closed there was only a very small amount of mud in the bottom of a few core tubes. With the weather deteriorating once more sampling operations were suspended.

Monday 26 April

The weather improved overnight, but at 0600Z was still marginal. There was a heavy swell running at about 50 degrees to the wind. At 0900Z it was decided to move to the start position for a trawl, arriving on station at 1102Z. The sea state had improved markedly during this time and so the trawl was deployed almost immediately at 1107Z (St. 54901#2). The net reached the bottom at 1620Z and lifted off without too much trouble at 1835Z. The trawl was inboard by 2232Z, with a good and varied catch. Most notable was the continued presence of the holothurian *Amperima rosea* (see science report). The ship hove to for just over two hours while the catch and the trawl were cleared from the deck and the Goteborg Lander was put in place under the ‘A’ frame for the next operation.

Tuesday 27 April

Once the Goteborg Lander had been secured in place on the deck, the ship steamed for the launch site at 0100Z, arriving at 0242Z. This area was a site sampled by landers on previous BENGAL cruises. A technical problem with the lander delayed its deployment until 0410Z. The launch went smoothly and the lander reached the seabed at 0632Z (St. 54901#3).

The ship then proceeded to the site where a Bathysnap had been laid on RRS *Discovery* Cruise 231 (27 March 1998, St. 13370#8). The Bathysnap was released at 0727Z and was seen floating on the sea surface at 0845Z. It was inboard by 0910Z, suffering some damage to the connector on the camera as it landed on deck.

Good weather now favoured us and the ship proceeded to the central BENGAL locality at 0933Z to deploy the multicorer. The multicorer was in the water at 1124Z (St. 54901#4). With 4786m wire out, and with the corer just 75m above the seabed, the winch was stopped at 1303Z. Great cries of anguish were heard from the aft deck. The ship's engineers had noticed that the coring wire had fallen of the spooling gear next to the winch drum. The wire had to be stoppered off and placed back on the spool. The wire was then checked for damage and was found to have several broken strands. It was impossible to complete the coring operation. The wire was found to be damaged along a length of at least 1500m, mainly at the end of the wire close to where we had stopped paying out. It was likely that the wire had fallen off the spooling gear early in the deployment. Digital photographs and video were taken of the damaged wire. RVS Operations were alerted to this new problem. Hauling commenced slowly at 1550Z to allow the wire to be inspected at regular intervals and was all inboard at 1747Z, thankfully with the multicorer still attached! Following further conversations with RVS Operations it was decided to cut the damaged wire (c.4800m), having first wound the damaged wire onto a spare winch drum aboard ship. This operation was started at 1930Z and was completed at 2338Z.

Wednesday 28 April

Steady progress was made during the early hours of the morning in preparing a modification of the otter trawl to include a depressor weight in front of the trawl. It was hoped this would take the trawl onto the seabed with some 8000m of wire out rather than the normal 12000m. Deployment of the trawl started at 0418Z and was completed by 0510Z (St. 54901#5). In order to make sure the trawl landed on the seabed the trawling speed was reduced to one and a half knots. As a consequence, while a good catch was achieved, it was mixed with a considerable amount of mud and had to hosed down for a while on deck. The trawl was found to contain a large bag of gravel. Mud mixed with the gravel in the bag was dark olive greenish / dark brown in colour and quite different from the natural sediment of the abyssal plain. A sample was taken for chemical analysis and a proportion of the gravel was sieved on 250 and 500 micron meshes. The trawl was on the bottom from 0930Z to 1210Z and was on deck at 1517Z.

The ship then made way for the central station once more and a multicorer deployment was started at 1947Z (St.54901#6). There was a large swell running, so the chances of success appeared slim. The corer was on the bottom at 2125Z and was back inboard at 2256Z. While 11 out of 12 cores had taken a sample, they were badly shaken and the overlying water was extremely turbid. The tops of the cores had all been disturbed, so the

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cores were discarded. Once the multicorer had been cleared from the deck and tied down the ship steamed for a new position at 2327Z to start another trawl.

Thursday 29 April

The otter trawl was deployed at 0218Z (St 54901#7). Flushed with the success of the previous trawl using 8000m of wire, this time the ship's speed was kept closer to 2kts. A good clean catch was obtained. The trawl was on the bottom between 0700Z and 0856Z, and was inboard at 1225Z.

The weather conditions were less than ideal for recovering the Goteborg Lander and there was considerable discussion as to whether we should release the lander or not. In the end it was decided that while the wind had freshened the swell appeared to be quite reasonable, based on the experience of bringing in the trawl. The lander was released at 1417Z. It was grappled at 1545Z and taken astern. However, problems were encountered in passing the lazy line astern and the Goteborg Lander got stuck by the starboard quarter for a while, impacting several times on the ship's side and breaking its spars. As the lander came over the stern it was also evident that the sampling module had not retracted back into the buoyancy, so it had to be landed carefully on deck. The lander was inboard at 1615Z.

It took some time to clear the lander and move the rest of the equipment around on the deck. Finally, the ship steamed back to the central station at 1800Z for another multicorer. The multicorer was deployed at 1910Z, reaching the bottom at 2100Z (54901#8). There was a heavy swell running and, as expected, the largest waves coincided with the period that the corer touched down. The corer was inboard at 2254Z. There were no samples. A few core tubes had a small amount of mud, but most were empty and two core-catching arms had been twisted through 90 degrees. With the corer safely stowed at 2320Z the ship made for the start of another trawl.

Friday 30 April

The trawl was launched at 0125Z. However, signals from the acoustic monitor could not be detected. The intermittent fault detected on previous hauls had now become permanent. Therefore the trawl was brought back inboard at 0330Z. Various repairs were made to the acoustic monitor (e.g. re-soldering a dry joint) and the net was re-launched at 0606Z (St. 54901#9). It sampled the bottom between 1203Z and 1445Z producing another large and varied catch, including what looked like an expendable submarine surfacing aeriel or sonar buoy. The trawl was inboard by 1755Z. This was the fourth and final otter trawl sample from the BENGAL area for the cruise. Subsequent trawls were taken “out of area” to assess how widely the *Amperima* population was spread.

The ship then headed for a position to deploy the Goteborg Lander for a second time, arriving at 2024Z. Following further preparation of the lander it was launched at 2250Z, reaching the bottom at about 0101Z the following day (St. 54901#10).

Saturday 1 May

With the lander successfully deployed the ship then headed for the central station once more and the multicorer was deployed at 0228Z (St. 54901#11). In perfect coring conditions the counters on the winch system packed up just as the wire was starting to be paid out. It took half an hour to sort this problem, and the downcast was continued at 0258Z. The corer reached the seabed at 0430Z taking twelve cores, but on recovery of the corer at 0610Z all of them were found to be disturbed. As the weather was so good a second attempt was made immediately. The corer was outboard at 0652Z, on the bottom at 0826Z, and inboard at 1001Z (St. 54901#12). 12 good cores were obtained as well as a water sample using a 10L water bottle strapped to the corer frame. Another multicorer was deployed at 1156Z, on the bottom at 1324Z and inboard at 1457Z (St. 54901#13). Again there were 12 good cores and a water bottle sample. With this new-found success the multicorer was deployed again at 1536Z, reaching the bottom at 1705Z, and then returning to the deck at 1840Z (St. 54901#14) with another perfect set of cores and a water bottle sample.

The ship then made for a site some 40nm to the southeast of the BENGAL area to take the first “out of area” trawl, starting with an echo sounding run to determine whether there were any potentially dangerous seabed features which might impact on trawling operations.

Sunday 2 May

The trawl was deployed at 0034Z (54902#1) reaching the seabed at 0509Z and sampling until 0707Z. The trawl was inboard by 1012Z. Another good catch was obtained, but with some notable differences from the BENGAL area. *Amperima* was again abundant in this area, but most of the specimens were very small. There were also very few *Pseudostichopus villosus* and *Pseudostichopus sp.*, two species common at the central BENGAL locality. The trawl also recovered a well-bored wooden pallet, but at what depth this was collected is not clear.

The ship then proceeded northwards to an area about 40nm to the northeast of

BENGAL for another trawl starting at 2000Z.

Monday 3 May

The trawl reached the bottom at 0037Z and lifted off the seabed at 0242Z (St. 54903#1). A good catch was inboard by 0554Z, with many *Pseudostichopus villosus* and *Pseudostichopus sp.,* in contrast to the previous trawl. *Amperima* was present in abundance once more, although the specimens were larger and more like those collected at the BENGAL locality.

The ship then made for the central BENGAL locality and deployed the multicorer at 1024Z (St. 54904#1). The corer was on the seabed at 1214Z and was inboard once again at 1353Z with a full set of good cores. RRS *Discovery* had arrived at the BENGAL locality overnight and was waiting to sample macrofauna at the BENGAL central station using a box corer (see introduction). At the end of the multicore RRS *Challenger* cleared the area for RRS *Discovery* to start work setting course for the Goteborg Lander station, passing RRS *Discovery* on the way.

The Goteborg Lander was released at 1559Z. While the lander was ascending the ship moved a mile or so from the position and deployed a Bathysnap (St. 54904#2) at 1633Z. The Bathysnap reached the seabed at 1832Z. The lander was grappled at 1723Z and was all inboard without too much stress by 1737Z. The ship then made way for a station some 100nm north of the BENGAL site.

Tuesday 4 May

The ship reached the new sampling area at 0420Z and started an echo sounding survey to check the seabed for obstacles. None were apparent so the trawl was launched once the ship had turned on a reciprocal course at 0636Z (St. 54905#1). The trawl reached the bottom at 1028Z and fished until 1231Z. Hauling was then commenced and the trawl was inboard by 1524Z. The ship then hove to repair the steering mechanism before setting off for a port call in Galway at 1712Z. A party was held on board during the evening to celebrate a successful first leg despite the problems in Southampton and the subsequent poor weather.

Wednesday 5 May

The day was spent clearing up the labs in preparation for receiving visitors in Galway.

Thursday 6 May

The ship arrived in Galway at 0830Z (0930 local time). The Goteborg Lander was offloaded and some equipment for Leg 2 was taken onboard (box corer, Agassiz trawl and rock dredge). A party of some 30 students from the National University of Ireland, Galway were shown around the ship and given a talk on deep-sea biology and the aims for RRS *Challenger* Cruise 142. Unfortunately, because equipment was being manoeuvred on deck it was not possible to show the students the gear used in deep-sea studies. A reception was then held for senior members of the Martin Ryan Marine Institute and for post-graduate students that had collaborated with SOC in past European programmes. Professor Paul Tyler gave a lecture at the Martin Ryan Marine Institute in the late afternoon, followed by a reception hosted by the Marine Institute. A very pleasant evening was spent in Galway with colleagues and friends from the Martin Ryan Marine Institute.

Friday 7 May

The ship left Galway at 0830Z in good weather and steamed for a position on the northeast side of the Porcupine Seabight. A meeting was held to discuss the priorities for the second leg, including 1) the study of carbonate mounds and other seabed features, 2) additional sampling for the *Amperima* study, and 3) multicores from the northwest side of the Porcupine Seabight for time-series meiofauna research.

Saturday 8 May

The expected time of arrival on station at 0100Z was delayed to 0600Z by the weather, which had gradually deteriorated during the previous evening. The first task was to have been an echo sounding survey of a carbonate mound, involving several passes at right angles to each other. The sea state did not allow this, but partial success was achieved by adopting a suitable course relative to the weather over both a mound feature and a possible mud volcano (0640Z to 0751Z). The mound feature was not particularly striking and was either a domed or flat topped structure, perhaps with some coral on top (reduced 10kHz backscatter). The volcano mound, however, was a very dramatic haystack feature, with very low 10kHz return strength (?coral), about 800m in diameter and about 100m high.

As the weather did not permit the continued study of these mounds the ship then made for a position in 4250m water depth on the Porcupine Abyssal Plain, close to the mouth of the Porcupine Seabight. The trawl was prepared. However, the weather continued to deteriorate and by 0030Z (9th May) the ship was hove to in a Force 8 gale.

Sunday 9 May

The weather continued to deteriorate to Force 9/10 during the morning with 55 to 60 kts winds. No work was undertaken during the day.

Monday 10 May

With the wind still Force 6 to 8 no work was possible during the day.

Tuesday 11 May

The depression to the west of our position continued to move slowly northeast and fill leading to a gradual decrease in wind speed, although there was still a large swell running. At 0600Z the ship's speed was increased to about 4 kts heading for the start of the trawl position arriving at 1050Z. With a favourable weather report at 1000Z the net was shot at 1126Z with little effort in a Force 5 to 6 (St. 54906#1).

On the downward traverse of the trawl the acoustic monitor worked only intermittently, but the haul was continued. The trawl reached the bottom at 1530Z. The acoustic monitor suddenly started to behave perfectly. However, about 10 minutes into the trawl there was a brief increase in tension and thereafter the trawl appeared to fish erratically. The trawl lifted off the bottom at 1732Z, reaching the surface at 2108Z.

As the trawl doors came onboard it was clear we had a problem. Normally the trawl floats at the surface with just the cod end weighted down. In this case there was no sight of the net and the wires from the trawl doors led directly below the ship rather than streaming aft. As the net was retrieved it was clear that it had been torn from top to bottom. The cod end was retrieved followed by the bottom line and a few remnants of the net. The headline leading from the trawl doors, however formed a loop over the stern and it was clear that there was still a heavy weight attached to the wire. The deck was cleared of all personnel apart from the Chief Engineer (Safety Officer) and the Bosun. One side of the wire was cut, but still the weight remained on the headline. The wire was hauled in slowly. A large anchor was seen to break the surface before the line snapped under the weight and it disappeared once more into the gloom at 2144Z.

Despite this catastrophe the trawl was a success! It contained *Amperima rosea* (the most abundant animal) proving that this holothurian occurred widely on the Porcupine Abyssal Plain. The cod end also contained bits of wood and old hinges indicating that the net must have snagged a wreck on the seabed. With a few mangled wires, bits of netting and an ill acoustic monitor (retrieved on one of the trawl doors) it was decided to end the deep-water trawling work and head for shallower waters. The ship started a long steam for the northeastern corner of the Porcupine Seabight at 2158Z.

Wednesday 12 May

The ship arrived at the carbonate mound site in the northeast of the Porcupine Seabight at 1435Z and a WASP deployment was started at 1516Z (St. 54907#1) in rather rough seas so that the wire ran slack during much of the pay out. There was no indication of the depth of WASP from its acoustic monitor and when the system approached the seabed the altimeter also failed to work. The deployment was terminated and WASP was brought inboard again at 1643Z. WASP had suffered some damage.

The ship then re-positioned over the mound and a rock dredge was used to collect coral and associated fauna from off the top of the mound (St. 54907#2). The rock dredge was deployed at 1845Z, reached the bottom at 1913Z and was inboard again with a small catch at 2039Z. The dredge may have landed just downslope of the mound. During this haul a problem occurred with the winch metering system. Repairs were made between 2042 and 2228Z before a second dredge was deployed at 2315Z (St. 54907#3) resulting in a much better catch.

Thursday 13 May

The dredge reached the seabed at 0014Z and was inboard again at 0111Z. Problems with the winch metering system still occurred. In order to give time for WASP and the metering systems to be repaired the ship steamed at 0155Z to a site in the north of the Porcupine Seabight to investigate some carbonate mounds reported in that area. A detailed echo sounding survey was started at 0815Z lasting until 1018Z. From several passes a good echo sounding record was obtained over a complex mound group and a large ridge-like mound. There was some hope that the fault on WASP had been fixed so the ship steamed to one of the mound features noted on the echo sounding survey. WASP was launched at 1054Z (St. 54908#1), arriving at the bottom at 1119Z, but again the altimeter failed to work, so the deployment was aborted and WASP was retrieved at 1212Z.

In order to give time for the WASP system to have a thorough overhaul the ship proceeded at 1228Z to a station further south for a series of multicorer deployments. These cores were taken for a comparison with samples taken in the same area in 1982. The first two multicorers were deployed at 1612Z (54909#1) and at 1812Z (54909#2). With renewed hope that WASP might work the ship headed 4 nautical miles upslope to a location known to have a dense patch of sponges. WASP was deployed at 2006Z and reached the bottom at 2042Z (St. 54910#1). This time it worked perfectly and returned at 2220Z with 65 minutes video of the seafloor.

The ship then returned to the multicoring site and a further multicore deployment was made at 2328Z.

Friday 14 May

The multicorer was on the seabed at 0009Z (St. 54911#1) and returned with a full set of cores, as for the previous two deployments. The weather was improving with every passing hour. Perfect weather for coring and for WASP. Two further multicore deployments were made at 0125Z (St. 54911#2) and at 0322Z (St. 54911#3).

With the coring programme completed by 0455Z the ship then returned to the carbonate mound site in the northern part of the Seabight, arriving at 0900Z. WASP was deployed immediately at 0903Z (St. 54912#1). The system worked well, but an echo sounding error gave a false reading of the true depth of the bottom, resulting in the hard impact of WASP on the seabed. This proved terminal for the electronic monitor and the system had to be retrieved immediately, arriving on deck at 0952Z.

The box corer was then deployed at 1114Z to sample the seabed (St. 54913#1). As for WASP there were difficulties in determining the depth of the corer accurately because of the effect the mounds and their coral were having on the 10 kHz echo sounder. The core reached the seabed at 1137Z and obtained a small, washed-out sample mostly of coral/carbonaceous debris. Another attempt to use WASP was made at 1300Z (St. 54913#2), but the deployment was aborted while the system was still in surface waters. Another box corer was attempted reaching the seabed at 1408Z (St. 54913#3). It took a small sample, which washed out partially at the surface. There was some coral in the core.

Another attempt was made to get WASP to work starting at 1508Z (St. 54913#4), but the altimeter on WASP was still not making any sense and did not switch the camera on, so the deployment was aborted and WASP was brought back inboard at 1559Z. With evidence of coral in the area the rock dredge was then prepared and deployed at 1630Z (St. 54913#5), reaching the bottom at 1657Z. The dredge was towed until 1725Z and returned to the deck with a large catch of coral and associated fauna at 1800Z.

With no solution in sight for the WASP altimeter problems, the ship headed to the western side of the Seabight to fish a trawl in about 1450m depth. Following an echo sounding run over the intended trawling area the net was shot at 2348Z (St. 54914#1). The net reached the seabed at 0145Z and came off the bottom at 0257Z. When the trawl arrived on board at 0435Z there was a large catch, oozing slime through the mesh. There was an exceptionally large catch of all sorts of fish and a wide variety of invertebrates.

With this success in trawling the ship then headed into slightly deeper water for another trawl. On arrival on station the net was streamed to clean all the remaining slime off the net. The net was then deployed at 0918Z (St. 54915#1), reaching the seabed at 1146Z and coming off the bottom at 1250Z. On recovery at 1438Z the trawl doors were found to be crossed. It is likely this occurred when the net was shot. Only a very small catch was found in the cod end.

With a good long period to exam and test WASP, the ship then returned to the carbonate mounds in the northeastern part of the Seabight. WASP was deployed at 1832Z (St. 54916#1) and reached the seabed at 1903Z. The altimeter worked so a long pass of the mound was made ending at 2012Z. Unfortunately while a long run of still photographs was obtained the video failed to work. With WASP inboard at 2035Z the ship then proceeded to echosound an area for a sledge run. The area chosen had some strange furrow marks as seen on sidescan sonar, but was in an area surrounded by carbonate mounds.

Saturday 15 May

The sledge was shot at 0048Z (St. 54917#1). Based on the echosounding run the sledge was landed some half a mile before the target area at 0128Z and lifted off the seabed at 0212Z before it collided with the carbonate mounds directly ahead.

The net was inboard at 0236Z after a bit of a struggle to get the cod end over the transom. It was found to contain some exceptionally large rocks and a mountain of mud. Nevertheless it contained an interesting catch of fauna not normally sampled. The net had been torn badly and the collar on the bottom bar was almost totally abraded. The weak link had parted and the bottom bar was distinctly bowed.

Having sorted out the WASP video problems the ship then headed back to a carbonate mound and WASP was deployed at 0617Z (St. 54918#1). It had been found that by isolating a faulty pressure transducer the rest of the WASP system worked perfectly. WASP reached the seabed at 0650Z and both the altimeter and the video worked. The tow was terminated at 0853Z and WASP was inboard again at 0915Z. A spectacular video of the coral community had been filmed. It had been worth the wait.

The ship then headed to the western side of the Porcupine Seabight and surveyed a track for a photosledge. The sledge was then deployed at 1522Z (St. 54919#1) and reached the seabed at 1641Z. It behaved well on the bottom producing a long video of the seafloor.

The gear lifted off at 1815Z and was inboard at 1912Z and the ship then steamed for the carbonate mounds in the northern part of the Seabight, arriving at 2145Z. WASP was deployed immediately (St. 54920#1) and reached the seabed at 2211Z. Following a run lasting until 2321Z over the mound, WASP was recovered at 2342Z.

