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I.O.S.

RRS DISCOVERY
CRUISE 122

30 JUNE – 27 JULY 1981

PHYSICAL OCEANOGRAPHY OF THE N.E. ATLANTIC OCEAN

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NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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RRS DISCOVERY
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Physical oceanography of the
N.E. Atlantic Ocean

Cruise Report No 118

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CONTENTS

SCIENTIFIC PERSONNEL

R. Bonner	IOS Wormley
J. Cherriman	" "
D. Collins	" "
E. Cooper	RVS Barry
A. Cutler	IOS Wormley
J. Gould	" "
C. Hunter	" "
V. Lawford	" "
R. Lloyd	RVS Barry
N. Millard	IOS Wormley
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B. Stanton	IOS Wormley
I. Waddington	" "
D. Weddell	" "

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OBJECTIVES

The first part of this cruise was a continuation of the work carried out on Discovery Cruises 114, 119, 120 and 121 in studying the physical oceanography of the front southwest of the Azores. Cruise 122 marked the final phase of these investigations and required the recovery of two full depth current meter moorings set on Cruise 114 in November 1980. Following this work the array of moorings set near 33°N22°W on Cruise 114 and the subject of further investigation on Cruise 117 were to be recovered and some CTD stations worked to within a few meters of the sea bed.

A narrow channel through the Azores-Gibraltar fracture zone was visited with a view to investigating the characteristics of water flowing through this channel and two near bottom current meter moorings were set in the channel for recovery in the summer of 1982.

Finally a Sea Soar* section was to be worked northwards along 15°30'W to 45°N and thence to the continental slope. En route a tide gauge was recovered for IOS Bidston.

* Sea Soar. A towed CTD and fluorometer undulator derived from the Hermes Batfish probe.

NARRATIVE (All times in GMT)

RRS Discovery sailed from Ponta Delgada (Azores) at 0715 on Tuesday June 30th. In fine weather course was set towards 35°N 36°W, the start position for a Sea Soar survey of the frontal area previously studied on Cruises 114, 119, 120 and 121. Owing to a defective cooler in the engine room passage speeds were reduced from their normal values due to the high sea surface temperatures. The P.E.S. fish was launched at 1100 and routine watchkeeping duties were started. Routine underway observations included sea surface temperature from a towed fish and pumped thermosalingraph observations. These were logged on the PDP 11/34 system. While the PES fish was being deployed a 1 ton weight test was carried out on the double barrelled winch.

Passage continued and the Sea Soar Survey commenced at 1530/1. The instrument worked well with the new steel wings that had been flown out to Ponta Delgada and the survey continued at around 9kts towards 35°N36°W. The front (defined by 16°C water at 200 m) was crossed at 1600/2nd and at 1800 course was altered to 180°. This brought the ship back into eastern (low temperature) water. At 2100 the towed vehicle's behaviour became erratic and it had to be recovered. Inspection showed that the new wings had bent near their roots and so the wings were changed for the original fibreglass ones. While the modifications were made course was continued southwards with 2 hourly T-4 XBT drops to fill in the data gap. Sea Soar was repaired and the survey recommenced at 0000/3. At 0500/3 after the front had been recrossed into western water course was altered to 090° and the ship continued on this heading until 0430/4th. The intention was to pass to the north of the detached eddy whose position was revealed by the satellite tracked buoys trapped within it. At the end of the eastward leg course was altered to 221° through the eddy centre as defined by the buoy tracks. The section through the eddy revealed 16°C isotherm depths as shallow as 110m dropping to 300m at the southwest end of the leg. At 2130/4 course was altered to 000° to run up the western side of the eddy but on this leg (at 0430/5) problems were experienced with the conductivity sensor. It gave erratic readings on the downward profiles and would not work on the ascent. Course was set towards mooring 295. By 1200/5 the towed vehicle experienced additional towing problems and so the Sea Soar was recovered (one wing was found to have been fouled with a plastic onion sack) and two hourly XBT drops were continued until the mooring was reached at 1800/5th. Mooring recovery was completed uneventfully and Sea Soar (with only temperature working) was redeployed at 2030/5 for a survey track overnight en route towards mooring 294. Sea Soar was recovered around noon/6th five miles from the mooring position and the mooring recovery then proceeded successfully. At 1445 course was set towards the position of Bencat (a benthic current and temperature recording package) which had been deployed on Cruise 119 but which had failed to return to the surface.

Two 5 kHz bottom transponders were deployed on an 8 km baseline to the northwest of the Bencat position and preparations were made for dragging. On passage over the Bencat position an attempt was made to interrogate the instrument's acoustic beacon which on Cruise 119 during recovery operations had apparently suffered a catastrophic failure. The release beacon was surprisingly turned on without difficulty and a further attempt was made to release Bencat acoustically but without success.

Dragging operations commenced at 2330/6th and continued overnight using acoustic navigation to give ship positions and positions for the leading end of the drag. The drag line was finally recovered by 1900/7th but without any success in recovering the Bencat instrument. Only one of the acoustic navigation beacons could be released from the sea bed at the end of the dragging operations. The other one switched acoustically but did not release from its anchor. Bencat was abandoned and its acoustic beacon turned off at 2200/7th. Course was set towards the eddy centre with 2-hourly XBT drops on passage. A CTD station (10383) was worked at the eddy centre and a 200m drogued satellite buoy (1811) launched at 1403/8th. Course was set for a further CTD station in western water outside the eddy. The station position was reached at 0050/9 (Stn 10384) and the CTD station to 2500m completed by 0318.

Course was set towards the expected position of drift buoy 1813 launched on Cr. 119 with 2-hourly XBT drops on passage. Although sporadic radio signals were heard from 1900/9 onwards no useful directional information could be gained and it was fortunate that the buoy was seen from the bridge before dusk. The buoy and its drogue were recovered without difficulty and in excellent condition and the buoy and buoy rope together with a new drogue were released at 2130/9.

Course was then set towards the Benthic array area (33°N 22°W). During the afternoon of July 10th a brief stop was made to investigate an overheating tailshaft bearing and the opportunity was taken to dispose of the old wire from moorings 294 and 295. The westernmost of the Benthic array moorings was reached at 1600/11 and this (mooring 302 - see Cruise report of Discovery Cr. 117) and its neighbour mooring 300 were recovered by 2040 in breezy conditions.

After steaming away from the moored array a wire test was made of the electronics for the 35 kHz near bottom neutrally buoyant float. The test was unsuccessful in that no measurement of the height of the transducer above the sea bed could be made. Course was set towards a CTD station at the position of mooring 302. However it was found that the temperature sensor was not working and the replacement deep CTD had a large pressure offset. At 0530/12 the station was abandoned and course set towards mooring 301. This and mooring 296 were recovered by mid afternoon and then a further test of the float electronics was made - again without success.

Course was set towards the position of mooring 301 with the intention of doing a CTD station but by that time several possible faults in the float electronics had been identified and corrected so the CTD was preceeded by further float electronics trials. The electronics could be made to work near the sea surface but not near the sea bed. A CTD to within 10 m of the sea bed was completed by 0410/13 and course set towards mooring 299. On reaching the mooring position the acoustic beacon could not be activated and in view of additional problems with the satellite navigation receiver mooring 298 was recovered instead and without any difficulty. It had been intended to occupy a CTD station at the mooring position but there were problems with the conductivity sensor and while this was being repaired a further (unsuccessful) test of the float electronics was made. The CTD station was then occupied but the conductivity values jumped at around 4800 m. The station was completed by 2300/13 and course set towards a new CTD position with a further float electronics test en route. The float test started at 0020/14 but was not completed until 0556 due to a failure of the coring winch overspeed cutout. This had to be replaced with a similar unit from the trawl winch. There was not then time enough to occupy the intended CTD station so course was set towards mooring 299 which we had been unable to contact on the previous day. An acoustic and visual search was started at 0810/14 and at 1030 despite poor navigation the release beacon was heard. The mooring was then released and recovered uneventfully by 1220. This was followed by the recovery of the central VACM mooring (303). A CTD station to within 10 m of the sea bed was then worked at the mooring position and this was completed by 1745/14. The data from this station were however marred by salinity jumps which persisted on the next CTD station to the east of the moored array. Course was set towards a final CTD station to the north of the moored array and the position was reached by 0300/15. It was then found that on the previous station the protective cap had been left on the oxygen sensor and that the sensor had been irreparably damaged. The station was abandoned at 0600 and course set towards the next work area - a channel between the Iberia and Madeira abyssal plains. In the evening of the 15th a shallow CTD station was worked (to 2500 m) which confirmed that the problems with the CTD conductivity sensor had been successfully diagnosed and corrected and a further unsuccessful test made of the float electronics. The problem with the CTD had been traced to

(a) crevice corrosion around the conductivity sensor mounting

(b) a broken wire inside the base of the electronics package.

