I.O.S.

R R S DISCOVERY

CRUISE 125

30 JANUARY – 25 FEBRUARY 1982

GEOCHEMICAL SAMPLING OVER THE MADEIRA/CAPE VERDE ABYSSAL PLAINS

CRUISE REPORT NO 125

1982

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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R.R.S. DISCOVERY

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Institute of Oceanographic Sciences,
Brook Road, Wormley, Godalming,
Surrey, GU8 5UB.

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ITINERARY

Departed: Research Vessel Base, Barry 1200 Z 30 January 1982

Arrived: Naval Dockyard, Gibraltar 0930 Z 25th February 1982.

SCIENTIFIC PERSONNEL

R.J.P. Burnham	R.V.S.
M.P. Burnham	I.O.S.
J.D. Burton	Southampton University
Mrs. S. Colley	I.O.S.
E. Darlington	I.O.S.
R.H. Edge	I.O.S.
H. Elderfield	Leeds University
B.S. Elloway	R.V.S.
T.J.P. Gwilliam	I.O.S.
D.J. Hydes	I.O.S.
G.A. Lake	I.O.S.
V.A. Lawford	I.O.S.
Miss C.A. Lunn	N.S.S.
R.M. Pagett	Leeds University
R.D. Peters	I.O.S.
W.R. Simpson	I.O.S.
P.J. Statham	Southampton University
Mrs. H. Sutherland	I.O.S.
J. Thomson	I.O.S. (Principal Scientist)
T.R.S. Wilson	I.O.S.

SHIP'S OFFICERS

P.H.P. Maw	Master
S.D. Mayl	Chief Officer
S. Sykes	2nd Officer
P.G. Pepler	3rd Officer
A.E. Coombes	Chief Engineer
T.A. Rees	2nd Engineer
F.J. Richards	3rd Engineer
G. Gimber	4th Engineer
N. Davenport	5th Engineer

K.T. Sullivan	5th Engineer
F.P. Sharpe	Electrical Engineer
Miss C.A. Langley	Radio Officer
R. Overton	Purser/Catering Officer

OBJECTIVES

This cruise was planned to obtain samples of sediment, sediment pore waters, seawater and seawater particulate matter for geochemical research. There were requirements for both Science Vote work and work commissioned by the Department of the Environment on oceanographic aspects related to possible future disposal of high level radioactive waste. For this latter purpose it was intended to sample in areas of interest to the NEA Seabed Working Group. Those areas are designated Great Meteor East, Cape Verde 1, 2 and 3 and considerable background information was available on the geological characteristics of those areas.

The primary objectives were:

i) to sample sediments above and below the carbonate compensation depth, mainly in the area Cape Verde distal abyssal plain/Mid-Atlantic Ridge foothills, by means of a 2 m Kastenlot corer and the I.O.S. box corer.

ii) to obtain pore water samples complementary to the sediments in (i) above by means of the I.O.S. Mark II *in situ* pore water sampler and by squeezing sediment from box core subsamples.

iii) to make detailed hydrographic casts of the upper ocean water column, and casts of the complete water column, for trace metal analysis. The metals of particular interest were manganese, iron and cadmium, the rare earth elements and aluminium.

iv) to make tests of the new I.O.S. *in situ* filtration device and to quantify and sample the particulate material of the water column with this device.

In addition, two secondary objectives, accepted on a 'ship of opportunity' basis, were:

v) to make a collection of surface seawater for the Standard Seawater Service, and,

vi) to obtain expandable bathythermograph (XBT) records of the ocean mixed layer on passage between the U.K. and the Azores.

NARRATIVE

The schedule of Cruise 125 had been altered over preceding months due to delays in the 1981 refit, during which Discovery had received some large scale alterations. Among these alterations one of importance to this cruise was the installation of a new hydraulic traction winch for coring and trawling work. Remedial work to some teething troubles on this winch which had been revealed on Cruise 124 (Engineering Trials) was in progress when the scientific party joined the ship on Thursday 28 January. Sailing was delayed from 1200Z Friday 29 January until 1200Z Saturday 30 January in view of progress of work on the winch, and when it was discovered that the 10 mm conducting warp of the midships hydraulic winch had developed an insulation fault. The outboard 500 m of the 10 mm warp was discarded at Barry, when the remaining 7 km was confirmed to be sound.

Discovery sailed at 1200Z Saturday 30 January immediately following the loading of 8.75 tons of explosives for subsequent cruises. The ship proceeded at low speed while equipment was moved on to the poop and other equipment secured by the crew. The P.E.S. fish was streamed at 1700Z, following which the ship continued at full speed.

P.E.S. watches commenced at 0800Z Sunday 31 January, and the firing of XBTs every ½° along the ship's track from 48°N to 38°30'N began at 0200Z Monday 1 February. Approximately one hundred 10 gallon bottles were filled from the ship's fire hoses following extensive flushing, in the early afternoon of Monday 1 February 1982, between positions 46°54.4'N12°47.3'W and 46°48.4'N 12°59.6'W. This collection for the Standard Seawater Service was measured on three occasions during filling to have a salinity close to 35.5.

