I.O.S.

RRS DISCOVERY
CRUISE 117

19 JANUARY – 12 FEBRUARY, 1981

CURRENTS AND MIXING NEAR THE SEA FLOOR IN THE MADEIRA BASIN

CRUISE REPORT NO 111

1981

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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Institute of Oceanographic Sciences,
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INTRODUCTION AND OBJECTIVES

"Discovery" cruise 117 was part of an investigation of currents and mixing near the floor of the deep ocean. The interest was stimulated by the need to understand processes in and above the benthic boundary layer which would determine the dispersion of radioactive waste accidentally released from the sea bed.

A site was selected near 33^{O}N 22^{O}W where the Institut für Meereskunde, Kiel have maintained a full-depth mooring for the past 2½ years. Measurements at this location should continue for some time and provide a 'climatology of currents' useful for our programme. On "Discovery" cruise 114 six benthic moorings were laid in an array (approximately 50 km x 50 km) west of the Kiel mooring and on cruise 117 we proposed to add one further mooring to complete the array and make numerous float and CTD observations there. A bathymetric survey was also planned as cruise 114 had revealed that the area was not a flat abyssal plain as originally conjectured. On a larger scale we proposed to make a hydrographic section along the axis of the Madeira abyssal basin in order to reveal the meridional gradients in water properties and establish a spatial context for the small scale experiment.

The program of work for the cruise was thus as follows:-
In the vicinity of 33^{O}N 22^{O}W

(i) To lay mooring 303 with six current meters at heights between 10 and 100m off bottom:

(ii) To deploy a cluster of neutrally buoyant floats at a depth of 5000 m, that is approximately 300 m above bottom, and to measure their dispersion at separations of 1-10 km for 3-20 days:

(iii) To make observations of the temperature with a CTD lowered in the vicinity of the seven moorings in order to interrelate the (uncertain) calibration of individual current meter temperature sensors:

(iv) To explore the extent of the benthic boundary layer both vertically and horizontally in the vicinity of floats and current meters:

(v) To map the topography of the area of the current meter array:
and on a larger scale

(vi) To make a series of 9 CTD stations, with salinity sample checks and reversing thermometer observations between locations 30^{O}N 25^{O}W and 38^{O}N 17^{O}W.

In very large measure all these objectives were met.

NARRATIVE

Jan. 19-25 (Float and mooring deployment and stations near moorings)

"Discovery" sailed from Funchal at 0700 on the 19th and arrived near 33°10'N 22°00'W twentyfour hours later. Three neutrally buoyant floats - one the remote interrogator - were deployed and the first deep CTD station 10261 completed by the end of the day. The old CTD unit interfaced with a 1 m path transmissometer (from Seatech) was lowered from the new hydraulic midship winch which operated smoothly but initially rather slowly. A second station completed by 2130 on the 21st confirmed the unsatisfactory operation of the CTD unit observed on the first dip. Firing the multisampler led to unacceptable salinity and transmittance offsets. For the remainder of the cruise we used the second (new) CTD unit without its oxygen sensor - broken at Barry prior to cruise 116. Reluctantly we abandoned the use of the transmissometer which could not be interfaced with unit two for lack of space.

Mooring 303 was satisfactorily launched at 33°10.1'N 21°59.8'W at 1210 on the 21st and three MkII floats launched by 0430 the following morning close to the first two. These second three floats sank very near the bottom and because the currents were so small we could not rule out grounding. Two were recalled and relaid 300 m shallower by 0500 on the 23rd to form a cluster of five floats (2 km across) separated from the remote interrogator by about 4 km. By 1600 on the 24th January a further four floats (MkII) were launched to the east of the remote interrogator float in order to increase the separation of the most distant floats to nearly 10 km. The arrangement of 10 floats within the cluster experiment was now determined. An unanticipated aspect of the measurements so far was our failure to detect float separation due to vertical shear of the horizontal currents. Prior to the cruise we had expected to relay floats until all depths were within $\pm$ 50 m of each other. In the event floats were spread over a few hundred meters in depth but showed no systematic shear behaviour, whilst drifting slowly W and SW at less than 0.5 cm/s.

CTD stations 10264-10269 were made between am 22nd and am 25th in the vicinity of all seven IOS moorings but not near the Kiel mooring whose position we felt was somewhat uncertain because of water depth discrepancies. All lowerings were made with the new CTD unit which suffered only slow conductivity cell drift. Winch operation was now speedy enough for the CTD (1m/s) and was smooth and reliable with drivers gaining in confidence.

When proceeding to station positions mooring releases were interrogated and their position determined by steaming two or more non-parallel courses and observing beam on times. In this way moorings 296, 299 and 302 were 'repositioned' on the 21st and 297 on the 23rd. Moorings 298, 300 and 301 were not interrogated in this way.

Jan. 25 to 27 (Southern stations in large scale hydrographic section)

A welcome break in the routine of working within a very small area was afforded by a series of CTD lowerings to the SW. Each station was 80 miles from its neighbour and 3 such stations were made before returning to the float and current meter area: the most southerly lowering was near 30^{O}N 25^{O}W. For most of the period (1400/25 to 1540/27) the IBM 1800 ships computer was out of operation.

Maintenance work on the PES fish (09 to 15/27) improved the signal to noise ratio markedly.