Throughout the passage leg to the "MADIB" gap head winds of 20 kts were encountered which reduced passage speeds to below

8 kts at times. A final wire test of the float electronics on the evening of the 16th was still unsuccessful and it was decided that the float should be launched without the bottom echo sounder working so as to provide a test of the float ballasting.

The channel was reached at 1500/17 and after a brief PES survey the neutrally buoyant float was launched at 2030. The vessel then hove to in 25kt winds for wire tests of the acoustic units for moorings to be set in the gap. After the first wire test the ship homed in on the float and got sufficiently close to suggest that the float had not sunk, or had settled at a very shallow level. After the second wire test the float was again located acoustically and proved to be at the surface. An echo sounder survey of the channel was performed until daylight when an attempt was made to find the float. At the time the satellite navigation was failing to produce satisfactory fixes and this delayed location of the float until 0800/18. The float was recovered at 0900 despite high winds and seas. It was found that all of the external balance weights which had been secured by seizing wire were missing - presumably having shaken loose during the float's time at the surface. Further echo sounding runs were then made to determine the depth and orientation of the channel and in the afternoon two moorings, each with a single current meter were set on either side of the channel. Weather conditions were deemed unsuitable for CTD stations to be worked and the ship proceeded northwards overnight.

The Sea Soar was launched at 0830/19 but the data appeared very noisy and the vehicle was recovered with difficulty in Force 8 winds and heavy seas. The fault was traced to an intermittent contact between the CTD and fluorometer pressure cases. The fault was rectified but deployment was deferred pending an improvement in the weather.

Sea Soar was relaunched at 0530/20 and the northward run continued in moderating weather. The tide gauge position was reached at 0800/21 in excellent weather. Sea Soar was recovered and the tide gauge retrieved by 1030. Sea Soar was relaunched at 1115/21 and course set for $47^{O}N12^{O}W$. On reaching this position a surface temperature feature was seen in the SST and thermosalinograph records so the run was extended for 20 miles in order to fully define the feature.

The Sea Soar vehicle was recovered at 1000 and the ship then returned to 47^{o}N 12^{o}W for a CTD station and the launch of a neutrally buoyant (MKIII) float ballasted for 4600 m (200 m above the sea bed).

At the end of the CTD station (1530/22) the float was located and found to have settled to approximately 3000 m. A further CTD station was then worked 20 miles to the north of the float. This was completed at 2300/22 and course set back towards the float. A further wire test of float electronics was performed and the float interrogated, this revealed that the float had settled on the sea bed and at 0400/23 an attempt was made to release the float. The electronics appeared to switch normally but the float remained at depth. A repeat CTD station was worked and at 1440 Sea Soar was deployed and course set towards $45^{o}30'$N $12^{o}50'$W. The Sea Soar run via this position and then to 47^{o}N 10^{o}W was completed by 1740/24 and was followed by a final wire test of the float electronics and a shallow calibration station for the Sea Soar CTD unit. At 2100/24 course was set towards the position of the UK data buoy DB1 ($48^{o}40'$N $09^{o}00'$W). It had been hoped to rendezvous there with the EMI vessel "Fathomer" but having been unable to make radio contact the buoy was boarded in order to measure the diversions of a new compass housing.

During this time all the Discovery's overside equipment was recovered and on the return of the buoy landing team course was set towards Barry.

The ship docked at 0130/27th.

EQUIPMENT AND OBSERVATIONS

Neutrally buoyant floats and acoustic navigation (Millard)

There is a growing demand for the use of acoustic navigation as an aid to the accurate positioning of instruments towed by or lowered on wires from the ship. The dragging operation for Bencat was used as a trial for the system. Two bottom transponders were laid 8 km apart to form the base line the centre of which was about 3 km to the N.W. of Bencat. A remote interrogator was placed on the drag wire such that for the large part it was clear of the bottom but its position gave an indication of the beginning of the 'working' section of the wire. In this way it was possible to navigate the wire around the Bencat position. The ships position was also plotted relative to the bottom transponders and a comparison with the normal ships navigation were good apart from when close to the base line. See fig 1.

Another object of the cruise was to gain some experience with the loading of the new MK III neutrally buoyant floats fitted with the near bottom echo sounder. A set of float electronics was assembled in a tube for wire tests on the midships winch. Several tests established that the electronics were satisfactory as a transponder, that the acoustic release worked and fired a puffer, that on the way down the bottom echo sounder worked as expected from surface reflections but failed to work close to the bottom, the telemetered pulse remaining locked into the maximum range (600 m). Furthermore on returning to close to the surface it would no longer work off the surface reflection. However on recovery it was always working in the laboratory. The possibility of temperature effects were investigated firstly by leaving the test package at 100 m for 1½ hours after returning from a deep test but still it failed to start working. Secondly measuremenets were made on the electronics at 5°C in the constant temperature laboratory. Following these measurements it was decided to return the filter and increase the prefilter gain by 20db. and also to clip the signal prior to the filter to improve its selectivity. These modifications, along with some other changes failed to change the operation.

In an attempt to isolate the cause of the problem the CTD near bottom echosounder was converted to be a transponder listening for 35 kHz and replying at 10 kHz. This was lowered on the wire with the float electronics to establish if there was a failure of the floats 35 kHz transmission pulse. This test established that the 35 kHz pulse continued to be transmitted throughout the wire test. Also it was noted that the converted transponder would hear the echo from the bottom although only reliably to a range of 150 m. However the test did indicate that the transmit side of the electronics and the transducer were probably not the cause of the failure.

Even though the near bottom echo sounder could not be made to function two attempts were made at loading trials on a MK III glass sphere float. For the first attempt the float was loaded for 4800 m in about 5100 m water depth. It was launched in fairly rough conditions but did not sink. Whether this was because of trapped air which wasn't allowed to escape because of the wave action it is hard to say. On recovery several hours later it was found that the external 'fixed' weights which were held on with seizing wire had dropped off.

For the second attempt the float was loaded for 4600 m in about 4800 water depth. This time an additional 400 grms was added to the release weight with a soluble link to help take the float through the surface. This weight could be seen from the record to drop off after 15 mins, but the float continued to the bottom. The attempt to release it switched the electronics but the float failed to come up.

Moorings and currents meters (Cherriman, Waddington, Gould)

Current meter work on this cruise was entirely successful and preliminary study of the data tapes indicates that a very high return of good data will be achieved.

The objectives of the cruise and comments on their achievement are as follows.

(a) Recovery of two full depth moorings (294, 295) in the front SW of the Azores.

These two moorings were set on Cruise 114 close to the front boundary with Aanderaa current meters at depths of 200, 700 and 1500 m. On each mooring the uppermost current meter was intended to have a pressure sensor to monitor mooring motion. However on mooring 295 the uppermost and lowermost current meters had been inadvertently transposed so that the pressure record was offscale. The instruments sampled at 1 hr intervals with measurements of current speed, direction and temperature. There was a conspicuous difference between the amount of marine growth on the two moorings. Mooring 294 which had spent most of its life in western water had appreciably less growth than mooring 295. In addition there was a clear case of fish bite on the 1500 m current meter on mooring 295 with tooth marks on the rotor, part of one of the rotor blades missing and clear evidence that some creature had chewed the electrical connector on the upper end cap of the current meter.

(b) Benthic array moorings

The majority of these moorings were set in November 1980 on Discovery Cr. 114 and were the centre of further investigation during Cruise 117. (See Cruise report of this cruise for chart showing mooring positions). The central mooring of the array (303) with five AMF Vector Averaging current meters and a single Aanderaa instrument had been set on Cruise 117.

All the moorings and instruments were recovered with few difficulties and with no sign of physical damage or untoward corrosion on any components. The braided mooring line had given some cause for concern due to the stretch seen in many of the rope terminations on deployment. However there was no sign of further deterioration in these rope lengths. Corrosion of the older VACM pressure cases had occurred where insulating sleeves had become sufficiently compressed to allow contact between the aluminium case and stainless steel bolts.

All current meter tapes and cassettes ran the full distance and preliminary scrutiny of the data show it to be of high quality. All Aanderaa instruments in this array had been modified to record temperature with high ($\sim$ 0.0025^{o}C) resolution. The quality of this observation is yet to be determined.

(c) Moorings set in the MADIB Gap

Two moorings were set in the channel joining the Madeira and Iberian abyssal plains. These moorings (309 and 310) each had a single current meter 200 m above the sea bed and equipped with a high resolution temperature channel (see (b) above). The moorings were set without difficulty and will be recovered in the summer of 1982. The bathymetry and mooring positions are shown in Fig 2 .

(d) Tide gauge recovery

A single tide gauge was recovered for IOS Bidston near $45^{O}N$ $15^{O}30'W$. The gauge which had been deployed on Cruise 115 in December 1980 was recovered without difficulty.

Details of the current meter moorings are given in table 1 . Diagrams of the mooring designs are shown in fig 5.

