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RRS DISCOVERY

CRUISE 153

20 OCTOBER – 17 NOVEMBER

1984

GEOLOGY AND GEOPHYSICS OF THE GREAT METEOR EAST AREA, MADEIRA ABYSSAL PLAIN

CRUISE REPORT NO. 172

1985

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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WORMLEY

RRS DISCOVERY

Cruise 153

20 October - 17 November 1984

Geology and geophysics of the Great Meteor East area, Madeira Abyssal Plain

Principal Scientist

R.C. Searle

CRUISE REPORT NO. 172

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Chief Officer	N.A.C. Jonas
2nd Officer	S. Sykes
3rd Officer	G.P. Harries
Chief Engineer	D.C. Rowlands
2nd Engineer	N. Wilson Deroze
3rd Engineer	A. Greenhorn
4th Engineer	G.L.R. Parker
5th Engineer	J.G.S. Bray
5th Engineer	N. Davenport
Snr. Electrical Engineer	B.J. Regan
Purser	R.M. Morris
Radio Officer	J.G.L. Baker
Chief Petty Officer (Deck)	F.S. Williams
Petty Officer (Deck)	S.C. Francis
Petty Officer (Deck)	M.A. Harrison
Seamen	E.E. Owen
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	A. MacDonald
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	S.M. Beetlestone
Motormen	C.S. Fry
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	J.A. Lovell
Chief Cook	R.E. Williams
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Cook Assistant	R.J.A. McKeon
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Stewards	S.T. Coates
	A.V. Cook
	P. Dawson
	J.T. Coleman

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R.C. Searle	IOS, Geophysics	Principal Scientist
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Q.J. Huggett	IOS, Geophysics	WASP
S.R.J. Williams	IOS, Geophysics	Seismic profiling
D.E. Gunn	IOS, Geophysics	Coring
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I.P. Rouse	IOS, Applied Physics	Acoustic navigation
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B.G. Knowles	IOS, Ocean Engineering	Winches, workshop
T.J. Hamlyn	IOS, Ocean Engineering	Winches, workshop
R. Griffiths	RVS	Air guns, winches
P. Mason	RVS	Computer, magnetometer, SRP
M. Hurley	IOS/UCNW	CASE student
I. Stewart	BRE	Geotechnics
P. Platt	Fugro/BRE	Geotechnics
A. White	Flinders University	Deep-towed profiler

ACKNOWLEDGEMENTS

This cruise seemed to have more than its fair share of problems, from a variety of sources. First there were the difficulties encounted in loading penetrators; then the trouble with the ring main. At some time or another virtually every piece of scientific equipment broke down in one way or another; and, finally, there was a time when it looked as though none of the pop-up instruments would. On the ship side we had to suffer a period of water rationing and, to cap it all, we had to struggle home through gales with one engine out of action. Throughout these troubles we received continuous, willing and cheerful support from every department of the ship's crew for which the scientific party was extremely grateful. I would also like to express my thanks to the scientific party for the very real support they gave to me personally. The successes we achieved were due very largely to the special efforts put in by everyone under very trying circumstances; it is a pleasure to acknowledge all their efforts.

R.C.S.

ITINERARY

20 October 1984 (294) — Departed Falmouth
17 November 1984 (322) — Arrived Falmouth

BACKGROUND AND OBJECTIVES

This cruise formed part of the IOS research programme into the feasibility of oceanic disposal of high-level radioactive waste and was commissioned by the Department of the Environment. Several previous cruises by IOS and others had visited this area and a considerable body of knowledge had been built up (see R.C. Searle et al., 1984, IOS Report No. 193). The area is part of the distal Madeira Abyssal Plain and has been designated Great Meteor East (GME).

The seabed is generally flat-lying between scattered abyssal hills. Previous cruises had established that the interlayered turbidites and marls of the abyssal plain have a high degree of horizontal and vertical continuity, except where they are disrupted by faults. These faults are visible on 3.5 kHz and sometimes airgun seismic profiles and seem to be most common in the large, central basin of GME where the turbidites are thickest. The existing set of seismic profiling data suggested that sediment faults are relatively rare in the southwestern corner of GME, but the coverage there was relatively poor. The presence and origin of these faults is of concern to the radioactive waste disposal programme, first because the faults are evidence of non-uniform, possibly catastrophic processes at work in the sediments and, secondly, because they might provide preferential paths for pore-water movement. Heat-flow measurements carried out on Discovery cruise 144 had suggested the presence of non-linear temperature gradients near some faults and basement highs; one interpretation of those results is that they indicate active upward advection of pore water.

A number of hypotheses had been developed concerning the origin and nature of the faults, most of which attributed them to effects of differential sediment compaction, sediment dewatering, or both. A major objective of the cruise was therefore to learn more about these features and their effect on pore-water movement.

A second broad objective was to deploy a number of free-fall penetrators over the sediments of the abyssal plain in order to evaluate the effects of penetrator size, shape and mass on the depth of penetration and to infer geotechnical parameters of the sediments at depths beyond the present capability of piston coring. Several secondary experiments were planned to utilise various aspects of the penetrator programme.

Finally, we were interested in studying how the abyssal hills may influence the neighbouring abyssal plain environment, e.g. by concentrating currents so as to cause erosion and by acting as preferential sites for pore-water egress.

The detailed objectives of the cruise were, therefore, as follows:

1. To deploy Pop-Up Pore Pressure Instruments (PUPPIs) to measure in-situ pore pressures and thus infer pore-water advection velocities at a number of sites, especially near faults, over shallow basement highs (including an abyssal hill), and in areas of suspected non-linear temperature gradients.
2. To take core samples, mainly to provide material for physical properties measurements, both for geotechnical objectives and to complement PUPPI observations.
3. To investigate by seismic profiling an area in the southwest of GME that appeared to be relatively fault free.
4. To obtain continuous photographic coverage of the seafloor across the locations of known sediment faults, to look for any visual consequences of faulting or fault-related pore-water movement (e.g. visual differences in sediment type or texture, surface disturbances, or differences in type or number of benthic organisms).
5. To obtain a photographic traverse from the abyssal plain on to an abyssal hill, to search for variation in occurrence of manganese nodules, number and type of benthos, and evidence of current erosion.
6. To study further the structure of one or more known faults by use of deep-towed, near-bottom seismic profilers (both the high-resolution, low-penetration Babb profiler used on previous cruises, and also a new deep-towed air-gun receiver developed at Cambridge University).
7. To drop nine penetrators of various sizes and monitor their fall and deceleration within the sediments, using doppler and other telemetering devices.
8. To test the Penetrator Acoustic Telemetry System (PATSY) which had been developed at IOS for installation in penetrators, to enable telemetry of data from instruments to be carried below the seabed by the penetrators.
9. To deploy an array of analogue and digital Pop-Up Bottom Seismographs (PUBS), to observe the impacts of the penetrators on the seabed, and thus

(a) to determine by how much the penetrators deviated from a vertical path through the water and (b) to infer some physical properties of the sediments by modelling the dispersion of Scholte waves generated by the impacts.

10. To test the new digital PUBS and compare its response with the older analogue type.
11. To use the penetrator impacts as signals for a seismic refraction line to study the nature of "transparent ridges" that had been seen on seismic reflection profiles over many of the sediment faults.
12. To attempt to photograph the entry scars left by the penetrators, in order to help assess the amount of disruption and degree of hole-closure involved.

Objectives 1-5 were achieved with almost complete success. 7, 9, 11 and 12 were not achieved because industrial action prevented the penetrators from being loaded on the ship; however the remaining objectives, 8 and 10, were carried out independently and were successfully accomplished.

NARRATIVE

(See Figures 1-3 for track and station position charts, Table 1 for station list, and Table 2 for times of underway geophysical observations.)

Prologue

The scientific party joined the ship in Falmouth at 0930 BST on Monday 15 October. During the course of the day an industrial dispute arose, with the NUS and TGWU directing their members not to handle the penetrators that were due to be loaded for deployment on the cruise. The situation remained deadlocked, and at midday on Wednesday 17 October the scientific party were told to leave the ship but remain on 24 hours stand-by for sailing. At 1230 BST on Friday 19 October, we received instructions to join the ship and be ready to sail at 1400 BST the following day, without the penetrators. We travelled to Falmouth on Saturday 20 October and joined the ship between 1200 and 1300 BST (1100 and 1200 GMT).