Jan. 28 to Feb. 6 (Effect of topography on dispersion and bottom mixing)

On returning to the float cluster it was evident that after 3 days the separation of the floats had increased and their movement changed to NW. In attempting to relocate the remote interrogator more centrally a float in the western group was accidentally released and recovered at 1400 on the 28th: the remote interrogator, though its release mechanism switched, did not come to the surface. Float fixing was now reduced to one set of observations (ranging to the floats from 2 or 3 different ship locations) every 24 hours but this continued until floats were recovered. Trials were also made of the echosounder float; a ballasting test was made on the 31st January and the float was relaid at 1400 on the 1st February. Unfortunately its equilibrium depth (reached after about 12 hours) was at such a height above bottom to be just out of range of the echosounder: and the float could not be recalled.

In order to improve the safety of lowering the CTD unit close to the bottom a 10 KHz beacon was modified with an echosounder transducer to give a double pulse whose separation depends on height above bottom (8-300m range). After a successful wire test made on the night of the 29th the instrument was first tried on station 10276 on the morning of the 30th.

The first CTD station in this period 10273 (am 28) was made very long by a multisampler failure and efforts to repair it, but by the next station (pm the same day) its operation was restored. Early on the morning of the 29th a ridge with peaks 400 m above the plain was discovered in the path of the eastern group of floats and only a few km from them. A bottom yo-yo CTD station was started there (1600/29) steaming at about 0.5 kt with the wind on the ships starboard bow. After about an hour the station (10275) was abandoned because the height of the CTD above the sea floor could no longer be determined. The echosounder beacon (described in the previous paragraph) was then installed and within the next three days yo-yo stations (between the bottom and to heights 500 m above) were made from 03-07 on the 30th 16-20 on the 31st and 1930-2330 on the 2nd February. Shallow mixed layers were seen on the flanks and summit of the hill and deep mixed layers in the lee. Other individual dips were made close to the hill to map its influence and eventually (3rd-5th February) more distantly from it (25 km NW, NE and SE) to establish far field properties.

The latter excursions, interspersed by returning to fix the floats, established the existence of a number of small hills with peaks 300-400 m above the plain all north of the current meter array. The bathymetry was determined on surveys occupying up to eight hours per day during the period 3-6 February.

<u>30th January, 4-6 February (Recovery of equipment)</u>

A benthic tripod consisting of camera, flash and VACM current meter (MOORING 297) was interrogated, released and recovered between 1200 and 1400 on the 30th. 3 floats from the eastern group which had stalled in front of a hill were released and recovered between 0700 and 1130 on the 4th. The fourth member of the group had accelerated away from them around the south end of the same hill and was picked up with three floats from the western group (which had also begun to speed up) between 0730 and 1400 on the 6th. Three floats could not be recovered; the remote interrogator which had 'switched' but not dropped its external weight, (07/29), a MkII float which ignored the release command (09-1700/6 Feb) and the experimental echosounder float whose release behaviour could not be determined because of interference from the echosounder pulse.

<u>7th - 12th February (Northern stations in large scale hydrographic section)</u>

In the final phase of the cruise 5 CTD lowerings were made at 80 mile separations NE from the current meter array: all were accomplished without mishap and with numerous samples and thermometer measurements. The most northerly station was near $38^{\circ}N$ $17^{\circ}W$ (0130 on the 9th) with a bottom potential temperature nearly $0.1^{\circ}C$ warmer than that found near $30^{\circ}N$ (1954 on 26 Jan). Very deep fossil mixed layers were found as the topography became more complex. A station planned for $37^{\circ}20'N$ $15^{\circ}40'W$ was not made because of 30-35 kt northerly winds and swell. About 1915 on the 9th "Discovery" set sail for Gibraltar arriving at 0900 on the 12th February.

NOTES ON EQUIPMENT AND OBSERVATIONS:

Neutrally buoyant floats

The objectives of the float work were (1) to observe dispersion in the near bottom water, by accurate relative fixing of a group of floats at a chosen level (5000 m), (2) to test a float that would signal its height above bottom by means of a telemetering echo sounder, (3) to test and bring into use a more accurate method of measuring travel times of float signals. None of these objectives were fully attained, but progress was made towards all of them.

Three of the original floats made for MODE (Mk I) and eight of the new short 7" dia. tubes (Mk II) were available for the float dispersion experiment. The three Mk I floats were launched on arrival in the working area, 20 Jan., one as a remote interrogator, the other two as ordinary transponders, all loaded for 5000 m.

A note on the method of float navigation is appropriate here. All of the floats save the remote interrogator transpond to a 5.1 kHz transmission from the ship with each float identified by a certain reply frequency. The remote interrogator transponds to a 7.1 kHz transmission from the ship replying at 5.1 kHz and thus causing all other floats within range to transpond. Two-way and ring-round travel times allow the floats to be located relative to one another. If transmissions are made at 5.1 and 7.1 kHz from two or more locations separated by 3-5 km then given the ships positions (from satellite navigation + EM log and gyro) the float positions can also be determined geographically.