Forward hydraulic ring main, double barrelled winch and midships winch (Bonner)

During the cruise the ring main was used for the recovery and laying of moorings on the Double Barrel Capstan, and for CTD work and wire tests on the midships winch. Problems had been encountered on previous cruises when laying moorings, with the load running ahead of the motors when paying out, causing the mooring to be jerked as it was being lowered. This was to have been prevented by fitting an overcentre valve in the return line from the motors, to throttle the return flow. When tested however, it was found the overcentre valve was unable to control this due to its having the wrong ratio pilot piston fitted. The problem was overcome by removing the overcentre valve and fitting the flow control valve in the return line.

Since the "coring winch" motor driving the ring main was speeded up in April, considerable problems have occurred with its overspeed trip cutting out. This was particularly noticeable when starting to haul or pay out a mooring on the DBC, when the motor would cut out as soon as the flow valve was opened. It also cut out twice during CTD stations on the midships winch. Once when the A frame was operated and once while the winch was paying out. The problem has been that the trip was at its maximum setting but was in poor mechanical condition to cope with the changes in speed as the load changed. It was partly alleviated by using the trip from the trawl winch which is in better condition, though this one has cut out twice since installing. An uprated trip will need to be fitted during refit.

During the cruise the main flow and return hoses on the foredeck have been removed and the pipework in the pump room modified to give separate supply lines to the DBC and midships winch, with the facility to disconnect the DBC with quickfit couplings. The supply to the midships winch is now by flexible hoses from the pump room to the original deck connections in the cross alleyway and there has been no increase in noise with the new arrangement. The midships winch has run very well, the only adjustment necessary being to increase the torque available to the motor to improve hauling rates for deep CTD stations.

Ten Kilohertz Acoustics (Phillips)

The two moorings deployed (for 230 days) in the first work area (Sargasso Eastern Boundary) were of the 'full depth' type with a CR200 series release at the bottom and a ten kilohertz transponder 600 metres below the surface. The releases were at 3700 and 4200 metres depth and both were turned on at approximately 8 kilometres slant range. Both worked correctly releasing the moorings in the expected time. One transponder was not heard due to low transmission batteries, the other operated correctly. The transponder's hardware (aluminium and stainless steel) was uncorroded. The release aluminium hardware was uncorroded but the stainless steel had corroded in several ways: on one unit the washers on the half clamp assemblies had all corroded to nothing(6) leaving the release at the bottom of the bar still adequately retained but straining the electrical leads to the pyrolease units; the release assembly on this unit showed heavy crevice corrosion of the side plates underneath the nuts and bolts; the second unit had one half clamp badly creviced and one half clamp lightly creviced - the other two were uncorroded; the main cross pin securing the bar to the release assembly was also creviced on the contact areas.

BENCAT had been lost in this area and a day had been allocated for a recovery attempt by dragging. The release frequency was transmitted as we approached the area turning the acoustic beacon on immediately. Acoustic contact had been totally lost during the recovery attempt on Cruise 119; the unit was put through its firing sequence twice (to no avail), accurately positioned as a dragging target, and left pinging as a monitor of drag success. At 1130 on July 7th an extra pulse appeared produced by the tilting of a mercury switch mounted in the main spar; this indicated that the spar was not tilted at angle greater than ten degrees to the vertical. During the following hour BENCAT appeared to move with the ship on several occasions; it may have been moved along the sea bed. The ship then moved steadily away from BENCAT so the drag line was recovered. BENCAT was relocated and navigationally fixed; the acoustics were then cycled through the firing position twice (again to no avail); the different acoustic modes were checked - functioning correctly - and left in the automatic switch off mode.

In the second work area a near bottom array of six moorings had been deployed for 230 days and a seventh had been down 174 days; all used CR200 series releases at a depth of approximately 5300 metres. Six were interrogated at between 7 and 9 kilometres slant range and released as required; the seventh was more difficult to turn on but eventually performed as required (15 minutes transmission instead of 2). One pyrolease failed to fire due to a defective underwater lead. All the aluminium hardware was uncorroded. Six units used stainless steel overhauled and repassivated at IOS Wormley and showed only slight staining and no corrosion. The seventh unit had been new at deployment and was heavily corroded on contact surfaces of the release assembly side plates but was otherwise uncorroded.

Two of the sets of electronics recovered were realigned (several small adjustments on each unit), equipped with new batteries and hardware, wire-tested to 4000 metres, and relaid on two near bottom moorings in the third work area.

A tide gauge using two CR200 releases was successfully recovered from 3200 metres on the final working passage.

A Near Bottom Echo Sounder was used to enable the CTD to operate safely to 8 metres from the sea bed. This unit comprised a 35 kHz automatic echo-sounder interfaced to a ten kilohertz telemetry link using the standard IOS fixed pulse and variable pulse technique. The unit worked well and was also used for various attempts to debug a similar system used in a near bottom float system. The near bottom float system also required some modifications to its command release circuitry to achieve the standard release performance while operating at a higher voltage; these were carried out satisfactorily.

PDP 11/34 Data Acquisition System (Collins)

General Description

This system was used to acquire the following types of data.

(a) BATFISH data, this being variables Pressure, Temperature, Conductivity, Oxygen and Fluorescence.

(b) CTD STATION data, being variables Pressure, Temperature, Conductivity and Oxygen.

(c) SEA SURFACE TEMPERATURE data from the Gwilliam fish.

(d) THERMOSALINOGRAPH data.

(e) E.M. LOG and GYRO data.

(f) SATNAV satellite fixes.

Such data is temporarily stored in cyclic disk files from which it is archived to permanent storage on computer tape. Data from some disk files are averaged and/or calibrated and written to other disk files. Fuller details of this system may be found in earlier cruise reports (e.g. Discovery 114, 116, or 119).

Performance

The system performed well and, in most cases, could easily cope with the demands made of it. However there were occasions when there were problems.

(1) The system is prone to failure when a user is trying to start a new tape file (i.e. command 'NF' with 'RUN CON'). This seemed to only occur when the system was busy and manifested itself as CONARZ remaining in core after ending the previous file but before starting the next. Disk activity appeared to stop. This is a suspected software error but the cause was not pin-pointed.

The tape archiving system is soon to be modified.

(2) The system is not capable of servicing terminal input adequately when the system is busy. Users often need to type program input more than once. It appears to have an associated effect that the Calcomp and Hewlett Packard plotters frequently stop during plotting and need to be reactivated by pressing 'return' on the relevant terminal.

(3) In most cases, core was not full. Core is currently 128k 16-bit words. When core was full, such that the system needed to checkpoint tasks, performance became poor and it seemed advisable to cancel tasks. System hang-ups, from this cause, were avoided by suitably planning the work-load.

(4) The line printer proved to be troublesome. The printer is needed in the calibration procedure and it has been faulty since June 1978. The cause may have been pin-pointed to a defective 'chip' but this theory could not be confirmed as there was not a replacement 'chip' on board.

Use of Software

In most cases programs were easy to use but on the few occasions when a problem did arise, detailed knowledge of the system was required to resolve the problem. This situation can be eased by having a good reference manual for the software (in preparation).

Where adequate documentation did exist, it was clear that many watchkeepers preferred a trial-and-error approach rather than reading lengthy instructions. This approach is not acceptable with real-time calibration programs as any errors made cannot be easily reversed (if at all). Programs should therefore be as self-explanatory as possible. A few minor program changes are planned.

Additional programs

(a) CTDSAL

A program to convert figures displayed on the BATFISH/CTD monitor into calibrated values, as calculated within the acquisition software. It is used for calibration of CTD and Batfish. A program description is in preparation.

(b) AADUMP, AATRAN, AALIST, AACAL, AAPLOE, AAPLOH

A suite of programs to transfer Aanderaa current meter data from computer tape to a disk file in a standard format, to calibrate it and to plot. As the disk file format is a suggested standard some of these programs will be of general use. Write-ups are in preparation.

(c) ANAV

A program used for float navigation and positioning, proved to be very useful.

Summary of data collection and calibration

(a) BATFISH data

Data was very free of noise and only 10 minutes of data were lost in many days of data collection. Near real-time calibration involved fitting the current Temperature/Salinity curve to reference points for that part of the Ocean. At times this was straightforward, at other times it was extremely difficult and one has to devise new reference points. This sort of calibration would probably benefit from one person doing the calibration for a longer period of time to maintain consistency. A previous cruise has tried 2 people for 12 hours each, rather than our 3 people for 4 hours each.

(b) CTD STATION data

At times, this type of data was unacceptably noisy even though Batfish data collected before and after was almost noise free. The cause was not established although it did not appear to be the winch neither was it radio-transmissions. It was noticed that test plotting programs which generate their own data, also produced noisy plots at this time. This problem needs investigation before the next CTD cruise.

At this time there are various versions of the CTD software. This needs to be rationalized.

(c) SEA SURFACE TEMPERATURE data

The instrument developed various electrical faults but the main problem was the lack of calibration coefficients for the sensor in use.

(d) THERMOSALINOGRAPH data

No problems at the computer end.