Cruise 153 (all subsequent times GMT)

Discovery sailed from Falmouth at 1323 GMT on Saturday 20 October 1984 (Day 294). The afternoon was spent hove to in the lee of the Lizard peninsula while scientific gear was secured on deck. The PES and 3.5 kHz fishes were launched between 1500 and 1630, and at 294/1830 we set course for GME at full speed on three engines. The PES and 3.5 kHz systems were switched on the following day (295/0900) as we crossed the edge of the continental shelf near Meriadzek Terrace, and computer logging was started at 1406 the same day. The magnetometer was streamed at 295/1500.

At about 296/1730 the 3.5 kHz record suddenly became very noisy, so the fish was recovered to investigate. Both the fairing and cable were found to be damaged (presumably by contact with some flotsam), so the spare fish was deployed and worked well for the rest of the cruise. A new cable and fairing were fitted to the original fish. Discovery got underway again at 296/1918.

The ship was briefly stopped twice on passage for engine room repairs (total time lost, about 9 hours). During day 299 problems were encountered in trying to run up the forward hydraulics ring main; this problem was to dog us for the next ten days.

We arrived at GME shortly after midday on day 300, recovered the magnetometer and hove to to test the WASP camera for trim. This was completed by 1337, and at 1435 the first of three acoustic transponders was laid (Station 11168). The other two transponders were laid at 1721 (11169) and 2114 (11170), and a short time was then spent surveying the transponder net.

At 301/0230 we began manoeuvring to recover the PUPPI that had been deployed at Station 11141 during Discovery Cruise 149. The PUPPI was released at 0705 and was on board by 0915. We then ran a WASP station (11171) but the near-bottom echo sounder (NBES) on the WASP failed, so the station was abandoned.

The camera was inboard by 302/0107, and at 0240 a wire test of the PUPPI electronics was carried out on the main (coring) warp, the midships winch being out of action owing to the hydraulic ring-main failure. This test was successfully completed by 0730, and at 302/0830 we began an acoustically-navigated 3.5 kHz survey of one of the faults which had been studied during Discovery Cruise 144. This survey allowed us to locate our new navigation network with respect to that used on Cruise 144 and also, with an average line spacing of only 500 m, to define better the along-strike variations in the fault system. Two brief pauses were made during this survey for shallow tests of the WASP NBES, but without success.

At 302/2135 we hove to for a piston core (Station 11172) which was to be taken immediately to the southeast of the fault system in an area where Cruise 142 heatflow measurements had suggested non-linear temperature gradients. The ship manouevred whle the corer was being lowered, guided by the acoustic navigation system (but a remote pinger attached to the coring warp to navigate the corer itself failed to work). The corer was recovered with a 13.6 m core. We then set off for an airgun and 3.5 kHz survey of a box in the southwest corner of GME. This area appeared from previous work to be fault-free, but the existing data coverage was poor. This survey also provided time for repairs to the hydraulic ring main and the WASP to continue. The profiling gear was deployed by 303/1222, and a fifteen-hour survey began.

During the period of this survey, the crew rigged a chain block and tackle on the midships A-frame. This, together with a hydraulic hand-pump, allowed the A-frame to be deployed without use of the hydraulic ring main. A wire was led forward to the midships A-frame block from the after auxiliary winch and, with this jury-rigged system, it became possible to deploy PUPPIs.

The survey ended at 304/0340 and we returned to the main work area to deploy the first PUPPI. This was released at 1332 (Station 11173), a few hundred metres southeast of the central fault and close to core 11172. This station was immediately folowed by another piston core (11174) which was recovered from a point 200 m northwest of the same fault. Once again the ship was acoustically navigated to put the corer in the right place but, again, the remote pinger failed to work satisfactorily. Whle the corer was being recovered, Searle spoke by VHF to Walter Zink, Chief Scientist on the Meteor which was visible a few miles off making a CTD station in the vicinity of IOS current meter mooring No. 365.

Another PUPPI deployment (11175) was attempted at 305/0232, but the stray line fouled the lance as it was let go, so the PUPPI was released in mid-water and recovered after some long and difficult manoeuvring of the ship without the bow-thruster, which had failed as the PUPPI was deployed. By this time (305/0524) everyone was exhausted, so we returned to the southwestern box to continue the survey there, this time with 3.5 kHz only.

During the survey the WASP NBES had been rebuilt, and it was briefly and successfully tested at 305/1900. We therefore broke off the survey and prepared for a full WASP deployment over an abyssal hill/abyssal plain transition (Station 11176). The station began at 2218 and ran successfully, ending at 306/0918.

We then manouevred to the site of the next PUPPI deployment (Station 11177) which was on the northwest side of the central fault, near Core Station 11174. The PUPPI was deployed at 306/1311. At 1450 we began a PATSY wire test on the main warp, paying out to 5100 m. The test was only partially successful.

After the PATSY test we made a further 3.5 kHz survey of the fault for four hours while the WASP was being prepared. The next WASP station (11178) was designed to cross the central fault, and began at 307/0249. By the time the camera reached the seabed it appeared that it might already have run past the fault location (the remote acoustic navigation pinger still not working properly), so a slow (10 degrees a minute) 180-degree turn was made with the ship in order to re-cross the fault. By hauling in on the wire as we turned, and paying it out again afterwards, it was possible to make the camera follow the ship around quite closely. The station continued until 307/1245, by which time we were sure the camera must have crossed the fault, and it was recovered and on board by 1619.

A short 3.5 kHz survey of a buried basement high in the northwest part of our main work area ensued and then, at 1830, one of the PUPPIs was lowered to 4000 m on the main warp for a wire test. (This was the instrument that had been laid on cruise 149 and replay of the data had shown up a small fault in the logger which it was hoped had now been rectified.) After this, the ship hove to at 2320 for a core station (11179) over the buried basement high. Again, the ship was manoeuvred with the corer in the water to obtain the optimal placement relative to geological features. The corer was recovered, with a 16.5 m core, by 308/0824.

This same day, the replacement of the pump in the hydraulic ring main was begun.

At 308/1029 another PUPPI was deployed, this time over an area of deep basement, well away from any faults, as a control station (11180). We then returned to Station 11173 to recover the PUPPI laid there. This was on board by 1530, after which we carried out another PATSY wire test to 5500 m. Again, this test was only partially successful, the problem being that the acoustic transponder was proving too sensitive for this form of test and was triggering erratically on noise. At 308/2318 another WASP station (11181) was begun, again over the central fault. This was completed by 309/1234, whereupon we moved back to the buried basement high from deployment of a PUPPI there. The instrument was released at 1435 (Station 11182), but it appeared not to have been let go exactly over the crest of the high.

We now returned to the southwest area once again for further airgun and 3.5 kHz lines, and began deploying the profiling gear at 1830. At 2123, the hydrophone array failed abruptly and, after recovering it by slowly backing the ship on to it as it was pulled in (to minimise the applied tension), it was found that the rope in the spring section had either parted or pulled away from its termination. The damaged section was removed and the array redeployed, but now the airgun was found to be leaking and, after several attempts to correct this, it was decided at 310/0030 to continue with the survey with 3.5 kHz and magnetometer alone.

The survey was completed by 310/1130 and we returned to Station 11177 to recover the PUPPI. The new ring-main hydraulic pump had been installed and run up the previous day so, before recovering PUPPI, a brief test was carried out by lowering a weight on the midships winch to 250 m. All went well. The PUPPI was recovered by 1819, after which a full test of the winch was carried out, lowering the weight to 5000 m. We then recovered the second PUPPI (11180) which was onboard by 311/0121, and carried out another PATSY test until 0630.

Late the previous afternoon the signal from acoustic beacon No. 1 was noticed to be getting very weak but, because the beacon had no light attached, we had been unable to recover it immediately. We now (311/0640) attempted to do so and repeated transmissions of the release signal from a variety of positions of the ship. By this time there was no response at all from the transponder but we searched the area for several hours after the time it was expected to be on the surface, without finding it. By 1105 the search was called off and we proceeded to attempt to release the second transponder which, by this time, was also getting weak. We spent nearly two hours continually transmitting the release signal from a variety of positions, but the beacon did not release.

At 311/1450 we called off the release attempt and steamed to the start of a station (11183) which was to use the Cambridge deep-towed seismic profiler. This was deployed by 1603 but there were more problems with the airgun whch was not working until 1830. Shortly afterwards there was found to be no signal from the hydrophone, and the gear was recovered. It was subsequently discovered that there were broken conductors in the umbilical cable, which was then repaired.