Working over an abyssal plain, clear bottom reflections could usually be observed, and heights above bottom calculated for each float. These showed more scatter than had been expected; instead of 250 $\pm$ about 50 m above bottom, they were at 250, 420 and 490 m. With the Mk II floats, depths were more uncertain. None of this batch had been used before. The first three that were launched (a.m. 22 Jan) were loaded for 5000 m and went to the bottom, 5290 m, or within 100 m of it. With the 100 msec pulses normally used in the transponders, it is not possible to distinguish bottom echoes from within 100 m of the seabed, though ranges (and heights) can in general be measured to $\pm$ 10 m. Two of them were recalled and re-ballasted; the other, which settled at 120 m off the bottom, was left down until 28 Jan., when it was accidentally released in an attempt to recall the remote interrogator. Erring on the side of caution the two re-ballasted floats were set for 4300 m; they went to 650 and 680 m off the bottom, i.e. 4640 and 4610 m depths. They must have been only just on the bottom, the first time. More Mk II floats were launched, making two clusters each spread initially over a few kilometres on either side of the remote interrogator float, mostly in the range 400-600 m off the seabed. From 24 Jan. to 4 Feb., ten or eleven floats were being tracked. They appeared to disperse linearly, due mainly to lateral rather than vertical shear, which may have been caused by the unexpected presence of four hills, each several kilometres across and about 400 m high, within 30 km of the centre of the experiment. The floats were recovered in two batches, three on 4 Feb. and four on the 6th. One had been accidentally released on the 3rd, and two would not come up. The method of relative fixing by measuring ranges simultaneously from the ship and remote interrogator worked well, out to ranges of approx. 20 km (ship to float) and 12 km (RI to float, each being a few hundred metres off bottom). With the experience now gained on this batch of floats, it should be possible to put them within 100 m of a chosen depth of order 5000 m without further trial. For this or better accuracy in loading, individual compressibilities of tubes are needed, or empirical relationships between loads and depths from previous use of individual floats.

A telemetering float circuit, combined with a near-bottom echo-sounder, was tested successfully lowered on a wire. It was built into a 17" dia. Benthos glass sphere and launched on 31 Jan. loaded for 3000 m. This was only a ballasting test. The float had not been used before, and the calculated compressibility was appreciably greater than for the usual aluminium tubes. (The calculated relationship between load and depth changes was approximately 6 gm per 100 m, compared to 14 gm per 100 m). On the first launch, it went to 4360 m, and took about 12 hours to settle to a steady depth. It was recalled and launched again on 1 Feb. loaded for 5050 m. This was intended to put it near enough to the seabed to be within range of the echo sounder

(300 m). It settled at 4920 m, 370 m off the bottom and just out of range. Many attempts were made to release it, in the next few days, but it would not come up, despite its release having worked promptly the first time. Thereafter it was tracked as one of the cluster. It was disappointing not to have got any results from the neutrally buoyant echo sounder, but there is no reason to suppose that it would not have worked if it could have been put down again 5 grams heavier. In air, that float weighed 47 kg.

J.C. Swallow

Automatic Float Reply Detection

In an attempt to measure the incoming float replies with greater consistency and also with less effort the outputs from the existing deck unit, which were normally displayed on the Dobfax, were multiplexed under the control of a cosmac microprocessor into an 8 bit A to D converter. Certain criteria were applied to the signals to decide when a float reply occurred. Having made such a decision the level of that signal and its time of arrival after the outgoing transmission pulse were stored in RAM against the channel number, to be typed on a terminal at some time after all the replies had been received. The criteria applied to the signals were first that its level must exceed a certain threshold, which was under operator control, and then that the signal had reached its highest value. In this way it was hoped that the center of the reply would be detected rather than some arbitrary threshold exceeded the latter giving rise to range dependent detection. If several signals were detected in any channel, as would often be the case either from noise or multipath situations, it was hoped that the information about the signal level would help to interpret the results.

Initially the typed results were confused by a programme error which caused not only the highest value of the float reply to be stored but also every value thereafter seen by the A to D converter on the negative going slope of the reply. After correction of the error the results looked better but even so the noisy nature of the signal often produced multiple detections of a single reply which, although they could be edited out, still failed to present the operator with the simple result required.

Preliminary comparison of the detected times with those read from the Dobfax records showed an agreement to about $\pm$ 15 ms but a more detailed look at the results is required.

An analogue tape recording was made of a series of interrogations so that further work can be carried out ashore.

N.W. Millard

Hydrographic Observations- CTD

The CTD - Multisampler system was used for 33 casts during the cruise, all but one were to within 10 m of the bottom. On four stations, yo-yos were made for several hours in the bottom 500 m.

The first two stations 10261 and 10263 were made using the 'old' CTD, and a transmissometer on loan from Oregon State University. A change to the 'new' CTD was then made (to which the transmissometer could not be interfaced) because of doubts about the stability of the 'old' instrument. After station 10274 the conductivity cell of the CTD was replaced by a new unit as small (0.005 ppt) shifts in the computed salinity became noticeable. Pressure and temperature calibrations remained constant throughout the cruise when compared to the reversing thermometers and the new cell conductivity was also stable.

The CTD sea and deck units together with the Digidata tape recording unit, which acted as a backup to the PDP11/34 system, performed reliably and with no electronic problems. Flooding of the multisampler unit caused the loss of the up data from one station. Several of the Niskin water bottles were found to be leaking, and some taps and 'O' rings were replaced; the thermometer frame elastic was replaced on all such bottles.

On one cast (station 10288) an experimental density sensor was interfaced to the CTD. Results were disappointing due to a very high noise level which could not be reproduced on deck. Laboratory trials will be made to try and solve this problem.

It was the first time that the CTD-Multisampler unit was deployed from the midships hydraulic winch and handling was straightforward in the low to moderate sea state conditions met.

G. Griffiths

Reversing Thermometers

Deep Sea Reversing Thermometers were used on the Rosette sampler as a check on the CTD temperature and pressure calibration. The CTD indicated temperatures were lower than the reversing thermometer indicated temperatures by approximately .045°C. This difference was almost constant at all measured temperatures and pertained throughout the cruise, indicating the stability and linearity of both the CTD and the reversing thermometer calibrations.

