I.O.S.

RRS DISCOVERY

CRUISE 102

10 MAY – 6 JULY 1979

PHYSICAL OCEANOGRAPHIC STUDIES IN THE WESTERN EQUATORIAL INDIAN OCEAN
A CONTRIBUTION TO THE FGGE OCEANOGRAPHIC PROGRAMME

CRUISE REPORT NO 83

1979

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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Institute of Oceanographic Sciences,
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K.M.F.R.L. = Kenya Marine Fisheries Research Laboratory

I.F.M. = Institut fur Meereskunde

N.P.O.L. = Naval Physical and Oceanographic Laboratory

ACKNOWLEDGEMENTS

The work reported here could not have been accomplished without the wholehearted cooperation of the Master (Captain M.A. Harding, Leg 1; Captain J.J. Moran, Leg 2) and crew of the RRS "Discovery". Once again, particular mention must be made of the indispensable contribution to the scientific work by Mr. R. Burt, Netman.

Besides those engaged in the actual work at sea, many others contributed substantially to the success of the cruise. With the ship being in the second half of a long period away from the U.K., and work being planned in the territorial waters of many different countries, problems of supply and diplomatic clearance were more difficult than usual. The efforts of all who had to deal with those problems are gratefully acknowledged.

INTRODUCTION AND OBJECTIVES

"Discovery" Cruise 102 was part of a cooperative study of the development of the Somali Current and its relationship to the equatorial circulation of the western Indian Ocean. This had been identified as being feasible to attempt during the year of the FGGE, with its greatly increased network of meteorological observations. The aims of the oceanographic study, as set out by the Indian Ocean Panel of SCOR Working Group 47 (oceanography in FGGE) were to observe:

1. The development of the structure of the upper layers of the Arabian sea during the advance of the monsoon.

2. The onset of the Somali Current, particularly the evolution and vertical structure of the different inflows and outflows.

3. The variation in time and space of the eddies off East Africa, and the relationship between the regions of upwelling, the eddies, and the main boundary current.

4. The vertical distribution of current through the whole water column along the equator in the western Indian Ocean, with particular emphasis on its zonal and temporal variation in the upper thousand metres.

The specific objectives of "Discovery" cruise 102 were (a) to contribute to mapping the Somali Current and offshore eddies during May and June when the current should be almost fully developed, (b) to examine the vertical structure of the Somali Current and its relationship to the subsurface equatorial jets. Descriptions of the methods of observation and their performance are given in later sections of this report. For plans of related work by other research vessels, refer to reports of the Indian Ocean panel of SCOR WG 47, and of the informal INDEX group coordinated by Nova University, or the relevant FGGE publications.

NARRATIVE

"Discovery" sailed from Port Victoria, Seychelles, a.m. 10 May, having got formal clearance to work in Somali waters only the day before. On passage towards $2^{O}S$, $49^{O}E$, the starting position for a section across the equator, routine logging of surface meteorological sensors and computation of surface currents (from 2 component EM log and gyro, and satellite fixes) were begun. These routine but important observations continued with few interruptions throughout the cruise. In a trial lowering of the CTD plus vector averaging electromagnetic current meter (VAECM) the CTD leaked, and was still behaving erratically when the equatorial section was started a.m. 12 May. As a back-up, casts of 16 water bottles to 2000 m were done at each station in addition to the CTD and VAECM. Station positions are shown on the track charts in Figs. 1 and 2 and are listed separately for each type of observation in Tables 2-5, and 7. Several instrumental problems were encountered, some of which were due to condensation. For that reason, current profiling by acoustic tracking of a sinking float was not attempted at the equator. The simpler alternative of tracking neutrally buoyant floats at fixed depths was adopted. Of six floats launched, only four were tracked successfully and only three recovered. After that, floats were tracked at a few selected stations, mainly at 700 m and 2000 m, the depths of two of the westward maxima found along the equator in April by Dr. J. Luyten (personal communication). Leaving the equator a.m. 15th, the section was continued northwards to 1°N, then north-westward to cut across the boundary current. Satellite-tracked drifting buoys, drogued at 20 m, were launched at 0°30'S and 1°N. XBTs were launched on passage between stations. The first of four current meter moorings was set p.m. 17th near 2°N, 48°E (see table 4 for details of moorings). Continuing northwestwards from that mooring position, stronger surface currents were encountered, reaching a maximum of over 4½ knots some 70 km offshore. This strong current was running towards 060°, distinctly away from the coast, and surface temperature dropped to below 26°C (compared to 29° - 30°C offshore). Near the continental slope, a float at 700 m moved southwestwards at 16 cm/sec, counter to the 4 knot surface current. The section was completed a.m. 20 May with XBTs to within 5 miles of the coast. After a quick run parallel to the coast to 4°N, an XBT section was done along that latitude to 53°E, with a second current meter mooring being set near 50°E a.m. 21st. A length of mooring line broke (a splice pulled out) and the mooring had to be recovered and reset. Relatively weak surface currents, about 1 knot, were found along 4°N; the strong current to the south had turned eastwards. Another section (CTD and VAECM, WB) was started a.m. 22nd, running northwestward from 4°N, 53°E. A tide gauge was laid that evening in a suitable depth on Chain Ridge. Again, surface currents were weak, and the third current meter mooring was set 30 miles northwest of the proposed position, closer to the boundary, in the morning of 25 May. Inshore of that position there was a moderate boundary current, the maximum surface speed being less than 2½ knots. During this section, the doppler shear meter was brought into use. The section was completed a.m. 27 May; A second tide gauge was laid that evening at 7°10'N, 49°49'E, and the fourth current meter mooring was set next morning at 7°18'N, 50°29'E, again somewhat closer to the slope than had been planned. It had been intended to continue out to 7°N, 56°E, but in view of the weak currents encountered so far in this northern region the track was changed to go from the fourth mooring position to 6°N, 52°E and thence south-westwards to 4°S, 44°E. Hourly XBTs were launched. The surface currents differed very little from those encountered on the way north. Arriving at 4°S in the morning of 31 May, a section was worked westwards to the coast. Floats were tracked at five stations. There was a north-going boundary current within 100 km of the coast, with speeds of nearly 2½ knots at the surface, and a subsurface countercurrent of 10-20 cm/sec at 700 m. The section was completed p.m. 4 June and "Discovery" arrived at Mombasa next morning.

During the stay in Mombasa, results and plans were discussed with scientists from the RVs "Researcher" and "Iselin" and from the Kenya Marine Fisheries Laboratory, and the "Researcher" generously replenished our stock of XBT probes. We were also lent a profiling current meter hull.

As a result of the discussions, the section in to Mombasa was not reoccupied on starting the second leg: instead a section off the north Kenya banks was worked, because of its particular interest to the Kenya Marine Fisheries. Leaving Mombasa p.m. 9 June, a quick passage was made up the coast to 2°S and the section started early in the morning of the 10th. The profiling current meter hull, that had been acquired in Mombasa, was fitted with a spare Aanderaa current meter and used for measuring profiles of current on this second leg. The VAECM, which appeared to be working but gave results inconsistent with other observations, was discontinued. This allowed the second CTD sea unit, with an oxygen sensor, to be brought into use, together with the 11-bottle multisampler. Dissolved oxygen, silicate and phosphate were measured routinely on the water samples in addition to salinity.

In the section from 2°S on the continental slope to 3°S, 43°E, currents were similar to those found earlier at 4°S, i.e. a 3 knot boundary current 100 km wide at the surface and a countercurrent of about 20 cm/sec at 700 m. From 3°S, 43°E the section was continued to 2°S, 49°E with stations every 60 miles amd hourly XBTs on passage, then northward to the equator. Surface currents indicated clockwise circulation about a centre near 1°S, 47°E, a distinct change from what had been seen there in the first leg. The equatorial station was occupied 16-17 June; neutrally buoyant floats were tracked, confirming westward flow of about 25 cm/sec. at 220 m and 700 m. The section was continued northward to 1°N, then northwestward, as in Leg 1. Surface currents were appreciably stronger - at $1^{\circ}N$, $49^{\circ}E$ there was already more than 2 knots ENE, and the current increased steadily along the section to more than $6\frac{1}{2}$ knots near $3^{\circ}N$, $47\frac{1}{2}^{\circ}E$. Mooring 272 was recovered without incident on 19 June, and the section was completed p.m. 21st. Under the strongest part of the surface current, flow was found in the same direction at both 700 m and 2000 m. As in Leg 1, the surface current had a strong offshore component and there was evidence of upwelling (lower surface temperatures, higher near-surface nutrients). Running northeastwards then in approximately 200 m depth, the surface temperature dropped below $22^{\circ}C$, and continued low ($< 24^{\circ}C$) along latitude $4^{\circ}N$ where the XBT section was repeated. The second current meter mooring was recovered on 22 June in a $4\frac{1}{2}$ knot eastward surface current. That evening, a sharp front was crossed, where the surface temperature increased by over 4 deg. C. and the surface current changed from approximately 4 knots eastwards to over 2 kts to the northwest. The tide gauge on Chain Ridge was recovered a.m. 23rd. A short diversion was then made towards the southwest to locate the front again, before turning northward to start the next CTD/PCM section at $4^{\circ}45'N$, $51^{\circ}45'E$. That section, running northwestwards to the continental slope, was occupied 24-27 June. Surface currents were predominantly northwestward, i.e. a distinct inshore component, but the strongest current was less than 4 knots. The section appeared to be in southern part of a clockwise eddy of surface water of Arabian Sea origin that had grown there since May, with little evidence for a continuous boundary current along the Somali coast. Neutrally buoyant floats were tracked at three stations; again the inshore ones at 700 m suggested a deep countercurrent. The third current meter mooring was recovered 25 June. The plan was then to run parallel to the continental slope as far as $7^{\circ}20'N$ and occupy sections eastward to $52^{\circ}E$, then northeast to $9^{\circ}N$, $53^{\circ}E$, thence northwestwards towards Ras Hafun, but the last part of this plan had to be abandoned. The second tide gauge, in 525 m depth near $7^{\circ}10'N$, $49^{\circ}49'E$, was recovered p.m. 27 June, and a third FGGE buoy (designed to measure and telemeter wave statistics) was launched that evening. The wind had increased to over 30 knots and corresponding sea, which made station work more difficult. The last mooring was recovered p.m. 28th. On arriving at $9^{\circ}N$, $53^{\circ}E$ p.m. 30 June, floats were launched for 700 m and 2000 m, and a PCM/CTD station occupied, but after a second pair of float fixes it was considered advisable to heave to. The surface current was 3 knots eastward, increasing to 5 kts (according to the FGGE wave buoy trajectory) to the northwest of our position. To continue the proposed section would have meant stemming the 5 knot current, on a course almost at right angles to the wind, with the ship in a fairly light condition. Instead, slow progress was made southwards, then westwards, with XBTs at approximately 10 mile intervals. On arriving in quieter conditions in 700 m depth near 9°N in the evening of 3 July, course was set to pass close by Ras Hafun. There was strong evidence of upwelling near 10°N, with surface temperatures near 18°C and high surface nutrients. Underway observations were stopped after passing C. Guardafui, a.m. 4 July. During passage across the Gulf of Aden, in the evening of 5 July near 11°58'N, 45°20'E, the ship passed through a dense patch of red tide at least 5 miles wide. Cruise 102 ended on arriving at Djibouti at 0700 GMT on 6 July.

NOTES ON EQUIPMENT AND OBSERVATIONS:

HYDROGRAPHIC OBSERVATIONS

Introduction

The following physical and chemical properties of the Water Column - temperature, salinity and the concentration of oxygen, phosphate and silicate - were measured to a depth of 2000 m on 34 stations of leg 1 and on 38 stations on leg 2. (See the attached station lists). On each station of leg 1 bottle casts were made on a 4 mm wire separate from the lowering of a Neil Brown CTD on its 7 mm wire; thus samples were drawn distinct from detailed pressure-temperature-conductivity measurements. On each station of Leg 2 a single lowering of a CTD and General Oceanics multisampler combined both sets of observations. This strategy was dictated by the following circumstances.

On the first leg the CTD (unit 1) consisted of a standard unit interfaced with an IOS built vector averaging current meter (VAECM) with all of the data entering the CTD deck unit and HP 2100 logging system. On several of the initial stations deterioration or loss of data was encountered - so bottle casts were made both as back-up for the physical measurements and also to provide chemical samples. The CTD difficulties were traced to condensation of water vapour in the lowered unit when subject to low temperatures at the bottom of the cast. Once the problem was solved we decided to continue the separate bottle/CTD lowerings in order to preserve homogeneity of the data set.

At the outset of the second leg we abandoned the use of the VAECM because the current measurements appeared to be corrupted by a vertical motion (heaving) of the wire. A second CTD unit, equipped with a Beckman oxygen probe was combined with a multisampler unit on the 7 mm wire. On this leg the detailed temperature-conductivity measurements and samples for salinity and chemistry were made on the same lowering.

CTD and Hewlett Packard 2100: Leg 1

On station 10014 the first lowering of the CTD - unit one - was terminated with data failure and slight flooding of the instrument due to a leakage past an O-ring behind the pressure sensor: the sensor was reseated and the pressure card in the electronics unit replaced. As a consequence the calibration of the pressure sensor had to be determined against reversing thermometers on this leg. Generally two bottles with reversing thermometers were employed per cast - one at the top, one at the bottom. A second lowering on the first station and subsequent lowerings to station 10019 were all affected by persistent condensation within the unit when lowered to 2000 m where the temperature was 2.6°C (Lab temperatures were 28-31°C at this time). The CTD problems were manifest as loss or deterioration of data generally on the recovery and especially from the pressure sensor. Eventually a prolonged drying out of the electronics, thorough purging of the assembled instrument with freon and the liberal use of desiccant all conducted within the air conditioned clean room brought the problem under control. Stations 10021 - 10054 were accomplished without further servicing of the lowered unit. Our difficulties were compounded at this time by the absence or erratic presence of air conditioning in the electronics lab., the CTD deck unit also failed when very high temperatures were encountered. When moved into the air conditioned clean room it functioned with only minor problems for the remainder of the cruise.

The Hewlett Packard 2100 computer acquired CTD data employing entirely new software which had been supplied by the Woods Hole Oceanographic Institution and adapted for IOS use by Dr. D. Webb (Wormley). All of the logging, plotting and listing programs functioned excellently. One of the tape units was unserviceable for most of the leg until an investigation by J, Sherwood (RVS, Barry) revealed a dry joint/intermittent connection on the capstan motor amplifier board. On several of the mid-leg stations the HP 2100 halted when logging CTD data. This was traced to a mains voltage loss in the laboratory area (~ 20 volts) resulting from the start up of a 400 cycle generator in the asdic trunk. After investigation the remedy adopted was to turn on the generator only when the HP 2100 was not logging data.

CTD and Hewlett Packard 2100: Leg 2

On the second leg of the cruise we employed CTD unit 2 equipped with a Beckman in-situ oxygen sensor and our ancient multisampler unit with a new control unit; both instruments performed for 38 stations without electronic fault. Ten bottles were available on the multisampler (four with thermometer frames) but a further bottle clamped to the CTD wire above the instrument and a second lowered to 10 m on a separate midships wire brought the number of samples to 12 per lowering. Prior to both stations 10061 and 10062 difficulties were encountered with the oxygen sensor: unscrewing its protective cover simultaneously unscrewed the sensor from the CTD housing. This led to loss of silicone oil surrounding the sensor. The oil and an O-ring seal were replaced before each station; after the second occurrence no further problems were encountered. A series of stations 10074-10078 were made in strong currents, 3.5 to 5.5 kt, and the messenger did not trip the 2000 m bottle.