Sunday 16 May

With success in WASP operations at last, two more WASP runs were made on targets in the same general area. The first was over a mound and the surrounding sediment between 0225Z and 0334Z (St. 54921#1), and the second over a rather flatter mound with a different acoustic signature slightly further to the north (St. 54922#1) (0501Z to 0541Z). All three WASPS produced some excellent video. The final WASP was inboard at 0600Z and the ship immediately set course for Glasgow.

Monday 17 May

The day was spent clearing away the equipment and writing cruise reports. Clocks were advanced to British Summer Time.

Tuesday 18 May

A glorious day for viewing the coast of Northern Ireland and western Scotland.

Wednesday 19 May

Arrived at Govan 0900Z after a scenic tour of the Clyde. The cruise track chart is shown in Fig. 1.

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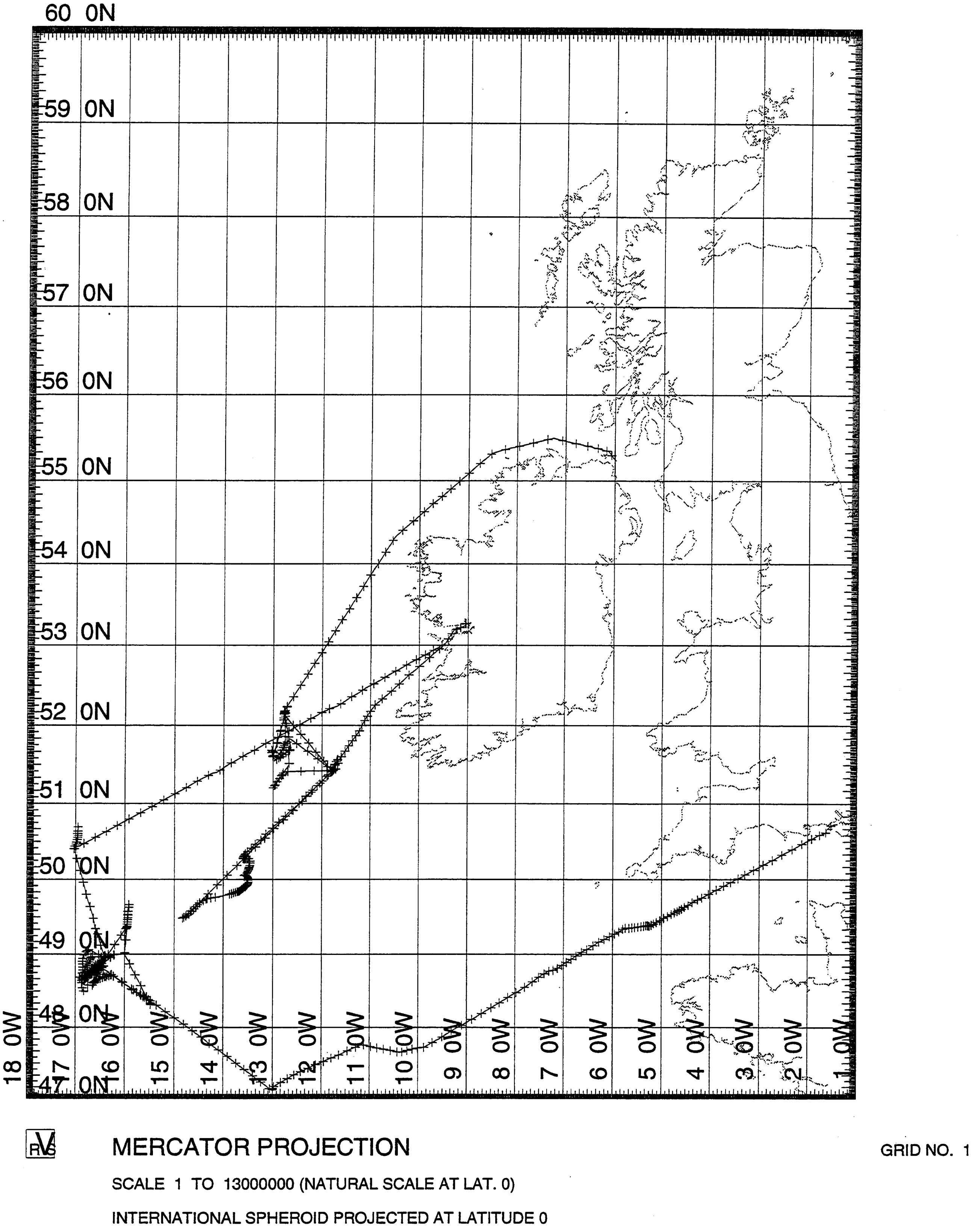

Figure 1. RRS *Challenger* Cruise 142 - chart showing cruise track.

SCIENCE REPORTS.

Otter trawl operations

The otter trawl (OTSB14) was fished seven times during the first leg of the cruise. The first deployment (54901#2) was fished in conventional fashion. The otter trawl was shot at a paying out rate of about 60 m/min with 4 to 4.5 knots recorded on the ADCP for the ship's speed (other logs, EM and GPS showing 5-6 knots). A total of 12,000m of wire were paid out. The telemetry from the trawl door monitor was good throughout showing touch down and lift off and all points between (good record on the Waverley thermal printer).

Prior to the second trawl (St. 54901#5) some 5000m of main warp were lost as a result of damage sustained during an aborted deployment of the multiple corer (see cruise narrative). With only 8000m of useable main warp remaining, it was necessary to modify the rigging of the otter trawl to continue fishing at abyssal plain depths (4850m). A 50m pennant was added inboard of the junction of the two standard trawling pennants. A depressor weight (chain clump, c. 150kg) was attached at the inboard end of the extra pennant. The complete rig is shown in Figure 2.

The launch (and in reverse the recovery) procedure is shown in schematic in Figure 3 (2 parts). The trawl was launched in the normal manner (Figure 3a-d) until the point where the 50m pennants was singled up to the main warp. The additional 50m pennant was then attached inboard of the swivel and the load transferred to the auxiliary winch carrying the extra pennant (Figure 3e-f). The extra pennant was then paid out. The main warp was then connected to the inboard end of the extra pennant via a swivel and large oval link and the load transferred to the main warp (Figure 3h-j). Finally the chain clump was connected to the oval link with a ‘Boss’ hook.

As far as could be ascertained by acoustic telemetry from the monitor in the starboard trawl door, there appeared to be no change in the fishing characteristics of the net with the addition of the depressor weight. The doors were partly face up during transits through midwater, transferring to up-right or partly face down when trawling on the bottom. Though stable on the seafloor, the door attitude was highly responsive to small changes in ship’s speed. A ship’s speed of 2.5 knots was found to be the most suitable. At the fished scope (the ratio of wire out to water depth) (c. 1.65), and with the 150kg depressor weight, the maximum fishing speed appeared to be approximately two knots.

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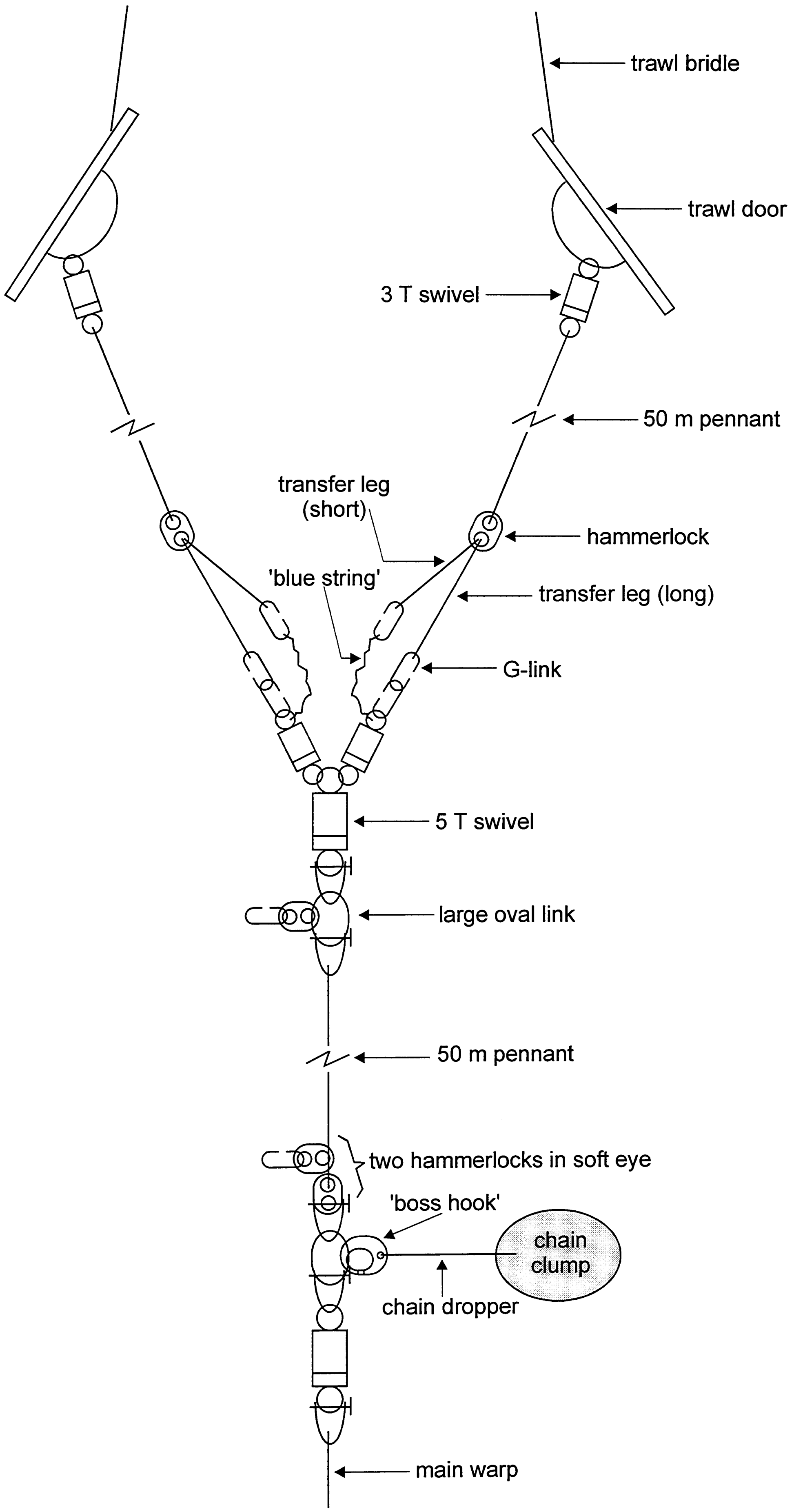

Figure 2. Semi-Balloon Otter Trawl (OTSB) design for use with a depressor weight (OTSB-D)

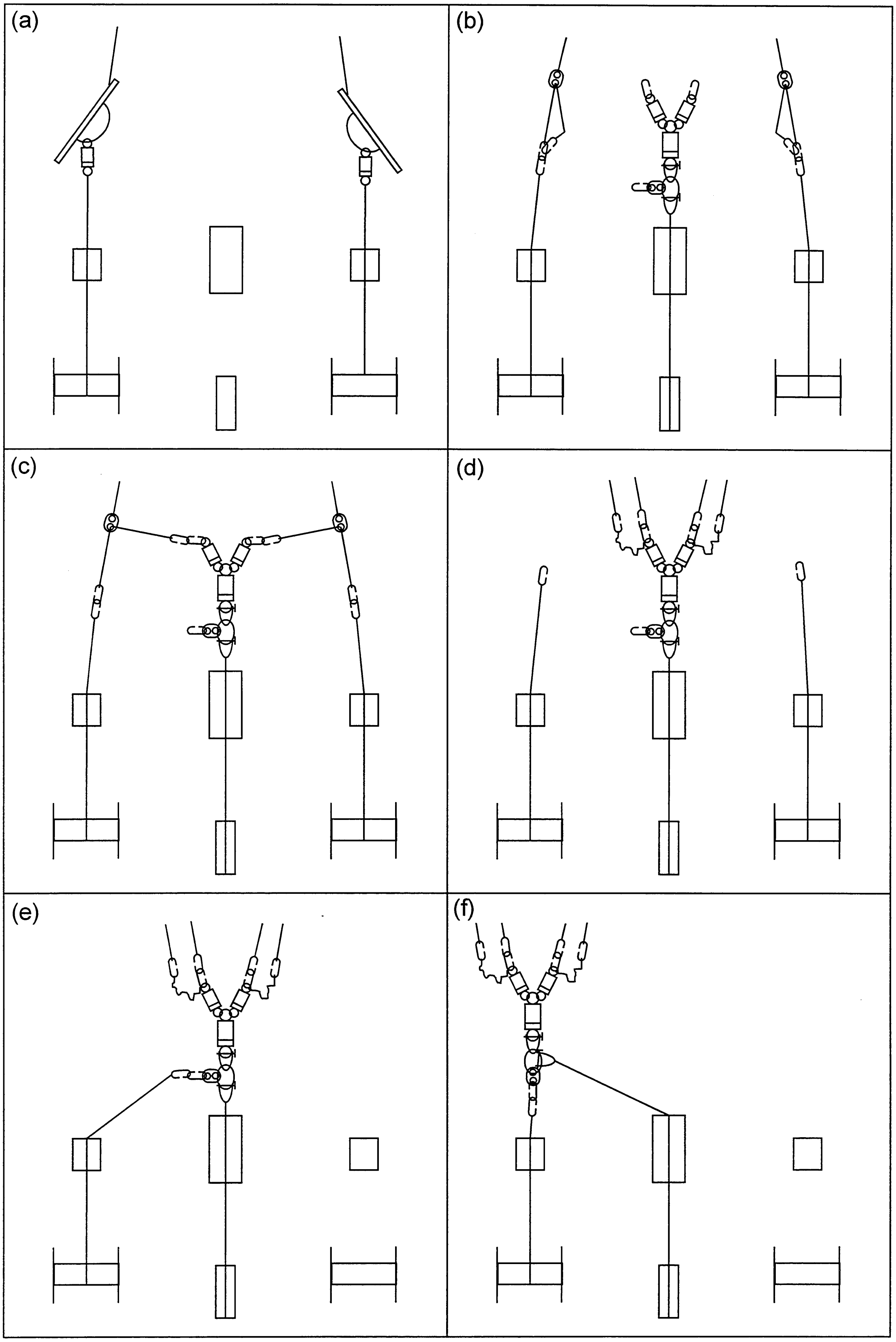

Figure 3. Schematic showing the launch (and in reverse recovery) procedure for OTSB-D

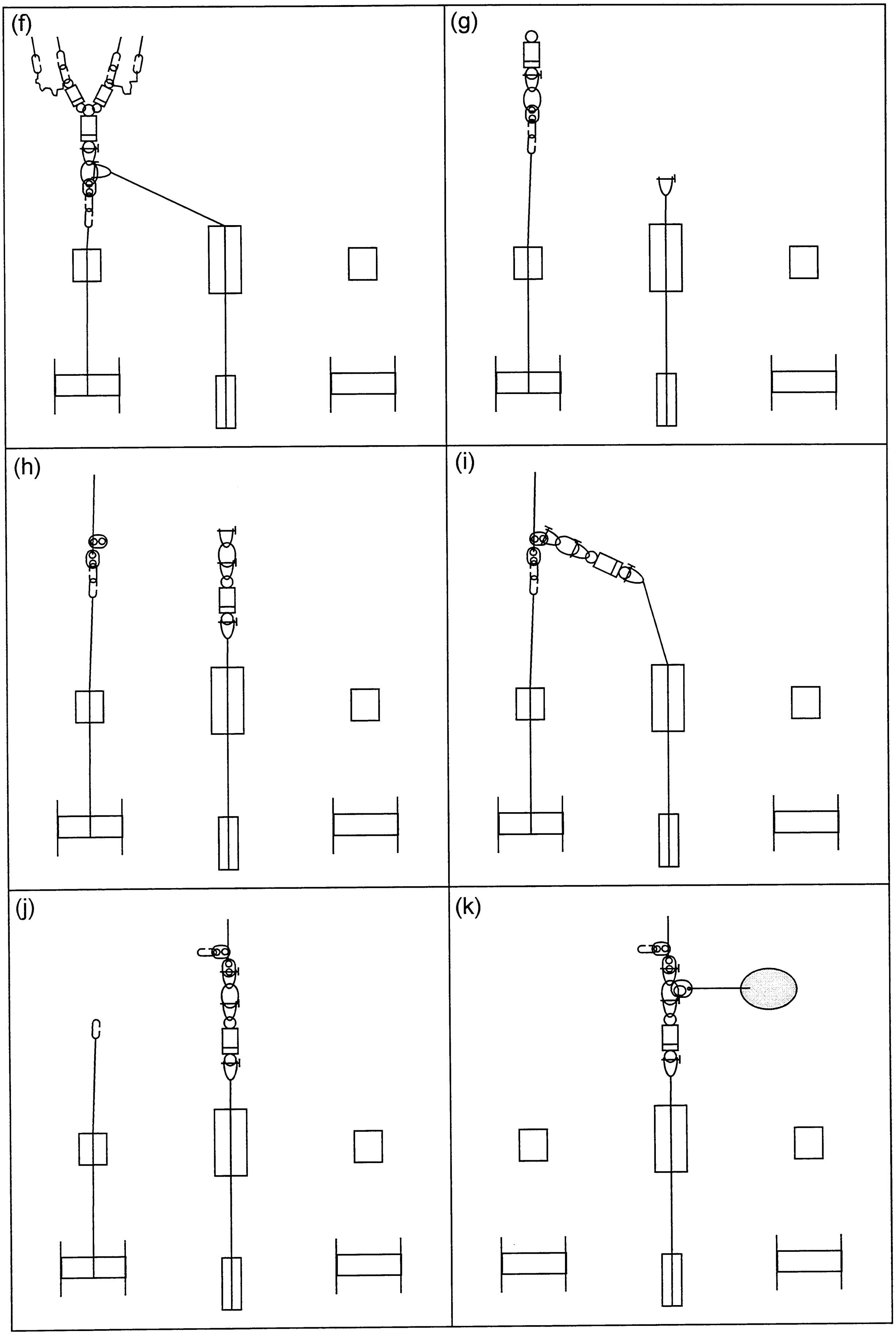

Figure 3. continued

No significant problems were encountered during launch, recovery or fishing. Telemetry of door attitude and depth provided clear indications of bottom contact and lift off during all seven trawls. Some problems were encountered with the telemetry during one haul (see report of acoustic operations), but overall telemetry was of a very high quality throughout the trawling operations, giving strong easily interpreted signals.

The trawl at St 54906#1 was rather unusual in that the net snagged a large anchor on the seabed. While the net streamed well when launched and fished properly for the first 5 mins or so on the seabed, suddenly there was an brief increase in tension and the monitor signals were lost for a period. When the traces reappeared the net was clearly fishing oddly, with the door face up or at 45 degrees up. Varying the ship's speed both up and down had no effect on the door angle. On recovery the body of the net it was found to be ripped to pieces, but the cod end was intact. There was a great weight on starboard footrope and port headrope. The port wire under tension was cut, but this did not release the deadweight. After much manoeuvering with the auxiliary winches a large anchor (admiralty pattern style) began to emerge from the water, but the headrope, taking all the load at that point, parted and the anchor returned to the deep.

BRIAN BETT

Otter trawl acoustic operations

Leg 1

A total of seven trawls to a depth of about 4850 m were carried out during Leg 1. The $LiSO_2$ battery packs were replaced before they exceeded 40 hours operation (three trawls) even though they would probably have been usable for one more trawl each. This was to avoid any unnecessary loss of time should the batteries have failed. Acoustic signals were monitored on the OTD waterfall display using the GDD waterfall box that had been set up for the Simrad output. A PES beam steering unit was also available and was needed for deployments beyond 7000 mwo. The waterfall box running directly through the PES fish had insufficient gain to monitor the OTSB beyond 7000 mwo, even with the beam steering facility. All the deployments were monitored with the RVS Waverley thermal printer, which after some minor modifications at the start of the cruise worked faultlessly. The MORS releases on the Bathysnap and the Goteborg Lander were also monitored on the waterfall, with the MORS TT301 deck unit transmitting through the hull transducer.

Only one problem held up operations. On the second trawl it was noticed that the traces appeared to jump intermittently, especially near the surface. The monitor was opened up but no obvious fault was found, and the fault did not reproduce itself in the laboratory. On the third trawl the traces became unreadable, with long periods of no signal at all. The gear was recovered and the monitor removed. On inspection the pressure transducer's plug was found to be shorting out one of the ICs when it vibrated more than a millimeter or two. A small piece of insulating tape that had been placed there at some time in the past had worn through. The tape was replaced with a more robust insulator and the gear was re-deployed. The problem recurred on the fourth trawl, although not as badly as before. The monitor was again removed after the trawl, and carefully tested to find the cause of the problem. At the same time the connector was filed down so that it would no longer be a problem. Several suspect wires were replaced, including the pressure switch lines and the power lines to the logic board. It proved impossible to get the fault to recur predictably, but after the wires had been replaced the fault did not occur again.

A second potential problem that was noticed was the presence of corrosion around the pressure transducer. This component will have to be dismantled and examined back in the laboratory, although it was deemed best left untouched for the duration of the cruise as no spare component was being carried onboard ship.