However there was inconsistency between the CTD indicated pressures and the unprotected thermometer indicated pressures confirming a fact that has been noted for some time: that the reported Q values (pressure factor) of some unprotected thermometers were in error. The opportunity was taken to check the Q values against the CTD pressure sensor. The opportunity was ideal for several reasons (a) the CTD sensors including the pressure sensor were particularly stable; (b) the CTD was being lowered to well below 5,000 decibars pressure to just above the seabed using a bottom pinger. The depth as indicated by the CTD pressure sensor and bottom pinger was in close agreement with the depth indicated by the ship's echosounder. (c) With 5,000 decibar lowerings it was possible to check a variety of unprotected thermometer ranges at various pressures. (d) The sea conditions were calm so that a maximum of thermometers could be loaded at each CTD lowering with a low risk of loss.

On cruise 117 12 unprotected thermometers were compared from between 4 and 15 times with the CTD pressure sensor at various depths. Preliminary calculations show that the Q factor of some of the thermometers are as much as 0.7% in error relative to the CTD pressure but more typical values are one half of this. The full results of this comparison will be issued in a separate report.

An NIO bottle and messenger, both modified to fit the new 3/8" wire of the hydraulic midship winch, was tested on station 10288 and operated correctly at 1000 m.

Salinometers

The Guildline salinometer was troublesome at the beginning of the cruise. The digital readout was unstable and it was not possible to get a steady reading to either calibrate or measure unknown samples. The cell was removed and inspected and a trace of verdigris found on one of the electrodes in a position impossible to clean without dismantling the cell. When the cell was refitted it was found that the instability could be temporarily overcome by disconnecting and reconnecting the cell. A steady reading then persisted but instability usually recurred as soon as another sample was put in the cell (or the cell flushed and refilled with the same sample). A cure for this fault was achieved by putting a switch in series with one of the four cell leads (the lead marked LoI on circuit diagram). The salinometer then worked well and duplicate samples measured on separate days with separate standardisations indicate agreement. At the middle of the cruise and from then on to the end of the cruise the salinometer remained stable for most of the time, and on rare occasions when instablity made it impossible to read the indicated ratio, it could be immediately cured by opening and closing the switch mentioned above. The switch has been left fitted. Because of the above trouble the Autolab salinometer was brought into use as a check on the performance of the Guildline. The Autolab worked satisfactorily and should always be carried as a reserve salinometer should the Guildline not be available.

J.A. Moorey

Near bottom echo sounder with 10 kHz telemetry link

This instrument was built at the beginning of the cruise to provide a convenient means of testing the near bottom echo sounder. It contains the 35.5 kHz N.B.E.S., a signal processing system and an acoustic 10 kHz pulse telemetry link. The instrument is housed in a 4" O.D. cylindrical pressure case with the 35.5 kHz and 10 kHz transducers providing the end caps for the pressure case.

The 35.5 kHz echo sounder measures the distance of the instrument from either the sea surface, or the seabed, and for signal display purposes has had its range limited to 300 m. One of the functions of the signal processing system increases the acoustic transit time of the E/S transmission pulse by a factor of four. This provides a higher resolution for the final display system making it possible to read off distances to better than $\pm$20 cms. Another function provides a reference pulse, that has a precise 2 second repetition rate. This pulse is followed by a depth range pulse, the time interval between the pulses being a measure of the echo sounding range. These pulses are transmitted back to the ship in the form of a 2 msec pulse that has a 10 kHz carrier frequency. The pulses are recived by the standard shipboard P.E.S. system and displayed on the Mufax (facsimile recorder) which is set to a 2 second scan rate. There are two main reasons for using a 10 kHz telemetry link:-

1. For a given transmission power it is possible to obtain at least five times the telemetry range that would be provided by the 35 kHz system.

2. The signal can be received by an E/S that is used on all RVS ships.

The advantages of this system over the standard 10 kHz beacon are:-

1. The delay pulse has the same signal level as the reference pulse while the echo pulse of the beacon is at least 6 dB weaker than the direct pulse.

2. The expanded scale enables the display to be read with four times the accuracy of the beacon system.

The echo sounder was initially tested on a vertical wire to a depth of 350 m to check that it would echosound off the sea surface to its maximum range of 300 m. As this wire test was satifactory the unit was clamped onto the CTD frame and used to monitor the distance of the CTD from the seabed for the remainder of the CTD stations. During this time the E/S was again tested on a vertical wire and it was established that it has an echo sounding range in excess of 600 m at a depth of 5300 m.

While the performance of the E/S was satisfactory, it could be improved by modifying the 35.5 kHz transducer to reduce the ringing that follows the transmission pulse. Once this is achieved, it will be possible to reduce the present minimum E/S range of 7.5 metres. By improving the mounting arrangement of the E/S to the CTD frame it should be possible to reduce the interference from noise generated by rattling shackles and wire strops.

M.J. Harris

PDP 11/34 CTD Data Acquisition

The computer acquired CTD data during the 33 CTD stations (approximately 130 hours) of the cruise. As this is the first time this system has been used for a long series of such stations, it deserves a brief description.