The HP 2100 performed extremely reliably throughout the leg, logging CTD data and decoding tapes from Aanderaa current meters, both the current profile measurements made on each station and the data recovered from moorings 272-275. Because of a computer fault on station 10063 the CTD was recorded on the Revox tape recorder and after repair logged by the HP 2100. The fault on the HP 2100 was a failure of the preset clear function which was rapidly traced by Mr. P.Hartland (RVS, Barry) to a dry joint on board A2.

The stability of all the sensors on this leg appears, from preliminary analysis, remarkably good and high quality data is anticipated.

P.M. Saunders

Chemistry

In leg 1, dissolved oxygen was measured on water samples from each shallow cast, usually 10 samples from surface to 900 m, and at most stations samples for phosphate and silicate measurement were drawn from the shallowest three bottles, usually 10,100 and 200 m. These latter samples were kept cool (not frozen) until leg 2. Approximately 300 oxygen analyses were done.

In leg 2, phosphate, silicate and dissolved oxygen were measured using the methods from "A practical handbook of seawater analysis" by Strickland and Parsons and the conventional Winkler method recommended by Carritt and Carpenter. Approximately 400 samples (38 stations, 10 - 12 samples/station) were taken.

D.T. Pugh (Leg 1)

M.J.McCartney (Leg 2)

Measurement of Salinity

The GUILDLINE salinometer was used on both legs 1 and 2 of cruise 102. In view of the high lab. temperatures the salinometer had to be run at high thermostat values of 27^{o} or 30^{o}C. The salinometer generally worked well but there were some occasional problems. My standard method of operation is to fill the cell once with the new sample, flush this out, refill, wait about 10 seconds for a steady reading and then read. The sample is again flushed out and the cell refilled and the digital display is read a second time. If the two readings are within about 10 digits (circa .002$^{o}/_{oo}$) I then proceed to the next sample.

The problem that occasionally occurred was that the first read was usually a "correct" value but the second read was about 100 to 150 digits higher, continually refilling and rereading would usually result in getting back to the "correct" (and always lower) value. I say "correct" on the evidence of the duplicate sample which gave no trouble. This fault could occur on one of the pair of duplicate samples sometimes the first sample of a pair, sometimes the second sample of a pair. The evidence is that the first reading is the correct reading, it is always lower than subsequent readings i.e. "wrong" readings are always high. The fault seems irrespective of whether the previous sample was a higher or lower salinity.

A second fault which may be connected with the above also involves high "wrong" values. In this fault the digital value cycles between a high "wrong" value and a lower "correct" value. The high wrong value can be quite stable and perhaps about to be written down as a correct value when the cycling starts. There may be 4 or 5 cycles of high to low to high values. The final "correct" value can be seen well before the cycling is finished and the reading stabilised. Once it has stabilised on the low number it will stay there even though it took perhaps four or five cycles to get there.

In both the above faults "wrong" numbers were always high.

As mentioned above lab temperatures were always high 26^{o} to 30^{o} (above 30^{o} occasionally but the salinometer was not used then) the final box of samples was done at a lab temperature of 24^{o} with thermostat at 30^{o}. In this case there were no problems so that the above faults may be due to high ambient temperatures.

J.A. Moorey

Expendable bathythermograph Observations (XBT)

Sippican T-7 (750 m) expendable bathythermograph probes were launched, using a hand-held launcher, between station positions on sections and at hourly intervals on passage in the Somali Current region. A bucket sample was taken at each XBT position, for surface temperature and salinity. A total of about 50 probes failed, for various reasons: wire fouling ship (this could nearly always be avoided) wire breaking in strong shear at thermocline (this occurred only under the strongest surface currents), inadequate earthing of recorder. Several losses were unexplained. Parts of some records were lost due to bad paper feed in the recorder.

Isotherms (depth of every whole degree) were read off each record and a running plot maintained, and selected temperatures and depths were transmitted as radio bathy messages. We were fortunate in acquiring 120 probes from "Researcher" in Mombasa, all of which were used in Leg 2. XBT times, positions and some temperature data are listed in Table 9 below.

J.C. Swallow

CURRENT MEASUREMENTS:

Introduction

The current measuring techniques available on this cruise can be divided into four methods giving currents at fixed depths and four profiling methods. In the first group, surface currents were derived throughout the cruise routinely from satellite fixes and dead reckoning (Table 10), and two satellite-tracked surface drifters, drogued at 20 m, were launched early in the cruise. (A third one, designed to measure waves and not fitted with a drogue, was launched later but worked for only 22 days). Below the surface, measurements were concentrated near the expected levels of maxima of westward subsurface equatorial flow (200 m, 700 m, 2000 m). Four moorings were set during the first leg, each with 3 or 4 current meters, and recovered in the second (Table 4). Neutrally buoyant floats were tracked for short periods (5 to 35 hours, average 11) at selected stations on each section (Table 5).

A current profiling method based on tracking a sinking or rising sound source relative to two bottom transponders had been tried on earlier cruises, but was not used this time. Its vertical resolution was inadequate, especially near the surface where much of the shear occurs in equatorial regions, and some early problems in the cruise with poor acoustic ranges from near-surface floats made it seem more profitable to concentrate the float work on fixed levels.

Two new methods of getting current profiles (at least, new to us) were used. A vector averaging electromagnetic current meter could be lowered along with one of the CTD sea units, and a profile of current relative to the ship obtained by holding the instrument package for a few minuts at each of a series of chosen depths. As will be seen from the detailed notes below, despite overcoming several instrumental problems we could not get results with this system that were consistent with other observations (e.g. floats) at depths of 200 m or more. The other new profiling system, a Doppler sonar method, was still being developed in the early part of the cruise and was brought into successful operation towards the end of the first leg.

A profiling current meter hull, designed at the University of Miami, was acquired in Mombasa and, fitted with a spare Aanderaa current meter, was used routinely on stations during the second leg, instead of the VAECM. We had the Kelvin-Hughes direct-reading current meters (DRCM) on board, that had been used for profiling in the 1963-4 Indian Ocean cruises. They were used intermittently for intercomparison with the VAECM, but being limited by cable (and often by leaking plugs) to no more than 200 m depth and inconvenient to use with the CTD package they were not used routinely.

J.C. Swallow

Surface Currents

Surface currents have been derived from the satellite fixes and the computed D.R. positions based on the E.M. Log during the whole time of the cruise. On average fixes were available every hour for a period of 6 hrs., followed by a gap of 5 hrs., which limited the time resolution somewhat.

In general only small scatter in the estimated currents was found when the ship was hove to or steaming slowly on station positions. The currents derived when the ship was steaming are very consistent with the ones on the stations, thus, the errors induced by errors in gyro, and log calibration appear to be relatively small. The only exception was during the period from 15 May 0300 to 18 May 0634, when the gyro had slipped by up to 17°, which led to large errors during times of steaming. However, these errors could be corrected later and new surface currents have been estimated for that period.

Table 10 gives the estimated surface currents for approximately equally spaced positions. When more than one satellite fix was available at the same geographical location, the estimated currents have been vector averaged. Some of these current vectors are plotted in Figs. 3 and 4. They show quite a consistent pattern, especially in areas of high current speed.

D.R. Quadfasel

Doppler Sonar Measurements

Some measurements have been made in an attempt to observe the velocity structure of the top 400 m of the ocean by an acoustic doppler scattering technique.

Four transducers were mounted on the back of the side-scan sonar plates in the stablised "SONAR" pod, disposed as an orthogonal set, at 45^{o} to the ship's head, with each transducer being depressed 45^{o} from the horizontal. These transducers operated around 75 khz., each driven with approximately 100 W of electrical power for transmission periods of either 100 or 50 msec. The signals that were returned from objects in the water by backscattering were heterodyned into the frequency range 0-250 Hz, digitally sampled, and the first 500 msec. after transmission digitally stored.

This data was then operated upon by a Fast Fourier Transform processor in either 50 or 100 msec. sections and the resulting spectra (each of which describes the doppler shift of the signal returned from a particular layer of water) were returned to the main processer. In this way it was possible to accumulate the spectra (by addition, frequency by frequency) to obtain averaged spectra for each layer and beam for typically 64, 128 or 256 transmissions. During 4-channel operation the diagonal pairs of transducers would be fired together, at two different frequencies, alternating with the other diagonal pair using the same two frequencies. In this way the cycle time, including processing, would be about 5 secs. for two double transmissions.

On the first leg there were many equipment problems, and some last minute jobs turned out to be quite lengthy. Consequently it was not until station 10031 that any data was taken. From then, until the end of the leg, measurements were made on station with either one or two channels of electronics, switching transducers to obtain two dimensional horizontal data. On the second leg all four channels operated from station 10058 onwards.

Even from the earlier data it could be seen that the acoustic calculations had been about correct, with data obtained to depths of about 450 m. The averaged spectra were however considerably broader than had been hoped, and straightforward interpretation into water velocities was not possible. The major reason for this broadening is thought to be the motion of the ship with respect to the water; both short term motion which would be expected to broaden the spectra but to average to zero (i.e. roll pitch) and also longer term (~ 5 to 15 mins) which it is suspected are not accounted for sufficiently accurately in the ship's navigation for good correction to be made. Whatever the reasons, the most self consistent data was taken with the ship lying-to, and the worst on a CTD station, where there is significant ship motion to maintain wire angle.

Another cause of disagreement of this data and other current measurements is perhaps the over-large depth cells. In conditions where strong shear was observed, this could cause very large variations of velocity and doppler shift over a cell, and it is uncertain how the technique will have responded.

Note on "Asdic"

Throughout the cruise the hydraulic system for roll stabilisation and azimuth control has leaked hydraulic oil. During periods when it has been standing idle it has also accumulated sea water, presumably through the same leak. It is also suspected of having a sticky azimuth control valve and mainly for this reason the pod was never deployed below the ship.

It is unlikely that this had adversely affected the acoustic performance on quiet weather stations, but it has meant that the transducer environment has been noisy when the ship has been pitching, or steaming at more than 2 or 3 knots. The lack of azimuth stabilisation has probably had little effect on the good results (for instance lying to, the head varied about $\pm 3^{\circ}$) but perhaps would have helped on wire-out stations where the bow-thruster has been used.

T.R. Crocker

Vector Averaging Electromagnetic Current Meter (VAECM)

One of the IOS designed VAECM units was modified to interface with the Neil Brown CTD unit and was used on most stations during the first leg.

The current meter was clamped to a bar hung via strops between the base of the CTD frame and a stream-lined weight. The outputs from the VAECM are the North and East components, each averaged over 3 3/4 minutes with offset zero to avoid negative numbers; these 5 digit numbers became the fourth and fifth data words in the serial bit stream from the CTD unit via the armoured conducting cable to the deck unit. The CTD lowering was stopped for each current measurement, generally two readings being recorded manually from the deck unit at each depth.

It is fairly difficult to check the speed and direction sensors or the vector averaging process before deployment and intercomparisons with other methods were undertaken. Initially considerable problems were experienced with condensation affecting gyro stability, becoming particularly apparent at depths below 300 m, and the unit had to be assembled and purged in the C.T. laboratory. Then the instrument checked well at shallow depths against the ships E/M log, with the

Kelvin Hughes DRCM and with a lowered Aanderaa current meter. However, beyond a depth of 150 m it was not possible to get the VAECM to agree with any other methods; in particular floats at 700 m on several stations and especially at 200 metres on two occasions gave much lower speeds than the VAECM which in this area could not be accounted for in the different averaging times of the methods. The speed components measured relative to the instrument are the vector combination of the actual ocean current, the movement of the instrument relative to this ship and the movement of the ship over the ground. The course corrected navigation gave the course and speed made good over the ground for the ship and this frequently large and, in two minute values often noisy, vector was subtracted; but the motion of the instrument relative to the ship could not be allowed for andintroduces error. For example, if the wire angle changes through 10^{o} over the 3 3/4 minute measurement period whilst the instrument is at 100 m depth the error amounts to just less than 8 cms/sec; in regions of high surface current this error may be tolerated, but being proportional to depth the error increases to 50 cms/sec at 700 metres where the currents are much lower than at the surface. A 10^{o} wire angle change may seem excessive, but on a CTD cast where the ship is being driven to keep the wire angle vertical at the surface and where there is large shear, the positional behaviour of the instrument package is uncertain. However, some indication is given by the pressure changes recorded by the CTD, though there is no knowledge of direction of movement to go with it. A 10 kHz transponder was fitted to the package to attempt acoustic positioning but beyond about 100 m depth this was too insensitive with the range resolution available and the restricted base line lengths on the ship. The form of the wire is probably steadier when deliberately towed by the ship as was done with the PCM on the second leg, but it was not possible to inflict this on the CTD.

A further possible source of error may be wave induced ship motion which raises and lowers the instrument. With typically a 1 m amplitude and 6 seconds period the peak vertical velocities at the current meter would be around 100 cms/sec; the resultant angles of attack of the flow on the sensor would be between $\pm 45^{o}$ from the horizontal in the near surface region increasing to between $\pm 80^{o}$ in weaker deeper currents, assuming the ship is not towing the instrument. The open coil sensor head is designed to accept such angles of attack without stalling but the effect of the proximity of the bulky pressure case is unknown and may be deleterious, and perhaps non-linear in giving a wake disturbance to the sensor on the upward half cycle only.

Many of the near surface profiles in the mixed layer showed some evidence for an Ekman spiral, but the disappointing agreement with other techniques at deeper levels, coupled with the availability of a PCM and the desire to use the alternative CTD fitted with an oxygen sensor caused the abandonment of the method and it was not used at all on the second leg.

B.S. McCartney

FGGE Buoys

Three buoys were launched to be tracked by the TIROS satellite system which also had the ARGOS capability of relaying modest amounts of data.

Two buoys were the standard semi-spar type and included barometric pressure, sea temperature and internal temperature sensors. Modifications by I.O.S. allowed the addition of a drogue loss sensor at the expense of battery voltage sensing. On these two buoys a "Window blind" style drogue of size 3 m square was fitted to have a drag centre at 20 m depth and, being heavy, held the buoy hull lower in the water. The drogue loss sensor is an underwater pressure sensor able to detect the change in flotation level should the drogue fall off. Because of buoy motions and dynamic pressures the signal from the loss sensor is noisy and must be averaged over several transmissions before concluding that the drogue has separated. The third buoy was designed to follow wave motions so that an internal, gimballed accelerometer sensor connected to a wave statistics processor could reduce the heave signals from a 20 minute period every two hours into four 8 bit data words. These data words giving maximum crest, minimum trough, numbers of zeros and crests are transmitted in addition to the standard FGGE barometric pressure, sea and internal temperatures and battery voltage data. The hull form is essentially a 1.2 m diameter discus with a cylindrical battery canister below and the aerial frustum above. Ballast was provided by 220 lbs of chain hung on a non-abrasive strop. In the event of overturning the weight should provide a self-righting moment to the buoy via the strop. Some difficulty was experienced with the timing system in the processor but after modifications the buoy was launched with all sensors operational.

For all the buoys the barometers were calibrated against the ship barometer for several days before launch and for several hours after launch until radio contact was lost. The buoy aerial is designed to radiate to the satellite and not along the sea surface and the primitive ship aerial was not ideally sited, so the variable limit ranges (of 25, 5 and 15 miles approximately) are not too surprising.