At 311/2100 we headed for Station 11182 and recovered the PUPPI there at 312/0021. Another PUPPI was then deployed nearby (11184), but this time we spent some effort surveying the area and manoeuvred carefully to ensure that the instrument was let go exactly over the crest of the basement ridge. At 0448 we began station 11185 using the Babb profiler, but no useful signals were received and the profiler was recovered by 0830. We then prepared for another attempt with the Cambridge profiler which was deployed at 1504 (Station 11186). At 1533 both the hydrophone and the pinger signal were lost, and the gear was recovered. It was found that one of the bulkhead conectors in the instrument pressure case had leaked and the instrument had flooded.

This was followed by a final PATSY test, this time on the midships winch.

The instrument had been modified to a free-running rather than a transponding mode and, with this arrangement, it was possible to see that it was indeed functioning correctly, and was telemetering good accelerometer data.

After this we steamed west to an abyssal hill and deployed a PUPPI there at 313/0311 (Station 11187). We then returned to the fault area for another attempt with the Babb profiler (Station 11188). However, in spite of various modifications, the profiler still did not give satisfactory signals. The station ended at 0930 and we began a further short 3.5 kHz survey while the Cambridge profiler was being prepared again. Station 11189, using this profiler with its spare electronics package, began at 1155. Initial results looked promising but, shortly after the instrument reached the bottom, we found we were getting intermittent loss of signals. At first the winch sliprings or CTD cable were suspected. After the instrument was recovered (313/1710) it was found that another of its connecting cables was faulty, as was the Brantner connector on the CTD wire termination.

The last station in the fault area (11190) used the WASP with a free-running PATSY strapped to the frame in the hope that this would act as a near-bottom 3.5 kHz profiler. The station ran from 313/1939 to 314/0800 but, although clear bottom-echoes were received from PATSY, the signal was not strong enough to provide a useful sub-bottom profile. However, this did provide us with another photo-run across a fault.

Shortly after 314/0900 we again tried to recover the second acoustic transponder beacon, but it still refused to release. At 0945 we abandoned it and made for the third beacon. This, too, was reluctant to release but finally did so after almost continuous transmission of the release signal for forty minutes. It was on board by 1402 and we then conducted a 3.5 kHz survey of the buried basement high while the two PUBS were being prepared for a comparative test.

The two PUBS (one analogue, the other digital) were laid at 314/1822 and 314/1840, at the start of Station 11191. We then steamed 30 km away to the northwest (collecting a useful 3.5 kHz profile in the process) and returned, firing a 1000 cubic inch airgun every two minutes. The airgun line ended about 315/0100 and we then tried to release the PUBS. Once again, the acoustic releases failed to operate and at 0252 we headed for Station 11184 to release the PUPPI there. This came up without any problems, and we returned to the PUBS. They still would not release, so we went to Station 11187 to release the last PUPPI. This, too, failed to leave the seafloor although the acoustic signal indicated that the release relay had switched. We therefore returned to 11191 to await the PUBS release by their back-up clocks at 315/1200.

It had only been possible at this stage to obtain an acoustic signal from one PUBS (it turned out to be the analogue one), and this clearly showed a lift-off at 1200. The PUBS was tracked acoustically until it reached the surface and it was recovered without difficulty by 1409. A weak acoustic trace from the other (digital) PUBS was picked up shortly before the first one reached the surface, and it suggested that the digital one surfaced at 1407. However, we could not pick it up visually or by radio. We searched until 1627 and then decided to adjourn the search until after dark when it was hoped the flashing light on the PUBS would be seen. Meanwhile, one last test of the Babb profiler was carried out (no station number), but without success.

The PUBS search was resumed at 1741 and eventually the light was spotted and the radio signal detected at 2035. Shortly thereafter, the light failed(!), but we were able to home-in on the radio signal and the instrument was recovered at 2135. We then proceeded to Station 11187 in the hope that the PUPPI would release on its back-up clock at 2350. Again, the release relay switched but the instrument did not leave the seabed. It was therefore abandoned and we prepared for one last station, a piston core on the abyssal hill (Station 11192). A good core was recovered by 316/0600, and at 0608 the magnetometer was streamed and we set course for the Argos buoy (moored on Cruise 152 near Data Buoy 2).

It had been intended to return on three engines but one engine was out of action when we departed GME and was being investigated for loss of water. At 316/1000 it was discovered that the problem was a broken tie-rod and that there was no chance of a repair before reaching the UK.

During the next three days several course changes were made to allow better speed in the face of a very heavy northwesterly swell, thus taking us off the direct route to the data buoy. On day 319 we reduced speed at 1600 to recover the magnetometer. About this time the Master estimated that a direct course to the data buoy would reduce our speed sufficiently to delay our arrival at Falmouth, perhaps as much as 24 hours beyond the programmed time of 322/0730, and on direct instructions from RVS we maintained our existing course, thus missing the data buoy. Discovery anchored in Falmouth Roads in the early hours of day 322, and docked, after a short wait for a berth, at 322/1030.

R.C.S.

PROJECT AND EQUIPMENT REPORTS

Pop-Up Pore Pressure Instrument - PUPPI

PUPPI is designed to measure differential pore pressures in sediments which, when combined with permeability and porosity measurements, provides an assessment of vertical pore water velocity. The objective for this cruise was to make several PUPPI deployments within the GME area to determine if any significant pore-water advection is occurring within this high-level radioactive waste study area.

Previously (Discovery Cruise 144) a PUPPI had been lost in the GME area as a result of over-penetration in the very soft turbidite sediments. Modifications to the mechanical design were successfully tested in GME on Discovery Cruise 149 and one instrument was left down (D11141) for recovery on this cruise.

Eight PUPPI stations were occupied during the cruise. These are shown in Table 3 together with their locations and times. All PUPPIs were launched from the midships winch platform. However, while the forward ring main was out of action, the operation involved using the auxiliary winch led forward through roller blocks and a hand pump on the 'A' frame.

PUPPI #2/1 (Number 2, Lay 1) was recovered at Station 11141 after nearly four months on the sea bed. It took about three anxious minutes to lift off from the bottom after the pyros had been fired. Despite a problem with the data logger it would appear from a 'first look' at the data that no residual differential pressure was recorded at this site close to a fault. All three instruments (acoustics, data logger and pressure transducers) were subsequently wire-tested in deep water. PUPPI Nos. 1 and 3 performed well but No. 2 still had a problem with the logger. Two other stations were then occupied close to and either side of this fault (D11173 and D11177). They also recorded little if any residual differential pore pressure. A problem with the logging program meant that at Station 11173 the cut was not made during fast sampling; this was rectified for subsequent stations.

At Station 11175, PUPPI #2 was deployed after having passed a bench test. However, it was thought during its descent that the stray line might have become entangled beneath the lead weights during the launch. If this had been the case it might have been impossible to recover the PUPPI after it had penetrated the seafloor. Consequently the drop was abandoned in mid-water and the instrument recovered. It transpired that the system was still not functioning properly, although the fault could not be located on the bench. The transducer and associated connector were replaced and a further wire test was carried out which proved satisfactory, and PUPPI #2 was deployed at Station D11180 in an area of thick sedimentary cover away from any faults. Once again, no residual differential pore pressure was recorded.

Stations D11182 and D11184 were located over a sub-bottom basement ridge which in places appears to have as little as 50 metres of sediment cover. Both these stations showed distinct residual differential pore pressures (≈ -0.15 kPa at D11182 and -0.45 kPa at D11184). Assuming the upper sediments at these stations are not dissimilar to those found close by, then the implication is that pore-water velocities of at least up to 5 mm/yr are occurring in a downward direction.

The final deployment was at Station 11187 where PUPPI #1 was deployed in pelagic sediments on an abyssal hill with a 3-metre probe, four weights and without a cone. Acoustic telemetry indicated that it had not fully penetrated but was vertical. However, the instrument failed to release from the bottom neither on command nor from the back-up clock. Assuming the telemetry indications are correct, then the loss can only be accounted for by the unlikely situation of a buoyancy loss or faulty pyros.

An interesting feature of the records is the differential pressure oscillations which are caused by tidal changes. Peak-to-peak differential pressures of about 0.2 kPa were observed with a period of aproximately 12 hours. This pressure is observed because the sediments are relatively impermeable. Not only does the observation imply that the instrument is functioning well but also that it should be possible to obtain the permeability of the sediments from the attenuation and phase information of this record if accurate tidal information is available.