DAVE WHITE

Otter trawl samples

54901#2. First trawl at BENGAL site (Fig. 4). This trawl lasted a little over two hours on the bottom, giving a good clean catch with plenty of fish, including 14 large *Coryphaenoides armatus*, several *Histiobranchus* and *Alepocephalus* and a very good specimen of a snipe eel (?*Nemicthys*). The holothurian *Psychropotes longicauda* was the largest component of the invertebrate fauna, together with other holothurians *Oneirophanta mutabilis* and *Paroriza prouhoi* (Table 1). *Amperima rosea* was present, but in smaller numbers than found before in 1997 and 1998. Many specimens were in good condition and were used for reproductive and molecular genetics research.

54901#5. Second trawl at BENGAL site (Fig. 4). The catch looked like a big bag of mud, but the bulk was a large polythene bag of gravel. The bag of gravel contained dark olive sediment, distinctly different from the normal PAP stuff. Some of the olive mud was sampled for organic chemistry and half a shallow red tray was filled with the gravel and elutriated through 500 and 250 um mesh sieves. The mixed residues were retained and preserved in formalin. The catch was good for holothurians but light on fish (only a few small *Coryphaenoides armatus*). Of the holothurians *Psychropotes longicauda* and *Pseudostichopus villosus* dominated (Table 1). Other interesting holothurians included *Molpadia blakei*. The catch took a long time to be processed because of the gravel bag. Some of the samples for reproductive and molecular genetics work, therefore, were rather degraded before they were dissected.

54901#7. Third trawl at BENGAL site (Fig. 4). A good catch given the relatively short haul. There were a number of *Amperima rosea* in good condition, as well as *Psychropotes longicauda*, *Pseudostichopus villosus* and *Oneirophanta mutabilis* (Table 41). A single large *Coryphaenoides armatus* and a fine specimen of *Alepocephalus* were also obtained along with some smaller *Coryphaenoides* and two *Histiobranchus*. Of the invertebrates of note, other than the holothurians, there were several *Munidopsis*.

54901#9. Fourth trawl at BENGAL site (Fig. 4). A large catch of fish and invertebrates. The catch also contained something that looked like an expendable submarine surfacing aerial or sonar buoy. Holothurians dominated the catch (Table 1), notably *Amperima rosea, Psychropotes longicauda, Oneirophanta mutabilis, Pseudostichopus villosus* and a second species of *Pseudostichopus* (aff. *P. marenzelleri*). There were 5 large *Coryphaenoides armatus*, a lot of smaller *Coryphaenoides*, probably both *C. armatus* and *C. profundicolus*, and an excellent specimen of *Bathysaurus*, presumably *B. mollis*.

54902#1. The first of three trawls taken distant from the BENGAL locality; this one some 50km to the southeast (Fig 4). A good clean catch was obtained with quite a few fish, including one particularly odd and large fish probably of the family Ophioiidae, which had a heavy eel-like body and a very large head with two pairs of nostrils on a raised fleshy area. The pelvic fins were reduced to 1 or 2 rays whilst the anal and dorsal fins were long and extended to the tail. Of the other fish there were 2 *Histiobranchus*, 3 large *Coryphaenoides armatus* and one *C. profundicolus*. The holothurian *Amperima rosea* was particularly abundant, but all the specimens were very small. Curiously, the trawl was notable for the scarcity of either species of *Pseudostichopus*. Otherwise the trawl was similar to those taken at the BENGAL locality (Table 1). The catch also contained the top half of a well-bored pallet with many animals inside.

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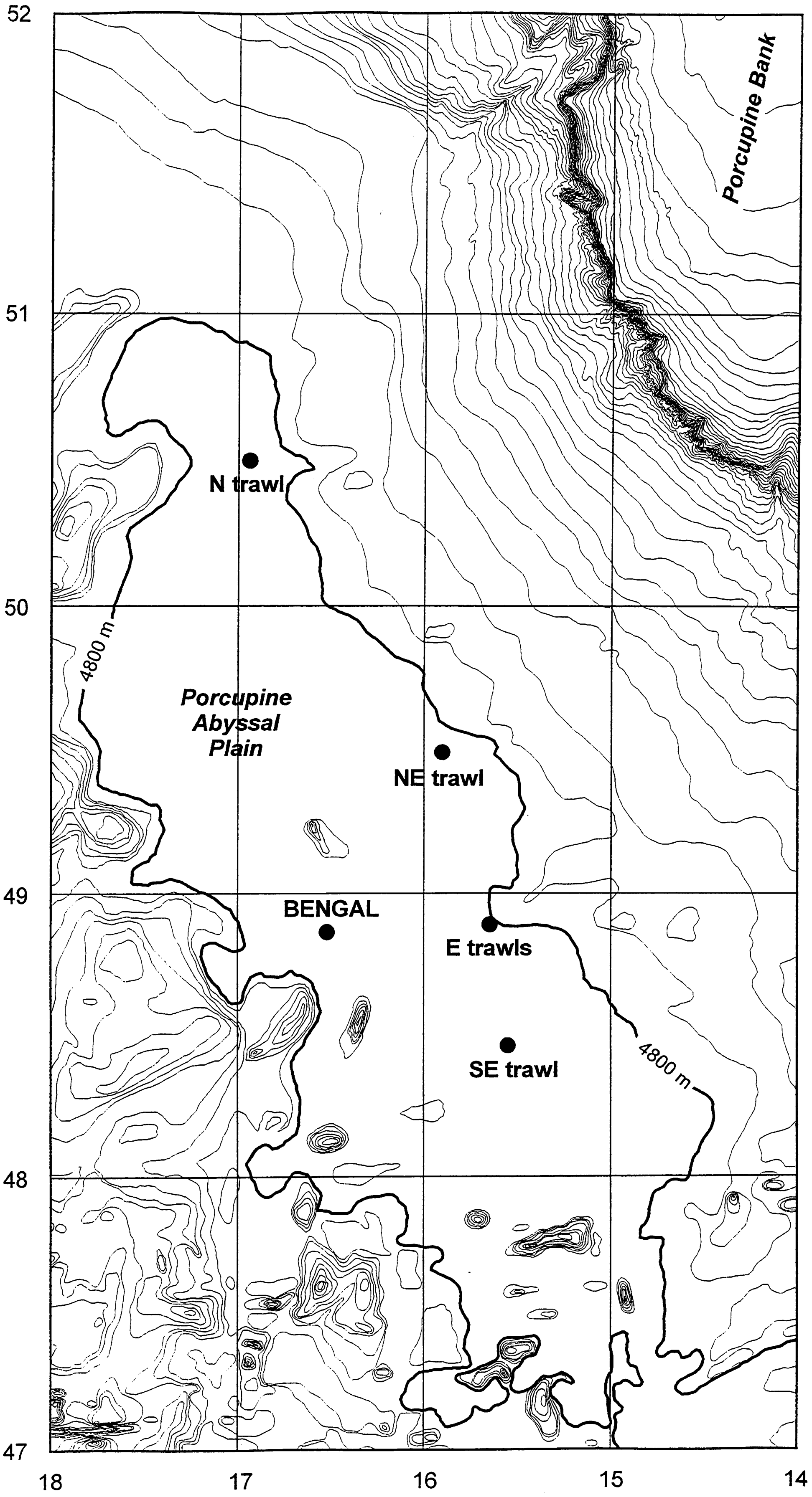

Figure 4. OTSB trawl positions showing BENGAL locality and other trawls sampled on the Porcupine Abyssal Plain

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TABLE 1.

Fresh weight biomass, corrected for area fished, for major taxonomic groups at the BENGAL locality and other trawls on the Porcupine Abyssal Plain

RRS Challenger Cruise 142 **19 April - 19 May 1999**		**54901#2**		**54901#5**		**54901#7**		**54901#9**		**54902#1**		**54903#1**		**54905#1**	
		Wet wt	per hectare 10.2489 hectares	Wet wt	per hectare 8.2114 hectares	Wet wt	per hectare 6.1482 hectares	Wet wt	r hectare 8.3964 hectares	Wet wt	per hectare 6.0337 hectares	Wet wt	per hectare 6.3680 hectares	Wet wt	per hectare 6.6844 hectares
PORIFERA				5.0	0.6			39.0	4.6	26.0	4.3	43.0	6.8	635.0	95.0
PENNATULACI	Umbellula	2.0	0.2	17.0	2.1	9.0	1.5	8.0	1.0	45.0	7.5			3.0	0.4
ACTINIARIA	Actinauge abyssorum	535.0	52.2	561.0	68.3	337.0	54.8	890.0	106.0	324.0	53.7	184.0	28.9	120.0	18.0
	Amphianthus bathybium	77.0	7.5	96.0	11.7	59.0	9.6	199.0	23.7	296.0	49.1	106.0	16.6	230.0	34.4
	Doantesia											102.0	16.0	148.0	22.1
	Iosactis	37.0	3.6	1.0	0.1	10.0	1.6	9.0	1.1	5.0	0.8	10.0	1.6	1.0	0.1
	Kadosactis	19.0	1.9	18.0	2.2	10.0	1.6	14.0	1.7			16.0	2.5	4.0	0.6
	Misc			36.0	4.4	15.0	2.4	30.0	3.6	1.0	0.2	40.0	6.3	4.0	0.6
	Segonzactis platypus	11.0	1.1					17.0	2.0	1.0	0.2				
	Sicyonis biotrans			175.0	21.3					451.0	74.7	3718.0	583.9	1971.0	294.9
	Total Actiniaria	**679.0**	**66.3**	**887.0**	**108.0**	**431.0**	**70.1**	**1159.0**	**138.0**	**1078.0**	**178.7**	**4176.0**	**655.8**	**2478.0**	**370.7**
MADREPORARIA		3.0	0.3	8.0	1.0	1.0	0.2	13.0	1.5	53.0	8.8	45.0	7.1	29.0	4.3
ZOANTHIDEA		8.0	0.8	5.0	0.6	14.0	2.3	19.0	2.3	1.0	0.2	15.0	2.4	15.0	2.2
ECHIURA		64.0	6.2	100.0	12.2	39.0	6.3	53.0	6.3			11.0	1.7	54.0	8.1
NEMERTINA												5.0	0.8		
SIPUNCULA		33.0	3.2	136.0	16.6	23.0	3.7	36.0	4.3	6.0	1.0	75.0	11.8	93.0	13.9
ANNELIDA	Polynoidae	97.0	9.5	80.0	9.7	101.0	16.4	129.0	15.4	67.0	11.1	273.0	42.9	130.0	19.4
	Worm tubes	77.0	7.5	64.0	7.8	18.0	2.9	291.0	34.7	190.0	31.5	195.0	30.6	249.0	37.3
	Total Annelida	**174.0**	**17.0**	**144.0**	**17.5**	**119.0**	**19.4**	**420.0**	**50.0**	**257.0**	**42.6**	**468.0**	**73.5**	**379.0**	**56.7**
CIRRIPEDIA		25.0	2.4	5.0	0.6	55.0	8.9	36.0	4.3	12.0	2.0	31.0	4.9	20.0	3.0
DECAPODA	Benthesicymus														
	Glyphocrangon							9.0	1.1	26.0	4.3				
	Paguridea/Zoanthidea							4.0	0.5	25.0	4.1				
	Munidopsis	21.0	2.0	83.0	10.1	59.0	9.6	149.0	17.7	149.0	24.7	105.0	16.5	139.0	20.8
	Natantia	242.0	23.6	63.0	7.7	137.0	22.3	304.0	36.2	157.0	26.0	197.0	30.9	324.0	48.5
	Plesiopeneus armatus	120.0	11.7					147.0	17.5			156.0	24.5	184.0	27.5
	Stereomastis			5.0	0.6	20.0	3.3	24.0	2.9			16.0	2.5	4.0	0.6
	Total Decapoda	**383.0**	**37.4**	**151.0**	**18.4**	**216.0**	**35.1**	**624.0**	**74.3**	**306.0**	**50.7**	**474.0**	**74.4**	**651.0**	**97.4**
ECTOPROCTA															
PYCNOGONIDA		10.0	1.0	1.0	0.1	2.0	0.3	26.0	3.1	2.0	0.3	1.0	0.2	5.0	0.7
GASTROPODA		2.0	0.2	4.0	0.5	14.0	2.3	8.0	1.0	11.0	1.8	46.0	7.2	9.0	1.3
SCAPHOPODA				1.0	0.1	2.0	0.3								
BIVALVIA		5.0	0.5	8.0	1.0			1.0	0.1			10.0	1.6		
CEPHALOPODA		786.0	76.7	29.0	3.5	88.0	14.3	60.0	7.1	2000.0	331.5	41.0	6.4	2910.0	435.3
ASTEROIDEA															
	Dytaster	428.0	41.8	355.0	43.2	184.0	29.9	100.0	11.9	179.0	29.7	363.0	57.0	257.0	38.4
	Freyella	3.0	0.3	5.0	0.6			5.0	0.6			12.0	1.9	31.0	4.6
	Freyastera	7.0	0.7	4.0	0.5	1.0	0.2	20.0	2.4	19.0	3.1	24.0	3.8	41.0	6.1
	Hyphalaster	107.0	10.4	309.0	37.6	125.0	20.3	207.0	24.7	6.0	1.0	207.0	32.5	80.0	12.0
	Pythonaster	24.0	2.3	25.0	3.0			32.0	3.8						
	Pterasteriidae											11.0	1.7		
	Styracaster	50.0	4.9	64.0	7.8	23.0	3.7	122.0	14.5	16.0	2.7	47.0	7.4	37.0	5.5
	Total Asteroidea	**619.0**	**60.4**	**762.0**	**92.8**	**333.0**	**54.2**	**486.0**	**57.9**	**220.0**	**36.5**	**664.0**	**104.3**	**446.0**	**66.7**
OPHIUROIDEA		27.0	2.6	30.0	3.7	81.0	13.2	59.0	7.0	3.0	0.5	6.0	0.9	1.0	0.1
ECHINOIDEA															
HOLOTHURIOI	Amperima rosea	1351.0	131.8	116.0	14.1	430.0	69.9	1284.0	152.9	3334.0	552.6	1318.0	207.0	1849.0	276.6
	Benthodytes sp			987.0	120.2	949.0	154.4	223.0	26.6					575.0	86.0
	Deima validum	119.0	11.6	819.0	99.7	296.0	48.1	559.0	66.6	325.0	53.9	423.0	66.4	620.0	92.8
	Ellipinion/Kolga	14.0	1.4	4.0	0.5			43.0	5.1			1.0	0.2	56.0	8.4
	Mesothuria candelabri	72.0	7.0	114.0	13.9	156.0	25.4	446.0	53.1			98.0	15.4	57.0	8.5
	Misc	4.0	0.4	2.0	0.2			6.0	0.7					61.0	9.1
	Molpadia blakei	60.0	5.9	488.0	59.4	163.0	26.5					219.0	34.4	250.0	37.4
	Oneirophanta mutabilis	8200.0	800.1	9047.0	1101.8	8910.0	1449.2	25200.0	3001.3	13750.0	2278.9	3600.0	565.3	7400.0	1107.1
	Paroriza prouhoi	3600.0	351.3	1785.0	217.4	2700.0	439.2	9500.0	1131.4			2100.0	329.8	427.0	63.9
	Peniagone	42.0	4.1			50.0	8.1	60.0	7.1	33.0	5.5	96.0	15.1	46.0	6.9
	Protankyra brychia	2.0	0.2	4.0	0.5	2.0	0.3	3.0	0.4						
	Pseudostichopus sp.	870.0	84.9	2291.0	279.0	740.0	120.4	2353.0	280.2	55.0	9.1	7100.0	1115.0	1600.0	239.4
	Pseudostichopus villosus	3000.0	292.7	11800.0	1437.0	2823.0	459.2	14064.0	1675.0	95.0	15.7	37000.0	5810.3	26500.0	3964.5
	Psychropotes longicauda	15800.0	1541.6	22800.0	2776.6	8500.0	1382.5	45800.0	5454.7	13300.0	2204.3	14100.0	2214.2	21900.0	3276.3
	Psychropotes semperiana			66.0	8.0			48.0	5.7	37.0	6.1	37.0	5.8		
	Total Holothuroidea	**33134.0**	**3232.9**	**50323.0**	**6128.5**	**25719.0**	**4183.2**	**99589.0**	**11860.9**	**30929.0**	**5126.1**	**66092.0**	**10378.8**	**61341.0**	**9176.8**
CRINOIDEA										2.0	0.3	3.0	0.5	11.0	1.6
TUNICATA		34.0	3.3	8.0	1.0	25.0	4.1	68.0	8.1	15.0	2.5	46.0	7.2	140.0	20.9
OTHER	Invertebrates	6.0	0.6	2.0	0.2	10.0	1.6			5.0	0.8	5.0	0.8	1.0	0.1
	Fish	37500.0	3658.9	452.0	55.0	3600.0	585.5	19000.0	2262.9	9000.0	1491.6	8735.0	1371.7	8200.0	1226.7
Total Invertebrates		**35994.0**	**3512.0**	**52488.0**	**6706.9**	**27148.0**	**3468.9**	**102668.0**	**13118.8**	**34958.0**	**4466.9**	**72169.0**	**9221.7**	**69116.0**	**8831.6**
GRAND TOTAL		**73494.0**	**7170.9**	**52940.0**	**6761.9**	**30748.0**	**4054.5**	**121668.0**	**15381.7**	**43958.0**	**5958.5**	**80904.0**	**10593.4**	**77316.0**	**10058.3**

54903#1. A trawl sample from some 50km to the northeast of the BENGAL locality (Fig 4.). There was a good catch somewhat different to the previous trawl, particularly in containing a large number of both species of *Pseudostichopus* (Table 1). *Amperima rosea* was fairly abundant, but again the specimens were mainly small. The fish catch was low, with only one large *Coryphaenoides armatus*, and a few small *C. armatus* and *C. profundicolus*. There was a lot of clinker.

54905#1. A trawl sample from 100km to the north of the BENGAL locality (Fig. 4). A good clean catch with plenty of fish was recovered. The fauna was very similar to that of the BENGAL locality. There were a lot of *Pseudostichopus villosus* and a fair number of *Psychropotes longicauda, Amperima rosea* and *Oneirophanta mutabilis.* Of the fish there were a large number (30+) of juvenile *C. armatus.* Other fish included *Bathypterois*, probably *B. longipes*, 8 *Histiobranchus bathybius* and another of the odd fish collected at St. 54902#1.

54906#1. The net was torn to shreds by a large anchor (see above and cruise narrative). However the cod end was retrieved and contained an interesting catch, particularly for a tow that can have lasted no more than 5 minutes. There were quite a few fish, including *Coryphaenoides armatus.* The most notable feature of the trawl was that the invertebrates were once again dominated by the holothurian *Amperima rosea*, as at the BENGAL locality even though the two sites were separated by a distance of 100km

54914#1. A successful trawl in shallower water that produced a huge slimy bag of holothurians, mainly *Benthogone rosea, Mesothuria lactea and Mesothuria sp. and Paroriza pallens.* There were many fish. A tentative identification of the fish was as follows:

Chimaera monstrosa (1)
Hariotta raleighana (1)
Apristurus sp. (1)
Lycodes crassiceps (a few)
Lepidion eques (2)
Paraliparis sp. (1)
? *Antimora rostrata* (a few) (small fish no barbel)
Alepocephalus bairdii (a few)
Alepocephalus rostratus (1)
Alephocephalus sp. (small very black fish)
Bathylagus euryops (a few)
Synaphobranchus kaupi (half a big red tub)
Polyacanthonotus challengeri (4)
Notacanthus bonapartei (3)
Hoplostethus atlanticus (2)

Cataetyx laticeps (2)
Trachyrhynchus murrayi (several)
Coelorhynchus occa (several)
Nezumia aequalis (several)
Chalinura sp. (several)
Coryphaenoides rupestris (a big black tub full).

54915#1. The trawl doors were found locked together on recovery of the trawl. There was no useful catch to speak of.

BRIAN BETT, DAVID BILLETT AND ALEX ROGERS

Amperima rosea (Elasipodida: Holothuroidea)

Samples of *Amperima rosea* from the cruise will be used for genetic, histological and biochemical analyses. The data will be useful in studying the population biology and ecology of *Amperima*. Specimens of *Amperima* were taken from each of the seven OTSB 14 trawls.

1. Genetics.

All specimens taken from the trawls were removed to the CT laboratory (4°C) as soon as possible after sorting. Hopefully this swift action prevented the degradation of enzymes and the digestion of DNA brought about by the increase in temperature and exposure of the specimens to UV light. Specimens were dissected and sections of tissue were placed in 2ml vials and were either frozen (-70°C) or immersed in 95% ethanol and refrigerated. The material taken from the *Amperima* specimens will be analysed initially by starch-gel electrophoresis to study the spatial genetic structure of the *Amperima* population(s) on the Porcupine Abyssal Plain. By comparing the results against the Hardy-Weinberg equilibrium we will be able to establish whether *Amperima* is sexually reproducing and outbreeding.