(e) E.M. LOG AND GYRO data

Some data was lost when a connection to the data input was inadvertently disconnected. This was remote from the computer.

One of the calibration programs, CALDR, aborted if the main console was in use while the program was trying to output information to it. This resulted in loss of data in the calibrated file and is not satisfactory. Several hours of calibrated data were also lost when the main terminal needed 'return' pressed through electrical noise.

(f) SATNAV data

Data was collected without problem at the PDP 11/34 end. It is of great concern, however, that the currents estimated as the difference between calibrated EM Log/gyro and SATNAV, differ considerably between the IBM 1800 (very similar to that given by SATNAV) and the PDP 11/34. Both are in doubt as they appear to have biases and recalibration of the EM logs is necessary.

Computing General (Cooper, Lloyd)

Four computer based systems were used on this cruise:-
IBM 1800 performed routine navigation and met. data processing.
PDP 11/34 processed CTD and BATFISH data.
PDP 11/04 translated current meter data.
HP 2100A served the satellite navigation system.

The IBM 1800 was run continuously throughout the cruise giving few problems. An error in the ship's clock caused initial problems but once repaired the system settled. An intermittent fault with disc drive 1 caused three system crashes - however the total loss of data was only 16 minutes.

The PDP 11/34 recorded and processed CTD and BATFISH data successfully. A problem that first occurred on Cr. 120 returned on the Calcomp 1038 plotter. With the welcome help of Chris Hunter the error was traced to a build-up of carbon deposit in the drive motors (total down time two days). A new application was programmed - the calculation and display of data from an acoustic navigation system. After an initial problem was shown by disagreement with satellite navigation data the program performed well.

The PDP 11/04 was used to process current meter data and write it to half inch magnetic tape. Many hardware problems with the Camac system hampered this process. No single module is thought responsible. The front panel connectors are likely to be the main cause.

The satellite navigation system gave a series of problems with missed or anomolous fixes. These were overcome by changing receiver boards or reloading the computer program.

Navigation

Discrepancies of 600 to 800 metres existed between the IBM 1800 data (and the PDP 11/34) and the acoustic navigation system used during the BENCAT drag. A marginal sat. fix was eliminated but this showed little change. Added to this a strong bias has been noticed on the calculated currents which all point to an urgent need to re-calibrate the EM logs. This problem was also reported on Cruise 120.

Dragging Attempt for BENCAT (Gould, Millard, Phillips)

In view of the plans to replace the existing trawl winch in the forthcoming refit it was deemed sensible to use the trawl warp in an attempt to recover the BENCAT (benthic current and temperature) recorder which had been lost on Cruise 119. The attempt was made in ideal weather conditions and employed acoustic navigation of the ship and the head of the drag line relative to two moored 5kHz acoustic beacons.

The dragging rig had to be improvised from equipment already on board Discovery and there was no time available to test the acoustic navigation technique or to survey in the beacons and BENCAT itself.

A total length in excess of 3000m of wire and chain was kept on the sea bed during this operation. The head of the drag was marked by a 10 kHz beacon to monitor the height of the head of the drag line above the sea bed and the 5kHz remote interrogator a further 100 m up the wire.

The navigation was carried out using the ship positions at launch time for the beacon positions and assuming that the beacons and the remote interrogator were at the same depth.

The ship track (from satellite navigation) during the dragging operation is shown in fig 3 and in fig 4 the acoustic navigation fixes of the ship and remote interrogator are shown. The head of the drag line was in general about 4 km astem of the ship. Acoustic navigation at the western end of the dragging operation became poor due to a variety of problems including:-

(1) ship and remote interrogator close to the base line
(2) remote interrogator lying on the sea bed and perhaps not pointing towards the ship
(3) large ship distances to the channel 15 beacon.

At 1130/7 the tilt pulse on the BENCAT beacon came on. At this stage there was still a further 1.5 km of cable to drag past the BENCAT position and this was done with hauling not commencing until 1310. The drag line was finally recovered at 1815 without recovering BENCAT but the tilt pulse still remained operative suggesting that BENCAT had been moved by the drag line and is now canted at some angle to the vertical.

Unfortunately at the end of the dragging operations one of the bottom navigation beacons could not be released from its anchor and had to be abandoned. The acoustic navigation technique appeared to have worked well despite at times unfavourable geometry and with no preparation possible before the dragging operations were commenced. The ability to navigate an instrument remote from the ship may well be of use in future work of this type and for the relative positioning of geological samples.

<u>Sea Soar Performance</u> (Lawford)

Sea Soar was towed for a total of 187 hours with few problems. The newly designed steel wings proved to have insufficient strength near the roots for sustained use - they had bent enough to seriously affect the handling of the vehicle after 30 hrs of towing at 9 kts and were replaced by the original fibreglass units. Data quality was high and for the most part noise free although towards the later stages of the cruise some spiking occurred. During the survey of the front SW of the Azores a slight leak of the conductivity sensor mounting resulted in the loss of this parameter for a short period but the other channels appeared unaffected.

Most deployments and retrievals of the towed fish were carried out in ideal weather conditions but at the start of the northern survey the weather deteriorated until it was deemed hazardous to both the Sea Soar and to the handling personnel to attempt deployment.

CTD Stations (Hunter)

The CTD sensor head gave a number of problems, most of which were caused by crevice corrosion taking place beneath the conductivity cell 'O' seal. This allowed a very small amount of water to enter, and partially short-circuit the wiring on the back of the cell, giving rise to shifts in the conductivity value of typically one to two microMhos, which would suddenly occur at two or three thousand meters depth, and remain all the way back to the surface as a zero error. The extent of the crevicing was so slight as not to have been immediately obvious, and several attempts were made to clean and reseat the cell; each being followed by another partially abortive CTD station, until the full extent of the problem was recognised by the use of an inspection lens. The sensor head was then stripped and the surface milled flat and polished with graded abrasive paper. On reassembly it was noted that the mechanical design was such that there was inadequate crush on the 'O' ring; and it was probably this which encouraged the crevicing conditions in the first place.

During the course of these problems, there were other individual fault occurrences. The temperature sensor failed due to a wire becoming detached. The oxygen sensor was damaged due to the protective cover being left on during a dip; in the course of its removal from the sensor head, a conductivity wire was broken and this was not realized until the next station. There was one total shutdown of the electronics unit, caused by the chassis becoming very loose as a cumulative result of excessive vibration and jarring whilst being moved on and off the winch platform.

The efficiency of fault finding and repair was not helped by an inadequate set of spares, there being almost no spare circuit boards. Interchange was not always possible because of differences in the build standard from one CTD to another. A complete spare sensor head and the corresponding interface boards would have saved many lost or corrupted CTD stations.

Satellite tracked buoys (Hunter)

Four drifting buoys having been launched on Cruise 119, the remaining buoy was positioned in the centre of the eddy and drogued at 200 m. Except for the failure of the quick release mechanism, this was accomplished without difficulty.

Later in the cruise we approached the position of one of the buoys (1813) set on Cruise 119. The radio signals were used to home in on the buoy, using a steerable antenna mounted above the wheel-house, signals being displayed on a chart recorder. Reception was very poor (put down at the time to faulty antenna positioning relative to masts and rigging), but eventually the buoy was sighted one mile ahead in failing light.

The buoy was recovered together with its drogue and found to be in generally good condition. It was redeployed almost immediately with a new drogue, so that the original could be retained for examination.

The 4 mm galvanised wire rope used to hold the ballast chain onto the drogue was badly corroded, and there was slight wear on the head-rope holding additional trawl floats to the top of the drogue. Eventually these items would have parted company, but the effect of this would not be too serious, merely altering the buoyancy and drag characteristics to some extent. There was some macro-fouling of the surface bearing parts of the system, mainly consisting of goose-barnacles (Lepas sp.) but everything else was in excellent condition, with no sign of wear or corrosion.

About four days after relaunch of this buoy, no further transmissions were received by the satellite. It is now believed that the batteries were running low prematurely, and that this was the reason for the poor radio signals when attempting to locate the buoy.