Poor weather conditions were experienced from late on Monday 1 February until Tuesday 9 February, with the wind rarely below Force 7, and a swell from depressions in the north Atlantic running through mainly from the northwest. Periods of Force 9 winds were experienced and the ship went to three engines on occasion to reduce the possibility of overload cut-out. The planned "shake down" station south of King's Trough had to be abandoned, as did the first planned intensive station at the Great Meteor East area where the ship stood hove to overnight from 1600Z Saturday 6 February until 0900Z Sunday 7 February on expectations of improvement from the weather forecast. An early requirement was a deployment of the tapered trawl warp which had been spooled with considerable torsion in the outboard 5 km of its length during Cruise 124. The first attempt to achieve this was made at 0900Z Monday 8 February in marginal conditions. This vertical deployment went smoothly until 1270 m of warp had been paid out, when the ship was pooped by aberrant swell, a slack wire condition developed, and the warp jumped the dynamometer sheave of the winch and the first grooves of the double capstan winch. This necessitated cutting the warp outboard of the winch and loss of 1270 m of warp and chain weight.

From Tuesday 9 February onwards the weather presented no problems. At the first station (10399 occupied from 0900Z Tuesday 9 February) over the Cape Verde 1 area, the torsion was removed successfully from the trawl warp by paying out 5 km with a one-ton streamlined weight attached on a double swivel arrangement. Only minor problems were evident on the coring winch and these were successfully overcome, although the combination of careful monitoring of the behavioural characteristics of this new machine, and its slow veer and haul speed at loads greater than 2.5 tons, meant longer winch times than usual. A Kasten core was successfully retrieved at station 10399, but a box corer run failed due to pretripping. Hydrographic casts were also begun successfully at this station, using a 12 x 2.5ℓ bottle rosette array in association with a C.T.D., the first use of this type of equipment by the I.O.S. chemistry group and its university collaborators. The C.T.D. temperature probe was calibrated by a reversing thermometer hydrocast. The live time data displays of the water column characteristics were extremely useful in selecting depths at which to sample. Initial testing of the in situ filtration device was accomplished successfully, and samples of particulate material recovered from three depths. Work with the coring winch was terminated at this station when it was discovered that the gearboxes were leaking oil, but subsequent investigation revealed that the loss had been trivial. In view of the remaining available station time, a decision was made to concentrate effort on only two further intensive stations, one a red clay site (station 10400), the other a carbonate ooze site (Great Meteor East area, station 10402). At 1245Z Friday 12 February the ship got underway for the next station.

Some time had to be expended on arrival at station 10400 (1800 to 2200Z Saturday 13 February) in finding a suitable area for sediment work, as a complex system of uncharted ridges was found. The box corer was run in the early hours of Sunday 14 February, but again no core was retrieved due to pre-trip. The first deployment of the pore water sampler was then made; but while the device performed as designed, only small samples of pore water were recovered. Two deep and one shallow C.T.D. hydrographic casts and the filtration device were successfully run at this station. Some time was spent trying a series of 'yo-yo' dips to determine whether the box corer was pretripping in the first 100 m of descent, where the ship's wake turbulence and stern movement is less damped, but no pretripping was effected. Following this a third box corer attempt was unsuccessful. A Kasten core was then successfully taken. During retrieval of this core a winch gearbox developed what appeared to be a serious bearing problem, and following consultation with I.O.S. Wormley it was decided that this required investigation before the winch was used further.

Discovery proceeded back to the Great Meteor East area at 2318Z Monday 15 February, one C.T.D. shallow water column cast being taken at station 10401 *en route* on Wednesday 17 February. The loss of use of the coring winch meant that only water column work was possible for the rest of the cruise. It was decided to reintroduce and intensify the work to sample the Mediterranean Outflow Water which had been lost at the putative 'shakedown' station, and also to obtain as good a west/east section as was feasible for the hydrographic programme on return to Gibraltar.

On arrival at station 10402 (the Great Meteor East area) at 0112Z Thursday 18 February, three deep and one shallow C.T.D. casts were made, along with a calibration hydrocast with reversing thermometers and further trials of the filtration device. Particulate samples from five depths and a detailed particulate profile were obtained with the filtration device, although the particle counter cell windows imploded at 4 km depth.

On Thursday 18 February 1982, a few commissioning tests were made of the auxiliary trawl winch, which had been installed just before sailing on this cruise. Among these tests a modified near bottom echo sounder (N.B.E.S.) was mounted on the warp above the box corer, with the aim of detecting the corer pretrip on descent. This device was proved by forcing a corer pretrip, clearly indicated by the N.B.E.S. return signal.

The ship sailed for station 10403 at 1600Z Friday 19 February and was on position at 0800Z Saturday 20 February. Three shallow C.T.D. casts were completed at this station, and the ship set out for the final station at 1700Z Saturday 20 February.

A message was received from the U.S. research ship *Knorr* (Dr. Michael Purdie, W.H.O.I., Principal Scientist) via R.V.S. on Friday 19 February requesting discussion of an "unidentified acoustic disturbance in the central Atlantic area". This disturbance was interfering with returns on Knorr's hydrophone array and they were attempting to identify its source. Some suggestions were made at 1500Z Saturday 20 February as to which European research ships might be carrying large air guns and have been known to work in the area, but no advice could be given on their movements.

Discovery hove to on station 10404 at 1235Z Monday 22 February. A series of five C.T.D. runs, three shallow and two deep, was made, along with one successful filtration device deployment which recovered four particulate samples. On Monday 22 February advice was received from I.O.S. Ship Liaison at Gibraltar that it would be possible to dock a day early if required. This opportunity was accepted as it was clear by that time that no problems for completion of the scientific programme would be caused.

Discovery completed the scientific work at 1800Z Tuesday 23 February and set course for Gibraltar, when scientific watches were concluded. The P.E.S. fish had been recovered at 1300Z following the last deep-water C.T.D. cast. The ship docked at the Naval Dockyard in Gibraltar at 0930Z Thursday 25 February, to unload explosives to storage for a future cruise. At 0730Z Friday 26 February the ship moved to different berth at the civil docks.