Information on the positions of the buoys as determined by ARGOS, and communicated over telex to IOS at Wormley, were forwarded by Dr. P.G. Collar every few days to the ship by radiotelegram. These were plotted onboard adding useful spatial coverage to the currents being determined by other means at the ship position.

FGGE Buoy Deployments

No.	Date/Day	Time GMT	Latitude	Longitude	Barometer mb	Sea Temp ^{o}C
1C2CC	May 13/133	0357	$0^{o}31'.92$ S	$48^{o}59'.95$ E	1010.6	29.5
1C326	May 15/135	1558	$0^{o}59'.49$ N	$49^{o}00'.02$ E	1010.3	29.9
1C380	June 27/178	1616	$7^{o}19'.51$ N	$50^{o}00'.37$ E	1008.0	26.9

B.S. McCartney

Profiling Current Meter

During the second leg of the cruise 55 profiles of temperature and current speed and direction have been obtained from a profiling current meter, given to us on loan from the University of Miami during the mid-cruise stop in Mombasa.

It consists of a 6ft long, 1ft diameter plastic tube with glass balls attached inside. An Aanderaa current meter with its rotor pointing downwards at right angles to the tube axis, is mounted in the centre of the tube. On one end of the tube a roller is attached which is slipped over the hydrographic wire and allows the whole device to slide freely down the wire. The complete instrument is slightly negatively buoyant and the idea of operation is, that it sinks slowly down the wire without being influenced by the vertical motion of the ship and the wire. When keeping a relatively constant wire angle of 15^{o}, the instrument was trimmed to have a sinking speed of approximately 15 cm/sec. The sampling rate of the Aanderaa current meter which was additionally equipped with a pressure (o-1000 psi) and a temperature sensor (fast response thermistor from profile No. 35) was set to 30 sec, thus giving a vertical resolution of 4-5 m. In Table 7 the positions and times of the profiles are summarised. Most of them go down to 700 m, giving about 150 data points during one 1½ hr profile.

On some stations repeated profiles have been taken, as a test of their reproducibility.

D.R. Quadfasel

Current Meter Moorings

Four subsurface moorings were set during leg 1 and recovered in the same sequence in leg 2, each mooring being in position for approximately 1 month. Dates, positions and nominal depths of instruments are listed in Table 4. The moorings were designed to have the shallowest current meter at 200 m, with subsurface buoyancy (a4 ft. diam. steel sphere) 10 m above that. The upper 1300 m of mooring (1500 m of nominal depth) was made of 8 mm wire; below that 10 mm of 8-plait line was used in nominal 500 m lengths (actual stretched length 560 m), the lowest length being cut to suit the water depth. Moorings were set buoy first. In setting mooring 273, the subsurface float did not submerge - a splice had pulled out of the last full length of plaited line (a manufacturer's splice), resulting in loss of the acoustic release and anchor. On subsequent moorings, a pair of glass spheres were attached above the release as back-up buoyancy.

The rotor on the shallowest current meter of mooring 272 was broken when recovered, and on mooring 273 the shallowest current meter rotor was missing. No other mechanical mishaps were noticed, nor any evidence of excessive corrosion.

Float Tracking System

The original tracking system was used because the EPC recorder around which the new receiver is built was not delivered in time to be freighted out to Cape Town. Twelve Mk I floats were available, six fitted with electromagnetic releases and six with standard 'pyro' releases. Pressure telemetering circuitry was available on two floats. All float positioning was done by running fixes using the towed interrogator fish. Two floats were lost when they switched but did not release, one failed to switch, one went out of range, and two at the end were lost because weather prevented the ship from getting back to their positions.

An experimental system based on the RCA 1802 Cosmac microprocessor was tested for digitising arrival times of transponder pulses in up to ten channels. Results obtained were satisfactory and encourage further development of the method.

B.S. McCartney

TIDE GAUGES

Two Mk IV tide gauges were deployed during leg 1, and recovered in leg 2, one in deep water at the southern end of Chain Ridge, the other on the continental slope off Somalia near 7^{O}N. Times, positions and depths are given in Table 4.

The deep water gauge gave 31 days of useful data from 3 pressure and 2 temperature sensors; the shallow gauge was released 4 days later and gave 30 + days of usable data from 1 temperature and 3 pressure sensors. On both loggers an integration period of 3 3/4 minutes per data block was used. Further information can be obtained from Dr. D.T. Pugh, IOS Bidston.

B.A. Hughes

COMPUTING

LEG 1: COMPUTER EQUIPMENT REPORT

The following have given trouble:-

Computer Room D5200:

Intermittent fault on line buffer card. This was due to a poor connection between a minibus strip and an I.C. pin. Fixed by adding a piece of wire. Intermittent memory corruption seemed to originate from the mains supply, and is greatly reduced if the sockets to the left of the voyager unit are used.

1627 Plotter:

As on previous cruises the swap box appeared to cause the plotter to lose drum increments. This fault became so bad after a few minutes use that the plotter could not be used when switched to the IBM 1800. The cause seemed to be mains ripple on the drum signal lines, being present at the plotter end of the cable, but not at the swap box. Running the mains via a separate lead did not improve matters. The problem was reduced by stepping up the voltage on the auto transformer. Finally the transformer was by-passed and the supply was taken from the IBM 1800.

PROGRAMS

The following have been amended:

- ONAV1 - Correct status setting and use
- WRFIX - Remove bridge O/P
- CCLOK - Read internal clock also
- NAVL3 - Remove bridge O/P
- HYDR2 - Call HYDR5

The following are new programs

- CURFL - list CURF
- PRATE - Change fresh print-out rate
- TE611 - 611 tests

ZIGZA - 1627 Test

SALIN - Hydrographic

CONRA - "

HYDR5 - "

MATAB - Produce 1500m/s Matthews tables

J. Sherwood

LEG 2: COMPUTER ENGINEERING REPORT

Satellite Navigation:-

Installation of the new antenna at Mombasa greatly improved the reception of both Doppler channels. A fault exists in the old antenna which only allows single channel (150 MHz.) fixes.

Fix accuracy using this antenna is bad due to the lack of refraction correction which requires both 150 and 400 MHz. channels.

Residual errors in fix calculations have been masked by the very large currents, but a quality appraisal based on frequency drift, RMS error, elevation of iterations and good doppler counts, would indicate that fix accuracy was within specification.

The bridge SAT-NAV failed completely for 12 hours due to a short circuit power diode in the computer power supply pre-regulator unit. A cooling fan had seized within the computer possibly precipitating the above fault. While the repair was carried out the IBM 1800 SAT-NAV was used, but very few good fixes were obtained.

IBM 1800 System:-

This was operated successfully for the whole of leg 2. Over one hundred track charts and profiles of data were plotted and two minute listing of navigation and met data listed.

Each morning the previous day satellite fixes were edited and if necessary the status down graded and the navigation re-run. A bad disk address caused the sampling to stop. The operations monitor alarm must then have been cancelled without subsequent action hence causing about 1.5 hours down time, luckily this was near the end of the cruise.

A large amount of time was spent adjusting the system printers which gave persistent trouble at the beginning of the cruise. Re-loads and subsequent 2 min data loss were caused by faults on the 1816 console printer and a bug in the system software, which saves to disk the same data buffer twice during a re-load.

Air Conditioners:-

The Voyager units can just provide enough cooling power if all unnecessary equipment is turned off. Fortunately an open circuit in the stator of the fan motor windings was repairable but there is a very good case for providing new air conditioners, especially so due to their age, difficult serviceability and the fact that spares are no longer available.

P.R. Hartland

METEOROLOGICAL INSTRUMENTS

Wet and Dry Thermometers:-

The Port and Starboard bridge screen thermometers have been compared (almost) daily with the 1053 Readout of the Monkey Island sensors. Small variations exist (a) between bridge screen values and the 1053 readout, (b) between similar sensors mounted on either side of the ship.

Example of a good agreement: Day 181 1336 hrs.

	Port dry	Port wet	dry-wet	Stbd dry	Stbd wet	dry-wet
Bridge screen	26.5	24.1	2.4	26.6	24.9	1.7
1053 Readout	26.5		2.6	26.7		1.7

Example of bad agreement: Day 165 1448 hrs.

Bridge screen	27.7	24.8	2.9	27.8	25.0	3.8
1053 Readout	26.5		1.5	26.1		0.7

Barometer:-

About one year ago and previously to that the bridge barometer and the 1053 readout agreed to ± 0.1 mb. In Jan. 1979 whilst "Discovery" was in Cape Town there was a recalibration of bridge barometer (by the local met. office?) which gave a correction of -0.7 mb. Since then the bridge barometer is lower than the 1053 by about this amount. On day 181 the bridge barometer was lower by 3.0 mb. The wind on that day was 40 knots gusting higher, is there a wind effect on one of the barometers?

Corrected wind:-

The relative wind speed and direction and ships speed and direction are noted daily, the calculated resultant of these two values agrees with the 1053 logging (allowing for errors in reading anemometer dials of speed and direction, and ship's speed and direction).

However, towards the end of leg 2, it was noted that the corrected wind speed and direction could change by several knots and tens or hundreds of degrees as the ship altered course and/or slowed for a station. Paul Hartland looked into this and found an intermittent fault on the Ø - DC board. He resoldered a connection to no avail, and temporarily cured fault by jamming rubber sponge between Ø - DC board and an adjacent board. (See his notes 1st July in scientific instrument log book).

Surface Temperature Measurement:-

The problem here is the varying time constant and varying depth of the sensors. On day 180 at 0700, surface temperature was measured with 6 different sensors.

R.A.S.T.U.S.	26.7	
Crawford Bkt.	26.8	
Hull Sensor	26.5	
S & T Profiler	27.45	(Salinity 36.45)
Bucket Thermometer	26.89	
XBT Surface Value	26.8	

The S & T profiler was using a new fish. Earlier in the cruise the fish leaked. It was opened up and dried out and reassembled. On the second occasion it was deployed it worked well. However, it had a temperature error of $\pm$ 0.6°C this was left without readjustment throughout the cruise. (Right at the end of the cruise it was adjusted to zero error for future use).

The salinity values of the S/T fish agree with the bucket salinities to within about $\pm$ .03‰.

For most of the cruise the Hull sensor read about 0.1°C higher value than R.A.S.T.U.S., however, for the comparison above, the hull sensor was reading 0.2°C lower than R.A.S.T.U.S.