TABLE 1

Moored current meter and tide gauge recoveries and deployments

CURRENT METERS

Mooring 294	16-Xl-80 to 6-VII-81		
	32°00'.4N 31°30'.0W		4250 m
29401	Aa 1261	210 m	
29402	Aa 421	720 m	
29403	Aa 2108	1520 m	
Mooring 295	19-XI-80 to 5-VII-81		
	33°01.4N 31°47.8W		3737 m
29501	Aa 3254	249 m	
29502	Aa 3338	752 m	
29503	Aa 3725	1558 m	
Mooring 296	26-XI-80 to 12-VII-81		
	33°05'.0 21°58'.4W		5283 m
29601	Aa 4738	4630 m	
29602	Aa 5201	5172 m	
29603	Aa 4734	5271 m	
Mooring 297	See cruise report Discovery Cr. 117		
Mooring 298	27-XI-80 to 13-VII-81		
	33°10'.0N 21°56'.8W		5286 m
29801	Aa 5206	5173 m	
29802	Aa 4740	5273 m	

Mooring 299	29-XI-80 to 14-VII-81		
	$33^{o}13'.0N$	$22^{o}0'.21W$	5300 m
29901	Aa 4737	4642 m	
29902	Aa 5207	5186 m	
29903	Aa 4733	5287 m	
Mooring 300	27-XI-80 to 11-VII-81		
	$33^{o}10'.0N$	$22^{o}06'.4W$	5300 m
30001	Aa 4739	4643 m	
30002	Aa 5205	5187 m	
30003	Aa 4741	5288 m	
Mooring 301	27-XI-80 to 12-VII-81		
	$32^{o}54'.1N$	$21^{o}59'.6W$	5275 m
30101	Aa 5203	5163 m	
30102	AA 5204	5263 m	
Mooring 302	28-XI-80 to 11-VII-81		
	$33^{o}09'.5N$	$22^{o}17'.4W$	5333 m
30201	Aa 5202	5220 m	
30202	Aa 3624	5321 m	
Mooring 303	21-1-81 to 14-VII-81		
	$33^{o}10'.1N$	$21^{o}59'.8W$	5923 m
30301	Aa 4736	5176 m	
30302	V 0156	5210 m	
30303	V 0132	5232 m	
30304	V 0430	5253 m	
30305	V 0672	5264 m	
30306	V 0629	5275 m	

<u>Mooring 309</u>	Set 18-VII-81 for recovery summer 1982	
	37°22'.35N 15°48'.17W	5046 m
30901	Aa 3340	4824 m
<u>Mooring 310</u>	Set 18-VII-81 for recovery summer 1982	
	37°21'.2N 15°45'.72W	5046 m
31001	Aa 3726	4824 m
<u>Tide gauge</u>	Set 14-XII-80 recovered 21-VII-81	
	44°56'.5N 15°34'.6W	3164 m

TABLE 2

CTD Stations

Station No.	Date	Time (Z)	Lat N	Long W	Max depth m	Comments
10383	8-VII	1155-1356	32°15'.1	33°15'.0	2500	Centre of eddy
10284	9-VII	0056-0318	32°30'.4	31°30'.0	2500	Western water
10385	12-VII	0105-0409	32°54'.3	21°59'.3	5290	At Mooring 301
10386	13-VII	1123-1148	Station abandoned - CTD malfunction			
10387	13-VII	1926-2301	33°10'.3	22°19'.5	5342	At Mooring 302
10388	14-VII	1441-1748	33°10'.2	21°58'.0	5313	At Mooring 303
10389	14-VII	2052-2356	33°10'.0	21°40'.0	5300	East of NEADS 1
10390	15-VII	0302-0550	33°25'.4	21°59'.5	Station abandoned - CTD malfunction	
10391	15-VII	1948-2114	34°23'.4	20°34'.4	2500	CTD function check
10394	22-VII	1140-1528	47°00'.4	12°00'.2	4787	
10395	22-VII	1928-2253	47°21'.0	12°01'.5	4836	
10396	23-VII	1018-1343	47°00'.7	12°00'.0	4890	
10397	24-VII	2015-2058	47°04'.6	10°05'.0	300	Shallow CTD calibration.

TABLE 3

Sequence No	Date	Time Z	Lat N	Long W	Max Depth m
1	2-VII	2200	34°20'.8	36°19'.5	545
2	5-VII	1305	32°47'.6	32°37'.1	556
3	5-VII	1501	32°54'.5	32°16'.8	530
3A	5-VII	1704	32°59'.4	31°53'.6	542
4	7-VII	2300	31°27'.5	31°08'.4	525
5	8-VII	0101	31°26'.9	31°31'.7	522
6	8-VII	0300	31°28'.1	31°54'.8	549
7	8-VII	0457	31°38'.2	31°12'.9	530
8	8-VII	0657	31°50'.5	32°30'.9	512
9	8-VII	0902	32°02'.6	32°49'.2	549
10	8-VII	1659	32°18'.7	32°47'.9	555
10A	9-VII	0458	32°36'.6	31°15'.1	531
11	9-VII	0700	32°46'.6	30°57'.2	543
12	9-VII	0900	32°54'.3	30°38'.3	550
13	9-VII	1100	33°02'.4	30°18'.9	533
14	9-VII	1300	33°14'.1	30°01'.7	531
15	9-VII	1600	33°31'.8	29°36'.3	540

FIGURE CAPTIONS

<u>Fig. 1</u> Track Chart

<u>Fig. 2</u> Bathymetry in gap between Iberian and Madeira abyssal plains. Positions of moorings are shown.

<u>Fig. 3</u> Satellite navigation ship track during BENCAT dragging attempt.

<u>Fig. 4</u> Acoustic navigation track during BENCAT dragging attempt.

<u>Fig. 5</u> Schematic diagrams of moorings recovered and deployed on Cr. 122

(1) Moorings (294, 295)

(2) Central VACM mooring of benthic array (303)

(3) Moorings set in MADIB Gap (309, 310)

(4) Benthic array moorings (298, 301, 302)

(5) Benthic array moorings (296, 299, 300)

Codes for rope lengths.

A	10 mm Braidline
B	12 mm Braidline
C	8 mm kilindo wire
D	12 mm trawl warp

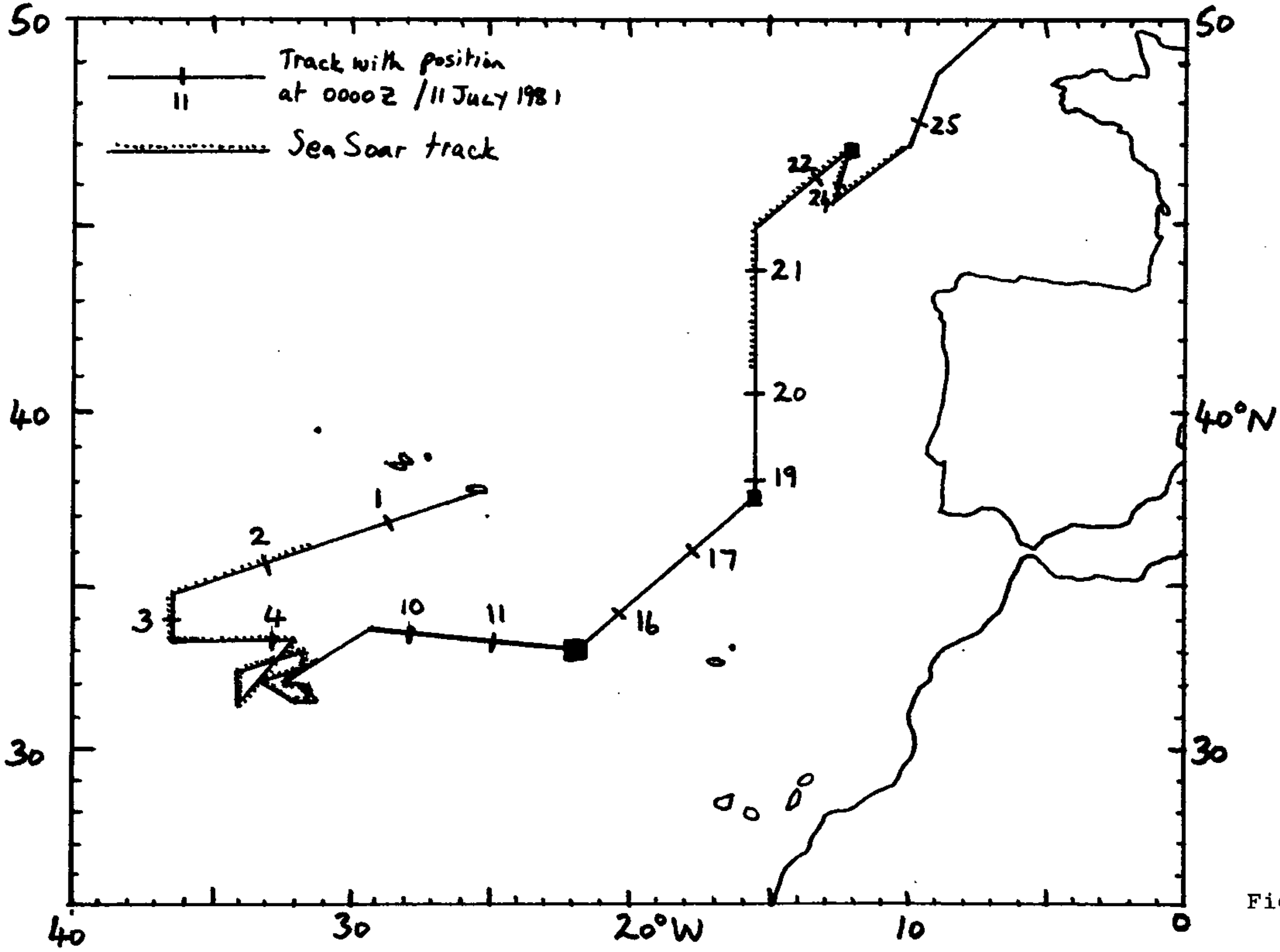

Track with position
at 0000Z /11 July 1981
11
SeaSoar track
50
40
30
40°N
20°W
10
0
1
2
3
4
10
11
16
17
19
20
21
22
24
25