For all six recoveries, the accelerometer logging systems worked perfectly, allowing the calculation of deceleration, speed and distance penetration histories. The results indicated that the weighting of the instrument had been nearly optimal. For D11182 there was slight underpenetration (by about 30 cm) and for the other deployments, overpenetration by 0 to 20 cm.

The performance of the acoustic release system was generally good, release channel operation being reasonably quick. The beacons, however, gave some problems. On D11180 (CR 2500), failing beacon batteries caused the repetition period to become unstable, making recovery more difficult. A similar fault appeared for a short time on D11184 (CR 2501) but corrected itself. The beacon on D11187 (CR 2308) would not time out on the 320 channel after the instrument failed to release.

The radio direction finding equipment worked well in locating PUBs and PUPPI although, for most recoveries, the instruments popped-up only a few hundred metres or less from the ship. On D11180 the radio was useful in locating PUPPI #2 as the range at pop-up was 2.5 miles. The flashing light was spotted at 2 miles range.

For the recovery of the digital PUBS (D11191) the radio located the instrument over a range of about 3 miles. Recovery was at night and the flashing light had failed, thus the recovery would have been impossible without the DF system.

P.J.S. & S.McP.

WASP camera

The Wide Area Survey Photography (WASP) camera system was deployed on five occasions. The system is similar to that used on Discovery Cruises 134, 142 and 144 except that a pressure sensor has also been added to provide information on the absolute depth of the system. For this cruise an IOS Mk 4 underwater camera was added to the system for colour photography. Unfortunately the low film capacity of this camera was used up by accidental triggering of the system before it reached the seafloor. Therefore, no colour photographs of the seafloor were taken.

Station 11171: The Benthos camera was loaded with 60 m of 400 ASA, thin-based black-and-white film. The camera aperture was set at f3.5-4 and the data chamber aperture at f5.6. The IOS Mk 4 camera was loaded with 15 m of EKTACHROME film and the whole system was programmed to cycle at 12-second intervals.

The WASP was launched at 301/1300 and from the start the altimeter registered its maximum operating range (80 m) without (as it usually does) triggering on any 35 kHz noise. Unfortunately, the altimeter continued to register its maximum range even after the camera had reached the seafloor. The station was abandoned and the WASP recovered undamaged.

On examination, it appeared that the system had failed owing to a faulty altimeter transducer. This was repaired with some considerable effort and the WASP prepared for the next dip.

Station 11176: The WASP was set up as for Station 11171 except that the cycling rate had been altered to 16 seconds. This station was run over a low abyssal hill in the SW of the GME study area. The WASP was launched at 305/2225 with a ship's speed of 0.5 knots. Unfavourable winds forced us to increase the ship's speed to 1.5 knots which resulted in the monitor signals becoming weaker (but still useable). The seafloor was reached at 0223/306 and photographs taken until 0621/306 when the station was ended to avoid encroaching upon a current meter moored on the crest of the hill.

Upon recovery it was found that considerable corrosion had occurred on the monitor case. This had occurred as a result of faulty connectors on the flash units creating short circuits. After testing, a set of five serviceable flash units were selected for future stations. Apart from this, the station was successful and approximately 900 seafloor photographs were taken.

Station 11178: The WASP was set up as for Station 11176. This station was run within the acoustic navigation network and the remote interrogator pinger was clamped to the wire 200 m above the WASP. The target for this station was a fault trace identified on the 3.5 kHz profiler. There was no wind and very little swell and the ship's speed was maintained at 0.5 knots. The remote interrogator failed to work and so it was decided to make a 180° turn in order to ensure that the WASP crossed the fault. The turn was achieved in 35 minutes and the fault was crossed. Approximately 1100 photographs were taken during this station.

Station 11181: The WASP was set up as for Station 11176. Once again, the station was run within the acoustic navigation network. On this occasion, however, the remote interrogator was clamped to the wire 500 m above the WASP. This station was also run over the fault trace observed on the 3.5 kHz profiler. There was a 15-knot wind blowing and the ship's speed was maintained at 0.75 knots. The interrogator failed to work again; however, the acoustic navigation provided us with the ship's position and it was deduced that the WASP crossed the fault trace during the station.

Station 11190: The WASP was set up as for Station 11176 with the addition of a 3.5 kHz sound source. The 3.5 kHz source (taken from the PATSY system) was a downward-looking transducer triggered by the WASP monitor to produce a pulse every two seconds. It was hoped to receive the bottom echo of these signals to produce a near-bottom 3.5 kHz profile. The sound source proved too weak for this, however, and this aspect of the station failed to work.

The target for this station was again a fault trace identified from the ship's 3.5 kHz profiler. Acoustic navigation was not available for this station as two of the beacons were now so weak, so we relied upon the satellite navigation system. The wind was blowing at 15 knots and the ship's speed maintained at 0.75 knots until a 90° turn was executed when the ship's speed was increased to 1.4 knots to maintain way. Approximately 1000 seafloor photographs were taken and the fault trace was crossed.

Film Development: The black-and-white film from Stations 11176 and 11178 were processed on board using a continuous-process film processor. The negatives indicated that the stations had been successfully run; however, only four flash units were operating.

Conclusions: Two main points arose from the WASP stations run on this cruise:

1. WASP system operation: The WASP system was not functioning as well as it should and this was due to two malfunctions. The first was that the altimeter picked up 35 kHz noise and triggered the camera in mid-water, so wasting film. This problem has dogged the system since it was built and is still being studied. Secondly, the flash unit bulkhead connectors were appallingly inefficient both at making good circuits and remaining insulated from the sea; these are being replaced.
2. Station operation: Good experience at attempting to photograph specific targets was gained. Both 180° and 90° turns were successfully achieved under full control. It was clear, however, that the camera's drag-to-weight ratio was too high, resulting in a lot of wire being required to run a station at any speeds in excess of one knot. This situation is under review.

I would like to thank Richard Babb for his forbearance and help with the repairs of the monitor after Station D11171.

Q.J.H.

Piston Coring

The reliability of the piston corer has improved considerably since it was first used on Discovery Cruise 124. Piston coring is now a routine procedure with the acoustically-activated safety pin being withdrawn when the trigger core is only a few metres above the seafloor as indicated by the bottom echo from a wire pinger. In this way the dangers of pre-triggering have been largely eliminated.

Four piston cores were taken during the cruise (see Table 4). Cores D11172, D11174 and D11179 were taken on the abyssal plain in the turbidite sequence whereas D11192 was taken on an abyssal hill and probably contains a mainly pelagic sediment sequence.

The only problems encountered were:

(a) The trigger core was longer than usual which meant that the davit had to be fully raised for the launch and recovery. It was found simpler to use the auxiliary winch wire led over a block on the davit head to deploy the trigger corer rather than have the chain wrapped around the capstan.

(b) The piston end-plate and washer worked loose during Core D11172 and severely disturbed the upper 1.3 metres of this core. A new softer washer and longer retaining bolt were used for the remaining three cores without mishap.

All cores were logged using the P-wave logging equipment. This enabled the positions of the main turbidite units to be accurately assessed. Using this information, four 1.5 m sections were given to the BRE group for shipboard geotechnical testing.

D.G. & P.J.S.

Pop-up Ocean Bottom Seismometers (PUBS)

Two PUBS were deployed during the cruise. The purpose of the deployments was to test and compare a modified analogue recording instrument and a new digital recording seismometer. Both devices were deployed at the same site so that direct comparisons between records could be made. A thirty-kilometre refraction line was shot using a one thousand cubic inch airgun, firing every two minutes.

The PUBS launching and airgun firing went smoothly; however, instrument recovery was problematic. Activation of the devices' acoustic transponders proved to be impossible despite careful navigation and long transmissions of transponder switch-on frequency. Eventually, both instruments released their ballast weights under command of built-in back-up timers. One PUBS was sighted immediately upon surfacing, but the second one was located several hours later after a search of the area. It was recovered only a short distance from the site of the first device.

When opened aboard ship, both instruments could be seen to have made recordings. Conclusions drawn from the experiment remain dependent upon full analysis of the recordings at a later date. The acoustic problems encountered were most confusing and will be investigated fully.

R.E.K.