J.A. Moorey

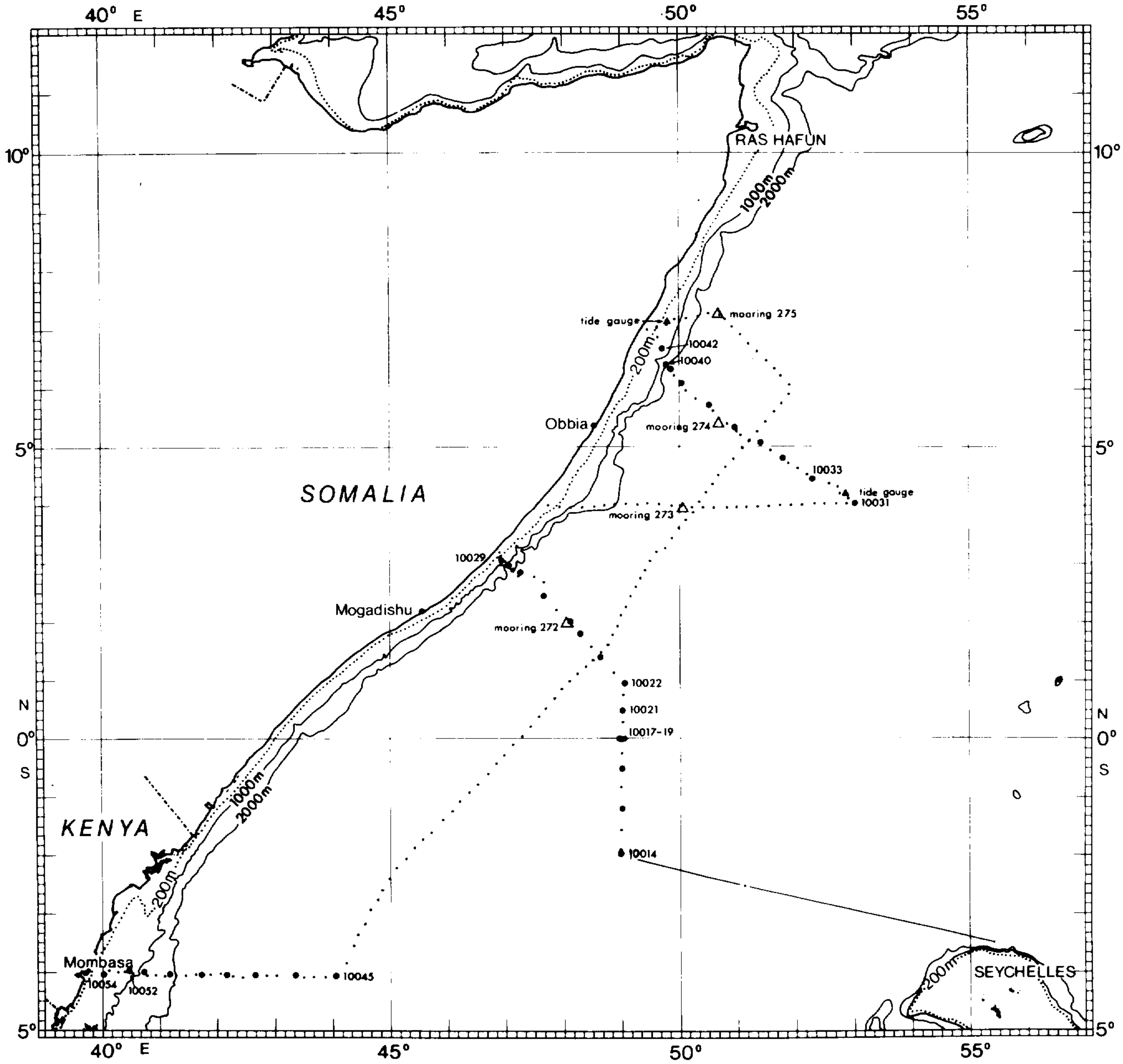

Fig. 1

DISCOVERY CRUISE 102

Leg 1

10 May - 4 June 1979

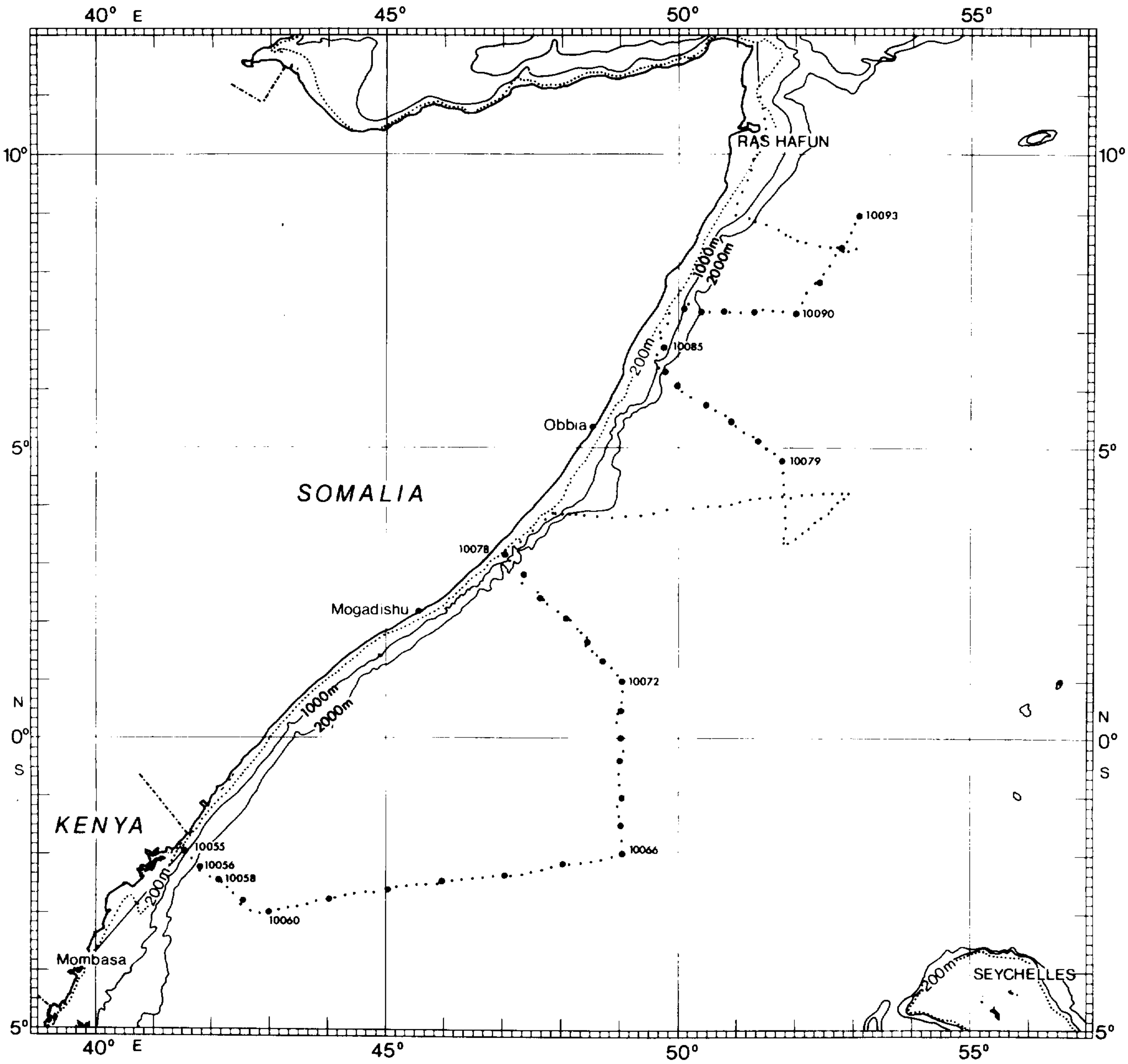

Fig. 2

DISCOVERY CRUISE 102

Leg 2

9 June - 6 July 1979

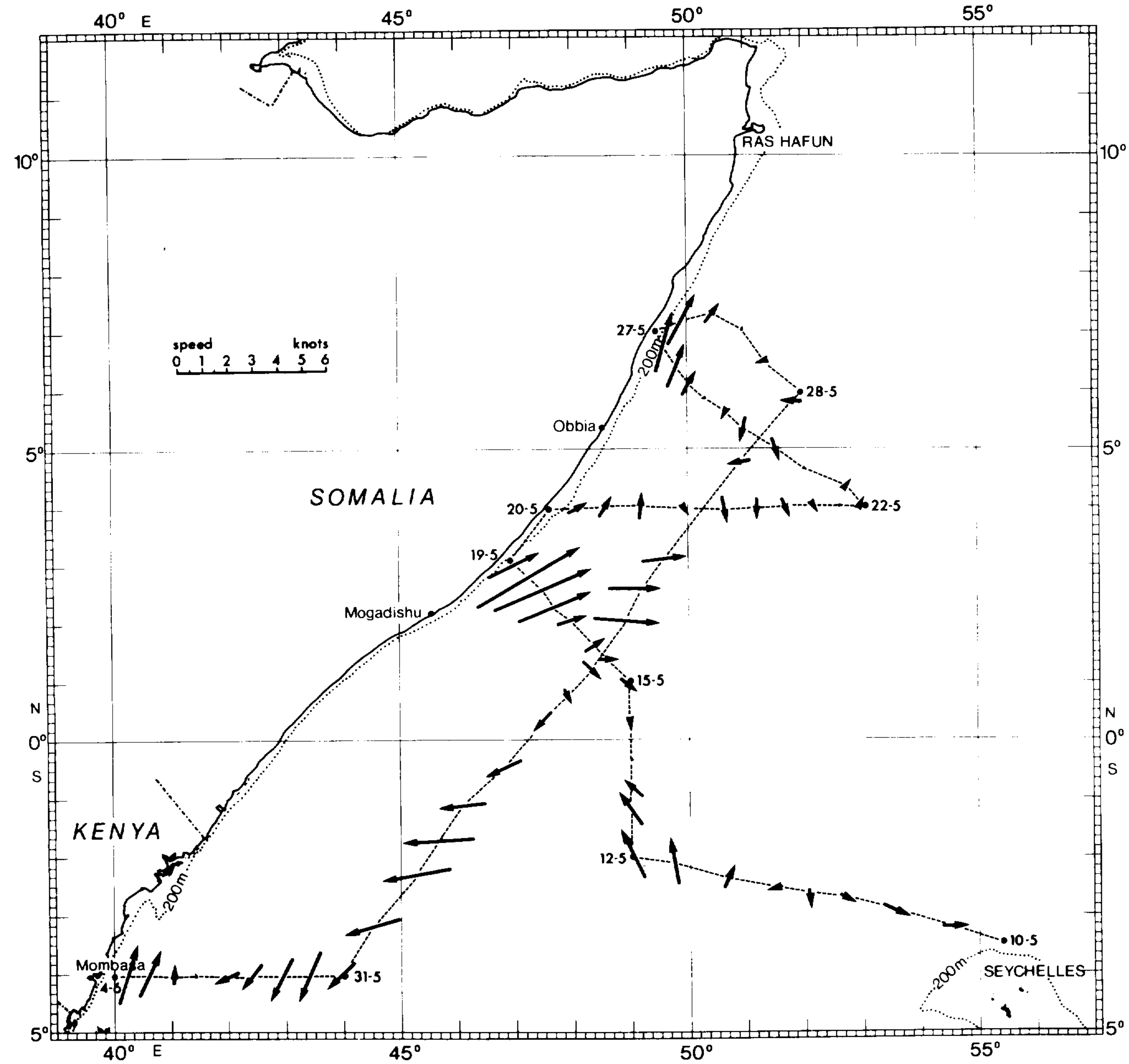

Fig. 3

SURFACE CURRENTS

DISCOVERY CRUISE 102 Leg 1

(May - June)

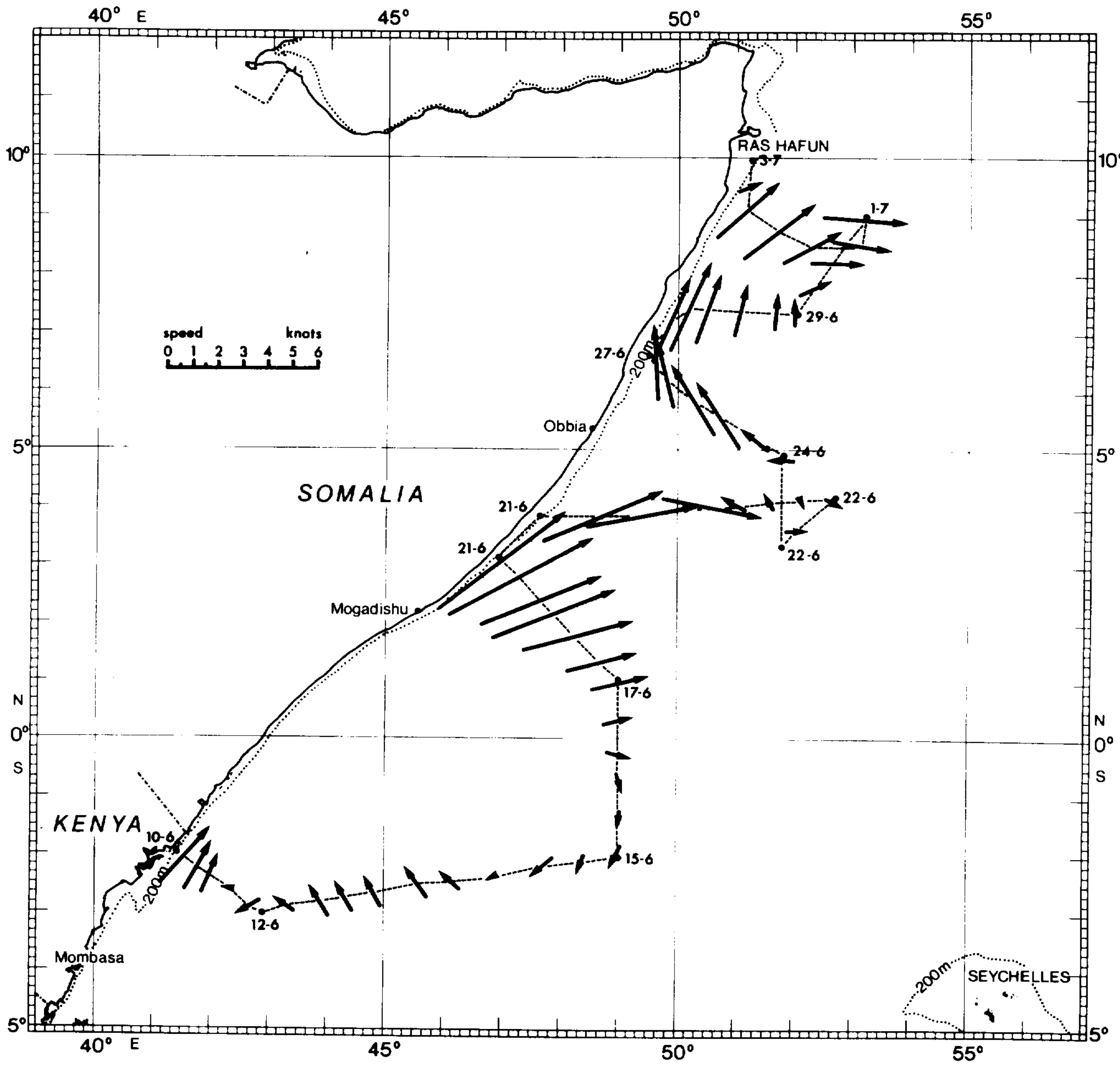

Fig. 4

SURFACE CURRENTS

DISCOVERY CRUISE 102 Leg 2

(June - July)

TABLE 1

Station List, Cruise 102

Stn. No.	Date	Time (GMT) Start	End	Gear Used
10014	12.V	0336	1502	CTD + VAECM, WB
10015		1842	2355	CTD + VAECM, WB
10016	13.V	0329	0925	FGGE Buoy, CTD + VAECM, WB
10017		1221	1536	CTD + VAECM, NBF
10018	14.V	0147	0417	CTD + VAECM
10019		2110		CTD + VAECM, WB
	15.V		0422	
10020		0540	0634	VAECM test
10021		0918	1244	CTD + VAECM
10022		1551	2346	FGGE Buoy, ACM, WB CTD + VAECM
10023	16.V	0335	1123	CTD + VAECM, WB, NBF
10024		2233		CTD + VAECM, WB, NBF
	17.V		0835	
10025		1127	2052	Mooring 272, CTD + VAECM, WB
10026	18.V	0133	1851	CTD + VAECM, WB, NBF
10027	19.V	0044	1544	CTD + VAECM, WB, NBF, ACM
10028		1752	2248	CTD + VAECM, WB
10029	20.V	0014	0254	CTD + VAECM, WB
10030		2240		Mooring 273
	21.V		1310	
10031	22.V	0448	1104	CTD + VAECM, WB, DSM
10032		1500	1655	Tide Gauge
10033		2044		CTD + VAECM, WB, DSM
	23.V		0203	
10034		0609	1049	CTD + VAECM, WB
10035		1354		CTD + VAECM, WB, NBF, DSM
	24.V		0518	
10036		0903	1412	CTD + VAECM, WB, DSM
10037		1829		Mooring 274, CTD + VAECM, WB
	25.V		0345	
10038		0727		CTD + VAECM, WB, NBF, DSM, DRCM
	26.V		0436	
10039		0604	1210	CTD + VAECM, WB, NBF, DSM
10040		1810	2058	CTD + VAECM, NBF
10041	27.V	0047	0143	VAECM test
10042		1008	1225	CTD + VAECM, WB, DSM
10043		1613	1930	Tide Gauge
10044	28.V	0119	0512	Mooring 275
10045	31.V	0540	1203	CTD + VAECM, WB, DRCM, DSM
10046		1545		CTD + VAECM, WB, NBF, DRCM
	1.Vl		0803	
10047		1052	1643	CTD + VAECM, WB
10048		1932		CTD + VAECM, WB, NBF, DSM
	2.Vl		0158	
10049		1107	1613	CTD + VAECM, WB, DSM
10050		1942		CTD + VAECM, WB, NBF
	3.Vl		0337	
10051		0935	1330	CTD + VAECM, WB, NBF, DSM
10052		1623	2105	CTD + VAECM, WB, NBF
10053	4.Vl	0700	0915	VAECM test

Station List, Cruise 102 (cont'd)

Stn. No.	Date	Time (GMT) Start	End	Gear Used
10054	4.V1	1855	2105	CTD + VAECM, WB
10055	10.V1	0244	0723	PCM, $CTDO_2$ + MS
10056		0955	1800	PCM, $CTDO_2$ + MS, NBF
10057		2050	2259	PCM,
10058	11.V1	0933	1339	PCM, $CTDO_2$ MS, DSM
10059		1716		PCM, $CTDO_2$ + MS. DSM, NBF
	12.V1		0213	
10060		0913	1355	PCM, $CTDO_2$ + MS, DSM
10061		2017		PCM, $CTDO_2$ + MS, DSM
	13.V1		0209	
10062		0815	1204	PCM, $CTDO_2$ + MS, DSM
10063		1742	2208	PCM, $CTDO_2$ + MS, DSM
10064	14.V1	0356	0817	PCM, $CTDO_2$ + MS, DSM
10065		1418	1816	PCM, $CTDO_2$ + MS, DSM
10066	15.V1	0001	0515	PCM, $CTDO_2$ + MS, DSM
10067		0836	1250	PCM, $CTDO_2$ + MS, DSM
10068		1602	2040	PCM, $CTDO_2$ + MS, DSM
10069		2340		PCM, $CTDO_2$ + MS
	16.V1		0355	
10070		0725		PCM, $CTDO_2$ + MS, DSM, NBF
	17.V1		0636	
10071		0925	1340	PCM, $CTDO_2$ + MS, DSM
10072		1642	2126	PCM, $CTDO_2$ + MS, DSM
10073	18.V1	0116	1151	PCM, $CTDO_2$ + MS, DSM, NBF
10074		1840		PCM, $CTDO_2$ + MS, DSM
	19.V1		0001	
10075		1352	1852	PCM, $CTDO_2$ + MS, DSM
10076	20.V1	0315	1350	PCM, $CTDO_2$ + MS, DSM, NBF
10077		2044		PCM, $CTDO_2$ + MS, DSM, NBF
	21.V1		1107	
10078		1705	2151	PCM, $CTDO_2$ + MS, DSM
10079	24.V1	0304	0755	PCM, $CTDO_2$ + MS, DSM
10080		1115	1534	PCM, $CTDO_2$ + MS, DSM
10081		1800		PCM, $CTDO_2$ + MS, DSM, NBF
	25.V1		0722	
10082		1509	2053	PCM, $CTDO_2$ + MS, DSM
10083		2326		PCM, $CTDO_2$ + MS, DSM, NBF
	26.V1		1216	
10084		1336		PCM, $CTDO_2$ + MS, DSM, NBF
	27.V1		0527	
10085		0742	1103	PCM, $CTDO_2$ + MS
10086		1616	2116	FGGE, Wave Buoy, PCM, $CTDO_2$ + MS, DSM
10087	28.V1	0633	1114	PCM, $CTDO_2$ + MS, DSM
10088		1737	2204	PCM, $CTDO_2$ + MS, DSM
10089	29.V1	0121	0608	PCM, $CTDO_2$ + MS
10090		1023	1443	PCM, $CTDO_2$ + MS, DSM
10091		1830	2300	PCM, $CTDO_2$ + MS, DSM
10092	30.V1	0305	0758	PCM, $CTDO_2$ + MS
10093		1158	2100	PCM, $CTDO_2$ + MS, NBF