2. Histology.

The analysis of histological sections of the female gonad allows us to infer the mode and timing of reproduction for an individual animal or species. Analysis of numerous individuals from the same area can provide information on the synchrony, or asynchrony, of reproduction in a population. The gonads were removed from 100 individuals and preserved in Bouin's Fixative before transfer to 80% alcohol. Individual preservation of fresh gonad material will provide higher quality sections for the analysis of reproductive patterns. A number of gonads were also taken from the larger individuals from the "out-of-BENGAL area" trawls. These will be used to compare the reproductive state of individual *Amperima* from several sites on the PAP.

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3. Biochemistry

The dissected bodies of specimens taken from trawls 54901#2 and 54901#5 were individually labelled and frozen at –70°C. 30 samples of gonad, taken from trawl 54901#9, were also suitably labelled and frozen at –70°C. It is proposed that this material will be used to examine the total lipid and protein content of the body tissue and the gonads.

TABLE 2.
Uses *Amperima rosea* samples taken from seven OTSB14 trawls.

Station No.	Number of samples taken for genetics	Number of gonads taken for histology	Number of gonads taken for biochemistry	Number of animals taken for biochemistry
54901#2	50	50	0	50
54901#5	49	50	0	49
54901#7	51	0	0	0
54901#9	50	0	30	0
54902#1	70	6	0	0
54903#1	65	9	0	0
54905#1	65	24	0	0

BEN WIGHAM.

Gametogenesis, fecundity and biochemistry of deep-sea echinoderms from the Porcupine Abyssal Plain.

Specimens collected and analysis to be undertaken

Specimens of asteroids and holothurians were collected for reproductive analyses using the otter trawl. Two species of asteroids (*Styracaster elongatus* and *Hyphalaster inermis*) and three species of holothurians (*Pseudostichopus villosus, Oneirophanta mutabilis* and *Psychropotes longicauda*) will be analysed. The gonads were obtained from 5 to 20 specimens of each species. Specimens were identified, measured, sexed and dissected in the constant temperature laboratory (4°C).

For the asteroids, the arm radius (R) from the mouth to the tip of the arm, and the disc radius (r) from the mouth to the lateromarginal plates of the interradius, were measured to the nearest 0.1mm with calipers (Table 3). The specimens were dissected and the gonads were isolated. One pair of gonads was fixed in 10% formalin and then transferred to 80% alcohol, for histology. The other 9 pairs of gonads were frozen at –70°C for biochemical analyses.

For the holothurians, each individual was measured to the nearest 0.5cm, and weighed, either individually, as a subsample or as part of the total catch in the trawl (Table 4). The specimens were dissected and the gonads were isolated and frozen at –70°C for biochemical analyses. Other preserved, whole specimens will be used for histology in order to study gametogenesis and fecundity.

TABLE 3.
Relation of female and male specimens of two species of asteroids analysed from 5 different OTSB 14 trawls in the Porcupine Abyssal Plain.

	54901#2	54901#5	54901#7	54901#9	54903#1
Styracaster elongatus	1 female 2 males	2 females 1 male	2 females 1 male	3 females 1 male	2 females 0 males
Hyphalaster inermis	None	3 females 3 males	4 females 3 males	6 females 3 males	5 females 5 males

TABLE 4.
Relation of male and female specimens of holothurians analysed from 5 different OTSB14 trawls in the Porcupine Abyssal Plain. * In the specimens of *Oneirophanta mutabilis* analysed, some individuals were clearly females with ripe gonads, but in other there was no mature gonads present, just empty thin orange tubules. No mature males were found.

	54901#2	54901#5	54901#7	54901#9	54903#1
Pseudostichopus villosus	3 females 1 male 1 no gonad	6 females 3 males 1 no gonad	5 females 6 males	13 females 5 males	7 females 3 males
Oneirophanta mutabilis	2 females 3 males	5 females 5 non sexed*	12 specimens, all non sexed*	8 females from 30 individuals dissected	6 females from 29 individuals dissected
Psychropotes longicauda	4 females 1 male	5 females 5 males	None dissected	4 females 4 males 2 no gonads	None dissected

The histological analysis of male and female gonads will give further details on the gametogenesis and fecundity of these species. The data will be compared with earlier collections at the BENGAL site and with material from the Madeira Abyssal Plain, the Cape Verde Abyssal Plain and the NW Africa slope.

The biochemical analyses will quantify total lipids, total proteins, carbohydrates and the calorimetry of both, male and female gonads, in order to identify the energy dedicated to reproduction in the different species from the different sites.

Gross morphology of gonads

The observation of fresh specimens allowed the external gross morphology of the gonads to be described.

Styracaster elongatus and *Hyphalaster inermis* have 5 pairs of gonads attached to the interradius. The gonads are tubular, with bright orange tubules full of large oocytes in the females, and thinner, ramified tubules, white-cream in colour for the males.

In *Pseudostichopus villosus*, the females have a mass of transparent tubules were orange-pink oocytes of different sizes float free in the gonad. The males have long, thin, white-cream tubules full of sperm. In *Oneirophanta mutabilis*, the external morphology of female gonads is similar to that of *P. villosus*, with transparent tubules containing orange-pink oocytes. In this species, no mature males have been found, and all the specimens that were not clear females had small, orange tubules that seemed to be empty gonads, as has been found before in reproductive studies in this species. In *Psychropotes longicauda* the females have a pair of large globular ovaries while the males have tubular, ramified testis.

EVA RAMIREZ LLODRA

Analysis of the embryology of the holothurian *Pseudostichopus villosus* and the asteroids *Styracaster elongatus* and *Hyphalaster inermis*.

The embryology of deep-sea invertebrates is still poorly know, and there are no studies available on the early development of Porcupine Abyssal Plain (PAP) echinoderms. During this cruise, we have tried to fertilise eggs of one holothurian (*Pseudostichopus villosus*) and two asteroids (*Styracaster horridus* and *Hyphalaster inermis*) in the constant temperature laboratory at 4°C (the ambient temperature at 4800m on the PAP). The experiments were carried out at atmospheric pressure.

Pseudostichopus villosus

Several specimens of *P. villosus* were dissected and the gonads were isolated. The ovaries and testis were strip-spawned in small jars with cold filtered seawater, and the gametes were mixed in 600ml beakers. The eggs were large (±400µm) buoyant cells in good condition and the sperm, even though not very active, did show some movement under the microscope. After 45min, some eggs were fertilised and showed a wide fertilisation membrane. Four hours later, we observed the presence of a polar body. The cultures were kept in the cold room, but did not develop any further, and after 36 hours they were discarded.

Styracaster elongatus and Hyphalaster inermis

Several specimens of *S. elongatus* and *H. inermis* were induced to spawn by injecting 1ml of 1-Methyladenine 100μM, but there was no response. The gonads were then dissected out and strip-spawned in small jars with cold filtered seawater. The eggs were large (±500μm) buoyant cells, but the sperm did not show any sign of activity. The gametes were mixed in 600ml beakers, but there was no fertilisation, and after 36 hours the cultures were discarded.

MARIA BAKER & EVA RAMIREZ LLODRA

Molecular Biology

There are relatively few studies of the molecular ecology and evolution of deep-sea organisms. To date, those that have been carried out have largely utilised starch gel electrophoresis of allozymes and have generally focussed on commercially valuable fish (Creasey & Rogers 1999). Recently there has been a flurry of genetic research on hydrothermal vent-endemic organisms. These studies have ranged from population genetics (e.g. Creasey et al., 1996) to studies of evolution and biogeography. However, hydrothermal vents make up only a very small percentage of the deep-sea benthos and it is interesting to note that there are still only a handful of genetic studies on bathyal and abyssal organisms. Most of these studies are of little value as they have only a few sampling stations and very small sample sizes.

RRS *Challenger* Cruise 142 provided an excellent opportunity to sample benthic organisms from a number of stations on the Porcupine Abyssal Plain. Sampling was initially focussed on the BENGAL site but later shifted to several stations at progressive distances away. This will allow the analysis of spatial genetic structure in a suite of benthic species over the Porcupine Abyssal Plain. The data generated by these studies will be of relevance in understanding dispersal, reproduction and population dynamics of these species. In turn, the data also may provide insights into the mechanisms that have caused recent variations in the composition of the benthic community in this area. Such intensive sampling across an abyssal plain has not been carried out previously. The material collected on the present cruise therefore should provide a unique opportunity to study population genetics in abyssal organisms and will, hopefully, stimulate further research in this area within the SOC DEEPSEAS group.

Methods

Specimens were captured using the OTSB14. All specimens were removed to a constant temperature room (4-6°C) as soon as possible after sorting to prevent 1) the degradation of enzymes and 2) the digestion of DNA by DNAses after the death of the animals caught in the net. Specimens were dissected and muscle tissue removed from the body wall (fish) or from the longitudinal muscles lying in the body wall (holothurians). This tissue was placed into 2ml cryovials and either frozen or immersed in 95% ethanol and refrigerated. In the holothurian *Oneirophanta mutabilis* the oral tentacles and mouth parts / foregut were removed and frozen for electrophoresis. The main species sampled can be seen in Table 5.

TABLE 5.
Number of specimens sampled for molecular biology analyses (Leg 1).

	BENGAL	South of BENGAL	NE of BENGAL	North of BENGAL
Coryphaenoides armatus	45	13	7	36
Oneirophanta mutabilis	97	49	48	48
Psychropotes longicauda	57	49	50	50
Pseudostichopus villosus	52	-	-	-
Amperima rosea	200	70+	70+	70+

Other species were also sampled for molecular systematic studies and these included a number of other holothurians (e.g. *Deima validum Molpadia blakei*, *Pseudostichopus* sp.), squat lobsters (e.g. *Munidopsis* spp.) and fish (e.g. *Bathysaurus*, *Histiobranchus*, *Alepocephalus* sp.).

Research Experience on RRS Challenger Cruise 142

RRS *Challenger* Cruise 142 was the first cruise carried out by the DEEPSEAS group with an aim to collect organisms for genetic research. Our experience during the cruise will be useful in planning future research programmes. For example, we found that it took a long time to dissect and preserve animals mainly because of limitations on personnel. It will be useful in the future to have 2 or 3 people dedicated to this task so that the animals are preserved as quickly as possible. Secondly, the number of sampling tubes we had on board was inadequate. In future 400+ tubes should be taken for every trawl planned on the cruise. In addition 5L of ethanol were taken for the duration of the cruise. This amount should be doubled on future occasions. We also found that the Simport type of cryogenic tubes were inadequate for storing ethanol at sea because they leaked. Cryotubes with rubber O-ring inserts are recommended for future use (though they are more expensive). The time taken to label tubes was also found to be very long. In future some better method must be found to do this. The placing of labels inside tubes was time consuming but valuable as some labels on the outside of tubes had already worn off prior to the end of the cruise. Finally, we found that the dissection of deep-sea animals was a very messy business, mainly because of the presence of gut contents (abyssal mud) in the body cavity of many specimens. It is therefore recommended that many rolls of "kimwipe" towelling are taken (one per trawl) on future cruises.

Future Work

The organisms collected on the present cruise will be used in studies of spatial genetic variation across the Porcupine Abyssal Plain, in the first instance. Investigations are already underway in the Molecular Ecology Research Group at the School of Ocean and Earth Sciences, University of Southampton, on DNA sequencing and microsatellite analysis of *Coryphaenoides* spp. *Coryphaenoides* taken on RRS *Challenger* Cruise 142 will be used to establish the presence of a putative minisatellite region, that was discovered initially in *Coryphaenoides rupestris*, in other *Coryphaenoides* spp. They will also be used to assess the utility of microsatellites developed for *Coryphaenoides rupestris,* in the study of other Coryphaenoides spp. Finally, samples of *Coryphaenoides armatus* will be used to analyse spatial genetic structure in populations of this species from the Porcupine Abyssal Plain and other localities as more material becomes available.

Amperima rosea will be analysed in the first instance using starch gel electrophoresis. This will enable us to assess spatial genetic structure on the Porcupine Abyssal Plain and to assess fits to Hardy-Weinberg equilibrium. This will allow us to establish whether this

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species is reproducing sexually and outbreeding routinely. The studies will be interpreted in the light of data on the ecology and reproductive biology of this species.

Spatial genetic structure will also be analysed in *Oneirophanta mutabilis* and *Psychropotes longicauda*. Initially this analysis will be based on the Porcupine Abyssal Plain but efforts will be made to obtain specimens from other geographic locations to address questions regarding the distribution of these species in the world's oceans and whether they are truly cosmopolitan species.

ALEX ROGERS

Collection of tissue samples for genetic analysis (Leg 2).

Tissue sampling method.

All tools that came into contact with the sample were washed either in ethanol or water, then dried with tissue between every sample taken. This procedure minimized the chance of within and between species DNA contamination. In order to reduce the probability of human DNA contamination all dissection and post-dissection manipulation of samples was carried out whilst wearing gloves.

Coryphaenoides rupestris were measured (fork length) and then a strip of skin was removed from the flank of the fish. From the exposed skeletal muscle 2 samples were taken; one was preserved in 95% ethanol and the second was frozen at –70°C. The same procedure was repeated for each fish. The samples will be compared using microsatellite techniques to other samples being analysed at SOC by Marie le Goff.

Lophelia pertusa and *Madropora oculata*: Living coral masses of a large size were selected in preference to small pieces. Five or more polyps were broken from these masses and preserved in 95% ethanol. Dr Alex Rogers (SOC) will be studying the genetics of these samples.

Paroriza pallens, *Mesothuria* sp. and *Mesothuria lactea* (Holothuroidea). Individuals from these species were dissected and sections of longitudinal muscle were removed. Pieces of muscle tissue were placed in 2ml vials and either frozen at –70°C or immersed in 95% ethanol. The samples taken from *P. pallens* will be analysed in comparison to specimens collected from bathyal depths in the Bahamas. Samples of *M.* sp. and *M. lactea* are to be used to resolve taxonomic problems within the genus and within the family Synallactidae (order Aspidochirotida).

Cidaris sp. One specimen was preserved whole in ethanol to enable correct identification on return to SOC. Tissue samples were taken by breaking apart the test and removing the aristotle's lantern. The lantern was cut in half; one half was frozen at –70°C, and the other half was preserved in 95% ethanol.

Echinus sp. Tissue samples from individuals of this species were obtained using a similar protocol to that described for *Cidaris* sp. Genetic analyses of the samples taken from both these echinoid species will be carried out by Dr. Alex Rogers, in association with Prof. Paul Tyler (SOES, SOC).

In addition to these samples an unidentified ophiuroid, and a specimen of *Bathybiaster vexillifer* were preserved whole in ethanol for use in the construction of a genetic sample tissue library of deep-sea species (Dr Alex Rogers, SOES, SOC).

TABLE 6.
Number of specimens sampled for molecular biology analyses (Leg 2).

Station No.	Gear	Species	No. of specimens
54906#1	OTSB 14	*Coryphaenoides rupestris* *Munidopsis* sp	12 6
54907#2	R-Dredge	*Lophelia pertusa* *Madropora* sp	11
54907#3	R-Dredge	*Lophelia pertusa*	30
54913#5	R-Dredge	*Lophelia pertusa*	30
54914#1	OTSB 14	*Coryphaenoides rupestris* *Paroriza pallens* *Mesothuria* sp. *Mesothuria lactea*	50 30 30 30
54915#1	OTSB 14	unidentified ophiuroid *Bathybiaster vexillifer*	1 1
54917#1	BN 1.5/C (SLED)	*Cidaris* sp *Echinus* sp.	30 34

BRUCE STOCKLEY AND BEN WIGHAM

Multiple corer

Leg 1

Nine deployments of the multiple corer were carried out, all at the central BENGAL Site. Of these, three were unsuccessful (54901#1, 54901#6 and 54901#8), two probably because of the adverse sea conditions at the start of the cruise, and the third because of a problem with the winch cable (see Narrative). Deployment 54901#11 was partially successful, with 12 slightly disturbed cores obtained. The last four deployments (54901#12, 54901#13, 54901#14 and 54904#1), carried out during a period of calmer seas, were entirely successful.

All the successful cores were 28 to 35 cm deep, with core stratigraphy similar to that recorded on previous cruises to the Porcupine Abyssal Plain. There was a distinct discontinuity between dark brown sediment and an underlying lighter sediment at about 20 cm sediment depth. A few cores contained burrows. No phytodetritus was apparent in any of the cores. The cores were used for a wide variety of purposes (Table 7).

A 10-litre Niskin water bottle was attached to the multiple corer frame and rigged so that it fired when the corer hit the seabed. Water bottle samples were taken on deployments 54901#12, 54901#13, 54901#14 and 54904#1 for Anders Tengberg, University of Göteborg.

TABLE 7.
Summary of the uses of samples taken with the Multiple Corer on Leg 1

Station	Analyses	No. of cores
54901#11	Organotin analysis	1
	Benthic Foraminifera	3
54901#12	Microbiology	2
	Benthic Foraminifera	2
	Organotin analysis	1
	Organic Carbon	3
	Pore waters	3
54901#13	Microbiology	1
	Benthic Foraminifera	2
	Organotin analysis	2
	Organic Carbon	1
	Meiofaunal Studies	1
54901#14	Microbiology	1
	Benthic Foraminifera	1
	Organic Carbon	1
	Pore waters	3
54904#1	Benthic Foraminifera	10
	Pore waters	2

Leg 2

Five successful multicore deployments were carried out during a period of unusually calm weather on Leg 2 of RRS *Challenger* Cruise 142 (Deployments 54909#1, 54909#2, 54911#1, 54911#2 and 54911#3). Twelve good cores were recovered from all deployments (Table 8). These cores were generally 16 to 19 cm deep. All cores showed a similar pattern of light sediment in the surface 7.5cm, with darker sediment below this. A lighter band, around 0.5cm thick, was observed on the surface of all cores. The cores were mostly flat, although some were slightly sloping or uneven, and some contained animal burrows. All cores contained phytodetritus, varying in amount from a light dusting to a layer 3mm thick, although most contained only a small amount.

As on the First Leg, a 10-litre Niskin water bottle was attached to the multiple corer frame and rigged so that it fired when the corer hit the seabed. All water obtained was used in invertebrate incubation experiments.

TABLE 8.
Summary of the uses of samples taken with the Multiple Corer on Leg 2.

Deployment	Analysis	No. of cores
54909#1	Benthic Foraminifera Organotin analysis Meiofaunal Studies Macrofauna	5 1 1 5
54909#2	Benthic Foraminifera Organotin analysis Meiofaunal Studies Macrofauna	5 1 1 4
54911#1	Benthic Foraminifera Organotin analysis Meiofaunal Studies Macrofauna	5 1 1 5
54911#2	Benthic Foraminifera Organotin analysis Macrofauna	5 1 4
54911#3	Benthic Foraminifera Meiofaunal Studies Macrofauna	5 1 2

Benthic foraminifera

For the quantitative analysis of benthic foraminifera, cores were sliced in 0.5cm sections down to 2cm sediment depth and in 1cm sections below this, to a maximum depth of 15cm (54909#1) or 10cm (all other deployments) (Table 9). The surface 1cm was retained from additional cores to provide material for a study of small-scale spatial variability. All samples were fixed in 4% buffered formalin.

On the second leg (Table 8), five cores were taken from each deployment for the quantitative analyses. Four cores were sub-sampled using a 25ml cut-off syringe. After cooling in a -20°C freezer, the syringe sub-cores were sliced in 1cm sections to 5cm sediment depth. All samples were fixed in 10% buffered formalin.

TABLE 9.
Details of samples retained for the study of benthic foraminifera

Station	Details
54901#11	1 core sectioned to 10 cm sediment depth 2 cores sectioned to 1 cm sediment depth
54901#12	1 core sectioned to 15 cm sediment depth 1 core sectioned to 10 cm sediment depth
54901#13	2 cores sectioned to 10 cm sediment depth
54901#14	1 core sectioned to 10 cm sediment depth
54904#1	1 core sectioned to 10 cm sediment depth 9 cores sectioned to 1 cm sediment depth

Organotin analysis

The 0 to 0.5 cm section was removed from four cores and frozen at -20°C for the analysis of organotin on return to SOC.

Pore Waters

Pore waters were extracted from four cores by centrifuging at 4°C, at 2400 rpm for thirty minutes. The extracted pore waters were then passed through a 45µm filter, before being stored for a variety of analyses (Table 10)

TABLE 10.
Pore water samples from Leg 1.

Sample	Type of sample	Slicing specifications	Sample storage
1 54904#1	Pore water for Nutrients	0-2 (5 mm); 2-10 (10 mm) 10-20 (20 mm)	Frozen in acid washed vials.
2 54901#12	Pore water for Alk	0-2 (5 mm); 2-10 (10 mm) 10-20 (20 mm)	Chilled in MQ rinsed vials
3 54904#1	Pore water for DOC and DON	0-2 (5 mm); 2-10 (10 mm) 10-20 (20 mm)	Frozen in acid washed vials for DOC. Frozen in Eppendor for DON
4 54901#14	Pore water for Calcium	0-2 (5 mm); 2-10 (10 mm) 10-20 (20 mm)	Chilled in MQ rinsed vials

Meiofaunal Studies

One core from each of the multiple corer deployments at Stations 54901#13, 54909#1, 54909#2, 54911#1 and 54911#3 was taken for Dr. A. Vanreusel, University of Gent, for use in metazoan meiofaunal studies. The top 2cm of the core was removed and separated into equal halves. One half was fixed in 4% buffered formalin and the other half was fixed in carnoy fixative.