Seismic Reflection Profiling

A total of some 200 km of single-channel seismic reflection data was shot at a speed of 7 knots in one continuous run in the southwestern survey area on 29 and 30 October. An 80 cubic inch (1311 cm^3) Bolt airgun was fired at 8.8 s intervals. Signals were received by a two-channel Geomechanique hydrophone array. No equipment was available for calibration of the depth sensor which indicated a depth of 20 metres at 7 knots. The airgun was buoyed to run at 15 metres below the surface. The two hydrophone signals were summed and this raw signal was pased through parallel bandpass filters set at 15-100 Hz and 50-160 Hz; the output signals from the filters were recorded on separate EPC graphic recorders with recording windows of 4 s and 2 s respectively and a sweep delay of 6.8 s after firing. The raw signal was recorded on Channel 1 of a Store 4 DS tape recorder at 15/16 inch per second (2.38 cm per second) with an input voltage range of -2V to +2V. A recorder trigger pulse was recorded on Channel 2 and an event marker signal was recorded on Channel 3 once every 30 minutes. The tape was later replayed through various narrow bandpass filters and the data were recorded on an EPC to aid selection of optimum filter settings for subsequent recordings. The quality of certain sections of data was impaired by bad triggering but the quality was otherwise satisfactory.

An attempt to shoot further SRP data was made on 4 November. Shortly after reaching survey speed, the internal rope parted in the first spring section. The broken section in the hydrophone array was removed, the hydrophone re-deployed, tested and found to be in good working order. Unfortunately, when the airgun was re-deployed it would not seal and, because of shortage of time, the reflection survey was cancelled and the equipment retrieved. The survey proceeded using only the 3.5 kHz and magnetometer systems. Thus, less than 20 minutes of SRP data were obtained in this second survey.

S.R.J.W. & P.M.

3.5 kHz profiling

The 3.5 kHz profiler fish was deployed on 21 October and finally retrieved on 16 November. In order to prevent interference, the system was sometimes switched off when certain other devices (acoustic navigation, near-bottom profiler, PATSY, Cambridge deep-tow profiler) were being used. It was also switched off for short periods to facilitate communications with acoustic transponders on the corer, PUBS and PUPPIs.

The system worked well and good data with penetration of over 100 metres in places were obtained both when running planned survey lines and also while in transit between stations. Reasonable data were also obtained in transit to and from GME despite ship speeds in excess of 10 knots. The 3 to 4 kHz pulse correlator was used exclusively except for a few short intervals when the system was operated in normal AGC mode. Faint, laterally-coherent signals appearing on the records just above the seabed reflection were considered to be artefacts of the correlator as no corresponding reflectors were seen on the 10 kHz precision echo-sounder records.

Numerous crossings were made of some of the faults detected in the area by previous surveys. It was seen that the along-strike variability in the pattern and structure of the faults was more pronounced than had been expected; the central "fault" in our work area was resolved into a narrow (~ 1 km-wide) band of faults, individual faults being no more than 2-3 km long but the whole band persisting for ~ 10 km or more along strike. The majority of these faults are reverse faults. The resolution with which the pattern of faulting could be determined, therefore, depended largely on the accuracy of the navigation data.

S.R.J.W.

Near-Bottom Seismic Reflection Profiler

A near-bottom seismic reflection profiler was borrowed from the Bullard Laboratory, Cambridge University. The CTD wire with a conducting swivel termination was used to tow the deep-towed section of the instrument. This section comprises a weightstand containing the electronics pressure case and a 3.5 kHz transducer attached to a neutrally-buoyant 30-m hydrophone streamer. The hydrophone array detects low-frequency acoustic signals (10-15 Hz) from a conventional surface-towed airgun source. These signals are modulated about a 675-Hz carrier and mixed with the 3.5 Khz signal for transmission via the CTD wire to the deck unit. At the deck unit the signals are separated and demodulated for real-time monitoring on two EPC recorders; however, for subsequent processing they are also tape recorded, along with a flutter tone and timing pulses. In addition, the deck unit can generate coded 8.2 kHz tone bursts down the CTD wire to command the 3.5 kHz transducer on or off and also to cycle through a series of gain settings in the low-frequency signal channel.

Three deployments of the near-bottom profiler were made on this cruise (Stations 11183, 11186, 11189) and, in each case, 200 kg of extra weight (heat-flow instrument weights) was added to the weightstand so that the total end-weight on the CTD wire was approximately 300 kg. Before each deployment the profiler was fully assembled on the afterdeck and tested for low-frequency signal reception, commandable gain and commandable 3.5 kHz transducer. Deployment was from the afterdavit off the starboard quarter with the CTD wire running aft through two roller blocks from the midships winch. The hydrophone array was first streamed by hand followed by the weightstand from the davit; ship speed was 1-2 knots. Recovery was the reverse of deployment and both operations ran smoothly with no difficulties being encountered.

In the first deployment (11183) the airgun (80 cu in) took so long to deploy that the near-bottom profiler was close to the seabed (5000 m wire out) before the gun started firing. It was immediately apparent that no low-frequency signals were being transmitted by the hydrophone streamer although the 3.5 kHz transducer was working well. The profiler was recovered and the fault was traced to internally-severed conductors in the streamer cable. This damage appeared to have been done prior to the borrowing of the profiler. The second deployment (11186) ended at 500 m wire out when both low-frequency and 3.5 kHz signals abruptly stopped. It was found that the electronics pressure case had leaked owing to an accidental fracture of a bulkhead connector. With the electronics replaced by a spare set, a third deployment was made (11189). There was good reception of 3.5 kHz and low-frequency airgun signals as the profiler was lowered, although by 5000 m wire out there appeared to be a lot of noise in the low-frequency channel. This was probably due to the motion of the streamer through the water column as it was lowered. In addition, the airgun (40 cu in) was probably too small. At 5500 m wire out the 3.5 kHz transducer ceased to function properly. This was later traced to a leak in the plug/cable connecting the electronics pressure case to the transducer. At about the same time, signal reception along the CTD wire became intermittent. This was possibly caused by poor connection in the bulkhead connector on the conducting swivel which was later tested and replaced. Shortage of time prevented any further deployments of the profiler.

A.W.

IOS 7.5 kHz Near-Bottom Profiler

Following the successful trials on Cruise 144 of a two-body heave-reducing tow system, for this cruise the electronics and transducer array were installed in a small neutrally-buoyant vehicle, towed from the CTD wire using the TOBI system depressor weight and neutrally-buoyant umbilical cable.

This system was deployed three times during our last three days in the working area, but failed to operate correctly. On each occasion, the symptoms were similar: a large number of parallel strips of "interference", of unknown origin, appeared on the record, making it unusable. Between deployments, modifications were made to the electrical earths on the vehicle, and a faulty transducer was replaced, but to no avail.

Tests of the electronics on the return passage failed to reveal any defects, and it seems that the problem must be caused either by the use of glass floats as buoyancy on the vehicle, or by the electrical characteristics of the TOBI umbilical cable.

R.J.B.

Computer, magnetometer, satellite navigation and closed-circuit TV

The shipboard computing system was used to log navigational, scientific and meteorological data. Sampling was started on Day 295 at 1400 and terminated on Day 321 at 1100. The sampling ran continuously during this period with the exception of about an hour on Day 321 at 0430 when a power-supply failure prevented the data from reaching the computer.

The computer system was also used to produce listings, plots and profiles of the data, as requested by the scientists on board. The USER system was used to run and develop IOS-related programs.

The magnetometer was successfully deployed on many occasions and produced good reliable data.

The satellite navigator ran successfully throughout the cruise with the exception of one instance when its program became corrupted.

After the camera assembly had been repaired, the TV surveillance system gave clear, all-round visibility of the afterdeck. It was primarily used by the officer on watch to see what was happening on deck during station work. The system was equally good during the night and the day.

P.M.

Airguns

An 80 cu in chamber fitted to a 1500 c airgun was fired at 8-second intervals for approximately 14 hours with a streamed hydrophone on the first reflection survey with no problems. Towing speed was 6 knots at 25 m approximate depth.

A 40 cu. in. chamber fitted to a 600 b airgun was fired at 10-second intervals for the Cambridge Profiler exercise. The airgun was towed at 2 knots and consequently buoyed with an A6 buoy to 25-metre depth. Various problems were experienced, with airhose kinking due to slow speed, and airgun not firing, which required immediate stripping and re-assembly before successful firing was achieved. The airgun and Cambridge Profiler were retrieved when the profiler would not receive a signal.