Fig. 1

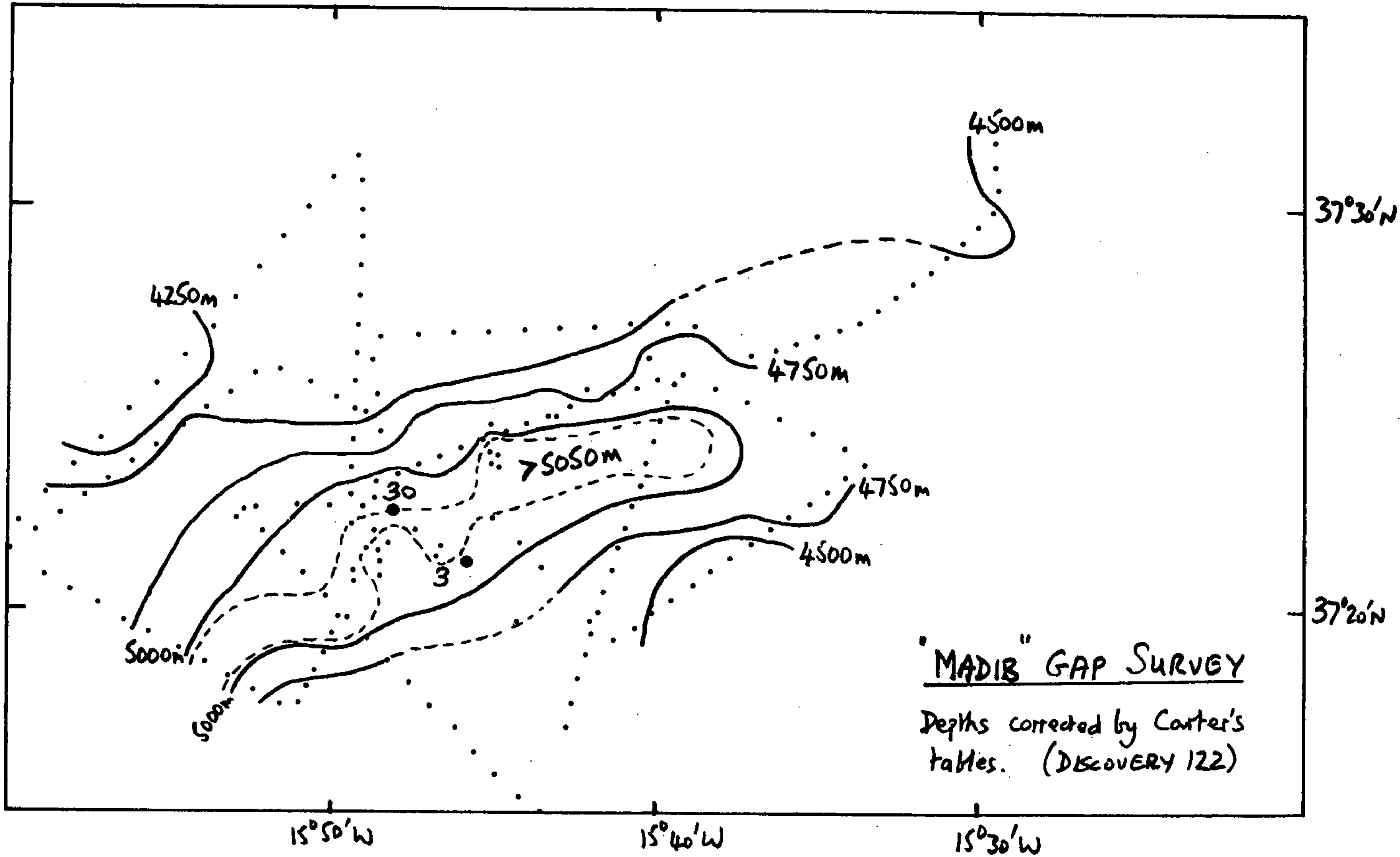

4500m
37°30'N
4250m
4750m
>5050m
30
4750m
3
4500m
5000m
37°20'N
5000m
"MADIB" GAP SURVEY
Depths corrected by Carter's tables. (DISCOVERY 122)
15°50'W
15°40'W
15°30'W