Macro-infauna

A selection of cores from each of the deployments were examined for benthic macro-infauna. The top 5 cm of the cores were passed over a 300 µm mesh and all animals found were retained and fixed in 10% formalin.

ALAN HUGHES, MARK HARTL AND ANDERS TENGBERG

Organic sediment geochemistry (University of Liverpool)

Sediment samples from 3 multiple corer deployments were collected for the University of Liverpool (Table 11). The cores were sectioned as follows: 0-5mm, 5-10mm, 10-20mm, 20-30mm, 30-40mm, 40-50mm, and 50-60mm. The sediment samples were stored in solvent-rinsed, foil-wrapped petri dishes. All samples were stored at -70°C.

TABLE 11.
Sediment samples taken by The University of Liverpool. The cores will be analysed for molecular organic chemistry.

Date	Station number	Position	No. of cores
01/05/99	54901#12	Central BENGAL	3
01/05/99	54901#13	Central BENGAL	1
01/05/99	54901#14	Central BENGAL	1

Biological samples (University of Liverpool)

Holothurians were collected from various trawls (Table 12). 8 Specimens were dissected: 2 *Oneirophanta mutabilis,* 2 *Psychropotes longicauda,* 2 *Pseudostichopus villosus,* 1 *Paroriza prouhoi* and 1 *Molpadia blakei.* Sediment from four gut regions; oesophagus, anterior, posterior intestine and the rectal region, were collected and stored in foil-wrapped, solvent-rinsed petri dishes. Samples of body tissue and the gut walls were also taken. From these samples we hope to determine the feeding strategies of the animal by determining the concentration of labile organic matter in each gut region. The tissue samples will be used in biochemical studies. All samples were stored at -70°C.

TABLE 12.
Holothurian samples taken for the University of Liverpool.

Date	Station number	Species	No. of animals	Use
26/04/99	54901#2	*Oneirophanta mutabilis*	4	3 frozen whole 1 dissected
26/04/99	54901#2	*Paroriza prouhoi*	4	4 frozen whole
26/04/99	54901#2	*Psychropotes longicauda*	4	3 frozen whole 1 dissected
26/04/99	54901#2	*Pseudostichopus villosus*	4	4 frozen whole
28/04/99	54901#5	*Deima validum*	1	1 frozen whole
28/04/99	54901#5	*Oneirophanta mutabilis*	2	1 frozen whole 1 dissected
28/04/99	54901#5	*Psychropotes longicauda*	1	1 frozen whole
28/04/99	54901#5	*Pseudostichopus villosus*	1	1 dissected
28/04/99	54901#5	*Pseudostichopus* sp.	3	3 frozen whole
29/04/99	54901#7	*Oneirophanta mutabilis*	2	2 frozen whole
29/04/99	54901#7	*Psychropotes longicauda*	1	1 dissected
29/04/99	54901#7	*Paroriza prouhoi*	1	1 dissected
29/04/99	54901#7	*Pseudostichopus villosus*	2	1 frozen whole 1 dissected
29/04/99	54901#7	*Molpadia blakei*	1	1 dissected
30/04/99	54901#9	*Psychropotes longicauda*	1	1 frozen whole
30/04/99	54901#9	*Molpadia blakei*	1	1 frozen whole
30/04/99	54901#9	*Pseudostichopus* sp.	2	2 frozen whole
30/04/99	54901#9	*Deima validum*	2	2 frozen whole
30/04/99	54901#9	*Amperima rosea*	20	20 frozen whole
02/05/99	54902#1	*Oneirophanta mutabilis*	3	3 frozen whole
02/05/99	54902#1	*Psychropotes longicauda*	2	2 frozen whole
04/05/99	54905#1	*Amperima rosea*	21	21 frozen whole

RENATO NETO

Microbiology (National University of Ireland, Galway).

Holothurians

Samples of gut contents were taken from four regions of gut for each of three species of holothurian during the course of this cruise as well as sections of gut wall and bacterial count samples. The three species chosen were *Oneirophanta mutabilis* (St. 54901#2), *Psychropotes longicauda* (St. 54901#5) and *Pseudostichopus villosus* (St. 54901#2). The gut was divided into four sections; the oesophagus, anterior intestine (foregut), posterior intestine (midgut) and the rectum (hindgut). In all cases the samples were preserved in glycerol (40% v/v) and frozen for laboratory analyses of bacterial community structure using nucleic acid based techniques. Sub-samples of 1 ml of each gut region were preserved in a final concentration of 2% (v/v) formalin and stored at 4°C for bacterial enumeration using epifluorescence microscopy. Sections of the gut wall from the four regions were stored in glycerol and frozen for *in situ* hybridisation studies. Gut contents were sourced as follows

Sediment

Sediment samples were collected with the multiple corer and sectioned at 1cm intervals down to 5cm depth. Sub samples of 1 ml were taken from each of the 1cm sections and preserved at 4° C in 2% formalin (v/v) for determination of bacterial numbers by epifluorescence microscopy. Samples sections, which were taken for bacterial community structure analysis via nucleic acid based techniques, were heat-sealed in whirlpak bags, frozen immediately and held at -20°C (Table 13).

TABLE 13.
Sediment samples taken for microbial community structure analysis

Station	No. of cores for DNA analysis
54901#12	2
54901#13	1
54901#14	1

It had been hoped to carry out a bacterial population adaptation experiment on water samples from 150m and sediment contact water. However, electronic failure of the water pump for the tangenital flow system prevented the ability to concentrate the water samples and thus to carry out the experiment.

JOE GALLAGHER

Bathysnap

The planned Bathysnap operations included:

a) Recovery of a Bathysnap deployed on RRS *Discovery* cruise 231 (St. 13370#8)

b) Deployment of a replacement unit (no recovery currently scheduled)

Recovery of Bathysnap 13370#8 commenced at 07:27Z 27 April 1999 with the successful release of the unit (MORS OEM release firing two pyros). The rig ascended at 73 m/min and surfaced at 08:27Z. The recovery proceeded without incident until the support frame was recovered to the deck where it fell over crushing the camera's bulkhead connector. During handling on deck the flash unit was seen to fire because contact with the pins caused an electrical short. The film was successful.

The rig to be deployed was refurbished as follows:

1. The camera and flash were replaced with units P5-02, which were prepared by Nigel Griffin of Ocean Instrumentation Limited. Both camera and flash having been rebatteried, the camera fully loaded with Eastman Kodak Vision 250D, databack time and date corrected and the camera's timing set to 288 minutes (5 frames per day: module C switch 7), focus was set at 1.3 m and aperture to f8.

2. The release was replaced by MORS OEM serial number 59, which had been prepared by Ian Waddington (George Deacon Division, SOC). This unit was successfully wire tested at the start of the cruise. The release's significant codes are:

ON	64C2
REL1	64C1+6411 (15s, 60s)
PYRO	64C1+6421 (15s, 60s)
PING	64CD
OFF	64C3

3. Mooring lines, other than the lazy line, were replaced by new 16 mm diameter white braid line spliced with hard eyes each end (supplied by Ian Waddington, George Deacon Division, SOC). All shackles and egg links were replaced.

4. The main buoyancy pack and its associated swivels were replaced. The middle float pack of the recovered buoyancy pack having a cracked hard hat.

The replacement Bathysnap was deployed as station 54904#2 at 16:32Z 3 May 1999 at position 48 58.8 N 16 24.6 W with a sounding of 4810 ucm (Fig. 5). The rig sank at some 40 m/min. The time of bottom contact could not be ascertained but was estimated to have occurred at approximately 18:30Z 3 May 1999. Prior to deployment two flash fires were witnessed: 04:33:12Z 3 May 1999 and 14:09:12Z 3 May 1999; the intervening flash fire was not monitored.

BRIAN BETT

Dredges

A rock dredge was used to collect coral and associated fauna from off the top of the carbonate mounds in the Porcupine Seabight. On the first deployment (St. 54907#2) the dredge may have landed just downslope of the mound. Corals (*Lophelia* and *Mardepora*) were present, together with bryozoans and a few large polychaetes (euncinid). The second dredge (St. 54907#3) was deployed further off the mound and held off until over the approximate top of the mound by echo sounder signature and depth. This produced a much better catch. The bag contained a good quantity of coral and associated debris and the bucket was nearly full with claggy mud and some sand. Prior to deployment tangles had been added to the dredge by attaching two hanks of the wrecked OTSB net and a polypropylene rope tangle. The net hanks worked very well returning a very fine gorgonian, but the rope was not so successful. Live coral and plenty of 'associates' were taken. A large sample of coral and associated fauna was taken at St. 54913#5.

BRIAN BETT

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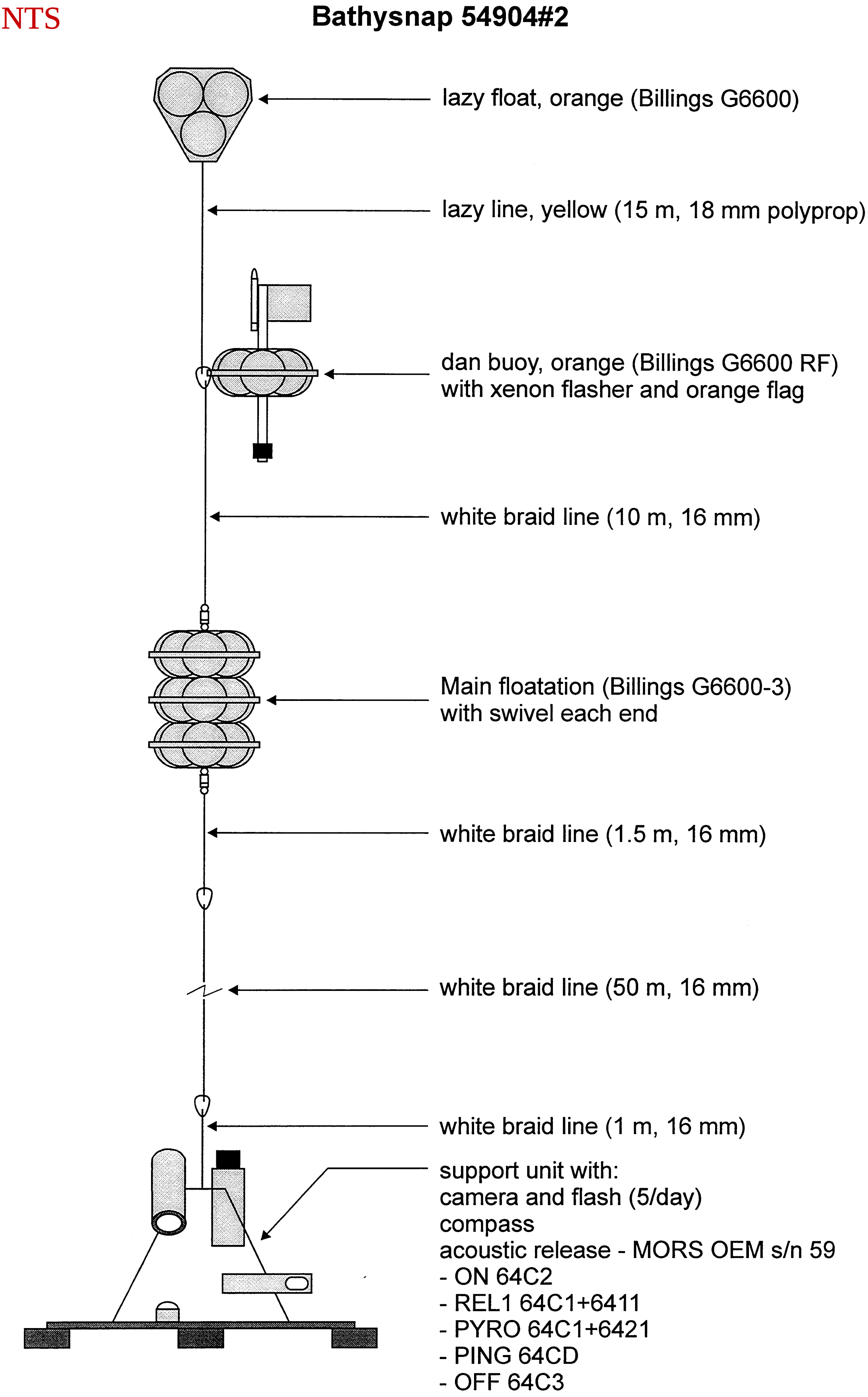

Figure 5. The Bathysnap mooring system.

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Photography

Summary of photographic deployments (WASP and sledge) made during RRS *Challenger* cruise 142 are listed in the table below.

Deployment	Date	Depth (m)	Video	Stills	Details
54907#1 WASP	12-5-99	Na	X	X	Camera failed. Aborted.
54908#1 WASP	13-5-99	na	X	X	Camera failed. Aborted
54910#1 WASP	13-5-99	1175-1200 m	✔	✔	Deployed over area of dense sponge populations. Both still and video photography provide good images. Dense phytodetritus in suspension reduces visibility. Thick layer of phytodetritus on the seabed and dense aggregations of sponges present throughout the deployment. 65 minutes of photography.
54912#1 WASP	14-5-99	Na	X	X	Heavy impact with seabed. Aborted.
54913#4 WASP	14-5-99	na	X	X	No pressure or altimeter telemetry. Aborted.
54916#1 WASP	15-5-99	919-950 m	X	✔	Video camera failed. Still photos provide good images of coral-based communities. 65 minutes of still photos.
54917#1 BN1.5/P	16-5-99	727-780 m	✔	✔	Deployed in the vicinity of a mound. Photography shows gravely sand substratum with current induced bed forms. Patches devoid of gravel showing well defined bed forms. Little visible fauna. 65 minutes of photography.
54918#1 WASP	16-5-99	860-984 m	✔	✔	Deployed on a mound. Photography provides good images of coral-based communities. 65 minutes of photography.
54919#1 BN1.5/P	16-5-99	1295-1341 m	✔	✔	Deployed over site on the west bank of the Porcupine Seabight. Soft sediment with layer of phytodetritus varying in thickness during deployment. Extensive lebensspuren / bioturbation. 65 minutes of photography.
54920#1 WASP	16-5-99	725-800 m	✔	✔	Deployed on a carbonate mound. Photography shows intermittent patches of thick coral debris and smooth sandy sediment with small patches of live coral. A number of boulders also noted. 65 minutes of photography.
54921#1 WASP	17-5-99	700-845 m	✔	✔	Deployed on and in the vicinity of a mound. Photography shows fine sediment with extensive lebensspuren / bioturbation. Briefly passes over patches of dead and live coral. 65 minutes of photography.
54922#1 WASP	17-5-99	640-750 m	✔	✔	Deployed on a mound (of different acoustic signature?). Photography shows a fine sediment with a thin layer of phytodetritus, only a few thin patches of coral debris. 40 minutes of photography.

BRIAN BETT

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The carbon cycle on the seafloor - GÖTEBORG LANDER

Introduction

One of our major goals within the recently completed European Union BENGAL and ALIPOR programmes (MASTIII) was to study the carbon cycle at the sea floor in a "typical" deep-sea environment (the Porcupine Abyssal Plain, PAP). Results obtained by the University of Göteborg during 5 expeditions to the PAP had indicated that Dissolved Organic Carbon (DOC) fluxes between the sediment and the overlying water played a major role in the remineralization of organic material (e.g. phytodetritus) (see Fig 6). DOC accounted for up to 50 % of the total carbon flux from the sediment. Previous investigations in the deep sea had either disregarded DOC fluxes because they were thought to be insignificant, or estimated the carbon recycling rate from the uptake of oxygen, which is not coupled to the release of DOC.

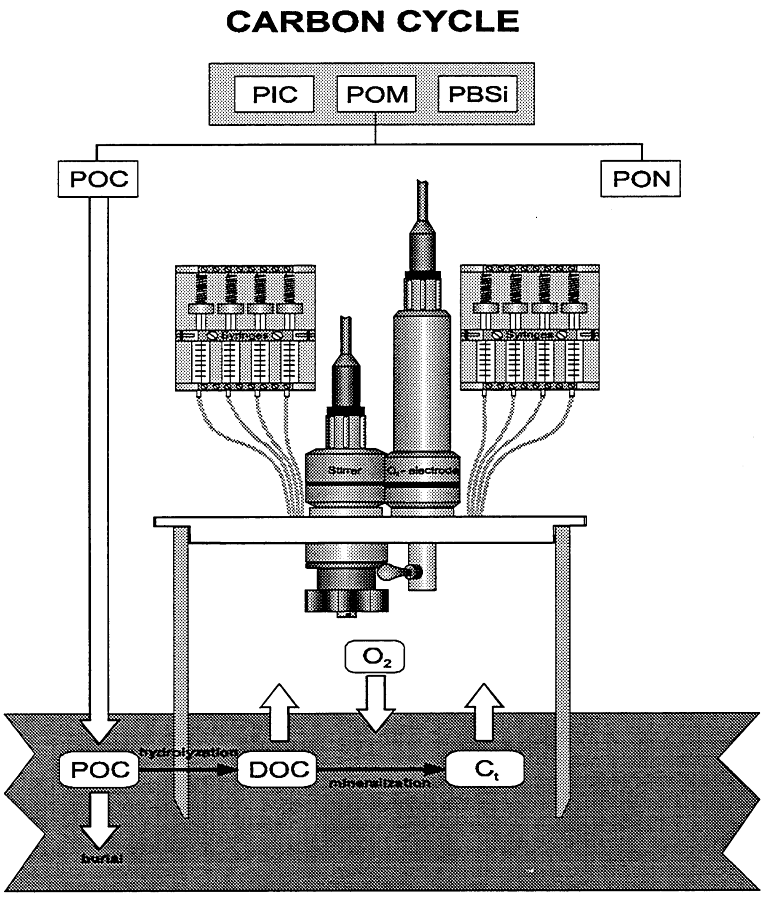

Figure 6. The sediment carbon cycle

In order to confirm or disprove the previous BENGAL/ALIPOR results on DOC fluxes the University of Göteborg participated on RRS *Challenger* Cruise 142 to estimate

DOC fluxes using an autonomous benthic lander as the main experimental device. This instrument (the Göteborg Lander) takes water samples in incubation chambers with the aim to directly measure sediment-water exchange rates of oxygen, total carbonate (C_T or ΣCO_2), alkalinity (A_T), Σnitrate, ammonium, silicate, phosphate, calcium, dissolved organic nitrogen and dissolved organic carbon (DOC) *in-situ*. In addition, by collecting sediment with a multiple corer, pore water distributions were determined for the above solutes. Samples of bottom water were collected with a Rossette bottle (mounted on the multiple corer) and analysed for all the above given solutes. Furthermore during one of the lander deployments a prototype of an acoustic deep sea current meter (RCM 11 from Aanderaa Instruments, Norway) was used to collect current speed and direction data 2.2 m above the bottom throughout the deployment.

Materials and methods.

The Göteborg Lander.

The Göteborg Lander is a modular system where one or several of the four experimental modules (with sampling syringes, electrodes, stirring motors etc.) can be exchanged as desired (chamber, gel peeper and microelectrode modules have been used on other expeditions). During this expedition, the lander was equipped with four squared benthic chamber modules each capable of closing off an area of 400 cm^2 with the overlying water (Fig. 6). In each chamber, 10 water samples were collected with syringes (glass for oxygen and plastic for other solutes) and analysed to calculate concentration changes with time (benthic fluxes). After terminating the benthic flux measurements the incubated chamber sediment is brought to the sea surface together with the ambient bottom water. This gives the possibility to determine the water volume incubated in each chamber (necessary for calculating the flux). In case of failure to collect the sediment the water column height can also be estimated from a video camera that "scans" from one chamber to the other throughout the deployment. To recover the instrument, ballast weights are dropped by either of two acoustic releases. Once at the surface, spotting is possible by a flash, flags, radar reflector, radio (VHF) and a satellite signal (ARGOS).

During the second deployment (St. 5491#10) a prototype of a rugged acoustic current meter for the deep sea (from Aanderaa Instruments) was mounted on the top of the lander (2.2 m above the sea floor), in "free current". This was the first time such a current meter was tested and used in the deep sea.

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Sediment sampling and pore water extraction

Sediment for pore water studies was collected using the multiple corer according to the sampling schedule given elsewhere in this cruise report.

Chemical analyses

Concentrations of oxygen and total carbonate were analysed on-board. The precision of the Winkler titration system for oxygen determination was better than 0.8 % RSD (n=20) using a sample volume of 10 ml. The precision of the newly developed IR-based system for determination of total carbonate was better than 0.15 % RSD (n=20), using a sample loop of 4 ml.

Preliminary results

A combination of a delayed departure and bad weather made only two deployments, out of the three planned, possible. These two deployment were overall successful giving results from eight chamber incubations (out of eight). The success rate of the sampling syringes was 94 % (76 syringes out of 80).