Station List, Cruise 102 (cont'd)

Abbreviations:-

CTD	=	conductivity - temperature - depth probe
$CTDO_2$	=	CTD with oxygen sensor
VAECM	=	Vector averaging electromagnetic current meter
WB	=	NIO water bottles
FGGE Buoy	=	satellite-tracked surface drifter
NBF	=	neutrally buoyant floats
ACM	=	Aanderaa current meter profile
DSM	=	Doppler sonar shear measurement
DRCM	=	direct reading current meter profile
PCM	=	profiling current meter
MS	=	rosette multisampler

HYDROGRAPHIC STATION LIST

Bottle casts made separately from CTD lowerings LEG 1 ONLY

Station Number	Date 1979	Time* Z	Lat.	Long.E.	No. of bottles /casts	Max wire out (m)	Water‡ depth (m)
10014	12.V	1014	1 58.9S	48 59.8	16/2	2000	4335
10015	12	2044	1 13.4	48 58.9	16/2	2000	4827
10016	13	0857	0 31.6	49 00.0	16/2	2000	4794
10019	15	0400	0 03.7N	48 49.5	10/1	900	4785
10022	15	1711	0 58.0	49 00.6	16/2	2000	4769
10023	16	1051	1 24.0	48 35.9	16/2	2000	4399
10024	17	0034	1 48.0	48 17.3	16/2	2000	4399
10025	17	2029	2 01.9	48 07.7	16/2	2000	3499
10026	18	0435	2 25.3	47 38.2	26/4	3400	3500
10027	19	0629	2 49.2	47 14.3	16/2	2000	2565
10028	19	1901	2 58.0	47 00.7	11/1	1300	1338
10029	20	0232	3 04.0	46 57.5	11/1	800	990
10031	21	0642	3 57.4	50 00.8	16/2	2000	~3930
10033	23	0140	4 27.3	52 18.0	16/2	2000	5105
10034	23	0749	4 49.8	51 43.7	16/2	2000	5094
10035	23	1608	5 03.6	51 20.2	22/3	4000	5001
10036	24	1052	5 21.3	50 53.5	16/2	2000	4967
10037	24	2250	5 42.7	50 25.3	16/2	2000	4570
10038	25	0919	6 05.2	50 00.3	16/2	2000	4101
10039	26	0751	6 21.1	49 49.5	16/2	2000	2178
10042	27	1206	6 42.0	49 42.7	10/1	700	763
10045	31	0723	4 03.6S	44 02.3	16/2	2000	4315
10046	31	1812	4 05.1	43 19.1	16/2	2000	3945
10047	1.VI	1308	4 03.9	42 40.9	16/2	2000	3673
10048	1	2115	4 04.8	42 10.3	16/2	2000	3334
10049	2	1236	4 03.2	41 42.6	16/2	2000	2877
10050	2	2136	4 03.0	41 13.0	16/2	1800	1886
10051	3	1013	4 03.0	40 42.7	12/1	1100	1195
10052	3	2046	4 01.6	40 28.3	10/1	900	927
10054	4	1914	4 02.1	40 01.9	10/1	680	701

Notes * (Messenger) Date/time and position is for shallow cast

‡ Water depth is for messenger time of deep cast

Oxygen analysis was made on all bottle samples in each shallow cast; samples for silicate and phosphate determinations were drawn for the first three samples on each shallow cast (see text).

TABLE 3

HYDROGRAPHIC STATION LIST

CTD LOWERINGS LEG 1

Station Number	Time Z*	Date 1979	Lat.	Long.E.	Max wire out (m)	Water Depth (m)	Temperatures, °C Depth ‡ 2m	50m	100m	400m	20°C Depth (m)
10014	1312	12.V	1 57.5S	48 59.4	2000	4475	29.1	25.9	22.5	11.1	117
10015	2305	12	1 12.8	48 59,3	2000	4853	28.4	27.1	19.5	10.3	94
10016	0601	13	0 32.1	48 59.4	2000	4846	28.8	27.5	19.1	9.9	95
10017	1433	13	0 01.5	49 00.6	2000	4794	29.4	28.9	23.1	10.5	111
10018	0331	14	0 03.0	48 59.2	2000	4792	29.6	29.4	21.5	10.6	108
10019	2345	14	0 01.0S	48 56.3	2000	4785	29.6	29.6	20.6	10.6	103
10021	1155	15	0 28.9N	49 01.5	2000	4800	29.9	29.8	22.9	10.7	106
10022	2300	15	0 56.3	49 02.1	2000	4782	29.3	29.3	21.6	10.6	103
10023	0531	16	1 23.8	48 37.8	1000	4619	29.6	29.6	24.4	10.9	110
10024	0807	17	1 48.1	48 18.4	1000	4401	29.2	29.0	25.1	10.9	122
10025	1754	17	2 01.4	48 06.3	1000	4230	28.5	28.3	23.3	10.8	105
10026	0928	18	2 27.3	47 41.5	2000	3505	27.0	26.5	25.0	11.2	108
10027	1027	19	2 50.7	47 17.4	1195	2586	27.0	24.1	17.4	11.5	80
10028	2220	19	2 58.8	47 03.6	1100	1731	26.2	23.2	19.7	10.7	95
10029	0147	20	3 03.9	46 57.2	600	905	26.5	22.1	18.0	10.7	89
10031	0915	22	4 01.2	53 01.3	2000	5109	30.3	30.0	23.5	10.8	121
10033	2227	22	4 27.6	52 17.1	2000	5105	30.0	29.5	23.2	10.9	126
10034	1008	23	4 49.3	51 44.1	2000	5095	29.6	27.8	23.4	10.7	127
10035	2042	23	5 03.7	51 23.1	2000	5001	29.4	29.3	24.0	10.7	135
10036	1302	24	5 20.0	50 54.1	2000	4965	29.3	29.1	26.0	10.6	134
10037	2005	24	5 43.5	50 25.1	2000	5078	29.0	29.0	25.5	10.8	138
10038	1253	25	6 06.7	50 00.8	2000	4117	29.0	28.9	25.0	10.9	134
10039	1110	26	6 21.4	49 50.3	2000	2067	28.9	28.8	23.9	10.9	131
10040	2025	26	6 25.1	49 44.5	1400	1492	28.1	28.1	22.6	10.6	113
10042	1122	27	6 41.6N	49 42.3	720	750	27.8	27.9	22.3	11.2	124
10045/1	0912	31	4 04.1S	44 01.2	200	-	28.1	28.0	22.2	-	117
10045/2	1025	31	4 04.4	44 01.3	2000	4409	28.1	27.9	22.0	9.3	116
10046	2331	31	4 07.2	43 23.0	2000	4001	28.3	28.2	16.7	9.2	91
10047	1555	1.VI	4 07.8	42 40.1	2000	3690	28.1	28.0	18.2	9.6	90
10048	0102	2	4 05.4	42 10.8	2000	3300	27.8	25.7	18.3	10.1	85
10049	1532	2	4 03.1	41 43.0	2000	2891	27.8	27.8	17.2	10.0	85
10050	0253	3	4 00.9	41 14.1	1900	1918	27.7	27.7	21.6	8.9	109
10051	1257	3	4 00.4	40 45.1	1220	1215	27.5	25.3	19.8	9.7	98
10052	1846	3	3 59.7	40 31.2	900	910	27.3	27.4	20.9	9.7	105
10054	2035	4	4 00.0	40 02.8	666	672	27.3	26.8	24.4	9.8	144

* Messenger time or down time

‡ Decibars and meters interchangeable (±1) over range 0-400

HYDROGRAPHIC STATION LIST

CTD LOWERINGS LEG 2

Station Number	Time Z	Date 1979	Lat.	Long.E.	Max wire out (m)	Water Depth (m)	Temperatures, °C Depth + 2m	50m	100m	400m	20°C Depth (m)
10055	0700	10.VI	1 58.1S	41 32.7	900	897	26.65	26.6	20.2	10.45	108
10056	1152	10	2 11.4	41 46.7	2330	2193	27.3	27.0	24.9	10.45	118
10058	1258	11	2 25,7	42 07.3	2050	2830	27.7	27.0	21.5	10.3	109
10059	1902	11	2 47.5	42 34.1	2100	3282	27.8	27.75	22.5	10.1	116
10060	1045	12	2 59.5	42 58.5	2100	3495	27.95	27.8	20.0	9.65	100
10061	0120	13	2 45.8	44 01.3	2100	3787	27.85	25.0	19.8	9.6	98
10062	1125	13	2 37.2	45 02.4	2050	4220	28.0	27.85	18.2	10.6	82
10063	1914	13	2 27.6	45 58.0	2100	4578	27.75	21.5	15.8	10.9	62
10064	0738	14	2 21.4	47 02.0	2100	4778	26.4	19.8	16.9	11.0	49
10065	1730	14	2 10.3	48 01.6	2150	4848	26.25	21.2	17.4	10.25	70
10066	0434	15	2 02.2	49 03.0	2100	4915	26.2	23.4	18.2	10.0	70
10067	1208	15	1 31.3	49 00.2	2070	4861	26.3	23.6	19.2	10.15	81
10068	1952	15	1 01.1	49 00.0	2150	4856	26.2	23.8	19.3	10.2	81
10069	0308	16	0 33.5S	49 01.6	2100	4855	26.4	24.2	19.7	10.8	90
10070	1242	16	0 00.1N	49 01.4	2100	4790	27.0	24.2	18.8	10.2	92
10071	1253	17	0 29.0	49 00.7	2060	4780	26.95	24.0	20.3	10.3	101
10072	2041	17	0 59.6	49 02.9	2150	4772	27.05	26.5	20.2	10.7	102
10073	0614	18	1 20.5	48 42.4	2200	4645	27.1	26.3	18.7	10.35	95
10074	2310	18	1 39.7	48 26.9	2200	4496	27.25	27.0	19.4	10.75	96
10075	1759	19	2 03.1	48 03.7	2350	4204	27.1	26.0	19.2	10.9	91
10076	0815	20	2 23.9	47 37.9	2170	3514	26.8	23.0	15.3	10.8	61
10077	0155	21	2 48.6	47 20.6	2150	2767	26.75	19.7	14.4	10.9	48
10078	1821	21	3 08.1	47 03.1	780	664	25.3	14.6	13.5	10.5	38
10079	0702	24	4 47.0	51 45.7	2250	5091	27.3	27.25	26.0	10.8	137
10080	1446	24	5 08.1	51 20.8	2100	5011	27.5	27.5	26.2	10.7	143
10081/1	2328	24	5 27.7	50 53.3	2100	4960	27.55	27.55	23.0	11.1	117
10081/2*	(0236	25	5 28.5	50 50.5)	200	-	27.55	27.5	21.1	-	105
	(0400		5 30.1	50 49.4)							
10082	1920	25	5 45.0	50 27.5	2100	4579	27.5	25.3	18.2	11.8	81
10083	0356	26	6 03.6	49 58.8	2150	4037	27.45	21.3	18.2	12.0	61
10084	1806	26	6 19.1	49 45.5	1950	1934	27.0	22.2	18.1	11.6	60
10085	1042	27	6 42.5	49 45.0	800	821	26.7	26.1	18.1	11.0	77
10086	2024	27	7 23.9	50 04.8	1000	942	26.75	26.7	17.5	11.15	73
10087	1033	28	7 19.8	50 23.2	2100	2808	26.35	26.3	18.8	11.2	92
10088	2128	28	7 19.7	50 46.0	2080	3745	26.5	26.5	22.8	10.45	116
10089	0525	29	7 21.6	51 17.3	2100	5014	26.6	26.65	24.4	10.65	119
10090	1404	29	7 16.7	51 59.6	2050	5070	26.8	26.8	25.6	10.2	152
10091	2212	29	7 51.2	52 23.7	2100	5076	26.7	26.7	25.45	11.35	164
10092	0700	30	8 24.1	52 47.1	2150	5049	26.35	26.35	25.9	11.7	164
10093	1742	30	8 58.8	53 05.4	2250	4895	26.0	25.8	23.7	11.15	137

* YOYO series, start and end time/positions given.

Moored Instruments: Cruise 102

Current meter mooring No. 272:

Set 1519Z 17 May 1979, 2°0.2N 48°2.7E
Released 0737Z 19 June 1979 Water depth 4215m
Aanderaa current meters at 221, 526, 781, 2102m

Current meter mooring No. 273:

Set 1256Z 21 May 1979, 3°57'.2N 50°03'.3E
Released 1305Z 22 June 1979 Water depth 3851m
Aanderaa current meters at 205, 510, 759, 2084m

Tide gauge - Stn. No. 10032 :

Launched 1523Z 22 May 1979, Depth before 3613m, after 3685m
On bottom 1635z - 04°13.53'N 52°52.40E
Temperature sensors 1T8 & 2T1
Pressure sensors s/g 2D3, DIGIQx 2262 & 2291

Current meter mooring No. 274:

Set 0308Z 25 May 1979, 5°40'.7N, 50°23'.8E
Released 1055Z 25 June 1979. Water depth 4542m
Aanderaa current meters at 212, 517, 773, 2090m

Tide gauge - Stn. No. 10043 :

Launched 18 58.30Z 27 May 1979 Depth before 525m; after 524m
On bottom 190820Z - 07°09.85N; 49°49.31E
Temperature sensor 1T9
Pressure sensors s/g 1D12, DIGIQx 662 & 2622

Current meter moorings No. 275:

Set 0503 Z 28 May 1979, 7°17'.8N 50°39'.2E
Recovered 1316Z 28 June 1979 Water depth 3335m
Aanderaa current meters at 190, 749, 2072m.

Note: Depths of current meters are estimated from observed wire and mooring line lengths and water depths, with no allowance for deflection of mooring by current. These may be revised when pressure records are analysed (available on shallowest current meters only).