Data is stored in cyclic disc files accessed by real-time software such that incoming data is rapidly averaged, calibrated and displayed. In practice the plotting of calibrated data is 1-2 minutes behind the raw data collection. The software is controlled through a simple control program which manage the sampling and archiving of data. Program CTDSAM writes raw CTD data, at 16 scans per second, to a disc file (file 1; current capacity ½ hour). Program CTDAVG averages file 1 data and writes the raw averaged 1-second values to file 7, current capacity 8 hours, together with the calculated temperature gradient for each average. Program CTDCAL reads file 7 data, calibrates, corrects for the temperature time constant using the temperature gradient and calculates any derived variables. The output is written to File 9, capacity 8 hours. Standard listings and plots were produced after each station. During some early stations it proved necessary to recalibrate file 7 data using CTDCAL in an attempt to fit the data to a common point in the θ-S curve. File 7 and File 9 data were archived to PDP tape, raw data being stored on Digidata tapes.

Many programs needed slight modification to suit deep CTD profiling (programs were originally written for BATFISH data). New programs were written to:

(1) Reread archived PDP data from tape, either listing it or writing it back to the original disc file. This enabled the checking of archived data. Tape headers were shown to be in error although the error is recoverable. This error results from software changes made several months before. The program additionally enabled replay of CTD stations, which will be extremely useful when further analysis is desired.

(2) Analyse float distributions. It is very easy to add additional programs, time permitting, although more difficult to add real-time software.

(3) Produce standard data lists for given pressure levels at a CTD station.

The software functioned well with minor problems. CTDAVG proved difficult to restart on one occasion. This odd fault has proved difficult to trace but a logic change is planned for the suspect code. Calculation errors and a system crash were the result of a task built without the floating point option. Such a task appears to use the additional core it would have been assigned with this option, with resulting chaos. There were two other system crashes during development (not acquisition). Although the VT100 terminal proved to be extremely useful for observing core activity, the crash causes were not established. It is suspicious that the line printer is invariably involved.

Various devices have suffered hardware faults. The HP flatbed plotter developed a pen fault (pen collection). Copy from one tetronix screen failed and, as often with this system, the line printer proved unreliable. More seriously one tape drive and one disc drive had faults which made them unusable for most of the cruise. Fortunately there were still sufficient devices to run the system without problem. The acquisition of one station was delayed when a simple wiring fault developed at a plug connection.

A sensible policy of no software development during data acquisition was adhered to, although this inevitably results in slow progress for development.

D.S. Collins

Midship Winch and Ring Main Hydraulics

The new winch was used extensively for the first time on cruise 117 and performed remarkably well. Thirty three lowerings were made to over 5000 m, involving a total of 136 hours of use, and the general operation was remarkably trouble-free with excellent level-winding.

At the beginning of the cruise a maximum speed of only 0.8m/s was available: adjustment of flow valves lead to a quite remarkable improvement- 1.2 m/s when hauling from 5000 m and a maximum of 1.5 m/s on pay out - both larger than required for CTD operation. Final flow valve settings, after a faulty spring had been replaced, yielded speeds somewhat in excess of 1 m/s.

Shortly after leaving Funchal A-frame guys were installed anchored at boat deck level. A fail-safe trip under the sheave on the A-frame stopped working after two stations - a reed switch leaked - and since in addition there was insufficient height between the rail and this trip, the trip was removed.

The ring main gave little trouble and by the end of cruise 117 had logged 210 hours of use. Improvements have been carried out - introduction of a fail safe switch to prevent loss of boost pump pressure and the installation of temporary ventilation to the pump room where the electric motor runs warm. Permanent air cooling needs to be fitted in the near future.

On station 10287 with 4000 m of wire out a faulty valve spring gave rise to flow ocillations which grew in magnitude causing a relief valve to open and the hydraulic pressure at the winch motor to fall to zero. The pump accelerating to a no load condition was first stopped by the operator and the winch, which had begun to run away, was stopped by application of the hand brake. After the faulty flow valve was adjusted and the pump restarted the station was continued. Mr. Griffiths, the winch operator, is to be commended for his prompt and apt actions. (PMS).

R.F. Wallace

Mooring Deployment - 303

A benthic mooring was successfully deployed on 21 January (1210 GMT) at 33 10.1N, 21 59.8W centred on the array of current meters previously laid on cruise 114.

The mooring consisted of 5 Vector Averaging current meters at 10 m, 20 m, 30 m, 50 m, 70 m and an Aanderaa current meter at 100 m. The acoustic release was an IOS Command Release unit 282.

Buoyancy was provided by 14 glass spheres of 17" diameter. Mooring line was 10 mm dia. braided terylene.

Deployment was from the foredeck using the double barrel capstan winch and forward crane, the mooring line being laid up on the capstan storage drum.

The mooring was deployed anchor first and the descent rate monitored using the command release beacon. (Rate of Descent 1.5 m/s).

I. Waddington

Mooring Recovery - 297

The benthic tripod, which was deployed during cruise 114 in November 1980, was recovered on January 30. Located at 33^{O} 12.8'N, 21^{O}57.2'W, in water approximately 5,290 m deep, the tripod supported a VACM current meter and a camera and flash unit. The current meter had a sample interval of 30 minutes, while the camera exposed one frame of its 16 mm film every 64 minutes. The instrument package was released at 1212 hours, surfaced at 1340 and was inboard at 1422. The current meter and camera appeared to have functioned normally during the deployment, and there was only minor corrosion on the supporting frame.

A.J. Elliott

Meteorological Instrumentation

The meteorological instruments functioned normally during the cruise and only required routine maintenance. Comparisons between the 1053 logged data and the bridge instruments are summarised below.

(a) Air Temperature

The bridge reading of temperature was consistently higher than the 1053 by between +0^{O}C to +0.7^{O}C. with an average of approximately +0.3^{O}C.