Preliminary results from the first deployment show similar low flux rates of total carbonate (0.8-1.2 mmol*m^{-2}*day^{-1}) as we have previously measured at this site. The total carbonate concentration change with time in the four chambers is presented in Fig. 7. Examples of results measured with the current meter mounted on the lander are given in Fig. 8 for current speed and Fig. 9 for current direction.

Owing to bad weather conditions during the first recovery both the Argos and VHF beacons were broken and parts of the lander frame were bent. The frame was repaired and the VHF beacon was replaced and the lander was ready for a new deployment within 24 hours.

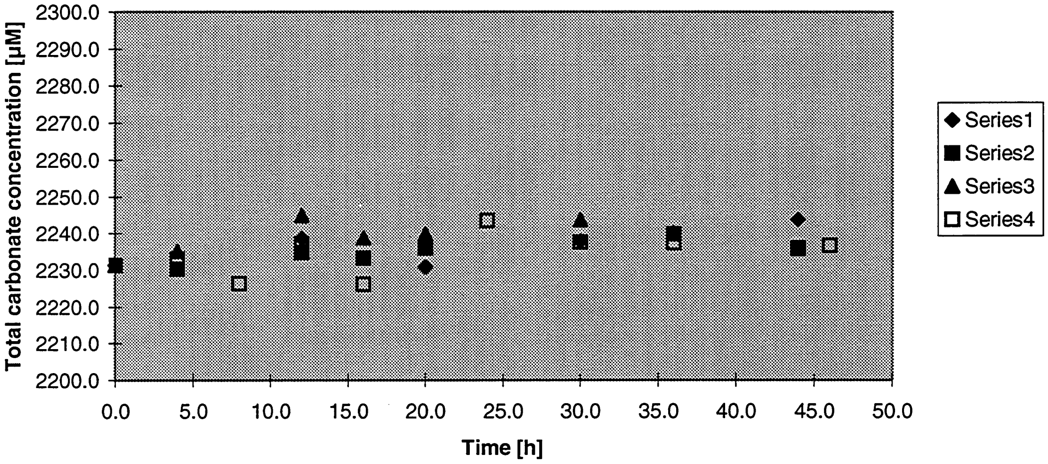

Figure 7. Total carbonate vs time in chamber 1-4 (series 1-4)

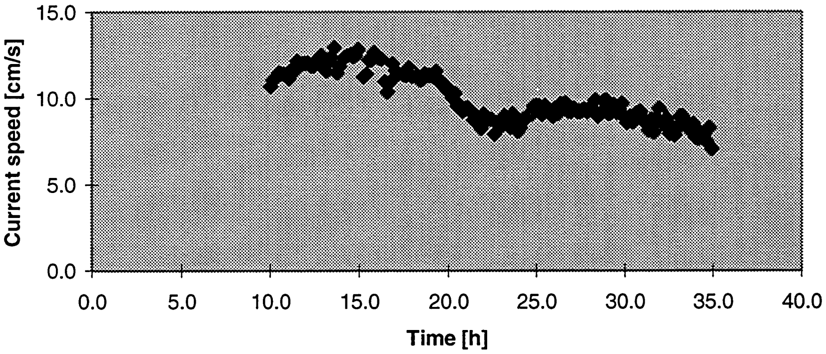

Figure 8. Current speed vs time 2.2m above the bottom. Measured with Aanderaa RCM11 prototype mounted on Göteborg lander (depth 4850m)

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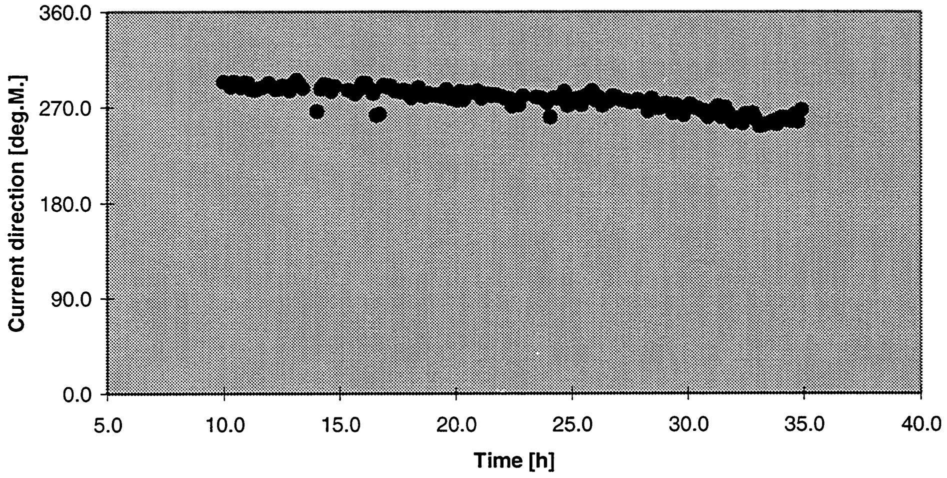

Figure 9. Current direction vs time 2.3m above the bottom. Measured with Aanderaa RCM11 prototype mounted on Göteborg lander (4850m)

ANDERS TENGBERG

Reference Material Collection for Atlantic Coral Ecosystems Study (ACES)

Material was collected for a reference collection to be maintained at the National University of Ireland, Galway. The samples from the coral mounds will be used for the proposed EU-funded project ACES (Atlantic Coral Ecosystem Study) (Tables 14 and 15). Additional material was collected for André Freiwald (University of Tübingen) (Table 16).

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TABLE 14.
University College, Galway deep-sea specimen reference material

Station	Jar Type	10% Form	80% EtOH	Sample	Genus	Species
54905#1	Y	X	X	HOLOTHUROIDEA	Psychropotes	longicauda
54905#1	1L	X	X	HOLOTHUROIDEA	Pseudostichopus	villosus
54906#1	Y	X		CRUSTACEA	Plesiopenaeus	
54906#1	1L	X		HOLOTHUROIDEA	Oneirophanta	mutabilis
54906#1	Y	X		PISCES	Histobranchus + indet.	
54906#1	V	X		ASTEROIDEA	Freyella	elegans?
54906#1	V	X	X	POLYCHAETA	Polynoidea	
54914#1	Y	X		HOLOTHUROIDEA	Paroriza	prouhoi
54914#1	IL	X		HOLOTHUROIDEA	Benthogone Mesothuria (dissected)	rosea Sp.
54917#1	Y*	X		ECHINOIDEA HOLOTHUROIDEA	Cidaris Echinus Psolus	cidaris affinis? squamatus

TABLE 15 .
Bulk fixed material for University College, Galway

Station	Jars	10% Form	80% EtOH	Sample Type	Remarks
54911#1	V x4	X		Macrofauna 0-2cm, 2-5cm 500u, 250,	Fragile branched foraminfera. Surface fluff. Smoke plumes of fines from surface formed due to compression of sediment during extrusion
54911#1	V x4	X		Macrofauna 0-2cm, 2-5cm 500u, 250,	Pteropod shell on surface
54911#1	V x3	X		Macrofauna 0-5cm ; 500u + residue, 250u	Large empty vertical burrow, c. 6mm diam.
54913#5	V x2	X		Macrofauna	Specimens picked from coral.
54913#5	V	X		Polychaetes	Including 2 large specimens of Eunice norwegicus taken live from galleries within hollow coral stems.
54914#1	R	X		Pisces	Various examples
54915#1	Y	X		Fish/invertebrates	Small gash haul
54917#1	Y*	X		Gash 4 - 2mm fraction. Various macrofauna	* Yellow bucket also contains >4mm specimens see above. Nemerteans or small actinarians ? common.

TABLE 16.
Samples for André Freiwald, University of Tübingen.

Station	Container	Fixation Method	Sample Type	Remarks
54913#5	Plastic bag	Frozen at -70°C	Lophelia branches	'Live' white and brown morphs
54913#5	Plastic bag	Frozen at -70°C	Madrepora branches	'Live' brown appearance
54913#5	1 lb jar	10% formalin	Lophelia branches	White branches with black subepidermal black spots - parasitic foraminifer *Hyrokkin sacrophaga* ?
54913#5	1 lb jar	10% formalin	Lophelia branches	With agglutinating foraminifer *Dorathia rudis ?*
54913#5	5L bucket	Air dried	Mixed coral	Exhibiting various stages of bioerosion

ANTHONY GREHAN

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ABBREVIATIONS FOR GEAR USED IN THE STATION LIST

BSNAP	BATHYSNAP: free-fall time-lapse camera system
GOTEBORGL	Goteborg multifunctional lander system
MLT CORER	Multiple corer, Barnett pattern, 12 x 57mm i.d. core tubes
OTSB14	Semi-Balloon Otter Trawl: 14 headline, fishing width 8.6m
OTSB14 (D)	Semi-Balloon Otter Trawl: as above but with depressor weight
WASP	Wide Angle Survey Photography instrument
DREDGE	Rock dredge with bag and pipe
BOX CORER	Spade box corer (0.25m2), modified USNEL type, fitted with plain box
BN 1.5/C 6000V	Epibenthic sledge, single 4mm mesh net, OCEANCAM 6000V video
BN 1.5/P	Epibenthic sledge, OCEANCAM 6000V video

STN.	DATE 1999	POSITION LAT.	 LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13370 # 8	27/ 3 27/4	48 59.7N	16 13.0W	BSNAP	4823-4823	1306 -0727	Deployed Discovery 231 (1998)	4823
54901 # 1	25/ 4	48 48.7N	16 30.8W	MLT.CORER	4837-4837	1357	No samples	4837
54901 # 2	26/ 4	48 42.2N 48 48.0N	16 51.6W 16 50.4W	OTSB14	4811-4837	1620-1835	Good catch Tow dist. 11.9173 km.	4824
54901 # 3	27/ 4 29/ 4	48 58.1N	16 25.0W	GOTEBORGL	4841-4841	0632 -1417	46 hour chamber incubations	4841
54901 # 4	27/ 4	48 50.0N	16 30.2W	MLT.CORER	0- 0	1303	Aborted, wire problem	4838
54901 # 5	28/ 4	48 44.9N 48 48.2N	16 40.5W 16 36.2W	OTSB14(D)	4835-4838	0930-1210	Good catch Tow dist. 9.5481 km.	4837
54901 # 6	28/ 4	48 49.7N	16 28.6W	MLT.CORER	4837-4837	2125	11 cores, all badly disturbed	4837
54901 # 7	29/ 4	48 47.4N 48 50.8N	16 48.9W 16 46.0W	OTSB14(D)	4836-4838	0700-0856	Good catch Tow dist. 7.1491 km.	4837
54901 # 8	29/ 4	48 50.0N	16 29.8W	MLT.CORER	4839-4839	2100	No samples	4839
54901 # 9	30/ 4	48 46.9N 48 50.6N	16 41.6W 16 36.4W	OTSB14(D)	4837-4841	1203-1445	Good catch Tow dist. 9.7633 km.	4839
54901 #10	1/ 5 3/ 5	48 57.9N	16 22.8W	GOTEBORGL	4842-4842	0101 -1559	60 hour chamber incubations	4842
54901 #11	1/ 5	48 50.3N	16 25.6W	MLT.CORER	4840-4840	0430	12/12 cores, disturbed	4840

STN.	DATE 1999	POSITION LAT.	 LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
54901 #12	1/ 5	48 50.2N	16 28.7W	MLT.CORER	4837-4837	0826	12/12 good cores, water sample	4837
54901 #13	1/ 5	48 49.4N	16 29.1W	MLT.CORER	4839-4839	1324	12/12 good cores, water sample	4839
54901 #14	1/ 5	48 49.9N	16 29.2W	MLT.CORER	4841-4841	1705	12/12 good cores, water sample	4841
54902 # 1	2/ 5	48 26.4N 48 24.3N	15 39.7W 15 34.9W	OTSB14(D)	4843-4845	0509-0707	SE area, good catch Tow dist. 7.0159 km.	4844
54903 # 1	3/ 5	49 32.1N 49 28.1N	15 56.0W 15 56.5W	OTSB14(D)	4810-4817	0037-0242	NE area, good catch Tow dist. 7.4046 km.	4814
54904 # 1	3/ 5	48 49.1N	16 31.5W	MLT.CORER	4840-4840	1214	12/12 good cores, water sample	4840
54904 # 2	3/ 5	48 58.9N	16 24.7W	BSNAP	4843-4843	1832	Long-term deployment	4843
54905 # 1	4/ 5	50 32.7N 50 28.7N	16 57.8W 16 59.5W	OTSB14(D)	4764-4786	1028-1231	N area, good catch Tow dist. 7.7725 km.	4775
54906 # 1	11/ 5	49 41.3N 49 37.9N	14 29.1W 14 34.2W	OTSB14(D)	4306-4380	1530-1732	Large anchor caught, net torn Tow dist. 9.676 km.	4344
54907 # 1	12/ 5	51 25.6N 51 25.3N	11 46.2W 11 46.4W	WASP	900- 965	1542-1600	Aborted, camera failed Depth limits - wire out	932
54907 # 2	12/ 5	51 25.4N 51 25.3N	11 46.7W 11 46.9W	DREDGE	1000-1000	1913-1934	Small amount of coral	1000
54907 # 3	13/ 5	51 25.6N 51 25.4N	11 46.3W 11 46.8W	DREDGE	1060-1060	0014-0042	Large coral catch	1060

CONTENTS

STN.	DATE 1999	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
54908 # 1	13/ 5	52 9.3N 52 9.4N	12 45.0W 12 45.1W	WASP	868- 900	1119-1130	Aborted, camera failed Approx. depth limits	884
54909 # 1	13/ 5	51 36.1N	13 0.3W	MLT.CORER	1329-1329	1657	12/12 good cores	1329
54909 # 2	13/ 5	51 36.3N	13 0.3W	MLT.CORER	1320-1320	1844	12/12 good cores	1320
54910 # 1	13/ 5	51 40.1N 51 40.8N	13 0.7W 13 1.5W	WASP	1175-1200	2042-2148	Good video - sponge patch	1188
54911 # 1	14/ 5	51 36.4N	13 0.3W	MLT.CORER	1326-1326	0009	12/12 good cores	1326
54911 # 2	14/ 5	51 36.3N	12 58.9W	MLT.CORER	1327-1327	0209	12/12 good cores, water sample	1327
54911 # 3	14/ 5	51 36.3N	12 59.9W	MLT.CORER	1330-1330	0405	12/12 good cores	1330
54912 # 1	14/ 5	52 9.8N	12 46.0W	WASP	700- 700	0930-0930	Aborted deployment. Impacted on seabed	700
54913 # 1	14/ 5	52 9.1N	12 46.4W	BOX CORER	681- 681	1137	Small washed out sample	681
54913 # 2	14/ 5	52 9.2N	12 46.2W	WASP	0- 0		Aborted deployment	
54913 # 3	14/ 5	52 9.2N	12 46.2W	BOX CORER	676- 676	1408	Small washed out sample	676
54913 # 4	14/ 5	52 8.9N	12 46.4W	WASP	0- 0	1508	Aborted deployment. No pressure or altimeter	

CONTENTS

STN.	DATE 1998	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
54913 # 5	14/ 5	52 9.2N 52 9.4N	12 46.5W 12 46.3W	DREDGE	700- 750	1657-1725	Approx depth limits	725
54914 # 1	15/ 5	51 37.5N 51 39.1N	12 48.1W 12 44.3W	OTSB14	1460-1465	0145-0257	Large catch Tow dist. 5.7581 km	1462
54915 # 1	15/ 5	51 18.6N 51 21.0N	12 52.8W 12 49.8W	OTSB14	1791-1797	1146-1250	Doors crossed, v. small catch	1794
54916 # 1	15/ 5	51 25.5N 51 25.5N	11 46.3W 11 46.2W	WASP	919- 950	1903-2012	Video did not switch on Still photographs	934
54917 # 1	16/ 5	51 31.8N 51 32.7N	11 42.3W 11 41.7W	BN1.5/C	727- 780	0128-0212	Rocks/mud. Net torn, weak link parted Tow dist. 1.866 km.	754
54918 # 1	16/ 5	51 25.4N 51 25.5N	11 46.1W 11 46.5W	WASP	860- 984	0650-0853	Depth limits - wire out Excellent video of coral	912
54919 # 1	16/ 5	51 42.2N 51 45.0N	12 47.6W 12 46.2W	BN1.5/P	1295-1341	1641-1815	Good video Tow dist. 5.665 km.	1318
54920 # 1	16/ 5	52 8.3N 52 8.9N	12 46.5W 12 46.8W	WASP	725- 800	2211-2321	Depth limits very approximate Good video	750
54921 # 1	17/ 5	52 9.8N 52 10.6N	12 45.3W 12 46.0W	WASP	700- 845	0225-0334	Depth limits approximate Good video	772
54922 # 1	17/ 5	52 13.9N 52 14.3N	12 43.3W 12 43.1W	WASP	640- 750	0501-0541	Depth limits approximate Good video	695

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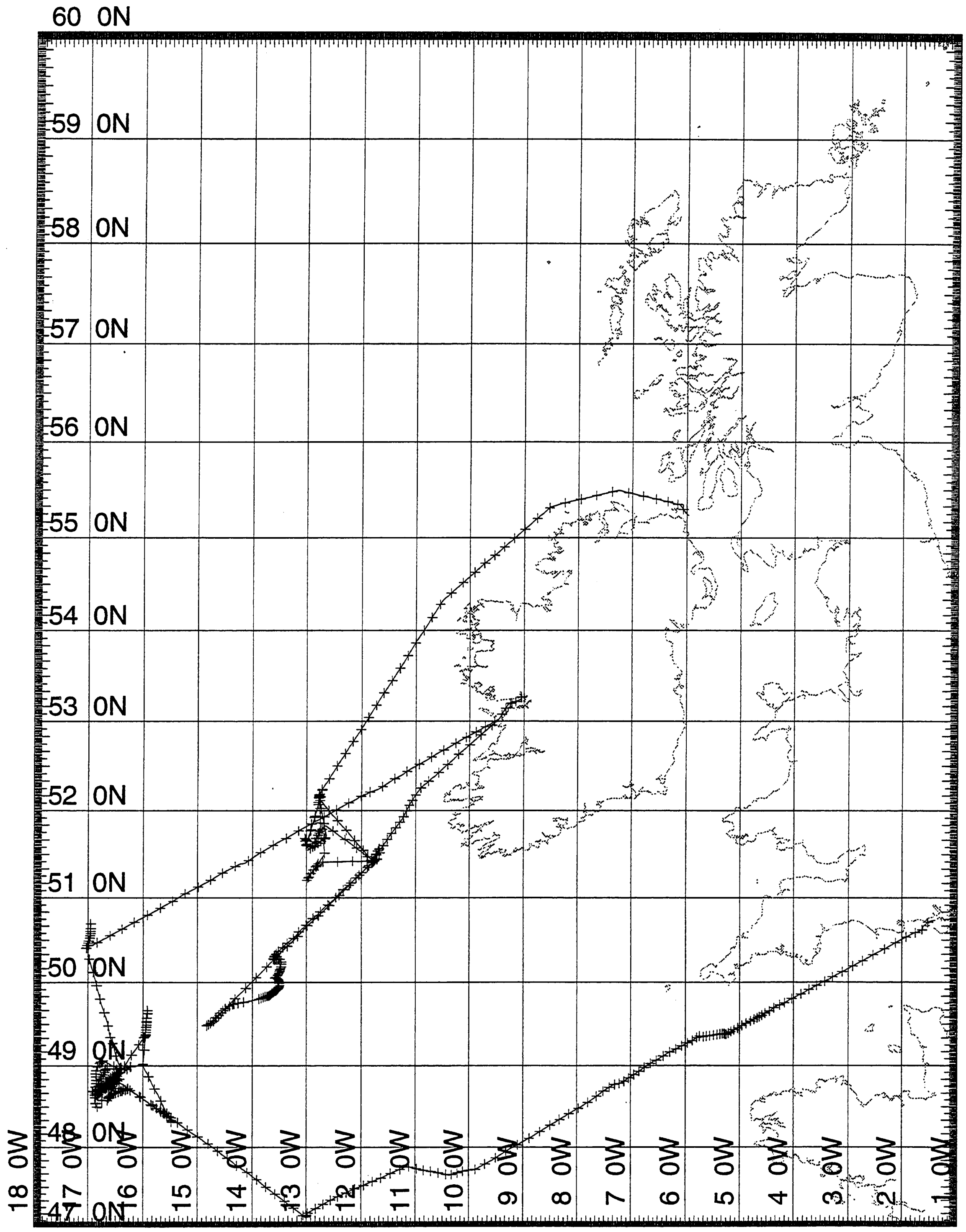