The ship's track for this cruise is illustrated on Figure 1, and details of the work undertaken are listed as Table 1.

J. Thomson

PROJECTS AND EQUIPMENT REPORTS

i) COMPUTER OPERATIONS

The principal computer requirement for the cruise centred about the PDP 11/34 machine dedicated to recording, displaying and archiving data from the in situ filtration device and C.T.D. rigs. Navigation was not a primary requirement and so the resident Discovery IBM 1800 computer was not employed. "Live track" requirements were carried out by the PDP 11 machine.

This application of the existing PDP 11/34 fast data acquisition system to the filtration project for the first time was an ambitious undertaking.

Many changes to the system were needed in order to configure the system for working this device. These changes involved an operating system upgrade, a high level language upgrade and new hardware as well as the new applications programs developed by N.C.S.

The fundamental system development was severely behind schedule before the cruise started which not even the four week delay in Discovery's sailing could remedy. The N.C.S. applications programs had had no opportunities to be tested. The first half of the cruise was spent trying to provide the basic system in order to do any filtration device work at all. At the end of this time it was realised that well-tried and proven software which worked under the old operating system would not do so under the new one. Consequently the system was scrapped for the duration of the cruise. The complete filtration device software was transferred back to the old operating system, and at this point things started to get better.

The backlog of C.T.D. tapes which had accumulated were processed successfully and all the expectations for this work realised. The filtration device applications programs were quickly implemented which is a credit to the N.C.S. development. As the results came through it was realised that another operational technique was desirable for sampling the HIAC particle counter. Attempts were made to provide this but the cruise ended before this could be done. Because of these system problems it was not possible to develop programs for use on subsequent Discovery cruises.

R.J.P. Burnham
B.S. Elloway

ii) EXPENDABLE BATHYTHERMOGRAPHS

This work was undertaken at the request of Dr. R.T. Pollard (I.O.S. Wormley), to examine the variation of the upper ocean mixed layer depth and temperature with latitude. It was intended that these data would provide some information between dedicated marine physics cruises in the winters of 1980 and 1982, and was of particular interest in view of the particularly cold winter in 1981. Twenty XBT casts to 900 m were recorded using Sippican "Deep Blue" probes, every ½° along the ship's track from 48°N to 38°30'N.

Preliminary examination reveals that the temperature difference between the surface and 900 m increases from 2.7°C at 48°N to over 5°C at 36°30'N, but the mixed layer is less than 200 m deep even at the northern stations in spite of the cold preceding winter. All isotherms in the thermocline drop by 150-200 m from north to south.

E. Darlington
H. Sutherland

iii) HYDROGRAPHIC STUDIES

This cruise was the first occasion on which the I.O.S. Chemistry group and university collaborators had taken advantage of the C.T.D. developments which have been made at I.O.S. over recent years. A 12 x $2\frac{1}{2}\ell$ water bottle General Oceanics rosette was used in conjunction with Go-Flo water bottles and with Neil Brown C.T.D. sea and deck units. We should like to thank the I.O.S. Marine Physics group for the loan of several parts of this system. The C.T.D./ rosette assembly was deployed from the midships hydraulic winch: the new platform fitted during the 1981 refit made it possible to mount the rosette directly on top of the C.T.D. sea unit, reducing overall drag and allowing payout at speeds up to 100 metres/minute. Data was recorded via the 10 mm conducting warp: raw data was recorded on Revox tape after decoding in the C.T.D. deck unit and averaged calibrated data recorded on ½" magnetic tape after PDP 11/34 computer processing. Real time profiles were displayed on a V.D.U. and hard copy plotted at the end of both outboard and inboard casts. Bottle firing positions were identified from the dead time of the data stream.

The electronics and mechanics of this system worked well, 21 casts in all being taken during the cruise. Some problems were encountered early on with bottle leakage, but these were largely overcome. On early stations some trouble was also experienced with the winch, due to foreign material in the hydraulic system. This necessitated filter changes (twice) and valve cleaning (once), after which the winch operated smoothly.

Samples for geochemical analysis were collected for three distinct purposes as described below.

R.J.P. Burnham
B.S. Elloway
T.J.P. Gwilliam
G.A. Lake
V.A. Lawford
C.A. Lunn
W.R. Simpson

I.O.S. Sampling

Subsamples were taken from water bottles for shipboard determination of salinity, dissolved oxygen, dissolved silicon and reactive phosphate for water column geochemical characterisation. Salinity was measured on a 'Guildline' salinometer unit, and dissolved oxygen determined by the conventional micro-Winkler method. Dissolved silicon and reactive phosphate were determined in a total of 177 samples from 18 casts using an Automatic Chemistry Unit (Pye-Unicam AC1). The difficulties encountered with this machine on previous cruises (108 and 110 leg 2) have now been overcome, and it performed reliably during some of the severe sea conditions experienced, giving a precision of the order of ±0.1μ M Si and ±0.01μ M PO_4.

A total of 144 samples of unfiltered seawater were collected from 14 casts for the determination of dissolved aluminium at Wormley. At stations 10403 and 10404 Mediterranean Outflow Water was present as a distinct layer in the water column, and was clearly visible in the C.T.D. output. Using the C.T.D. system in real time allowed accurate detailed sampling across the boundaries between the Mediterranean Outflow Water and the adjoining water masses.

The samples were stored at room temperature in acid leached linear polyethylene bottles (Nalgene) and will be analysed within three months of collection. After the initial analysis a portion of the samples will be retained for analysis at later dates to examine changes with time on storage.