The scatter in the differences is similar for both the port and starboard thermometers. The 1053 wet bulb depression differed from that of the bridge by $-0.1^{\circ}C$ to $+1.8^{\circ}C$ (average $+0.6^{\circ}C$) with no discernable trend with temperature.

(b) Wind speed

The bridge and 1053 wind speed differed from between +3 kts to -2 kts over a range of 3 kts to 34 kts (within the accuracy of the measurements). The wind directions were within $\pm 10^{\circ}$.

(c) Sea-level Pressure

The difference between bridge and 1053 sea level pressure varied from +0.6 mb to -0.2 mb. A plot of pressure difference against wind speed (not shown) suggests a dependence of this difference on wind speed with the difference decreasing for increasing wind speed.

(d) Sea surface temperature

The 1053 hull temperature and the R.A.S.T.U.S. reading of sea temperature differed by $\pm 0.2^{\circ}C$.

(e) Solarimeter

The solarimeter functioned normally.

K.J. Richards

SHIPS COMPUTING

IBM 1800

Cruise 117 began with a legacy from cruise 116 - the IBM 1800 was not working. After frantic efforts during the stay in Madeira plus good support from Barry the problem was solved and the machine started sampling at 1900 hrs. on the 19th. During the cruise disc drive zero broke down. It required a complete reassembly and readjustment before it was operational incurring the loss of 2½ days sampling time. At the same time a software problem appeared where satellite fixes acquired on the odd minute failed to be supported with E/M log data over this period. A large amount of effort was spent to no avail and the systems discs had to be abandoned and their backups used before the problem disappeared. A lot of time was spent evaluating the quality of the IBM 1800 navigation system. The essential conclusions are as follows.

(1) The IBM 1800 is not navigating as accurately as it could.

(2) The HP2100/Magnavox system even with only one e/m log component is more accurate.

(3) The IBM 1800 current in DR option has never worked. This problem has been solved.

It is recommended tha t before the navigation programs are transferred onto the new machines they are thoroughly checked out.

PDP 11/04

Using IOS Wormley CAMAC hardware the AANDARAA current meter suite of CATY programs were successfully installed. The Tally line printer and FACIT paper tape punch was successfully re-installed on the system.

PDP 11/34

The PDP 11/34 data acquisition and display system was used extensively to log and display CTD dips. Two major hardware problems occurred. One of the SE8000 magnetic tape decks failed and although the fault was quickly cured it was not used again until late in the cruise as it was still suspect. Drive 1 of the three RL01 flying head disc drives failed during a CTD dip. The system was quickly reconfigured to run on the other drives with little loss in acquisition time. This unit was sent back to the U.K. for repair. Other minor hardware problems also occurred during the cruise but these did not impair the overall system performance. The new VT100 visual display unit was a resounding success greatly boosting confidence that the system is operating correctly.

Many software problems still need to be resolved. These are not helped by the hard but very necessary rule that no programming development takes place during data acquisition.