The Cambridge Profiler exercise was repeated twice with the airgun buoyed at 17-m depth. Problems with the Profiler led to airgun and Profiler being retrieved before completing the stations.

A 40 cu. in. chamber fitted to a 600 b airgun was fired at 10-second intervals at 15-m depth and 6 knots towing speed with the streamed hydrophone in the second reflection survey. After 20 minutes towing at 8 knots the hydrophone first section parted internally. The airgun and hydrophone were both retrieved. The damaged hydrophone section was removed and the remaining hydrophone redeployed with the airgun. When the airgun would not seal and not fire itself on restart, the survey was cancelled and the equipment retrieved.

A 1000 cu. in. chamber fitted to a 1500 c airgun was fired at 2-minute intervals at 15-m depth for four hours approximately for the PUBS exercise which ran successfully. Towing speed was 5 knots.

R.G.

Hydraulic Systems, Winches, Compressors

FWD Ring Main: The hydraulic system was run up at the beginning of the cruise but no boost pressure was observed. Pressure relief values were suspected and these were removed, inspected and replaced although no visual damage was seen.

The system was run up again and worked perfectly for three deployments of acoustic beacons from the double-barrelled capstan. The system was subsequently run up and no boost pressure observed. The whole system was gone through systematically and thoroughly and, after consultation, it was decided to change the main hydraulic pump. This was done after days of hard work and the system then ran perfectly for over 60 hours with no further problems.

The conclusion is that boost pressure was being lost through the main pump where, presumably, a seal had broken down.

We would like to acknowledge grateful thanks to the Chief Engineer, Davy Rowlands and his men and also to Russell Griffiths (RVS) for their help and co-operation.

Aft Hydraulics: This system was used for a total of 147 hours, the main traction winch being used for four piston cores, five WASP camera surveys and several wire tests. The airguns were deployed from the auxiliary winch, as was PUPPI. PUPPI was deployed from the midships winch 'A' frame using the auxiliary winch wire from aft, over the block on the crane jib. This was done quite successfully until the FWD Ring Main was in commission again. The complete system gave no problems throughout the cruise.

VHP 36 Compressors: Both compressors were run for airgun surveys, in conjunction with the Cambridge Profiler, and for a PUBS refraction line. The No. 1 compressor was run for the first half of the cruise before being shut down. The No. 2 compressor was used for the second half of the cruise and gave no problems.

B.K. & T.H.

Acoustic Navigation

The acoustic navigation system consisted of three transponder beacons, an interrogator fish, a remote pinger and a deck-receiver system. The three beacons were deployed on Day 300 in an array of an equilateral triangle with side 8 kilometres. The beacons were positioned 200 m above the seafloor so as to give greater range for near-bottom navigation. Several baseline crossings were made to make initial estimates of the relative positions of the transponders. Between days 300 and 309 the transponder array was used to navigate the ship on surveys, deployment and recovery of PUPPIs and, using the remote pinger, to navigate coring and camera stations.

Several problems were experienced with the system, the most serious being the difficulty of reading the signals due to a poor signal-to-noise ratio at the receiver. The reason for this was partly due to the use of a non-ideal fish (a small "dolphin") to house the transceiver transducer, but mostly due to a non-linearity discovered in the 'front-end' of the receiver electronics which, amnong other things, allowed the first harmonic of the 3.5 kHz transmissions to seriously contaminate the record. The non-linearity was reduced at the end of the cruise by modifying the circuit concerned. The remote pinger was unreliable to begin with but a change of the power supply/PPA board effected a cure, though by this time two of the seabed transponders were failing, so no useful 'remote' navigation was achieved.

Throughout, a computer program 'PINGER' was used to calculate the positions of the ship and pinger. It was noticed, however, that when navigating outside the transponder array, the positions calculated by the computer did not agree with the positions determined by intersecting circles drawn on a chart. It was discovered that the difference was due to the tracking algorithm used by the computer.

During the camera station on Day 309, navigation became impossible due to two of the transponders failing to reply. On Day 311 it was attempted to recover these beacons. However, this proved unsuccessful, one of the beacons not transponding, the other transponding weakly but failing to release. On Day 314 the third beacon was recovered but only after forty minutes of interrogation of its release frequency. Another attempt was also made to release the other transponder, but with no success.

It was decided that, in future, the transponders should, ideally, have a completely separate release mechanism, one not reliant on the main battery pack. Also, to enable us to recover them at night, a flashing light, as used on PUPPI and PUBS instruments, and, for better daytime recognition, a red flag mounted on the transponder would be used. It was also noted that the orange hard hats, used for protecting the glass buoyancy spheres, were far more visible than the yellow type.

I.P.R.

TABLE 1 - Station List (General)

STATION NUMBER	TYPE	LATITUDE N	LONGITUDE W	DEPTH CORR. M.	TIME			COMMENTS
					LEFT SHIP	ON BOTTOM	ON BOARD	
11168	Acoustic transponder No. 1 ('Red')	31°26'.1	24°52'.6	Transponder at 5239 m	300/1435	300/1530	-	Transponder 200 m above seafloor. Power faded. Failed to release.
11169	Acoustic transponder No. 2 ('Green')	31°24'.3	24°47'.3	Transponder at 5238 m	300/1721	300/1812	-	Transponder 200 m above seafloor. Power faded. Failed to release.
11170	Acoustic transponder No. 3 ('Blue')	31°28'.3	24°48'.2	Transponder at 5235 m	300/2114	300/2222 to 314/1150	314/1400	Transponder 200 m above seafloor. Very slow to release.
11141	Pop-Up Pore Pressure Instrument (PUPPI)	31°27'.0	24°49'.2	5437	178/1041	301/0705 (released)	301/0915	Recovery of instrument laid close to fault during Discovery Cruise 149.

TABLE 1 - Station List (General) cont. 2

STATION NUMBER	TYPE	LATITUDE N	LONGITUDE W	DEPTH CORR. M.	TIME			COMMENTS
					LEFT SHIP	ON BOTTOM	ON BOARD	
11171	WASP camera	31°30'.5	24°50'.0	5437	301/1256	301/1742 to 301/2020	302/0106	Near-bottom echo sounder failed. No photographs.
11172	Piston core	31°26'.7	24°48'.2	5438	302/2237	303/0103	303/0420	5 barrels. 13.6 m core. On SE side of fault.
11173	PUPPI	31°26'.8	24°48'.8	5439	304/1331	304/1429 to 308/1320	308/1530	On SE side of fault.
11174	Piston core	31°26'.5	24°49'.6	5439	304/1736	304/2018	304/2354	6 barrels. 16.5 m core. 250 m NW of fault.
11175	PUPPI	31°26'.7	24°49'.4	5439	305/0232	-	305/0524	Stray line fouled probe on launch. Ballast weight released in mid-water.

TABLE 1 - Station List (General) cont. 3

STATION NUMBER	TYPE	LATITUDE N	LONGITUDE W	DEPTH CORR. M.	TIME			COMMENTS
					LEFT SHIP	ON BOTTOM	ON BOARD	
11176	WASP	31°22'.9 to 31°25'.2	25°18'.2 to 25°13'.6	ca. 5410 to ca. 5240	305/2225	306/0223 to 306/0621	306/0918	Ran over abyssal plain and hill. Successful.
11177	PUPPI	31°26'.4	24°49'.3	5439	306/1311	306/1405 to 310/1605	310/1819	On NW side of fault.
11178	WASP	31°25'.7 to 31°26'.8	24°47'.4 to 24°49'.4	5438	307/0249	307/0654 to 307/1245	307/1620	Crossed fault.
11179	Piston core	31°31'.0	24°52'.2	5438	307/2359	308/0330	308/0824	Over buried 'basement' high. 6 barrels. 16.5 m core.
11180	PUPPI	31°23'.6	24°47'.7	5439	308/1029	308/1124 to 310/2300	311/0121	Over basement low away from faults.

TABLE 1 - Station List (General) cont. 4

STATION NUMBER	TYPE	LATITUDE N	LONGITUDE W	DEPTH CORR. M.	TIME			COMMENTS
					LEFT SHIP	ON BOTTOM	ON BOARD	
11181	WASP	31°27'.1 to 31°29'.2	24°46'.8 to 24°48'.6	5440	308/2318	309/0330 to 309/0905	309/1235	Crossed fault.
11182	PUPPI	31°31'.8	24°52'.5	5439	309/1435	309/1529 to 311/2215	312/0021	Near crest of buried basement high. Differential pore pressure observed.
11183	Cambridge Deep-Tow	31°21'	24°42'	5439	311/1610	311/1811 to 311/1900	311/2050	No good signal obtained. Later found broken conductors.
11184	PUPPI	31°31'.4	24°52'.2	5439	312/0241	312/0336 to 315/0353	315/0635	Laid over buried basement high. Differential pore pressure observed.