S. Colley
D.J. Hydes

Leeds University Sampling

(a) Large volume (∿50 litres) samples were collected for neodymium studies. There were obtained, with one exception, from the ship's non-toxic supply in the aft Chemistry Laboratory. This outlet should provide the cleanest samples since it is the first takeoff point. In addition, to minimise contamination the supply was run either at full bore for a period in excess of three hours, or continuously at a lower rate for at least a day. Both methods drained the header tank and thereby reduced the residence time of sea water in the header tank for the duration of sampling.

Filtering the sea water direct from the supply was found to be slow, inconvenient and did not allow a quick collection time relative to the residence time in the header tank. Subsequently a 60 litre acid-cleaned polyethylene bottle was used to collect 50 litres of sea water rapidly and act as feed. A ten channel peristaltic pump pumped water from this secondary feed through 0.4μm Nuclepore filters for final collection in rigorously cleaned bottles. These samples were acidified with ∿ 200 ml of quartz distilled 6M HCl and stored at room temperature. Ten samples were collected in this manner and a further one from a 30ℓ Niskin feed (hauled over the side of the ship) for comparative purposes. All filters were stored and together with the water samples will be analysed at Leeds.

(b) Small volume (∿ 2 x 1ℓ) samples were collected for rare earth element studies. The General Oceanics rosette sampler and the Neil Brown C.T.D. sea and deck units were used as previously described. Five stations were worked (10399, 10400, 10402, 10403 and 10404) generating 55 water samples and associated filters. Complete and partial profiles were worked to enable study of bottom, surface and Mediterranean Outflow waters.

From each rosette bottle were drawn 2 x 1ℓ REE samples and smaller volumes for nutrient analysis wherever possible. The REE samples were drawn off into rigorously rinsed, acid-cleaned FEP bottles, filtered (0.4 μm Nuclepore), acidified with 3 ml of quartz-distilled 6M HCl and stored at room temperature for later analysis at Leeds. Corresponding nutrient samples were drawn into vials for immediate shipboard analysis on the Pye-Unicam Automatic Chemistry Unit as described above.

H. Elderfield
R.M. Pagett

Southampton University Sampling

Aliquots of seawater were pressure filtered from the Go-Flo bottles through 0.4 μm Nuclepore membrane filters and 90 of the samples were processed on board to separate and concentrate a range of trace metals in a form suitable for storage and transport to Southampton for subsequent analysis. Calibration of the method was undertaken for Fe, Mn, Cd, Ni, Co, Cu, Zn and Pb, with studies of the distributions of the first three elements as the primary objectives of the analysis. The shipboard procedure consisted of the complexation of the metals with a mixture of 1:1 ammonium pyrrolidine dithiocarbamate and diethylammonium diethyldithiocarbamate, and extraction of the complexes into 1,1,2-trichloro-1,2,2-trifluoroethane. The metals were finally back extracted into nitric acid solutions, giving stable solutions which were stored for further analysis. Analytical operations were carried out in a laminar flow cabinet in order to minimize the possibility of air-borne contamination. Sub-samples of 27 seawaters were subjected to ultraviolet irradiation under acid conditions, to release any organically or colloidally associated metals, prior to the chelation/solvent extraction procedure. The concentrates, totalling 226 including blanks and calibration standards, will be analysed for their trace metal content using graphite furnace atomic absorption spectrophotometry.

Separate aliquots of water from Go-Flo bottles were filtered through pre-combusted glass fibre filters and stored frozen for later dissolved organic carbon analysis at Southampton.

The range of samples obtained is expected to provide vertical profiles of the metals of interest and thus to extend our knowledge of the distributions in the Atlantic Ocean and the factors which give rise to them. Analysis of the Mediterranean Outflow Water should give valuable information on the trace metal content of this water mass. It was particularly valuable to be able to select bottle firing depths in the light of the real time information on the water column provided by the C.T.D. unit.

Other aliquots of filtered sea water were acidified and frozen for analysis at Southampton. These included additional material from vertical profiles, and 26 samples which were taken from the ship's non-toxic sea water supply whilst underway. The latter were collected in order to examine the potential of this system for providing uncontaminated surface samples for certain metals, particularly manganese.

J.D. Burton
P.J. Statham
H. Sutherland

iv) PERFORMANCE OF SOME ELECTRONIC EQUIPMENT

P.E.S. Fish No. 3 with a modified towing strut was streamed throughout the cruise (3840 nautical miles, 355 hours steaming) and performed satisfactorily for the most part. It was however noticeable on each occasion when the ship's speed exceeded 10 kts. that a noise threshold appeared to have been crossed.

This increase in noise was largely random spikes plus occasional bursts of a more gaussian nature. Clearly some investigation of this phenomenon is called for.

Intermittent troubles with the ship's Watesta clocks revealed (due to reliance on the new internal clock fitted in the Mufax) an apparent loss of synchronism between the Mufax time marks and its digitally displayed time. This asynchronism appeared to be reset automatically on the hour.

Although a standard I.O.S. 10 KHz pinger had produced reasonable echoes on station 10399, return echoes were virtually non-existent using the same unit at station 10400 on the red clay bottom: the susceptibility of the box-corer to pre-triggering was also causing some concern. An attempt was therefore made to solve both problems by building a Near Bottom Echo Sounder using a card from the Heat Flux Probe Telemeter. This was fitted into a 6 inch dia. pressure tube together with a spare 35 volt Net Monitor Type Transducer/ Re-chargeable Battery Pack. The cable connected type of echo sounder transducer was fitted with an encircling bracket and clamped midway and parallel to the 30 inch long tube. The reasoning was that the higher power output of this type of pinger would give a better bottom echo whilst at the same time the N.B.E.S. could be used to detect the continuing presence of the box corer at a precise distance from the pinger. Pre-triggering of the box corer causes it to drop by approximately 0.8 metre from its cocked position and this change in distance should be detectable by the N.B.E.S. which with its range expansion facility set to X16 should make the change easily resolvable on the Mufax.