R.J. Burnham

A.R. Lewis

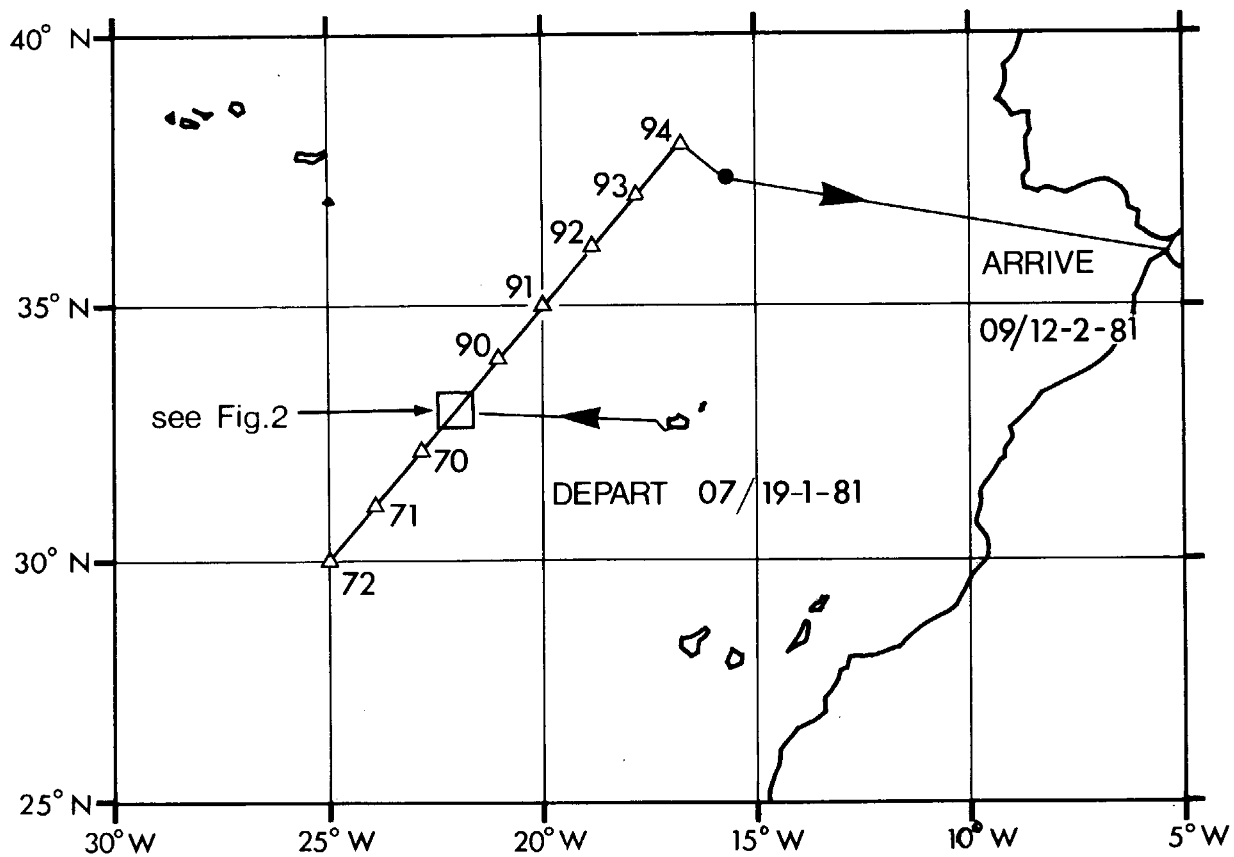

Fig.1 Discovery Cruise 117

70 = STN. (102) 70

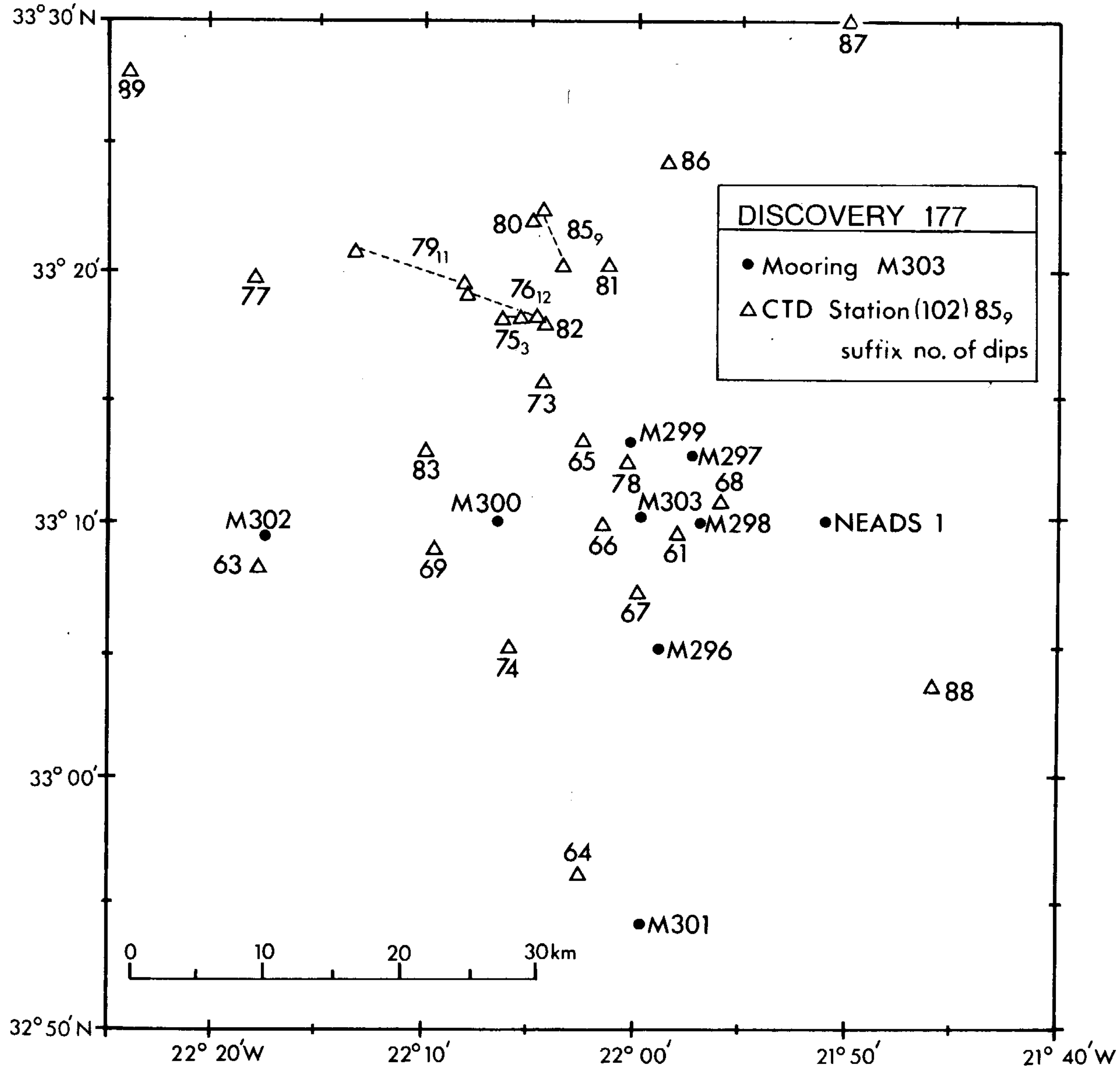
DISCOVERY 177
• Mooring M303
△ CTD Station (102) 85₉
suffix no. of dips
33° 30′ N
33° 20′
33° 10′
33° 00′
32° 50′ N
22° 20′W
22° 10′
22° 00′
21° 50′
21° 40′W
0
10
20
30km
M302
M300
M299
M297
M303
M298
M296
M301
NEADS 1
61
63
64
65
66
67
68
69
73
74
75₃
76₁₂
77
78
79₁₁
80
81
82
83
85₉
86
87
88
89