TABLE 1 - Station List (General) cont. 5

STATION NUMBER	TYPE	LATITUDE N	LONGITUDE W	DEPTH CORR. M.	TIME			COMMENTS
					LEFT SHIP	ON BOTTOM	ON BOARD	
11185	Babb profiler	31°27'	24°47'	5438	312/0646	-	312/0830	No good signal.
11186	Cambridge Deep-tow	31°20'	24°40'	5439	312/1504	-	312/1600	Lost signal at 500 m. Pressure case leaked.
11187	PUPPI	31°28'.4	25°04'.8	5378	313/0311	313/0409	-	Laid on abyssal hill. Failed to release.
11188	Babb profiler	31°27'	24°47'	5438	313/0730	-	313/0930	No good signal.
11189	Cambridge Deep-tow	31°24'	24°44'	5440	313/1201	313/1400 to 313/1520	313/1708	Intermittent, poor signal. Later found broken conductors.

TABLE 1 - Station List (General) cont. 6

STATION NUMBER	TYPE	LATITUDE N	LONGITUDE W	DEPTH CORR. M.	TIME			COMMENTS
					LEFT SHIP	ON BOTTOM	ON BOARD	
11190	WASP and PATSY	31°25'.9 to 31°27'.1	24°46'.8 to 24°50'.1	4538	313/1938	313/2351 to 314/0428	314/0800	Crossed fault. PATSY tried as deep-towed profiler/pinger but poor signal
11191	PUBS (analogue)	31°30'.1	24°53'.0	5439	314/1822	ca. 314/2020 to 315/1200	315/1409	Released on back-up clocks. 1000 cu in air-gun used for test shots.
	PUBS (digital)	31°30'.2	24°52'.9	5438	314/1840	ca. 314/2040 to 315/1200	315/2135	
11192	Piston core	31°29'.1	25°03'.8	5378	316/0059	316/0256	316/0600	On abyssal hill. 5 barrels. 10.75 m core.

Total successful stations:

WASP	4
PUPPI	6
Core	4
PUBS	1

Note: Positions are for instrument on bottom, based on acoustic navigation where possible. Camera positions give total range of station, not start and finish positions.

TABLE 2 - Underway Geophysical Observations

MEASUREMENT	START	STOP	COMMENT
PES	295/0900	321/1212	Continuous except for some stations.
3.5 kHz	295/0900	321/1300	Continuous except for some stations.
Magnetometer	295/1528 303/1244 310/0124 314/1442	300/1300 304/0348 310/1418 314/1754	Reduced to IGRF 1980.0
SRP	303/1200	304/0340	80 cubic inch airgun
Computer logging	295/1406	321/1030	

TABLE 3 - PUPPI stations (for positions, see Table 1)

STATION	PUPPI #N/Lay	LOCATION	TIME ON BOTTOM (hrs)	CONFIGURATION	COMMENTS
D11141	#2/1	Close to fault (on SE side of fault)	2995	Cone, 3 weights 4-m probe, short tip	Fault on logger, only partial data recovery. No diff. pore pressure.
D11173	#1/3	Close to fault (on SE side)	95	Cone, 3 weights 4-m probe, short tip	Cut on slow logging. No diff. pore pressure.
D11175	#2/2	-	-	Cone, 3 weights 4-m probe, long tip	Aborted in water column. Fault on logger.
D11177	#3/1	Very close to fault (on NW side)	97	Cone, 3 weights 4-m probe, short tip	No diff. pore pressure.
D11180	#2/3	Basement low thick sediments	60	Cone, 3 weights 4-m probe, short tip	No diff. pore pressure
D11182	#1/4	Basement high thin sediments	56	Cone, 3 weights 4-m probe, long tip	Diff. pressure -0.15 kPa
D11184	#3/2	Basement high thin sediments	72	Cone, 3 weights 4-m probe, long tip	Diff. pressure -0.45 kPa
D11187	#1/5	Abyssal hill Pelagic sediments	60+?	No cone, 4 weights 3-m probe, short tip	Failed to release from bottom. Instrument abandoned.

TABLE 4 - Cores (for positions, see Table 1)

CORE	No. OF BARRELS	TRIP CHAIN LENGTH (m)*	WIRE LENGTH CORER & FREE FALL	PISTON CORE RECOVERED (m)	TRIGGER CORE RECOVERED (m)
D11172	5	25.3	25.4	13.6	4.24
D11174	6	28.3	28.5	16.5	2.95
D1179	6	28.3	28.5	16.5	3.41
D1192	5	25.3	25.4	10.75	3.41

* This includes a 5.1 m long trigger core

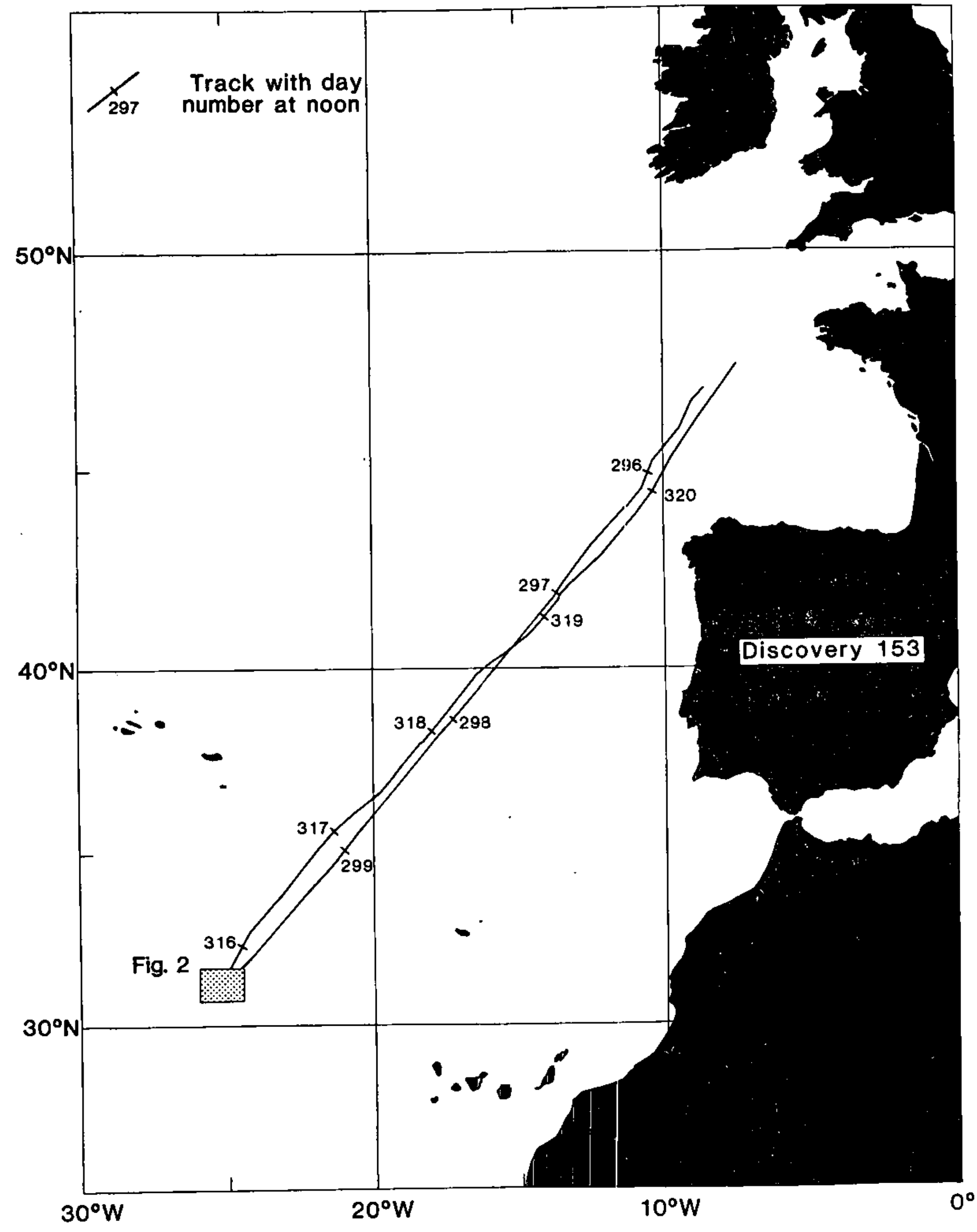
Track with day number at noon
297
Discovery 153
296
320
297
319
318
298
317
299
316
Fig. 2
50°N
40°N
30°N
30°W
20°W
10°W
0°