This work was completed in time for a trial at station 10400 where the higher output of this pinger did indeed produce a greatly improved bottom echo. Unfortunately the first attempt at "seeing" the box core was a failure - the echo sounder consistently indicated its minimum range, caused it was felt by the echo sounder detecting the warp in preference to the box core. Subsequent investigation however showed the cause to be 40 KHz pick-up by the unit's bi-quadratic filter from a wire carrying this frequency which had been inadvertently routed near to this part of its circuitry.

This unit was made operational but by this time the main winch was unuseable. Nevertheless a trial was conducted by mounting the box corer on the auxiliary trawl winch warp and the N.B.E.S. successfully demonstrated its ability to detect the occurrence of a pre-trigger. This device will be available for use on Cruise 129, but it is felt strongly by this admittedly biassed participant that the activation of the box corer should be under remote acoustic control.

The N.B.E.S. technique is such an improvement over the standard pinger that the step of modifying a N.B.E.S. so that it could be interfaced with the Pore Water Sampler was taken. This modified unit contributed to the successful deployment of the only P.W.S. run that events permitted, and it is hoped to incorporate such a device in future P.W.S. operation. Regrettably the standby standard N.B.E.S. was flooded during a C.T.D. dip, for which no obvious cause could be determined.

E. Darlington

v) SEDIMENT SAMPLING AND PORE WATER STUDIES

The failure of the coring winch resulted in a disappointing return of material from this cruise. For sediment work, only two Kastenlot cores were obtained. These were a 125 cm core, predominantly clay/carbonate with considerable layering texture from station 10399 and 185 cm red/brown clay core with some layering from station 10400. Both cores were sampled intensively for laboratory work-up later. The reasons for the three failures of the I.O.S. box corer on this occasion are not understood, as no alterations have been made to a device which previously has been very successful. Its failure, however, resulted in a lack of material for near-interface work, both of pore waters (via sediment squeezing) and of the solid phase.

One deployment of the I.O.S. Mark II in situ pore water sampler was made at station 10400. The device operated correctly, sampling for the preset period of 20 minutes which was all that could be allowed in the prevailing conditions. On recovery ∿ 32% sample was obtained: it appears that the fine grain size and/or low water content of the sediment in the 10-50 cm depth range prevented useful samples being obtained in this depth interval. No further opportunities to deploy the sampler occurred before the winch failure which precluded further operations.

M.P. Burnham
S. Colley
R.H. Edge
H. Elderfield
D.J. Hydes
G.A. Lake
R.M. Pagett
R.D. Peters
H. Sutherland
J. Thomson
T.R.S. Wilson

vi) SUSPENDED PARTICULATE MATTER STUDIES

The *in situ* large volume filtration system had its first deep water trials on this cruise. Briefly this device consists of four independent filter stacks each containing 1,10,60 and 100μm filters, four 2.5ℓ 'Go-Flo' bottles, a particle size cell, and sensors for pressure (depth), temperature and particle concentration. The device was deployed on the 10 mm conducting cable of the midships winch and the transmitted data decoded on a standard C.T.D. deck unit and recorded on magnetic tape. Archived data was brought back on magnetic tape for analysis due to the failure of the new C.T.D. system software. With a knowledge of the water column characteristics from C.T.D. casts, particle concentration and temperature profiles versus depth were recorded on outboard casts, and on this basis depths were selected for filtration on inboard casts.

At station 10399 two casts were made, and particulate samples recovered from depths of 1000, 500 and 133 m. The particle cell and transmissometer functioned well, but a cable fault occurred in the particle cell lead which caused electrochemical action between cell and transmissometer cases. Problems were encountered with the flow meters, but these were subsequently remedied.

On station 10400 filtration was carried out at two shallow depths. The particle cell was run continuously up and down at 0.25 m s^{-1} at this station with good results and no hysteresis. This suggests that it can be used as an *in situ* real time sensor, valuable for information on particle concentration, size distribution, mass and flux.

Live time calibrated (as opposed to analog) data were available at station 10402. The particle size profile was recorded at this station, since the Mediterranean Outflow Water was distinct from the Atlantic surface water in particle number and distribution. The particle cell windows imploded at 4000 m, somewhat earlier than had been expected from trials in pressure vessels. Particulate material was recovered from depths of 5300, 2000, 860, 550 and 75 m.

At station 10404, some electronic modifications had been made to solve an electrochemical noise phenomenon observed when the water bottles were fired. Particulate samples and complementary water samples were obtained from depths of 4400, 2500, 1500 and 15 m. Further work was aborted due to seepage into the data transmission pressure case.

All filters were subsampled for subsequent S.E.M.-E.D.X.-R. analysis and the 1μm filters sampled further for surface charge determinations (at the University of East Anglia) and organic coating-metal association studies (at the Centre des Faibles Radioactivités, Gif-sur-Yvette). A new coprecipitation technique for trace elements was applied to 1ℓ water samples from the bottles (for subsequent analysis by I.C.P.) and 100 ml aliquots were run off for subsequent arsenic and selenium determinations (at the Department of Chemistry, University of Southampton). Nutrient, salinity and dissolved organic carbon subsamples were also taken.

Overall the electronic and mechanical systems worked well, although in the light of these first deep trials some improvements are necessary and planned.