TABLE 5

DISCOVERY CRUISE 102

NEUTRALLY BUOYANT FLOATS

Serial No.	Nominal Depth (m)	First Fix				Last Fix				Mean Velocity		Duration hrs.	Remarks
		Date	Time GMT Z	Lat.	Long E	Date	Time GMT Z	Lat.	Long E	cm/sec	σ_T		
1	700	13.V	1905	0 01.9S	48 59.4	14.V	0818	0 05.8S	48 50.8	32.0	246	13.2	
2	1000	13.V	2000	0 00.8S	49 00.0	15.V	0316	0 03.3N	48 49.5	18.6	292	31.3	
3	1500	13.V	2053	0 00.0	48 59.5	14.V	1323	0 02.1N	48 58.9	6.7	343	16.5	
4	2500	13.V	1823	0 00.2N	48 59.5	15.V	0524	0 07.6N	48 58.1	11.0	349	35.0	
5	700	16.V	0634	1 23.5N	48 35.9	16.V	1230	1 23.1N	48 33.8	18.8	258	5.9	
6	2000	16.V	0629	1 23.6N	48 36.4	16.V	1200	1 24.5N	48 36.3	8.5	353	5.5	
7	700	16.V	2020	1 47.2N	48 15.8	17.V	0452	1 48.1N	48 13.8	13.6	294	8.5	
8	2000	16.V	2020	1 47.7N	48 17.1	17.V	0418	1 47.6N	48 16.1	4.5	307	8.0	
9	700	18.V	0336	2 26.4N	47 36.7	18.V	1138	2 29.1N	47 40.4	29.2	054	8.0	
10	2000	18.V	0338	2 26.1N	47 36.8	18.V	1312	2 27.4N	47 39.3	15.6	062	9.6	
11	700	19.V	0358	2 48.7N	47 14.2	19.V	1512	2 46.2N	47 11.8	15.9	225	11.2	
12	2000	19.V	0348	2 49.3N	47 14.5	19.V	1124	2 51.0N	47 16.8	19.0	053	7.6	
13	700	23.V	1704	5 04.7N	51 19.7	24.V	0428	5 02.9N	51 19.5	8.4	191	11.4	
14	2000	23.V	1706	5 05.1N	51 20.2	24.V	0244	5 05 5N	51 22.1	8.0	074	9.6	
15	700	25.V	0948	6 05.4N	49 59.7	26.V	0402	6 08.9N	49 56.2	13.8	315	18.2	
16	2000	25.V	1401	6 06.2N	49 59.7	26.V	0046	6 07.3N	50 01.4	9.6	055	10.8	
17	330	26.V	0826	6 21.1N	49 49.2	26.V	1336	6 21.1N	49 50.1	8.6	090	5.2	Pressure telemetering float
18	220	26.V	1636	6 22.1N	49 49.5	27.V	0500	6 21.1N	49 51.7	10.2	115	12.4	" " "
19	700	26.V	0826	6 21.3N	49 48.9	27.V	0626	6 27.4N	49 51.1	15.2	019	22.0	
20	2000	26.V	0840	6 20.6N	49 48.8	27.V	0222	6 21.5N	49 47.9	3.5	313	17.7	
21	700	26.V	2134	6 24.0N	49 42.2	27.V	0810	6 28.0N	49 43.8	20.9	021	10.6	
22	216	31.V	2006	4 05.7S	43 22.7	1.Vl	0238	4 08.0S	43 28.1	46	113	6.5	Pressure telemetering float
23	700	31.V	1920	4 03.1S	43 18.2	1.Vl	0718	4 02.6S	43 10.6	32.7	274	12.0	
24	2000	31.V	1930	4 03.5S	43 19.8	1.Vl	0436	4 03.6S	43 18.3	8.5	268	9.1	
25	700	1.Vl	2150	4 05.7S	42 10.9	2.Vl	0442	4 09.1S	42 09.2	28.5	206	6.9	
26	2000	1.Vl	2154	4 04.4S	42 10.9	2.Vl	0700	4.01.7S	42 11.5	15.3	011	9.1	
27	700	2.Vl	2250	4 04.3S	41 12.5	3.Vl	0430	4 06.0S	41 11.2	19.1	219	5.7	
28	1500	2.Vl	2250	4 04.5S	41 12.6	3.Vl	0426	4 05.9S	41 13.3	14.3	151	5.6	
29	700	3.Vl	1434	4 03.5S	40 41.9	4.Vl	0236	4 05.3S	40 40.0	11.3	226	12.0	
30	700	3.Vl	2014	4 02.3S	40 28.2	4.Vl	1322	4 03.7S	40 24.7	11.4	248	17.1	

TABLE 5 (cont'd)

DISCOVERY CRUISE 102

NEUTRALLY BUOYANT FLOATS (cont'd)

Serial No.	Nominal Depth (m)	First Fix				Last Fix				Mean Velocity		Duration hrs.	Remarks
		Date	Time GMT Z	Lat.	Long E	Date	Time GMT Z	Lat	Long E	cm/sec	°T		
31	230	4.Vl	0650	4 02.8S	40 27.5	4.Vl	1434	3 59.2S	40 30.2	30.0	037	7.7	Pressure telemetering float
32	700	10.Vl	1354	2 12.8S	41 45.3	11.Vl	0518	2 15.8S	41 40.2	19.9	240	15.4	
33	2000	10.Vl	1350	2 12.5S	41 45.4	11.Vl	0354	2.09.6S	41.46.2	11.0	014	14.1	
34	700	11.Vl	2030	2 48.0S	42 31.9	12.Vl	0434	2 48.9S	42 27 2	30.5	259	8.1	
35	2000	11.Vl	2030	2 47.1S	42 33.2	12.Vl	0246	2 44.6S	42 31.6	24.2	328	6.3	
36	220	16.Vl	1042	0 02.1N	49 02.8	17.Vl	0614	0 00.8N	48 52.9	26.2	262	19.5	Pressure telemetering float
37	700	16.Vl	1044	0 02.2N	49 02.9	17.Vl	0454	0 03.2N	48 54.4	24.4	276	18.2	
38	2000	16.Vl	1038	0 02.1N	49 03.4	17.Vl	0218	0 02.1N	49 02.7	2.5	275	15.7	
39	700	18.Vl	0410	1 20.1N	48 40.6	18.Vl	1348	1 20.5N	48 38.9	9.1	283	9.6	
40	2000	18.Vl	0406	1 20.0N	48 40.9	18.Vl	1214	1 19.6N	48 40.2	5.1	242	8.1	
41	700	20.Vl	0622	2 23.0N	47 36.3	20.Vl	1314	2 25.3N	47 36.0	17.2	352	6.9	
42	2000	20.Vl	0618	2 22.7N	47 36.3	20.Vl	1254	2 23.5N	47 37.7	12.5	059	6.6	
43	700	20.Vl	2358	2 47.0N	47 17.4	21.Vl	1030	2 51.0N	47 21.5	27.9	047	10.5	
44	2000	20.Vl	2356	2 46.8N	47 17.4	21.Vl	0806	2 48.9N	47 20.9	25.5	059	8.2	
45	700	24.Vl	2118	5 26.9N	50 54.2	25.Vl	0624	5 28.7N	50 55.2	11.9	032	9.1	
46	2000	24.Vl	2118	5 26.4N	50 54.1	25.Vl	0452	5 27.2N	50 55.0	8.2	049	7.6	
47	700	26.Vl	0212	6 02.0N	49 59.5	26.Vl	1120	6 01.6N	49 54.9	25.9	264	9.1	
48	2000	26.Vl	0206	6 02.1N	50 00.0	26.Vl	0942	6 02.2N	49 59.3	4.5	282	7.6	
49	700	26.Vl	1612	6 17.8N	49 46.9	27.Vl	0436	6 15.8N	49 42.1	21.6	248	12.4	
50	2000	26.Vl	1612	6 17.9N	49 47.7	27.Vl	0200	6 17.2N	49 48.6	6.3	129	9.8	
51	700	30.Vl	1530	8 59.1N	53 02.1	30.Vl	2018	8 59.1N	53 01.6	5.9	270	4.8	Floats had to be abandoned in poor weather
52	2000	30.Vl	1530	8 59.4N	53 01.4	30.Vl	2018	8 59.8N	53 01.3	3.8	350	4.8	

Cruise 102

VAECM Stns./Depths (Nominal)

Depths / Stn. No.	10	25	50	75	100	150	200	300	500	700	1000	2000	Remarks
10014			X		X		X	X	X	X	X	X	Check zeros only
'15			X		X		X	X	X	X	X	X	
'16			X		X		X	X	X	X	X	X	
'17							X	X	X	X	X		
'18			X		X		X	X	X	X	X	X	
'19			X		X		X	X	X	X	X	X	
'20			X										
'21		X	X		X		X	X	X	X	X	X	
'22			X		X		X	X	X	X	X	X	Aanderaa Comparison
'22			X		X		X	X	X	X	X	X	
'23			X		X		X	X	X	X	X		
'24	X		X		X		X	X	X	X	X		EM Log Comparison
'25	X		X		X		X	X	X	X	X		
'26	X		X		X		X	X	X	X	X		
'27			X		X		X	X	X	X	X		Aanderaa Comparison
'28			X		X		X	X	X	X	X		
'29	X		X		X		X	X	X	X			
'31	X		X		X		X	X	X	X	X	X	DRCM Comparison
'32													
'33			X		X		X	X	X	X	X	X	DRCM Comparison
'34			X		X		X	X	X	X	X	X	
'35			X		X		X	X	X	X		X	Float at 700m compar-ison
'36			X		X		X	X	X	X			
'37			X		X		X	X	X	X	X	X	
'38			X		X		X	X	X	X	X	X	
'39	X	X	X	X	X	X	X	X	X	X	X	X	Profile at 10m Vertical Spacing. DRCM Compar-ison. Float Comparison at 330M
'40			X		X		X						
'41			X		X		X						Comparison with float at 225m
'42			X		X		X	X	X				

Cruise 102

VAECM Stns./Depths (Nominal)

Depths / Stn. No.	10	25	50	75	100	150	200	300	500	700	1000	2000	Remarks
10045	X	X	X		X	X	X	X	X	X		X	Also at 60m DRCM Comparison
'46		X	X	X	X	X	X	X	X	X		X	DRCM Comparison
'47		X	X	X	X	X	X	X	X	X		X	
'48		X	X	X	X	X	X	X	X	X			
'49	X	X	X	X	X	X	X	X	X	X			
'50		X	X	X	X	X	X	X	X	X			
'51		X	X	X	X	X	X	X	X	X			
'52	X	X	X	X	X	X	X	X	X	X			
'53		X	X	X	X	X	X	X	X	X			
'54													Plug leaked, no data

TABLE 7

DISCOVERY CRUISE 102 (Leg 2)

AANDERAA PROFILING CURRENT METER

Prof. No.	Stn.No.	Date 1979	Start Time Z	Start Lat.	Start Long E	End Time Z	Remarks
3	10055	10.VI	0310	2 01.3S	41 29.0	0402	Rotor stuck-sea weed
4	10056	10.VI	1516	2 12.7S	41 45.4	1646	
4A	10056	10.VI	1726	2 12.1S	41 46.5	1747	Kiel housing
5	10057	10.VI	2112	2 02.7S	41 30.2	2228	Repeat of Stn 10055
6	10058	11.VI	0945	2 26.0S	42 06.4	1110	
7	10059	11.VI	2155	2 47.0S	42 33.0	2318	
8	10059	12.VI	0103	2 47.2S	42 28.8	0155	Kiel housing
9	10060	12.VI	1202	2 58.7S	42 58.4	1318	
10	10061	12.VI	2037	2 48.4S	44 00.1	2212	
11	10062	13.VI	0826	2 38.4S	45 00.2	0940	
12	10063	13.VI	2021	2 27.8S	45 58.7	2140	
13	10064	14.VI	0418	2 21.0S	47 00.6	0530	
14	10065	14.VI	1430	2 10.4S	47 59.6	1538	
15	10066	15.VI	0118	2 01.3S	49 01.6	0248	
16	10067	15.VI	0848	1 29.8S	48 59.2	1016	
17	10068	15.VI	1618	1 01.2S	48 58.1	1732	
18	10069	15/16.VI	2354	0 31.7S	49 00.5	0208	
19	10070	16.VI	0750	0 02.1N	49 02.8	0848	
20	10070	16.VI	1602	0 01.2N	49 01.4	1722	*
21	10070	16.VI	1752	0 00.2S	49 01.4	1908	*
22	10070	16.VI	2100	0 01.9N	48 57.8	2218	*
23	10070	16/17.VI	2314	0 01.0N	48 58.0	0042	*
24	10071	17.VI	0940	0 30.4N	48 59.9	1100	
25	10072	17.VI	1706	1 00.9N	49 02.0	1824	
26	10073	18.VI	0144	1 20.3N	48 41.1	0316	
27	10073	18.VI	0840	1 21.3N	48 39.8	1018	*
28	10073	18.VI	1046	1 20.7N	48 40.4	1142	*
29	10074	18.VI	1902	1 40.0N	48 21.5	2102	
30	10075	19.VI	1410	2 02.5N	47 59.0	1536	
31	10076	20. VI	0344	2 22.2N	47 35.7	0504	
31A	10076	20.VI	1032	2 22.8N	47 36.3	1205	* PCM stuck in thermocline
32	10077	20.VI	2112	2 46.0N	47 16.8	2242	
33	10077	21.VI	0430	2 47.6N	47 19.0	0536	*
34	10078	21.VI	1955	3 10.0	47 05.4	2138	
35	10079	24.VI	0326	4 45.3	51 43.9	0446	New fast response thermistor
36	10080	24.VI	1135	5 07.2	51 19.8	1256	
37	10081	24.VI	1902	5 26.6	50 53.6	2034	
38	10082	25.VI	1524	5 42.3	50 27.9	1714	
39	10083	25/26.VI	2350	6 01.8	50 00.6	0122	
40	10083	26.VI	0704	6 04.5	49 59.1	0850	*
41	10084	26.VI	1356	6 18.2	49 48.5	1536	
42	10084	26.VI	2040	6 17.0	49 47.2	2206	*
43	10084	26.VI	2248	6 17.4	49 47.6	2258	* } Yo-yo to 100m
44	10084	26.VI	2305	6 17.6	49 47.7	2314	*
45	10084	26.VI	2319	6 17.6	49 47.8	2328	*
46	10084	26.VI	2332	6 17.7	49 47.8	2340	*
47	10085	27.VI	0800	6 41.1	49 43.4	0924	
48	10086	27.VI	1640	7 20.1	50 00.6	1812	
49	10087	28.VI	0718	7 17.7	50 21.0	0834	
50	10088	28.VI	1750	7 17.9	50 43.5	1913	
51	10089	29.VI	0138	7 20.0	51 16.6	0320	
52	10090	29.VI	1035	7 17.8	52 00.0	1212	
53	10091	29.VI	1852	7 53.1	52 21.9	2000	
54	10092	30.VI	0326	8 26.4	52 44.5	0436	
55	10093	30.VI	1228	8 58.9	53 03.0	1406	

* Repeated profiles

DOPPLER SONAR OBSERVATIONS

Cruise 102

Day	Stn/Posn.	Times	Remarks
LEG 1*			
142	10031	0526-0932	Single channel, Plate horizontal
142/143	10033	2211-0041	" " " 45°/45°
143	10035	1853-2130	" "
144	10036	1150-1315	" "
145	10038	1544-1717	" "
145	10038	1748-1810	" "
145	10038	2015-2257	" " Trial of doppler shift seen with ship at various speeds.
146	10039	0741-0811	Two channels
147	10042	1130-1222	" "
151	10045	0726-0828	Single channel
151	4°4'S 44°1'E	1136-1215	Two channels
151	4°2'S 43°20'E	1550-1802	Single channel
151	4°6'S 43°23'E	2120-2232	Single channel
153	10048	0419-0447	Two channels
153	10049	1120-1228	" "
153	4°3'13S 41°12'77E	2105-2149	" "
154	10051	1225-1308	" "
155	4°3'S 40°27'E	0550-0627	" "
155	4°3'S 40°28'E	0700-0730	" "
155	4°2'S 40°26'E	1056-1252	" "
155	3°59'S 40°3'E	2116-2312	" "
LEG 2 +			
162	10058	1032-1104	4 channel 8 depth cells x 53m
162	10059	2113-2137	" " " " "
163	10060	1230-1300	" " " " "
163	10061	2222-2250	" " " " "
164	10062	0906-0929	" " " " "
164	10063	2113-2137	" " " " "
165	10064	0503-0528	" " " " "
165	10065	1507-1544	" " " " "
166	10066	0131-0154	" " " " "
166	10066	0020-0131	" " " " "
166	10067	0922-1025	" " " " "
166	10068	1712-1840	" " " " "
167	10070	0904-0938	" " " " "
167	10070	1623-1730	" " 16 depth cells x 26m
168	10070	0052-0116	" " 8 " " x 53m
168	10071	1035-1115	" " 8 " " x 53m
168	10071	1316-1342	" " 16 " " x 26m
168	10072	1818-1941	" " 8 " " x 53m
168	10072	1957-2032	" " 16 " " x 26m
169	10073	0504-0600	" " 16 " " x 26m
169	10073	0640-0702	" " 8 " " x 53m
169	10074	2231-2400	" " 16 " " x 26m
170	10095	1703-1800	" " 16 " " x 26m
170	10096	0727-0814	" " 16 " " x 26m
171	10076	1127-1221	" " 8 " " x 53m