MERCATOR PROJECTION

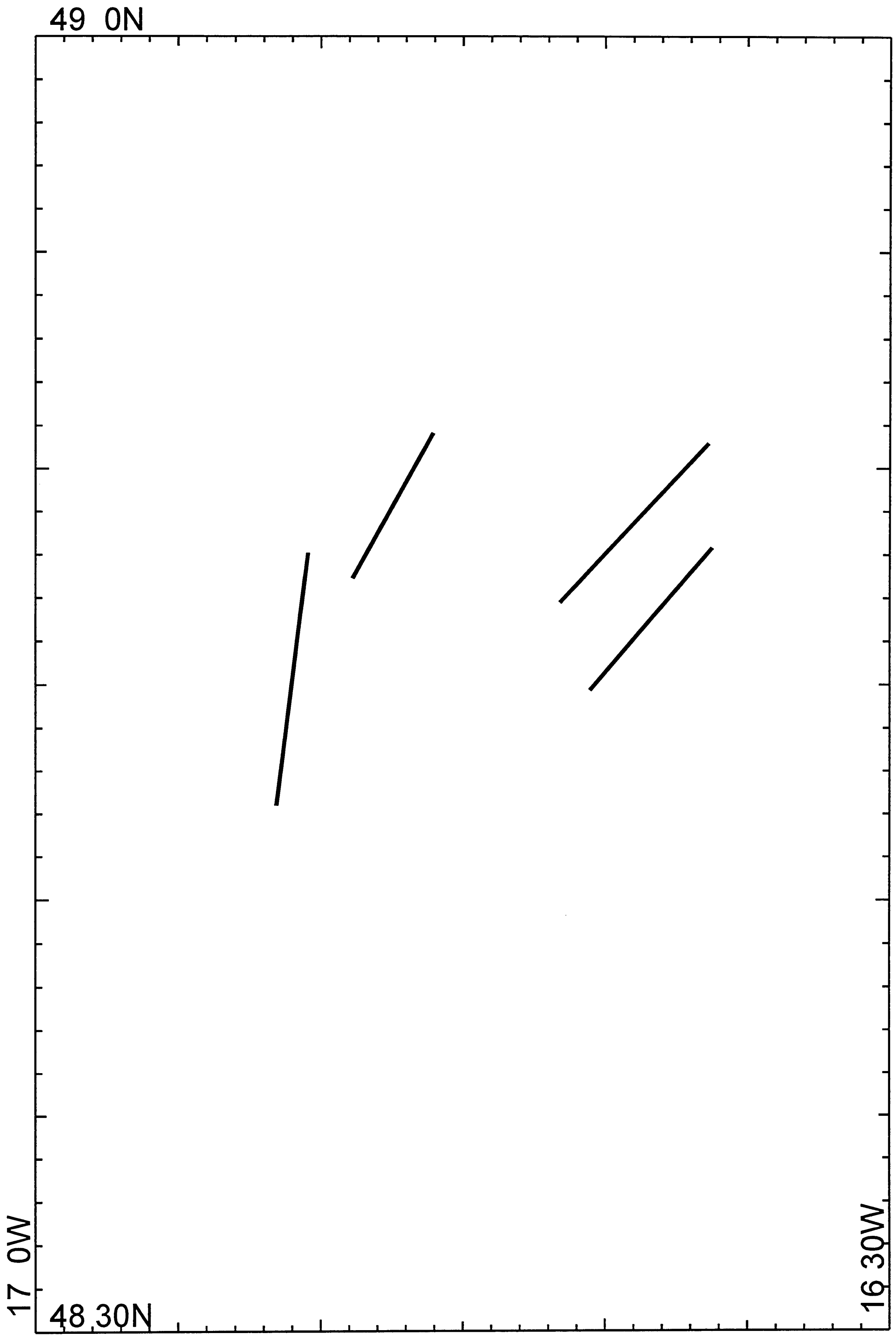
GRID NO. 1

SCALE 1 TO 13000000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

Full Course Track CH142

CONTENTS



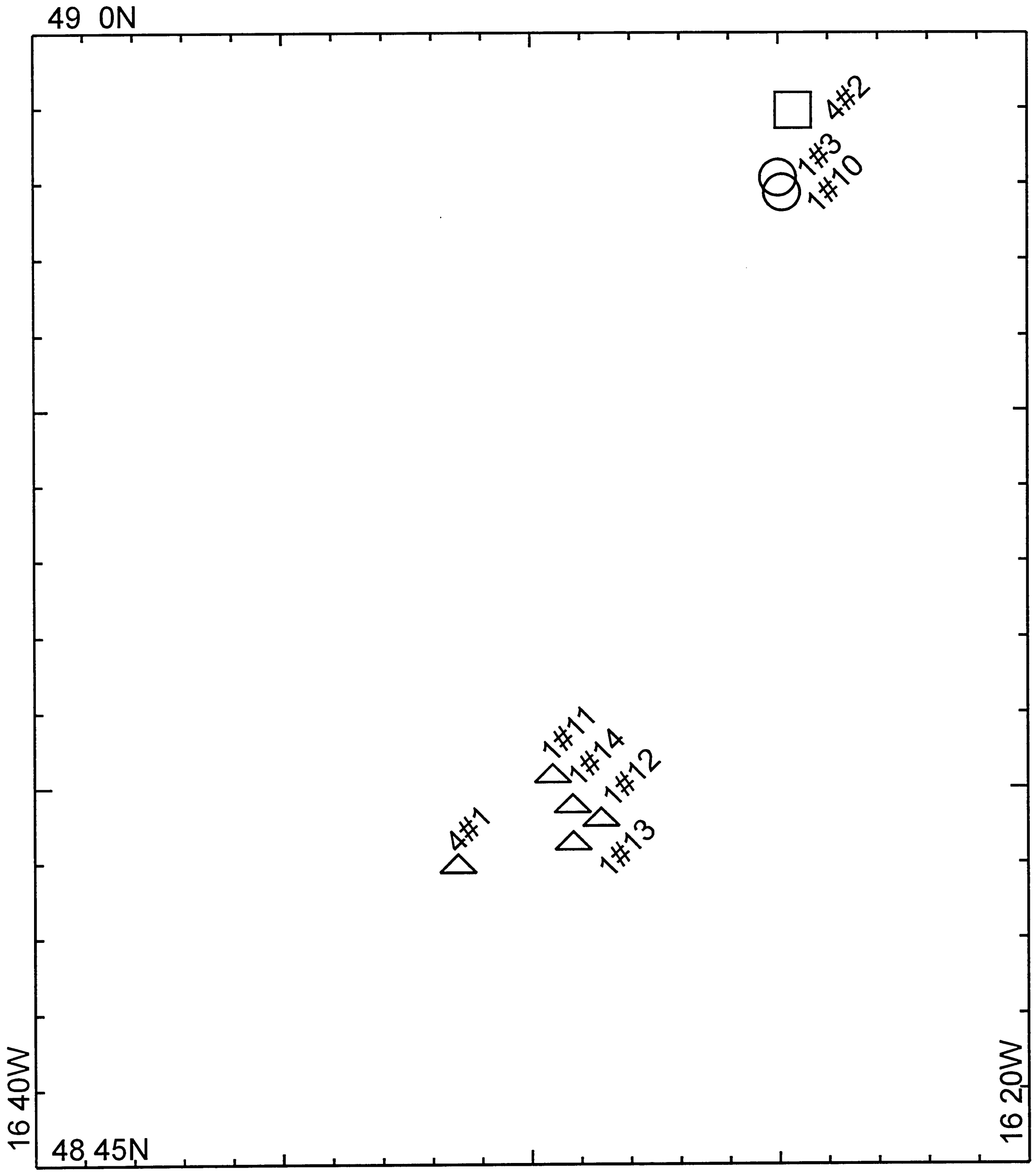
MERCATOR PROJECTION

SCALE 1 TO 370000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

Stations 54901#2, #5, #7, #9, BENGAL area

CONTENTS



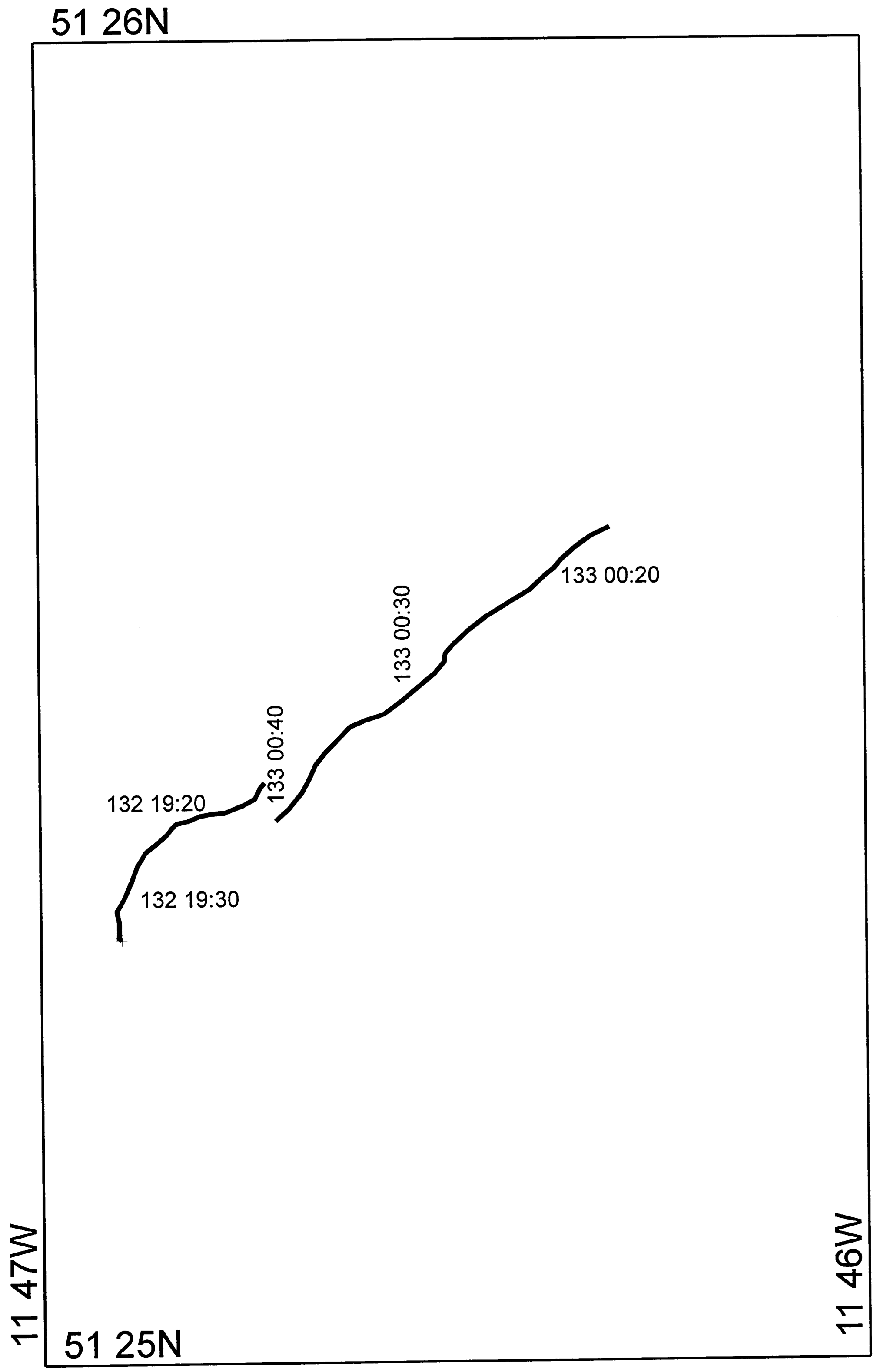
☐ MERCATOR PROJECTION

SCALE 1 TO 270000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

Multicore (triangle), Bathysnap (square) and Goteborg Lander (circle) stations at the BENGAL area

CONTENTS



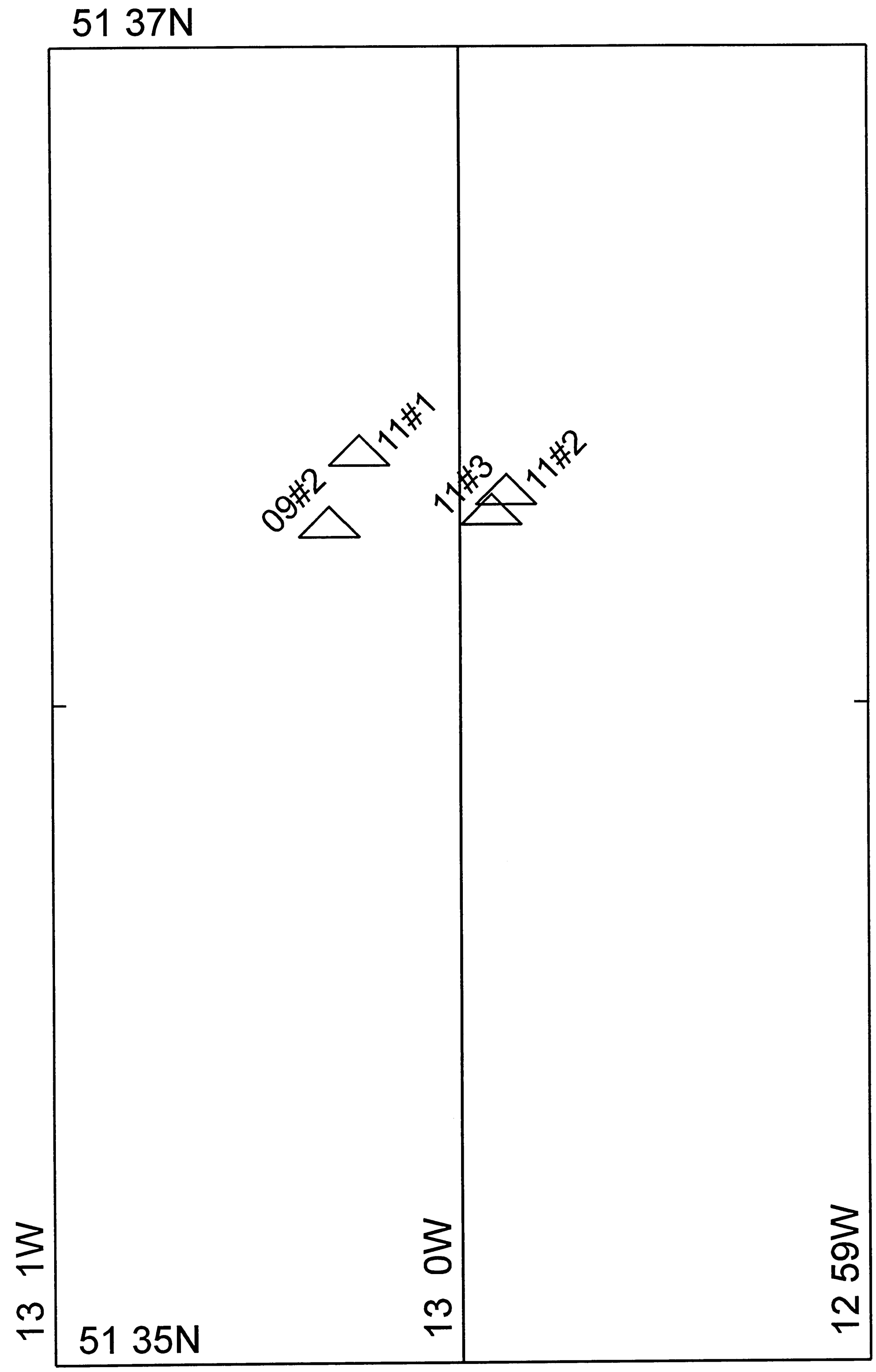
☐ MERCATOR PROJECTION

SCALE 1 TO 18000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

54907#1,#2 Rock Dredge.

CONTENTS



MERCATOR PROJECTION

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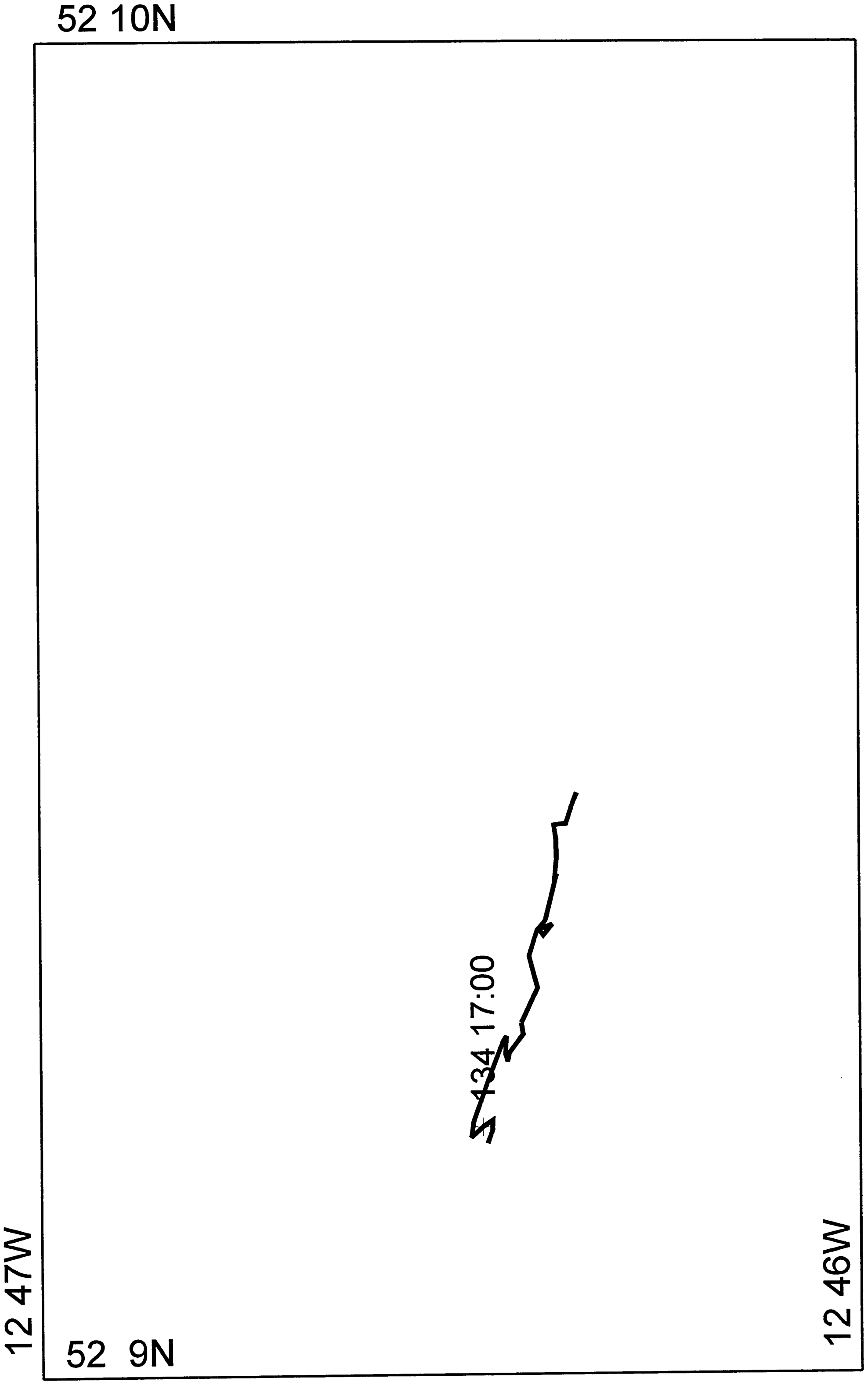
INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

Multicore Stations, Porcupine Seabight

CONTENTS



MERCATOR PROJECTION

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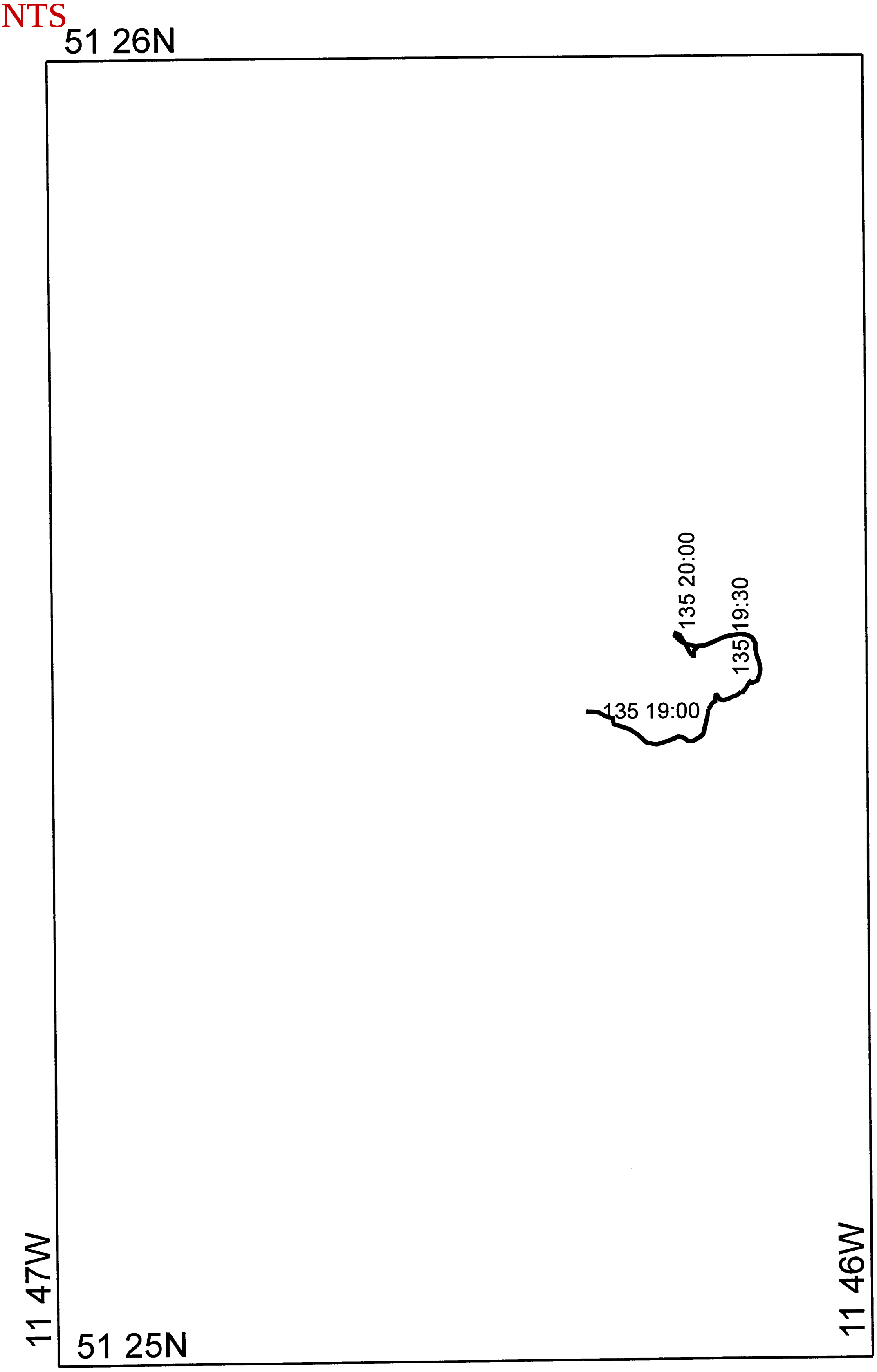
INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