T.J.P. Gwilliam
V.A. Lawford
C.A. Lunn
W.R. Simpson

vii) WINCH COMMISSIONING

A full account of the commissioning work performed during the cruise on both the main coring/trawl winch and the auxiliary trawl winch is contained in I.O.S. Internal Document 156 "Use of the Aft Hydraulics System on R.R.S. "Discovery" during Cruise 125" (March 1982).

M.P. Burnham
R.H. Edge
G.A. Lake
R.D. Peters

ACKNOWLEDGEMENTS

I should like to record my thanks to Discovery's officers and crew for their unfailing helpfulness during this cruise.

This cruise saw considerable increases in the sophistication of instrumentation and deployment gear used by this group for geochemical sampling. I wish to acknowledge the dedication and skill of the members of the I.O.S. Applied Physics and Ocean Engineering groups on this cruise in making the systems work and keeping them running.

J. Thomson

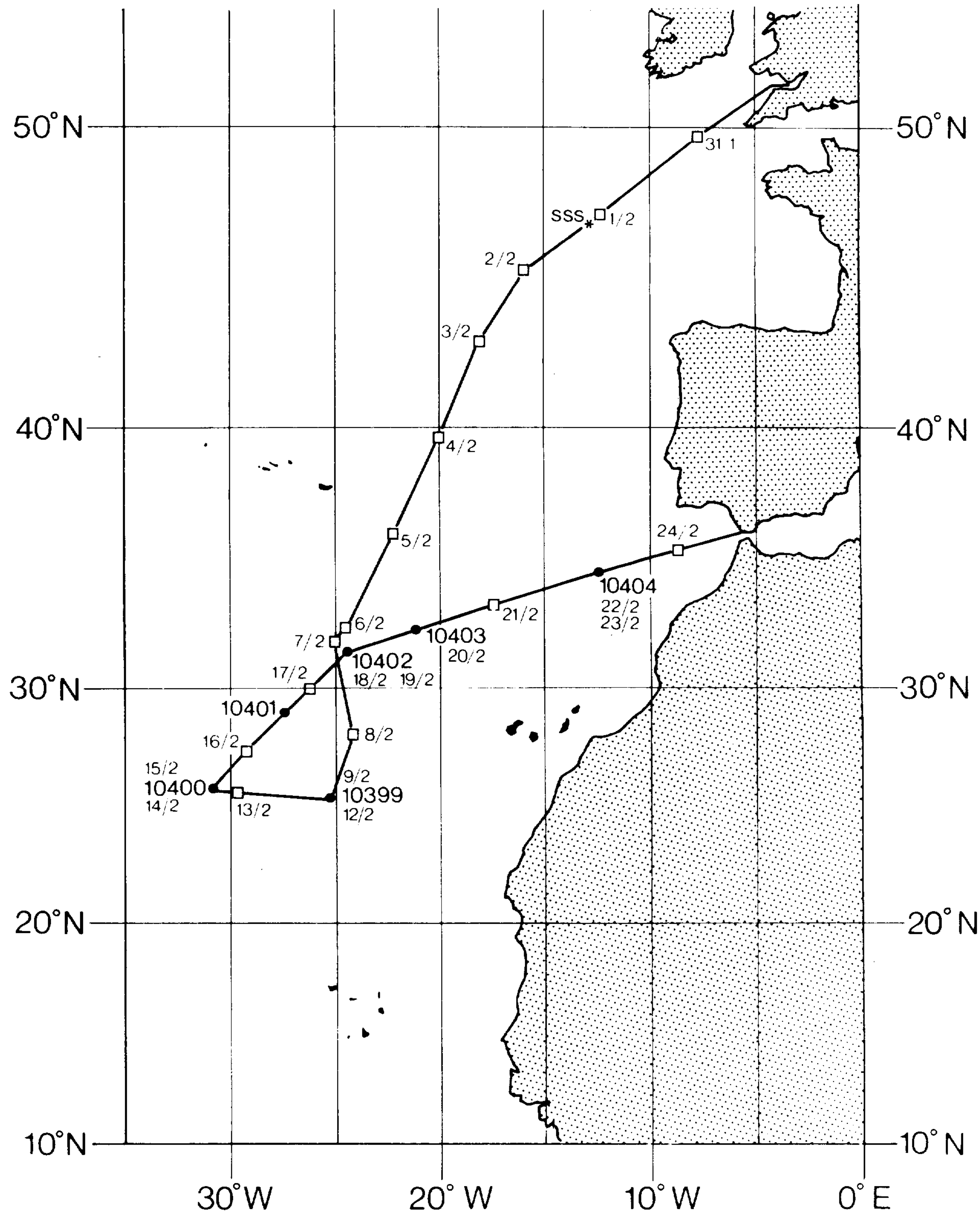

Figure. 1. DISCOVERY CRUISE 125: ship's track.

Bold figures: station positions. Light figures: midday positions

* sss Standard Seawater Service collection

TABLE 1: Details of work performed on Cruise 125.