Fig.2

Table 1

HYDROGRAPHIC STATION LIST

All lowerings made from hydraulic midship winch on starboard side

Station Number	Time Down	Date 1981	Lat.N	Lon.W	Water depth,m	CTD ht above bottom,m	Salinity Samples	Thermometer Frames	Comments
10261*	2211	20.I	33 09.5	21 58.0	5285	7	10	5	NR. MOORING 298
10263*	2002	21	33 08.2	22 17.6	5329	7	10	5	" 302
10264+	2256	22	32 56.1	22 02.6	5284	5	10	5	" 301
10265	1338	23	33 13.2	22 02.4	5293	5	10	5	" 299
10266	0417	24	33 09.9	22 01.5	5295	5	10	5	" 303
10267	1116	24	33 07.2	21 59.9	5288	5	2	2	" 296
10268	2358	24	33 10.8	21 55.8	5288	7	1	2	" 297/8
10269	0725	25	33 09.0	22 09.5	5311	5	1	2	" 300
10270	2143	25	32 00.3	23 00.7	5321	5	10	5	IN SW-NE
10271	0847	26	30 59.3	24 01.0	5428	7	10	5	SECTION
10272	1954	26	29 59.5	25 00.3	5430	5	10	5	"
10273	0650	28	33 15.6	22 04.4	5304	7	0	0	
10274	2200	28	33 05.1	22 05.9	5307	5	8	3	
10275!	1610	29	33 18.1	22 05.5	5250	10	0	0	YO-YO 1st down
	1657		33 18.1	22 06.2	5227	7			3rd "
10276	0308	30	33 18.1	22 04.5	5030	10	10	5	YO-YO 1st "
	0653		33 19.0	22 07.8	5332	9			12th "
10277	2038	30	33 19.8	22 17.2	5366	5	10	3	
10278	0442	31	33 20.3	22 12.4	5348	5	2	0	NR. MOORING 299
10279	1548	31	33 19.5	22 08.0	5335	7	10	5	YO-YO 1st down
	2000		33 20.9	22 13.2	5352	30			11th "
10280	0735	1.II	33 22.1	22 04.8	5329	5	10	5	
10281	1834	1	33 20.3	22 01.1	5335	5	2	2	
10282	2212	1	33 18.0	22 04.2	5035	7	2	2	

*Unit one (old) +Logging system problems !Change to new conductivity cell 380
all others (new) unit two with conductivity cell 222.

Hydrographic Station List Continued

Station Number	Time Down	Date 1981	Lat.N	Lon.W	Water depth,m	CTD ht above bottom,m	Salinity Samples	Thermometer Frames	Comments
10283	0416	2.II	33 12.9	22 09.8	5313	7	0	2	
10284	1001	2	33 25.3	21 57.8	to 600 m only...		0	0	WINCH PROBLEMS
10285	1937	2	33 20.3	22 03.6	4923	8	0	2	YO-YO 1st Down
	2337		33 22.5	22 04.3	5324	8			9th "
10286	1452	3	33 24.5	21 58.6	5324	7	0	3	
10287	2015	3	33 30.2	21 49.9	5348	8	0	3	CELL HCL CLEAN
10288	2243	4	33 06.6	21 46.0	5268	7	0	3	
10289	1602	5	33 27.9	22 23.7	5368	8	6	3	
10290	0428	7	33 59.6	20 59.4	5236	10	10	5	IN SW-NE
10291	1554	7	34 59.7	19 59.4	5211	5	10	5	SECTION
10292	0324	8	36 01.5	18 58.4	5477	8	10	5	"
10293	1329	8	36 53.8	18 06.3	5592	8	10	5	"
10294	0129	9.II	37 53.5	17 03.8	5518	8	10	5	"

OTHER STATIONS - MOORING 303 LAUNCHED

10262	1210	21.I	33 10.1	21 59.8	5293	5 VACM + 1 AANDERA CURRENT METER + 1 RELEASE

Table 2

NEUTRALLY BUOYANT FLOATS

Times and Positions of Launch and Recovery

Trajectory no.	Channel no.	Launch Time /Day	Launch Lat N.	Launch Lon W.	Recovery Time /Day	Recovery Lat N.	Recovery Lon W.	Observed depth m
526	10	1129/20	33 09.7	21 59.8	1253/37	33 15.5	22 08.5	4870
527	2	1144/20	33 10.4	22 00.0	1344/37	33 14.5	22 07.5	4790
528	1	1225/20	33 10.3	21 57.4	Not recovered			5040
	8	0420/22	33 10.4	22 02.0	1502/22	33 10.7	22 03.1	
	12	0426/22	33 10.4	22 02.1	1649/22	33 10.8	22 03.3	
529	16	0429/22	33 10.4	22 02.2	1357/28	33 12.6	22 08.1	5170
530	8*	0350/23	33 10.0	22 03.1	0932/37	33 20.1	22 11.6	4650
531	12*	0451/23	33 09.5	22 01.7	Not recovered			4620
532	7	2056/23	33 13.0	21 57.8	1035/37	33 17.7	22 10.3	4900
533	14	2123/23	33 12.2	21 57.0	0922/35	33 17.9	22 04.2	4770
534	9	1543/24	33 13.4	21 57.5	1012/35	33 17.4	22 02.9	4790
535	15	1610/24	33 12.7	21 57.3	0840/34	33 16.1	22 02.9	4270
536	13	1630/38	33 15.8	21 59.8	1130/35	33 18.1	22 03.4	4900
	11	1201/31	33 20.0	22 01.4	1204/32	33 20.9	22 03.1	
537	11*	1416/32	33 13.4	22 04.5	Not recovered			4910

* redeployed