DOPPLER SONAR OBSERVATIONS

Cruise 102

Day	Stn/Posn.	Times	Remarks
LEG 2 +			
172	10077	0120-0214	4 channel 16 depth cells x 26m
172	10078	1848-1902	" " " " " "
173		1416-1430	" " " " " "
174	4 13'N 52 54'E	0751-0805	" " " " " "
175	10079	0650-0745	" " " " " "
175	10080	1146-1250	" " " " " "
176	10081	0115-0227	" " " " " "
176	10082	2036-2050	" " " " " "
177	10083	0630 0644	" " " " " "
177/178	10084	2359-0047	" " " " " "
178	10086	2050-2115	" " " " " "
179	10087	1030-1110	" " " " " "
180	10088	0457-0541	" " " " " "
180	10090	2123-2156	" " " " " "
181	10091	0618-0720	" " " " " "

(* Day 142 - 155 = 22 May - 4 June)
(+ Day 162 - 181 = 11 - 30 June)

XBT LIST

TABLE 9

Consec No.	Date	Time GMT	Lat.	Long. E	Bucket T°C	Bucket S‰	From XBT record T (0m)	T (50m)	T (100m)	T (400m)	20°C depth (m)	Remarks
1	11.V	1532	2°31'S	51°07'	29.7	35.233	29.9	24.7	15.4	11.2	64	
2	12.V	1504	1°56'S	48°59'	29.4	35.074	29.3	24.6	22.7	11.3	119	
3		1702	1°34'S	48°58'	29.15	35.125	29.5	25.3	22.1	12.3	124	
4	13.V	0200	0°48'S	48°58'	29.02	35.100	29.2	28.9	20.5	10.7	102	
5		1100	0°14'S	48°59'	29.41	35.149	29.4	28.9	23.4	10.9	122	
6	15.V	0804	0°18'N	49°00'	30.02	35.371	30.0	30.1	24.0	11.0	109	
7		1428	0°46'N	49°01'	29.98	35.337	30.1	30.0	22.0	11.0	103	
8	16.V	0130	1°09'N	48°51'	29.78	35.314	29.9	29.9	20.4	11.1	101	
9		1530	1°35'N	48°28'	29.72	35.248	29.8	29.8	21.0	10.0	104	
10	17.V	1000	1°57'N	48°08	29.66	35.487	29.7	29.5	27.6	10.0	128	
11		2300	2°13'N	47°52	27.64	34.856	27.7	27.5	26.5	11.2	115	
12	18.V	2030	2°41'N	47°39'	27.58	34.839	27.6	26.4	25.2	11.4	109	
13		2200	2°46'N	47°29'	27.60	34.863	27.5	25.9	21.5	11.6	109	
14	19.V	0650	2°49'N	47°14'	27.48	34.834	27.2	24.7	17.8	10.4	84	
15		1648	2°55'N	47°07'	25.80	34.947	26.1	23.7	17.7	11.4	97	
16		2336	3°03'N	46°58'	26.32	35.108	26.4	23.3	18.2	11.7	85	
17	20.V	0330	3°07'N	46°53'	25.96	35.455	26.1	23.2	19.4	-	91	
18		0400	3°11'N	46°53'	26.21	35.490	26.2	"	"	"	"	Water depth 30m only
19		0954	4°00'N	47°44'	27.77	35.514	27.7	"	"	"	"	" " " "
20		1100	3°58'N	47°56'	27.53	35.441	27.6	24.3	20.0	11.7	100	
21		1200	3°57'N	48°07'	27.60	35.254	27.8	25.0	21.3	11.3	112	
22		1300	3°58'N	48°19'	27.70	35.197	27.7	25.8	21.2	10.9	122	
23		1406	3°59'N	48°31'	27.42	35.068	27.5	26.2	22.5	11.4	123	
24		1500	4°00'N	48°42'	27.32	34.949	27.3	26.4	22.5	10.7	120	
25		1600	4°01'N	48°53'	27.36	34.936	27.4	26.6	23.0	10.9	118	
26		1700	4°01'N	49°04'	28.00	34.951	28.2	27.2	21.0	11.0	104	
27		1800	4°01'N	49°16'	29.18	35.387	29.4	28.7	25.2	12.5	120	
28		1900	4°01'N	49°27'	29.30	35.405	29.5	29.4	23.0	11.2	107	
29		2000	4°01'N	49°38'	29.40	35.415	29.6	29.5	25.0	11.3	113	
30		2107	3°59'N	49°51'	29.32	35.355	29.5	29.4	20.9	11.2	105	
31		2200	3°59'N	50°01	29.30	35.387	29.5	29.5	24.3	11.3	116	
32	21.V	1405	3°57'N	50°13'	29.49	35.444	29.6	29.6	23.8	10.7	124	
33		1500	3°57'N	50°24'	29.42	35.453	29.8	29.7	25.4	10.4	135	
34		1600	3°57'N	50°35'	29.58	35.480	29.6	28.7	24.2	10.8	125	
35		1700	3°57'N	50°48'	29.61	35.544	29.8	29.0	24.2	10.5	128	
36		1800	3°57'N	50°58'	29.60	35.548	29.9	29.4	24.5	10.6	128	
37		1900	3°58'N	51°09	29.70	35.584	29.9	28.4	23.3	10.7	124	
38		2000	3°58'N	51°20'	29.67	35.600	29.8	29.7	23.9	10.8	132	
39		2100	3°59'N	51°32'	29.60	35.620	29.7	29.7	24.7	10.9	141	
40		2200	4°00'N	51°43'	29.40	35.438	29.7	28.6	24.2	11.0	138	
41		2300	4°00'N	51°55'	29.82	35.461	29.9	29.2	24.8	11.0	143	
42	22.V	0000	4°01'N	52°06'	29.98	35.495	30.1	29.0	24.2	11.1	132	
43		0100	4°02'N	52°18'	29.92	35.482	30.1	29.7	24.0	11.2	128	
44		0206	4°02'N	52°30'	29.88	35.461	30.0	29.6	23.9	11.0	131	
45		0306	4°02'N	52°42'	29.78	35.461	30.0	30.0	23.9	11.2	126	
46		0400	4°01'N	52°52'	29.98	35.460	30.1	30.0	23.4	11.3	127	
47		1200	4°06'N	52°54'	30.25	35.475	30.4	30.0	24.0	11.2	129	
48		1300	4°11'N	52°44'	30.20	35.468	30.3	29.5	24.3	11.0	125	
49		1800	4°18'N	52°43'	30.02	35.465	30.3	30.0	24.9	10.7	126	
50		1900	4°21'N	52°33'	29.99	35.513	30.2	29.4	24.2	10.8	130	
51	23.V	0300	4°32'N	52°11'	29.62	35.530	29.7	29.7	24.8	10.8	125	
52		0400	4°38'N	52°02'	29.73	35.615	29.8	29.6	24.3	10.7	130	
53		0500	4°44'N	51°52'	29.87	35.607	29.8	29.0	24.6	10.6	133	
54		1205	4°56'N	51°34'	29.66	35.458	29.9	27.9	23.7	10.7	140	
55		1300	5°01'N	51°26'	29.60	35.517	29.7	28.5	23.5	10.7	138	
56	24.V	0620	5°07'N	51°11'	29.28	35.504	29.7	29.7	26.0	11.1	144	
57		0715	5°12'N	51°03'	29.30	-	29.4	29.3	25.8	11.4	132	
58		0800	5°17'N	50°58'	29.25	35.497	29.4	29.3	25.1	11.2	141	
59		1500	5°24'N	50°49'	29.32	35.503	29.4	29.3	24.9	10.9	132	
60		1605	5°30'N	50°40'	29.20	35.486	29.3	29.3	26.1	10.8	143	
61		1700	5°36'N	50°34'	29.18	35.500	29.3	29.2	25.7	10.9	136	
62	25.V	0500	5°50'N	50°16'	29.02	35.448	29.1	29.1	26.0	11.1	140	
63		0620	5°58'N	50°06'	29.03	35.462	29.1	29.0	24.4	10.9	128	
64	26.V	0500	6°13'N	49°54	29.00	35.460	29.1	29.1	23.0	11.2	121	
65	27.V	1330	6°52'N	49°36'	27.42	35.097	27.4	26.1	22.8	-	131	
66		1430	7°00'N	49°27'	26.91	35.361	26.9	-	-	-	-	Water depth 25m only
67		1515	7°03'N	49°36	27.08	35.052	27.1	26.0	22.7	-	138	
68		1604	7°05'N	49°46'	27.56	35.110	27.5	26.3	23.1	12.3	170	
69		2000	7°11'N	49°55	27.71	35.125	27.7	27.0	23.5	10.7	149	

TABLE 9 (cont'd)

XBT List (cont'd)

Consec No.	Date	Time GMT	Lat.	Long. E	Bucket		From XBT record					Remarks
					T°C	S°/oo	T (0m)	T (50m)	T (100m)	T (400m)	20°C depth (m)	
70		2100	7°12'N	50°07'	28.20	35.237	28.2	28.4	23.0	11.7	149	
71		2200	7°14'N	50°19'	28.70	35.448	28.9	28.9	24.8	12.8	165	
72		2300	7°17'N	50°30'	28.79	35.461	29.0	28.8	25.8	12.0	142	
73	28.V	0000	7°19'N	50°41'	28.78	35.446	28.8	28.8	26.3	12.7	151	
74		0530	7°16'N	50°41'	28.70	35.351	28.8	28.7	27.2	12.7	152	
75		0615	7°10'N	50°47'	28.60	35.431	28.6	28.6	27.8	11.8	164	
76		0700	7°04'N	50°54'	29.62	35.646	29.7	29.6	27.3	11.5	174	
77		0800	6°55'N	51°02'	29.72	35.535	29.8	29.8	26.5	10.2	156	
78		0900	6°46'N	51°11,	29.78	35.531	29.8	29.8	26.2	10.4	160	
79		1000	6°38'N	51°20'	29.80	35.428	29.8	29.8	26.2	11.4	146	
80		1100	6°29'N	51°29'	29.85	35.461	29.8	29.7	25.7	11.1	155	
81		1200	6°20'N	51°37'	29.82	35.441	29.8	29.8	25.5	10.9	144	
82		1300	6°12'N	51°44	29.78	35.493	29.8	29.7	25.9	11.1	145	
83		1400	6°04'N	51°53'	29.72	35.450	29.7	29.7	24.2	10.9	150	
84		1500	5°55'N	51°54'	29.70	35.472	29.9	29.8	24.8	10.9	150	
85		1600	5°45'N	51°45'	29.73	35.560	29.9	29.6	24.4	10.8	149	
86		1700	5°36'N	51°37'	29.71	35.498	29.8	29.8	24.8	11.6	140	
87		1800	5°26'N	51°28'	29.71	35.598	29.9	29.9	25.5	10.9	148	
88		1900	5°17'N	51°20'	29.70	35.603	29.9	29.9	25.0	11.1	148	
89		2000	5°07'N	51°11'	29°68	35.641	29.8	29.7	24.3	11.1	145	
90		2100	4°58'N	51°04'	29.65	35.626	29.8	29.5	23.1	11.0	134	
91		2200	4°49'N	50°55'	29.59	35.652	29.6	23.4	23.4	10.4	130	
92		2300	4°40'N	50°47'	29.50	35.647	29.6	29.6	24.8	10.7	134	
93	29.V	0000	4°31'N	50°40'	29.32	35.612	29.5	29.3	25.2	11.0	131	
94		0100	4°22'N	50°33'	29.08	35.497	29.3	29.2	24.0	10.8	119	
95		0200	4°13'N	50°27'	29.24	35.529	29.4	29.3	24.5	10.6	126	
96		0300	4°03'N	50°20'	29.44	35.525	29.5	29.5	23.1	10.4	115	
97		0404	3°54'N	50°13'	29.53	35.530	29.6	28.8	21.5	10.3	115	
98		0500	3°45'N	50°06'	29.54	35.532	29.6	26.7	22.7	10.3	112	
99		0600	3°36'N	49°59'	29.02	35.339	29.1	26.8	20.4	10.4	103	
100		0700	3°26'N	49°52'	27.37	34.953	26.9	26.6	20.2	10.6	102	
101	29.V	0800	3°17'N	49°45'	27.28	34.978	26.	26.1	18.3	10.7	85	
102		0900	3°12'N	49°35'	26.91	34.979	26.5	25.9	18.2	11.2	83	
103		1000	3°03'N	49°29'	27.30	35.007	27.0	25.8	17.1	10.5	79	
104		1100	2°54'N	49°24'	27.30	35.003	27.0	25.8	16.7	10.7	84	
105		1200	2°45'N	49°19'	27.42	34.963	27.2	25.6	16.5	11.4	84	
106		1300	2°36'N	49°14'	27.55	34.918	27.5	25.5	17.1	11.0	91	
107		1400	2°26'N	49°09	27.72	34.911	27.6	25.5	16.9	11.5	88	
108		1506	2°16'N	49°04'	27.50	34.882	27.5	25.6	20.0	11.0	100	
109		1606	2°06'N	48°59'	27.70	34.931	27.7	25.6	20.2	11.0	102	
110		1700	1°57'N	48°55'	27.72	34.905	27.7	25.4	18.6	11.1	98	
111		1800	1°48'N	48°50'	27.65	34.897	27.7	25.0	18.2	10.9	91	
112		1900	1°38'N	48°46'	27.72	34.891	27.7	25.3	19.0	11.0	99	
113		2000	1°30'N	48°39'	27.81	34.925	27.8	25.0	17.5	10.8	92	
114		2100	1°22'N	48°30'	27.85	34.934	27.8	24.9	17.1	10.7	90	
115		2200	1°15'N	48°23'	27.91	34.922	28.1	23.6	16.8	11.0	92	
116		2300	1°08'N	48°14'	27.95	34.923	27.9	23.4	19.7	10.7	96	
117	30.V	0000	1°00'N	48°05'	28.07	34.924	28.1	23.0	20.2	10.8	106	
118		0100	0°52'N	47°57'	28.10	34.927	28.2	24.0	20.2	10.8	106	
119		0200	0°42'N	47°50'	28.12	34.935	28.2	21.0	19.2	10.7	85	
120		0300	0°32'N	47°42'	28.12	34.936	28.2	21.2	18.9	10.9	72	
121		0400	0°23'N	47°34'	28.18	34.936	28.2	20.5	18.8	10.8	52	
122		0500	0°13'N	47°25'	28.23	34.969	28.3	21.0	18.9	10.8	55	
123		0600	0°04'N	47°16'	28.20	34.962	28.4	20.5	18.7	10.8	52	
124		0700	0°05'S	47°07'	28.35	34.960	28.3	19.2	17.7	10.7	48	
125		0804	0°16'S	46°58'	28.48	34.966	28.5	18.3	16.4	10.6	45	
126		0900	0°25'S	46°50'	28.48	34.939	28.4	20.0	15.9	10.4	50	
127		1000	0°35'S	46°41'	28.50	34.958	28.6	21.6	16.6	11.0	55	
128		1100	0°45'S	46°31'	28.59	34.951	28.6	21.3	16.5	10.6	53	
129		1200	0°54'S	46°22'	28.65	34.950	28.6	22.2	16.3	10.5	65	
130		1300	1°04'S	46°12'	28.54	34.937	28.6	23.0	16.3	10.5	69	
131		1400	1°14'S	46°03'	29.28	34.976	28.3	22.9	16.7	10.5	78	
132		1500	1°23'S	45°53'	28.08	35.073	28.1	23.1	17.9	11.0	80	
133		1620	1°37'S	45°41'	28.30	35.149	28.9	24.9	18.9	10.1	88	
134		1700	1°44'S	45°34'	28.42	35.185	29.0	24.3	19.4	13.6	84	
135		1800	1°54'S	45°25'	28.32	35.212	29.0	25.0	16.3	10.9	78	
136		1900	2°04'S	45°16'	28.32	35.241	29.0	24.7	17.0	11.2	82	
137		2000	2°13'S	45°06'	28.20	35.191	28.9	28.0	20.0	10.6	100	
138		2100	2°24'S	44°59'	27.92	35.153	28.6	27.0	20.3	10.7	104	
139		2200	2°36'S	44°52'	27.59	35.147	28.2	28.1	21.3	11.1	112	
140		2300	2°47'S	44°46'	27.55	35.133	28.0	27.4	21.7	10.8	111	
141	31.V	0000	2°58'S	44°39'	27.00	35.135	28.4	27.5	23.7	11.1	120	