Station Number	Date	Latitude (N)	Longitude (W)	Equipment	Water Depth (m)	Times (Z)	Notes
	1/ii	48°00.1'	10°33.0'	XBT	2752	02-17	XBT#1
	1/ii	47°29.9'	11°29.0'	XBT	4645	07-04	XBT#2
	1/ii	47°00.2'	12°35.5'	XBT	4700	12-36	XBT#3
	1/ii	46°54.4' 46°48'4'	12°47.3' 12°59.6'	Fire hoses		13-35 14-38	Surface water collection for Standard Seawater Service.
	1/ii	46°30.0'	13°33.4'	XBT	4575	17-53	XBT#4
	2/ii	46°00.0'	14°37.7'	XBT	4615	00-16	XBT#5
	2/ii	45°29.1'	15°32.2'	XBT	4450	07-20	XBT#6
	2/ii	45°00.2'	16°22.7'	XBT	4420	13-53	XBT#7
	2/ii	44°29.2'	17°14.4'	XBT	3970	20-58	XBT#8
	3/ii	44°00.0'	17°31.8'	XBT	3830	01-20	XBT#9
	3/ii	43°29.3'	17°54.4'	XBT	3450	05-15	XBT#10
	3/ii	43°00.2'	18°08.8'	XBT	3995	09-12	XBT#11
	3/ii	42°29.4'	18°26.6'	XBT	4370	14-29	XBT#12
	3/ii	41°59.8'	18°52.2'	XBT	4775	19-14	XBT#13
	3/ii	41°30.2'	19°08.8'	XBT	4940	23-08	XBT#14
	4/ii	40°59.3'	19°25.4'	XBT	4930	02-48	XBT#15
	4/ii	40°29.9'	19°44.3'	XBT	4835	06-10	XBT#16
	4/ii	40°00.1'	20°01.2'	XBT	4655	09-12	XBT#17
	4/ii	39°30.0'	20°20.4'	XBT	4930	13-02	XBT#18
	4/ii	39°00.0'	20°41.2'	XBT	5035	16-36	XBT#19
	4/ii	38°30.0'	20°59.0'	XBT	4555	19-56	XBT#20
	8/ii	28°14.7'	24°11.4'	Chain Weight		10-02 11-40	Trawl warp de-torsioning. Warp fouled and 1270 m cut.

Station Number	Date	Latitude (N)	Longitude (W)	Equipment	Water Depth (m)	Times (Z)	Notes
10399#1	9/ii	25°12.9' 25°12.9'	25°19.9' 25°20.2'	CTD rosette		11-32 13-04	Cast to 1500 m. Mainly system evaluation.
10399#2	9/ii	25°12.9' 25°12.9'	25°20.4' 25°20.5'	CTD rosette		14-00 14-13	P.C.B. failure, aborted.
	9/ii 10/ii	25°12.1' 25°12.2'	25°19.5' 25°21.8'	1-ton weight		16-08 00-07	Trawl warp detorsioning. 300 m warp out only. Hydraulics investigation to improve winch veer speed. Problem cleared.
10399#3	10/ii	25°12.2' 25°11.4'	25°21.9' 25°22.1'	CTD rosette & N.B.E.S.	5235	01-18 05-24	Wire out 5294 m. N.B.E.S., first sample 8 m off bottom. 8 good samples from 12. (Leeds)
10399#4	10/ii	25°10.2' 25°09.9'	25°22.5' 25°22.7'	CTD rosette		07-35 09-00	Shallow cast to 1500 m. Bad leakage on five bottles (SUDO).
10399#5	10/ii	25°09'9' 25°13.0'	25°23.2' 25°24.4'	1-ton weight	5230	11-22 18-17	Trawl warp detorsioning. 4952 m warp out for 1.5 hrs. Detorsioning successful.
10399#6	10/ii 11/ii	25°12.5' 25°14.7'	25°24.1' 25°26.8'	Filtration device		19-42 01-45	Particulate and bottle samples at 250 m. Electrochemical fault.
10399#7	11/ii	25°15.1' 25°15.4'	25°27.3' 25°26.1'	Kastenlot corer	5235	03-05 08-33	125 cm. core.
10399#8	11/ii	25°15.6' 25°14'7'	25°27.2' 25°28.1'	Box corer	5235	13-05 19-00	No core, corer pre-trip.
10399#9	11/ii 12/ii	25°14.7' 25°15.0'	25°28.1' 25°27.9'	CTD rosette + pinger	5230	19-35 00-34	Sample taken within 25 m of bottom. Top ball valve blew out of one bottle. Leakage on two bottles. (SUDO)
10399#10	12/ii	25°15.3' 25°15.1'	25°27.4' 25°27'3	Filtration device		03-04 07-20	Run to 1500 m. Samples at 1000 m and 133 m. Electrochemical fault.
10399#11	12/ii	25°14.6' 25°14.7'	25°28.1' 25°27.9'	Hydrocast (12xNIO)		09-50 12-15	Reversing thermometer cast to 2500 m for C.T.D. calibration and sampling. (I.O.S.)