FIG. 1

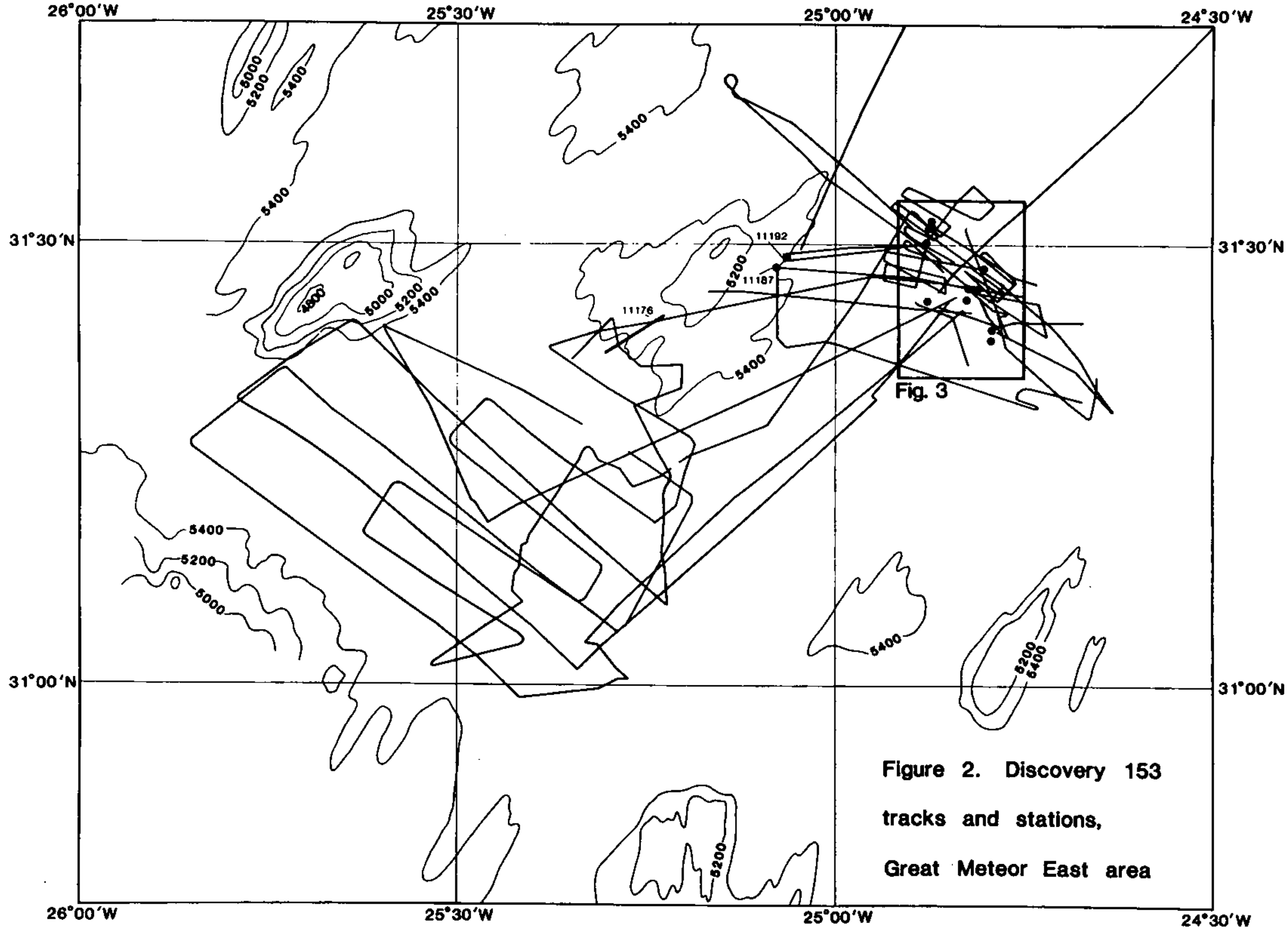

Figure 2. Discovery 153 tracks and stations, Great Meteor East area

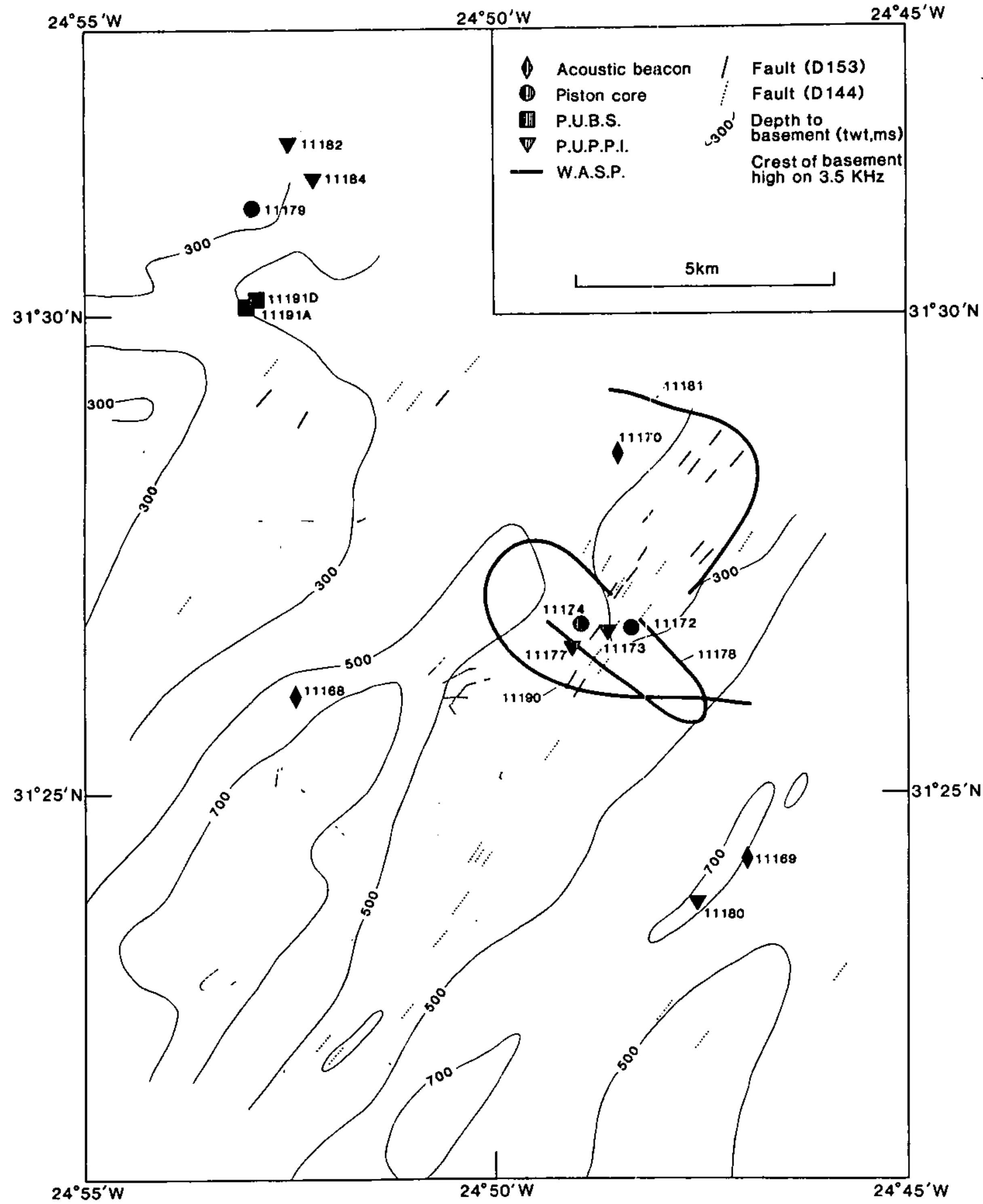

Figure 3. Discovery 153 detailed survey area