Fig. 2

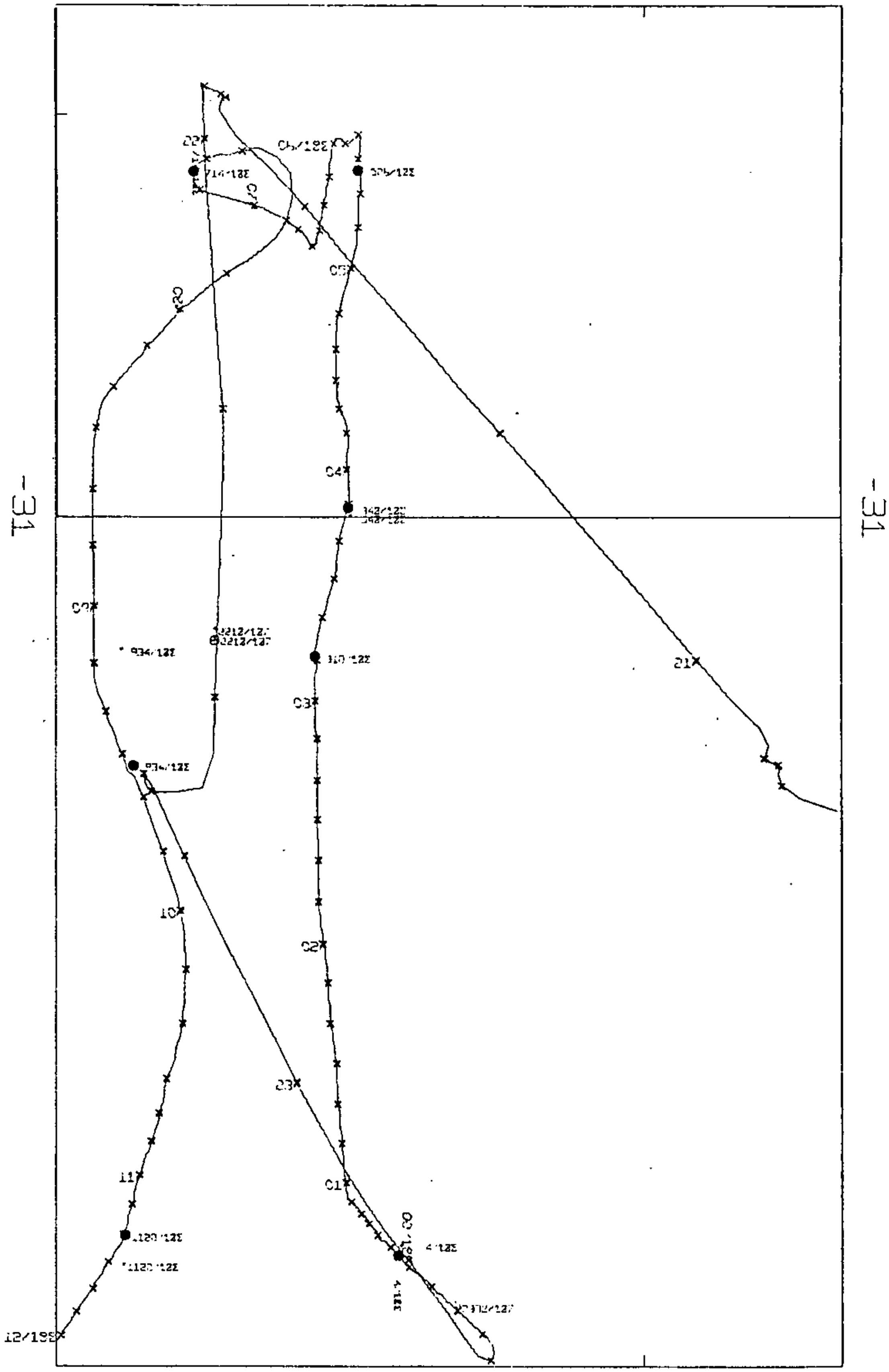
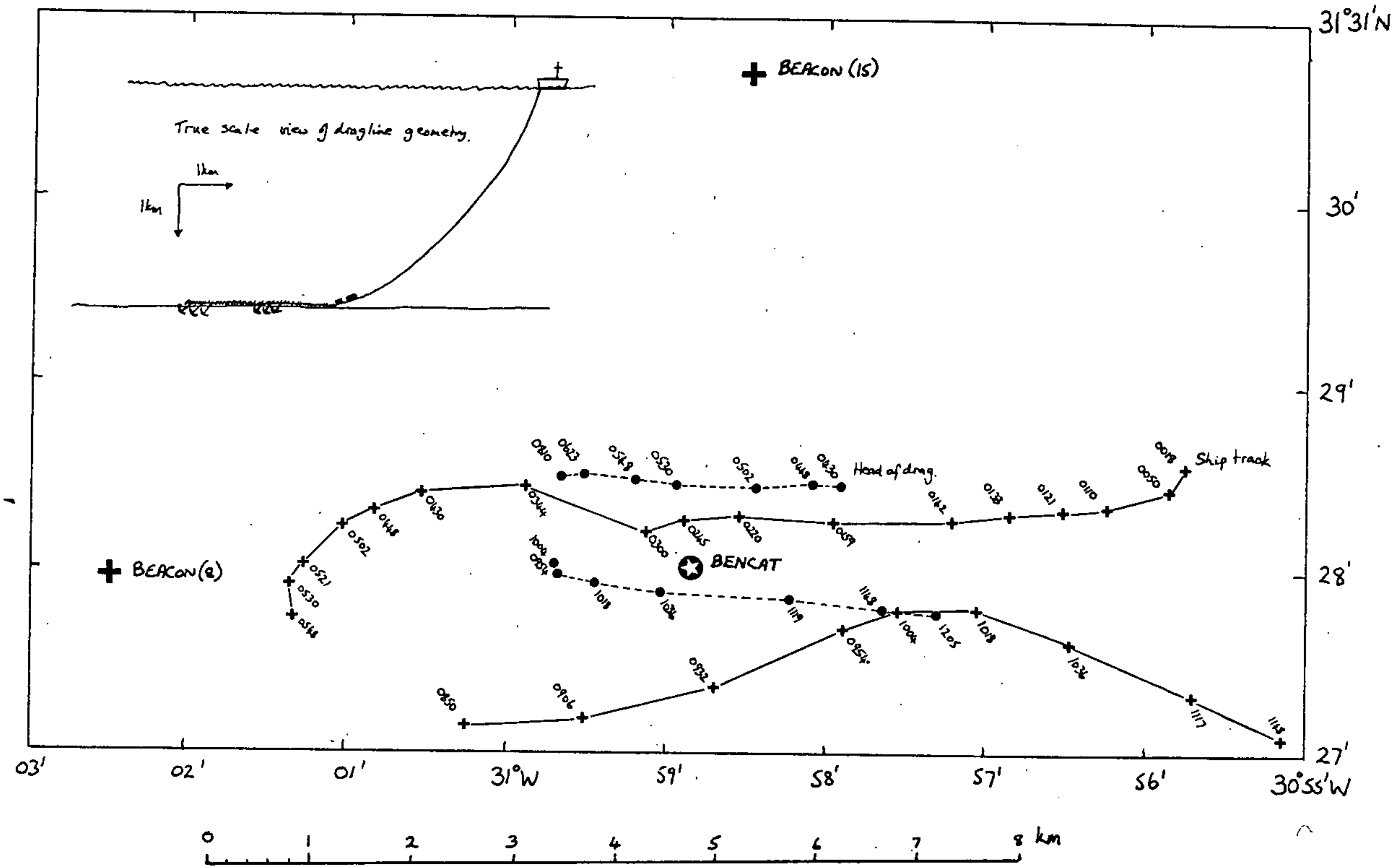
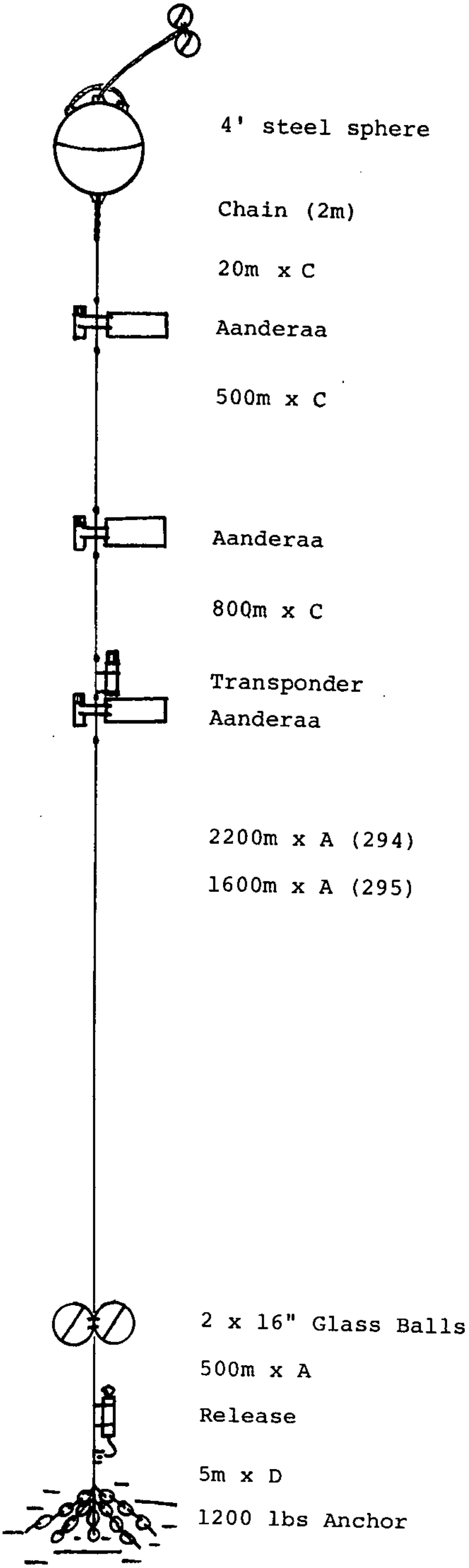