Station Number	Date	Latitude (N)	Longitude (W)	Equipment	Water Depth (m)	Times (Z)	Notes
10400#1	13/ii 14/ii	25°40.3' 25°41.6'	30°57.4' 30°59.3'	Box corer	5993	21-50 04-30	No core, corer pre-trip
10400#2	14/ii	25°40.1' 25°41.4'	30°58.0' 30°57.1'	P.W.S. +N.B.E.S.	6065	06-32 12-14	Correct operation but low volumes of water taken.
10400#3	14/ii	25°41.3' 25°41.8'	30°56.7' 30°57.6'	CTD rosette + pinger	6070	12-27 16-34	Wire out 6147 m (Leeds).
10400#4	14/ii	25°40.6' 25°38.1'	31°00.1' 31°03.3'	CTD rosette + pinger	6020	19-14 23-51	Weak bottom echo: CTD frame touched bottom. (SUDO)
10400#5	15/ii	25°40.2' 25°41.0'	30°57.2' 30°59.3'	Box corer	6060	04-00 12-57	Corer pre-trip test, then corer run. No core, corer pre-tripped
10400#6	15/ii	25°42.0' 25°42.2'	30°57.4' 30°56.7'	CTD rosette	6060	13-23 14-27	Shallow cast to 1500 m. (SUDO)
10400#7	15/ii	25°42.3' 25°42.4'	30°57.6' 30°57.7'	Filtration device		15-25 17-00	Cast to 400 m. Samples at 250 m and 20 m. Continuous particle size profiles.
10400#8	15/ii	25°42.4' 25°41.7'	30°57.7' 30°58.0'	Kastenlot corer	5965	17-08 23-12	185 cm core. Aft winch gearbox unuseable after this run.
10401#1	17/ii	28°56.0' 28°55.7'	27°34.9' 27°34.6'	CTD rosette	4940	02-00 03-05	Shallow cast to 1000 m. (SUDO).
10402#1	18/ii	31°30.8' 31°28.5'	24°30.5' 24°31.8'	Filtration device	5390	02-54 05-06	Sample at 2000 m. Real time plotting of temperature and transmissometer data.
10402#2	18/ii	31°28.3' 31°28.1'	24°32.0' 24°32.1'	Filtration device		05-25 05-48	Fault on flow meters. Cast aborted.
10402#3	18/ii	31°27.8' 31°26.2'	24°33.6' 24°34.2'	CTD rosette + pinger	5390	06-52 10-35	PES indicated first bottle at 50 m off bottom. Lost one bottle. (SUDO)

Station Number	Date	Latitude (N)	Longitude (W)	Equipment	Water Depth (m)	Times (Z)	Notes
	18/ii	31°27.1' 31°27.0'	24°34.2' 24°34.5'	1-ton weight		11-08 11-45	Auxiliary trawl winch test.
10402#4	18/ii	31°27.0' 31°26.0'	24°35.6' 24°36.5'	CTD rosette + pinger	5390	14-26 18-22	11 bottles. Bottle one fired at 5370 m (PES). Wire out 5425 m (Leeds)
	18/ii	31°26.1' 31°26.0'	24°36.7' 24°36.7'	Box Corer + N.B.E.S.		18-50 19-40	NBES tests to demonstrate pre-trip. Box corer on auxiliary trawl winch warp.
10402#5	18/ii 19/ii	31°26.8' 31°26.2	24°38.0' 24°38.7'	Filtration device	5390	20-43 03-28	Continuous particle size profile to 4000 m before implosion of windows. Samples at 5374 m, 860 m, 550 m and 75 m.
10402#6	19/ii	31°26.6' 31°26.0'	24°38.7' 24°38.4'	CTD rosette + N.B.E.S.	5390	04-08 07-38	10 bottles. Wire out 5400 m (Leeds)
10402#7	19/ii	31°26.9' 31°27.3'	24°35.6' 24°35.3'	CTD rosette		09-46 11-30	11 bottles. Shallow cast to 1350 m. (SUDO)
10402#8	19/ii	31°26.3' 31°26.3'	24°37.6' 24°36.9'	Hydrocast (12xNIO)		14-14 15-55	Reversing thermometer cast to 2,200 m for CTD calibration.
10403#1	20/ii	32°13.9' 32°13.4'	21°21.8' 21°21.3'	CTD rosette	5015	08-28 10-11	Shallow cast to 2500 m. 11 bottles. (Leeds)
10403#2	20/ii	32°12.8' 32°12.6'	21°21.0' 21°20.6'	CTD rosette	5015	11-35 14-01	Shallow cast to 2500 m. 11 bottles. (IOS)
10403#3	20/ii	32°12.4' 32°13.7'	21°20.5' 21°21.0'	CTD rosette	5015	15-31 16-50	Shallow cast to 1300 m. 11 bottles (SUDO).
10404#1	22/ii	34°22.4' 34°22.4'	12°29.2' 12°28.1'	CTD rosette + pinger	4435	12-55 15-51	Wire out 4470 m. 11 samples. (SUDO)
10404#2	22/ii 23/ii	34°23.3' 34°23.1'	12°26.7' 12°27.0'	Filtration device	4430	18-26 00-40	Filtration at four depths 4400 m, 2500 m, 1500 m, 15 m.

Station Number	Date	Latitude (N)	Longitude (W)	Equipment	Water Depth (m)	Times (Z)	Notes
10404#3	23/ii	34°24.8' 34°24.3'	12°26.9' 12°27.8'	CTD rosette		02-34 05-21	Wire out 3035 m. First bottle at 2750 m. 11 bottles. (IOS)
10404#4	23/ii	34°23.6' 34°22.9'	12°28.5' 12°29.5'	CTD rosette + pinger	4435	07-23 10-16	Wire out 4420 m. 11 bottles (Leeds).
10404#5	23/ii	34°22.7' 34°24.0'	12°29.8' 12°29.6'	CTD rosette	4435	11-31 12-31	Wire out 900 m. Shallow cast, 9 bottles. (Leeds)
10404#6	23/ii	34°24.2' 34°23.9'	12°29.5' 12°29.2'	Filtration device		14-34 16-00	Aborted due to seepage of water into electronics tube.
10404#7	23/ii	34°24.0' 34°23.9'	12°28.9' 12°28.7'	CTD rosette		16-36 17-44	Shallow cast to 1100 m. 10 bottles. (SUDO)

Abbreviations:

- CTD - Conductivity, Temperature and Depth Probe.
- Leeds - Leeds University, Department of Earth Sciences.
- N.B.E.S. - Near Bottom Echo Sounder.
- NIO - 1.5ℓ National Institute of Oceanography water bottles.
- P.C.B. - Printed Circuit Board.
- P.W.S. - Pore Water Sampler.
- SUDO - Southampton University, Department of Oceanography.
- XBT - Expendable Bathythermograph