54913#5, Rock dredge

CONTENTS



☐ MERCATOR PROJECTION

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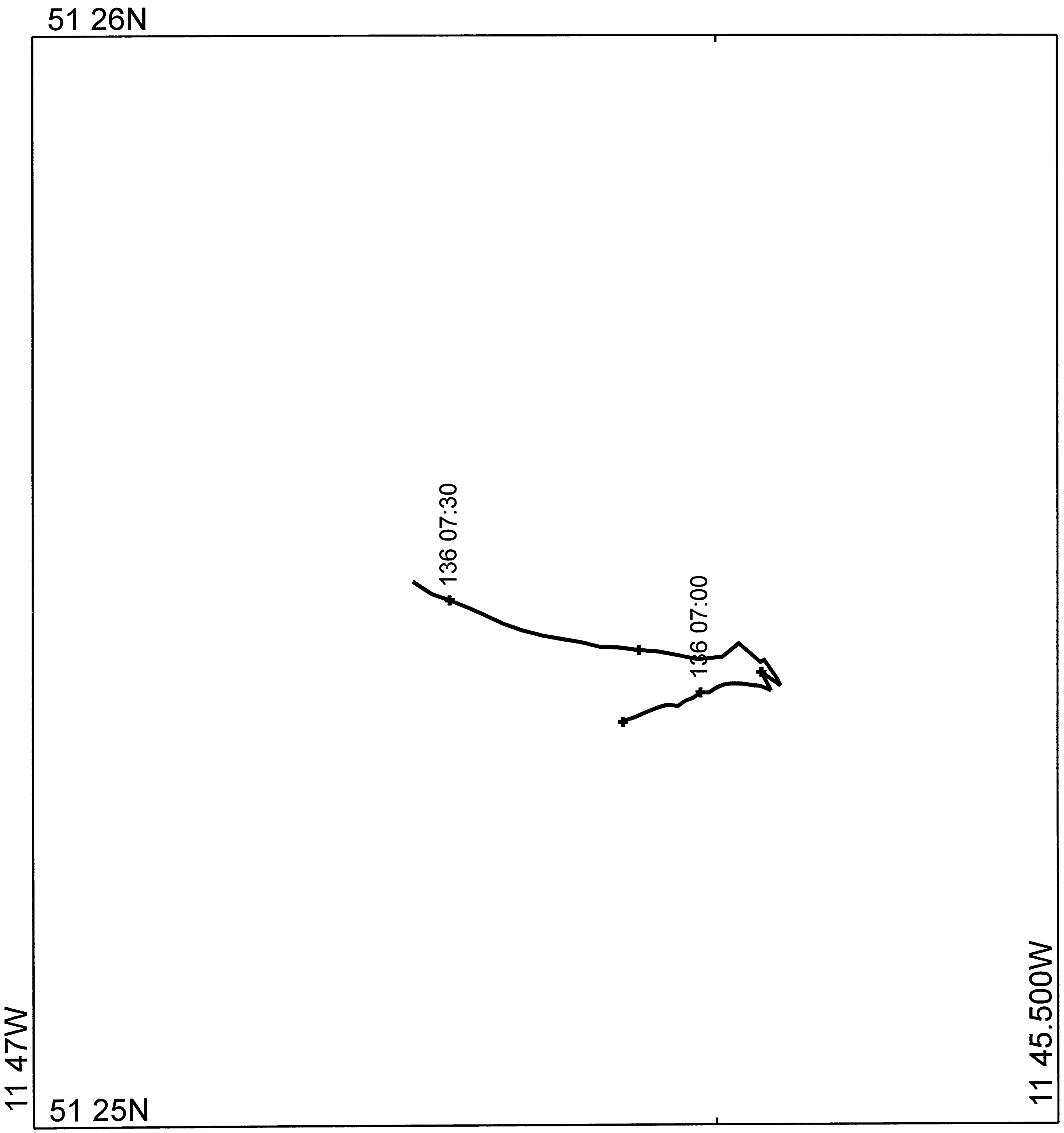
INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

54916#1 WASP

CONTENTS



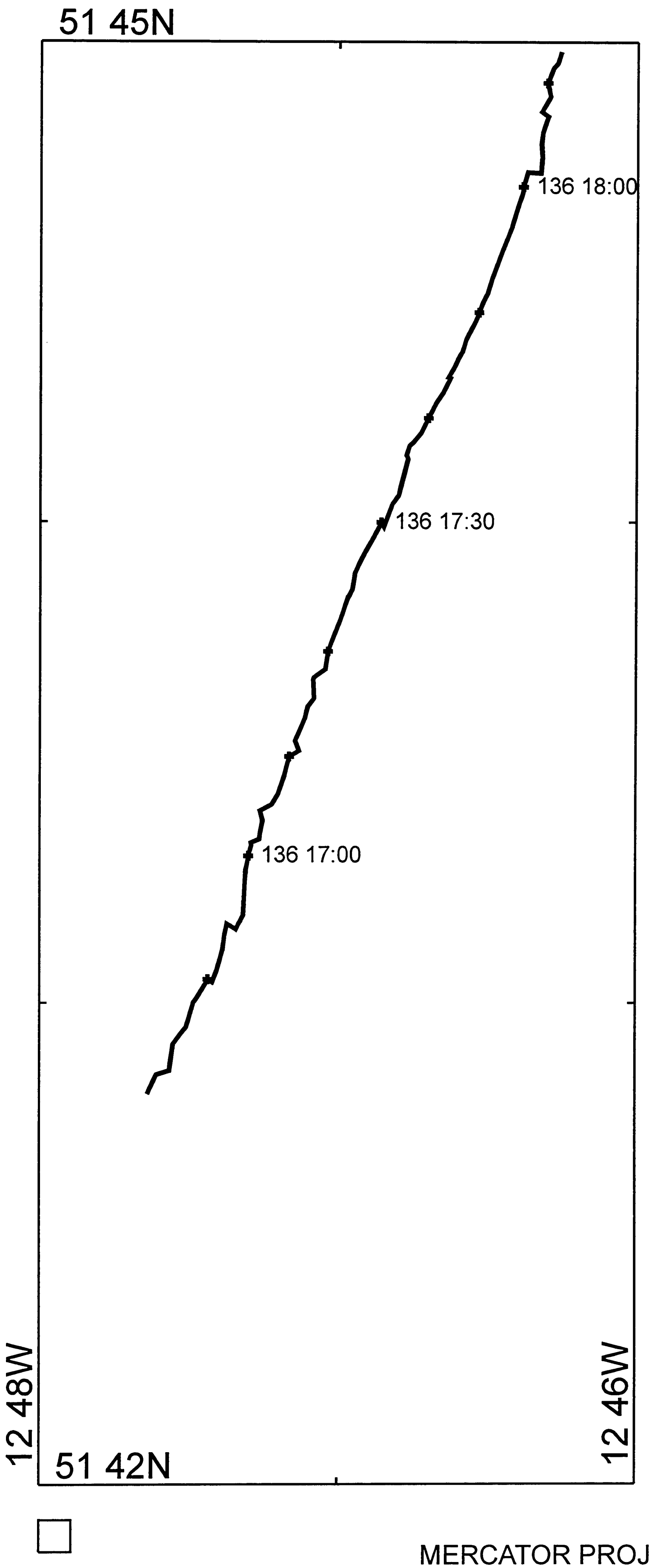
MERCATOR PROJECTION

SCALE 1 TO 18000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

54918#1 WASP, Mound “Theresa”, Porcupine Seabight

CONTENTS



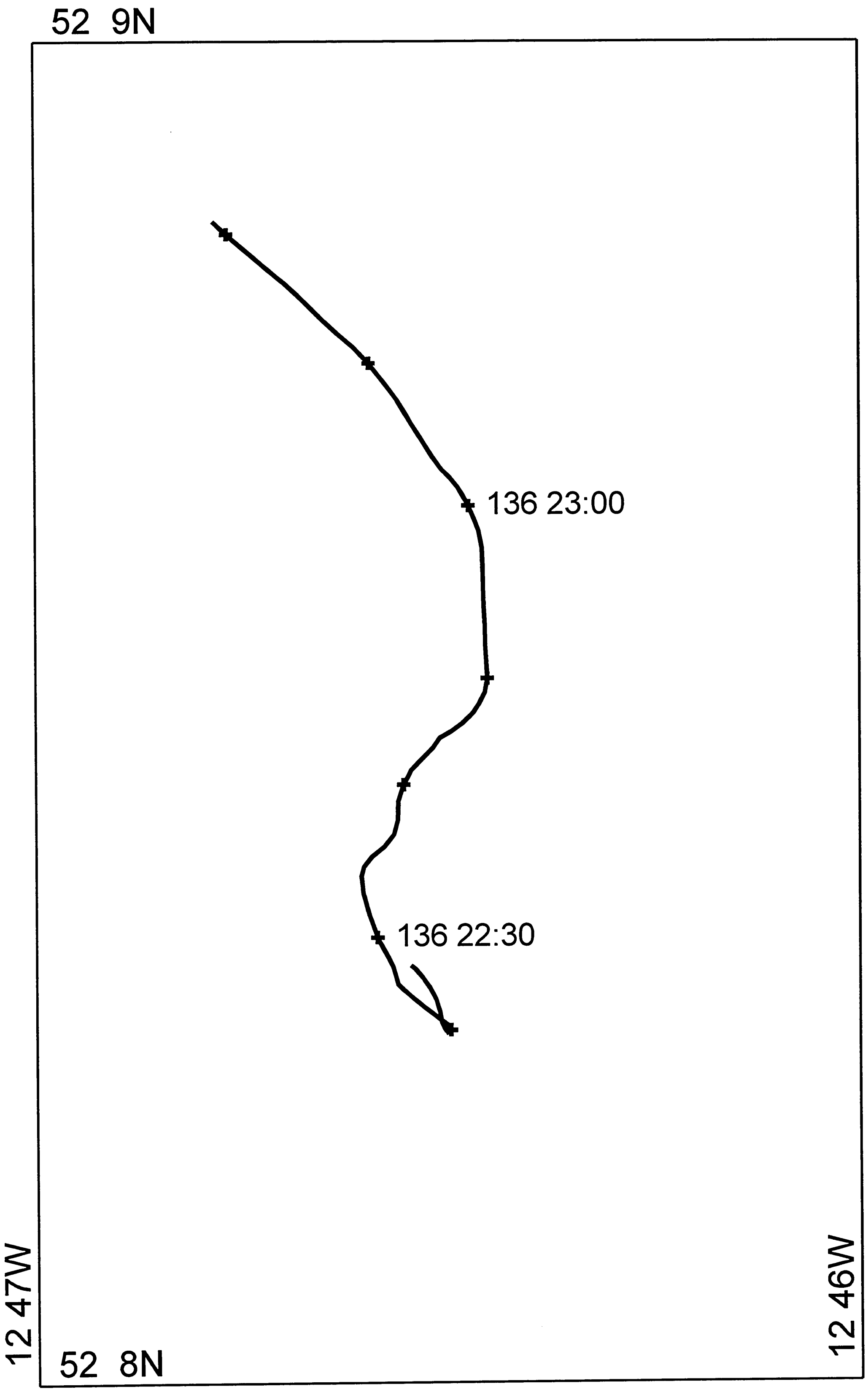
SCALE 1 TO 40000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

MERCATOR PROJECTION

54919#1, Photosledge, Porcupine Seabight

CONTENTS



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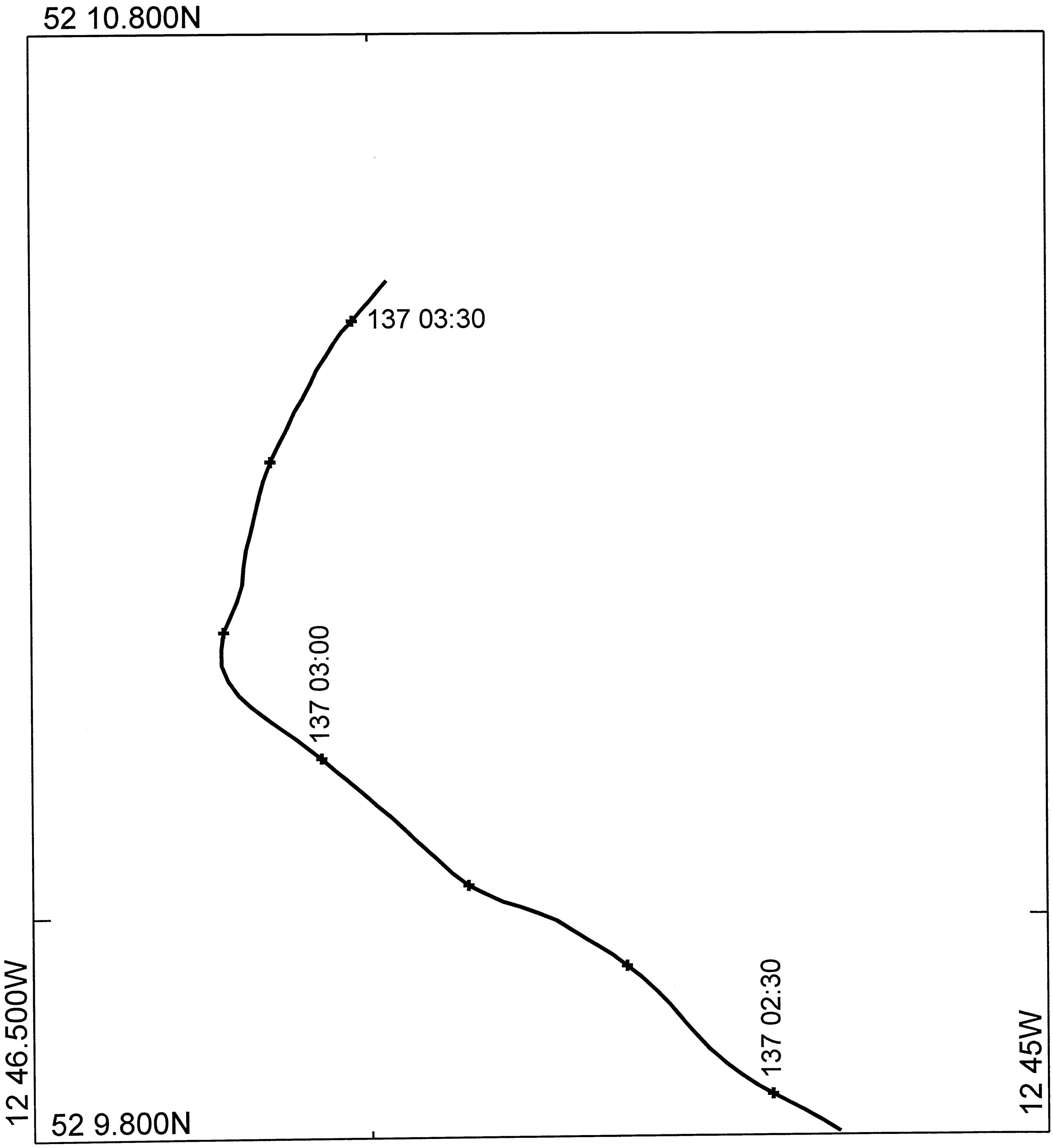
SCALE 1 TO 20000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

54920#1 WASP, Northern Mounds, Porcupine Seabight

CONTENTS



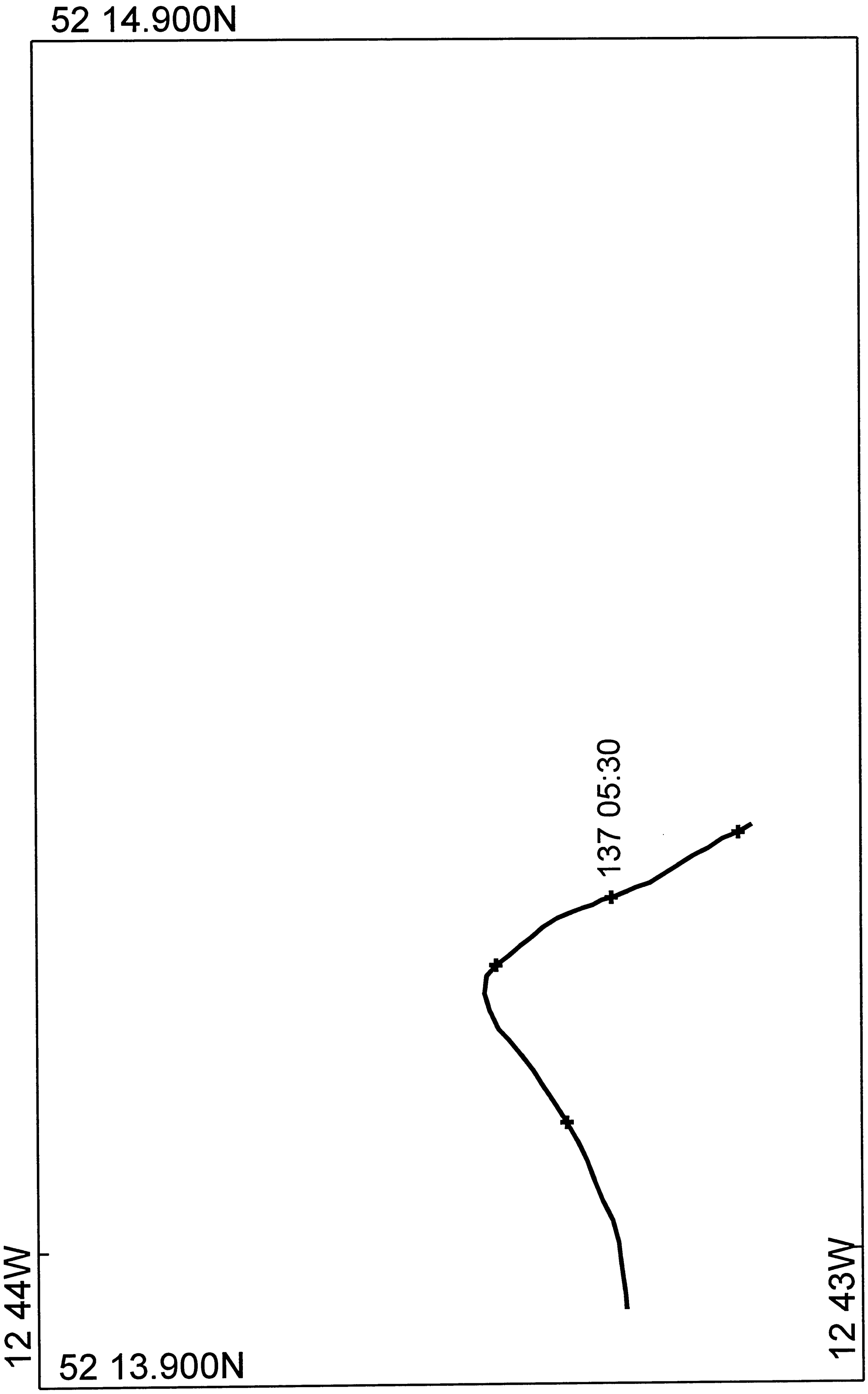
☐ MERCATOR PROJECTION

SCALE 1 TO 20000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

54921#1 WASP, Northern Mounds, Porcupine Seabight

CONTENTS



☐ MERCATOR PROJECTION

SCALE 1 TO 20000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

54922#1 WASP, Northern Mounds, Porcupine Seabight

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