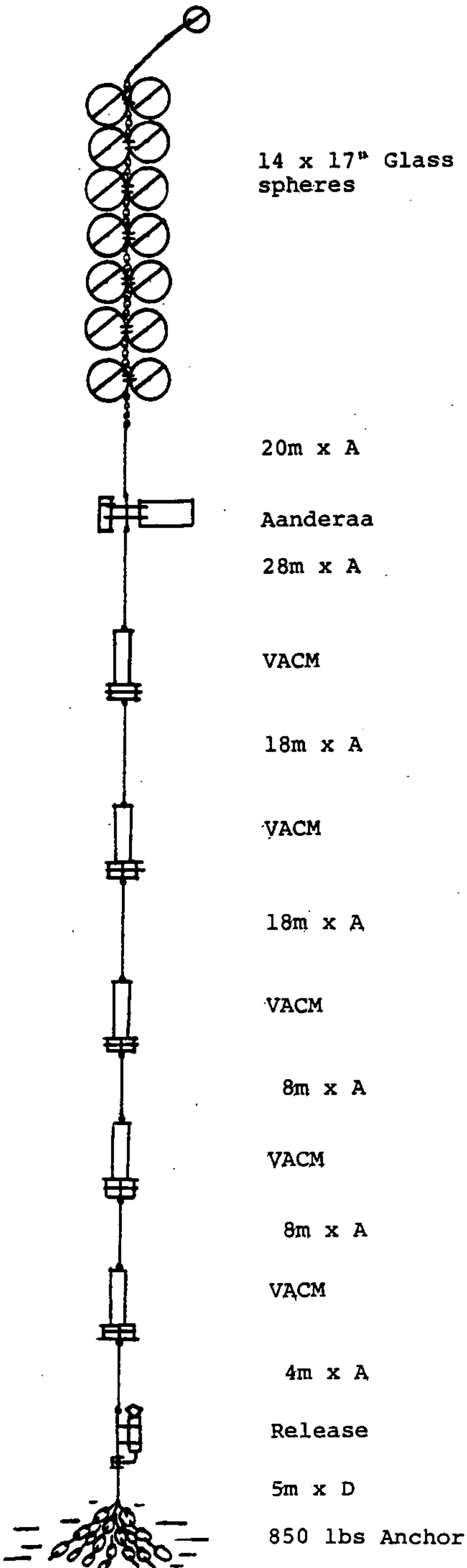
Fig 3

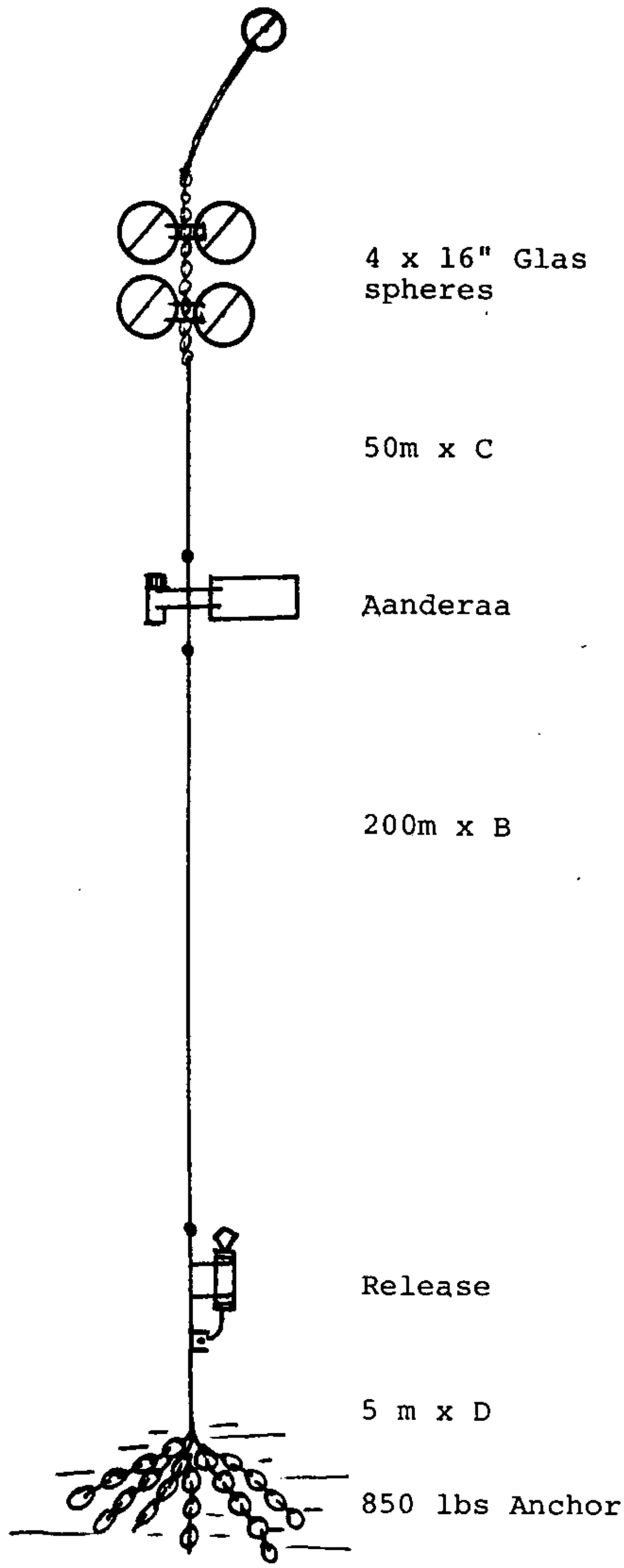


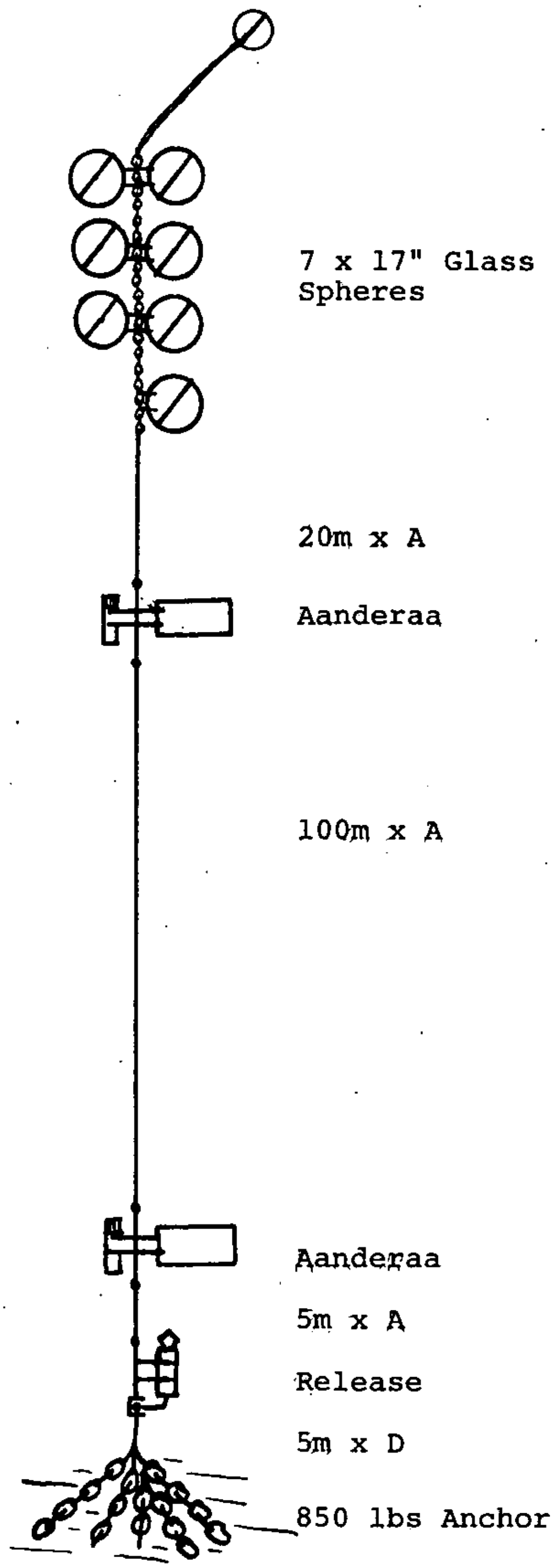
BEACON (15)
True scale view of dragline geometry.
1km
1km
Head of drag.
Ship track
BEACON (8)
BENCAT
31°31'N
30'
29'
28'
27'
03'
02'
01'
31°W
59'
58'
57'
56'
30°55'W
0
1
2
3
4
5
6
7
8
km

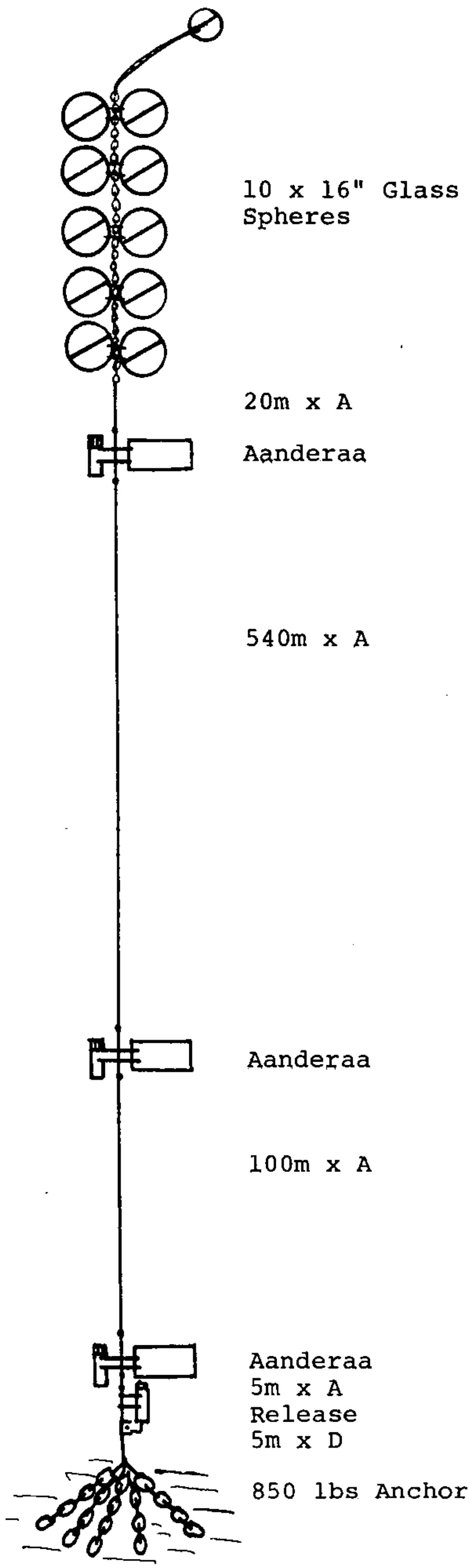
Fig. 4


4' steel sphere
Chain (2m)
20m x C
Aanderaa
500m x C
Aanderaa
800m x C
Transponder
Aanderaa
2200m x A (294)
1600m x A (295)
2 x 16" Glass Balls
500m x A
Release
5m x D
1200 lbs Anchor


14 x 17" Glass
spheres
20m x A
Aanderaa
28m x A
VACM
18m x A
VACM
18m x A
VACM
8m x A
VACM
8m x A
VACM
4m x A
Release
5m x D
850 lbs Anchor


4 x 16" Glas
spheres
50m x C
Aanderaa
200m x B
Release
5 m x D
850 lbs Anchor


7 x 17" Glass
Spheres
20m x A
Aanderaa
100m x A
Aanderaa
5m x A
Release
5m x D
850 lbs Anchor


10 x 16" Glass
Spheres
20m x A
Aanderaa
540m x A
Aanderaa
100m x A
Aanderaa
5m x A
Release
5m x D
850 lbs Anchor