TABLE 9 (cont'd)

XBT List (cont'd)

Consec No.	Date	Time GMT	Lat.	Long. E	Bucket T°C	Bucket S‰	From XBT record T (0m)	T (50m)	T (100m)	T (400m)	20°C depth (m)	Remarks
142	31.V	0100	3°10'S	44°33'	27.81	35.131	28.4	26.8	22.4	10.6	113	
143		0200	3°22'S	44°27'	27.89	35.136	28.5	28.0	23.5	10.7	128	
144		0300	3°34'S	44°21'	27.80	35.148	28.4	28.3	23.0	10.6	117	
145		0420	3°51'S	44°13'	28.00	35.146	28.6	28.4	23.3	9.7	117	
146		1300	4°05'S	43°51'	28.47	35.163	29.0	28.7	21.8	9.6	110	
147		1400	4°05'S	43°39'	28.35	35.227	29.0	28.8	22.3	9.8	109	
148		1445	4°05'S	43°30'	28.37	35.217	29.0	28.7	23.0	9.7	110	
149	1.VI	0900	4°04'S	43°01'	28.22	35.058	28.8	28.8	21.6	9.5	112	
150		1000	4°04'S	42°50'	28.30	34.971	28.8	28.8	20.5	9.6	103	
151		1800	4°07'S	42°26'	28.04	34.858	28.7	28.6	20.9	10.7	112	
152		1900	4°05'S	42°16'	27.87	34.785	28.5	28.6	21.0	10.3	111	
153	2.VI	0900	4°02'S	42°03'	27.83	34.803	28.4	28.4	20.2	10.3	103	
154		1000	4°02'S	41°52'	27.88	34.816	28.5	28.6	19.3	10.3	98	
155		1700	4°03'S	41°37'	27.85	34.836	28.5	28.4	19.5	10.3	95	
156		1800	4°04'S	41°27'	27.78	34.737	28.5	28.6	20.0	9.5	100	
157		1900	4°03'S	41°17'	27.71	34.716	27.3	24.8	18.2	9.6	80	
158	3.VI	0700	4°05'S	41°05'	27.70	34.890	28.4	28.4	20.5	9.5	105	
159		0800	4°04'S	40°55'	27.85	34.931	28.5	28.5	20.9	10.3	107	
160		0900	4°04'S	40°46'	27.73	34.863	28.4	28.4	21.7	10.2	150	
161		1550	4°02'S	40°32'	27.27	34.783	28.0	28.0	21.4	9.9	110	
162	4.VI	1600	4°00'S	40°24'	27.34	34.783	28.1	28.1	22.4	10.5	121	
163		1700	4°01'S	40°16'	27.35	34.788	28.0	27.7	25.3	10.6	134	
164		1800	4°02'S	40°07'	27.38	34.754	28.0	27.6	26.2	9.5	154	
165	10.VI	0839	2°05'S	41°40'	27.38	34.908	27.8	27.5	24.0	10.9	118	
166	11.VI	0730	2°18'S	41°49'	27.42	34.862	28.0	27.8	22.2	10.2	116	
167		0845	2°24'S	42°00'	27.68	34.905	28.2	27.9	21.6	10.5	111	
168		1415	2°29'S	42°11'	27.69	34.895	28.2	27.9	21.8	11.1	111	
169		1500	2°34'S	42°17'	27.58	34.904	28.3	27.9	22.3	10.4	119	
170		1600	2°40'S	42°24'	27.66	35.064	28.3	28.3	21.3	10.6	107	
171	12.VI	0615	2°53'S	42°32'	27.85	35.093	28.5	28.4	21.7	10.5	110	
172		0715	2°58'S	42°41'	27.83	35.198	28.5	28.4	23.0	10.6	119	
173		0815	3°00'S	42°50'	27.92	35.222	28.6	28.4	23.0	10.0	107	
174		1505	2°57'S	43°10'	28.03	35.180	28.0	27.8	22.1	9.7	109	
175		1600	2°55'S	43°19'	27.88	35.182	28.0	27.8	22.2	9.7	108	
176		1700	2°54'S	43°29'	27.90	35.180	28.0	27.8	21.6	9.7	108	
177		1800	2°52'S	43°39'	27.84	35.187	27.9	27.7	20.8	9.7	112	
178		1900	2°49'S	43°48'	27.88	35.201	27.9	27.9	21.3	9.6	113	
179	13.VI	0300	2°44'S	44°09'	27.88	35.198	27.9	19.5	19.5	10.9	92	
180		0400	2°41'S	44°19'	27.85	35.184	27.8	27.7	20.0	9.6	100	
181		0500	2°40'S	44°29'	27.88	35.206	27.9	27.8	19.1	10.6	90	
182		0610	2°38'S	44°40'	27.89	35.171	27.9	27.8	18.9	-	82	Bad trace below 200m
183		0700	2°38'S	44°49'	27.91	35.173	27.9	27.8	19.1	-	81	- " -
184		1300	2°34'S	45°12'	28.05	35.156	28.0	27.8	19.3	10.8	83	
185		1400	2°32'S	45°23'	27.93	35.186	28.0	23.6	17.6	10.7	68	
186		1500	2°31'S	45°33'	27.84	35.178	28.0	23.0	16.5	10.8	59	
187		1600	2°30'S	45°43'	27.82	35.126	27.9	21.5	15.7	10.8	58	
188		1700	2°31'S	45°53'	27.79	35.097	27.8	22.6	18.3	10.9	57	
189		2300	2°26'S	46°09'	27.66	35.039	27.6	20.4	15.0	11.0	52	
190	14.VI	0000	2°25'S	46°19'	27.22	34.924	27.2	19.9	15.1	10.9	48	
191		0100	2°24'S	46°30'	26.82	34.911	26.9	21.6	15.9	10.9	62	
192		0200	2°23'S	46°40'	26.53	34.933	26.6	20.8	16.2	10.9	54	
193		0300	2°22'S	46°51'	26.67	34.904	26.6	20.2	16.3	10.7	52	
194		0900	2°22'S	47°09'	26.84	34.999	26.7	19.6	17.0	11.6	45	
195		1000	2°20'S	47°20'	26.88	35.013	26.7	20.7	17.7	11.1	52	
196		1100	2°17'S	47°30'	26.72	35.011	27.0	20.5	17.9	11.1	63	
197		1200	2°15'S	47°40'	26.70	35.006	26.6	20.8	17.7	10.9	60	
198		1300	2°12'S	47°50'	26.52	35.016	26.5	21.2	17.7	10.7	69	
199		1900	2°09'S	48°09'	26.09	35.011	26.1	21.7	18.1	10.3	75	
200		2000	2°08'S	48°20'	26.27	34.977	26.2	22.0	18.1	10.1	68	
201		2100	2°06'S	48°31'	-	34.985	26.0	20.3	17.4	10.5	51	
202		2200	2°04'S	48°41'	26.14	34.979	26.1	22.8	18.7	10.6	71	
203		2300	2°02'S	48°52'	26.19	34.961	26.2	22.5	16.7	9.7	68	
204	15.VI	0600	1°56'S	49°03'	26.42	34.966	26.2	23.6	18.5	9.2	76	
205		0700	1°45'S	49°02'	26.48	34.980	26.2	23.7	19.1	9.3	81	
206		1400	1°20'S	49°00'	26.30	34.998	26.2	23.8	19.1	10.2	83	
207		1500	1°10'S	48°58'	26.30	34.998	26.2	24.4	19.4	10.6	90	
208		2200	0°48'S	49°00'	26.40	34.991	26.4	23.4	19.3	10.7	79	
209		2300	0°37'S	49°00'	26.53	34.989	26.5	23.2	17.6	10.5	79	
210	16.VI	0500	0°23'S	49°03'	26.66	35.014	26.5	24.3	14.3	10.5	87	
211		0600	0°12'S	49°03'	26.66	35.012	26.9	25.3	19.7	10.5	98	
212	17.VI	0800	0°16'N	48°57'	27.08	35.011	26.8	25.5	20.9	10.2	108	

TABLE 9 (cont'd)

XBT List (cont'd)

Consec No.	Date	Time GMT	Lat.	Long. E	Bucket		From XBT record					Remarks
					T°C	S‰	T (0m)	T (50m)	T (100m)	T (400m)	20°C depth (m)	
213	17.VI	0853	0°26'N	48°59'	27.10	34.968	26.9	24.8	20.5	10.2	109	
214		1430	0°38'N	49°02'	27.10	34.950	27.0	25.7	20.2	10.3	102	
215		1530	0°49'N	49°03'	27.08	34.930	27.1	26.5	21.3	10.8	106	
216		2230	1°07'N	48°58'	27.10	34.969	27.0	26.9	20.9	10.5	105	
217		2330	1°14'N	48°52'	27.12	34.988	27.1	26.5	19.0	10.8	97	
218	18.VI	1530	1°26'N	48°37'	27.37	35.101	27.3	27.0	20.0	10.3	100	
219		1630	1°31'N	48°32'	27.42	35.120	27.4	26.0	19.5	10.3	99	
220		1730	1°37'N	48°26'	27.24	35.144	27.3	25.1	18.4	10.5	94	
221	19.VI	0130	1°46'N	48°26'	-	-	27.2	26.5	18.5	10.4	95	
222		0230	1°49'N	48°22'	27.18	35.180	27.2	20.0	19.8	10.3	50	
223		0400	1°54'N	48°17'	27.18	35.142	27.2	24.4	16.9	10.6	90	
224		0530	2°02'N	48°10'	27.11	35.130	27.0	25.4	17.0	10.7	93	
225		1130	2°03'N	48°06'	27.19	35.132	27.2	23.8	16.8	10.5	81	
226		2100	2°11'N	47°56'	27.05	35.122	27.1	23.1	16.8	10.8	76	
227		2305	2°19'N	47°47'	26.92	35.069	26.9	21.7	15.7	10.8	60	
228	20.VI	0100	2°24'N	47°41'	26.81	35.074	26.8	23.0	15.5	10.7	68	
229		1700	2°31'N	47°32'	26.86	35.000	26.7	19.4	14.8	10.7	47	
230		1907	2°40'N	47°21'	26.88	34.967	26.7	21.8	14.6	10.6	56	
231	21.VI	1300	3°00'N	47°16'	26.44	34.997	26.5	18.7	14.1	10.8	42	
232		1500	3°03'N	47°08'	26.08	34.967	26.1	18.5	13.9	10.6	42	
233		2245	3°14'N	47°04'	23.28	35.019	23.6	14.1	13.6	-	15	Trace terminated at 260m
234	22.VI	0000	3°24'N	47°19'	22.90	35.030	22.9	14.6	13.6	10.3	21	
235		0100	3°34'N	47°31'	22.29	35.030	22.2	14.6	13.6	10.5	22	
236		0205	3°46'N	47°44'	21.82	35.020	21.8	14.6	13.7	10.5	23	
237		0240	3°52'N	47°51'	21.39	35.011	21.3	14.8	14.4	10.6	25	
238		0300	3°52'N	47°55'	21.42	35.018	21.6	16.4	14.4	10.6	35	
239		0330	3°52'N	48°02'	21.84	35.014	22.0	16.6	14.2	10.4	28	
240		0400	3°52'N	48°09'	22.36	35.006	22.2	16.4	14.1	10.7	26	
241		0430	3°52'N	48°16'	22.30	35.007	22.4	16.2	14.4	11.7	28	
242		0500	3°51'N	48°23'	22.68	35.008	22.8	17.0	14.9	10.8	34	
243		0600	3°50'N	48°37'	23.10	35.004	22.7	17.5	14.7	10.8	43	
244		0703	3°49'N	48°52'	23.62	34.998	23.6	19.5	15.3	10.6	46	
245		0800	3°50'N	49°06'	23.41	35.000	23.7	20.5	16.1	10.9	52	
246		0900	3°51'N	49°21'	23.79	34.991	24.2	20.7	17.5	9.9	58	
247		1000	3°53'N	49°35'	23.94	34.989	24.0	20.7	18.1	10.7	58	
248		1100	3°57'N	49°49'	24.08	34.994	23.8	20.7	12.0	10.5	63	
249		1700	3°58'N	50°15'	23.72	35.005	23.7	21.7	18.8	10.2	85	
250		1800	4°00'N	50°30'	23.48	35.030	23.5	22.0	19.4	10.8	90	
251		1900	4°00'N	50°44'	23.72	35.168	23.5	23.2	21.4	10.2	119	
252		2000	4°02'N	50°54'	28.30	35.505	28.3	24.6	20.3	10.6	102	
253		2100	4°04'N	51°03'	28.22	35.531	28.2	26.3	21.6	10.5	123	
254		2200	4°06'N	51°13'	28.20	35.539	28.2	27.0	21.8	10.6	118	
255		2300	4°08'N	51°23'	28.17	35.539	28.1	28.1	25.0	10.2	131	
256	23.VI	0000	4°09'N	51°34'	28.04	35.564	28.0	28.0	26.7	10.4	149	
257		0106	4°10'N	51°46'	27.95	35.562	28.1	28.1	26.6	10.7	130	
258		0200	4°10'N	51°55'	27.85	35.560	27.7	27.7	27.1	10.4	140	
259		0300	4°11'N	52°06'	27.68	35.621	27.7	27.6	26.4	10.9	142	
260		0400	4°12'N	52°17'	27.74	35.678	27.7	27.7	26.3	11.0	134	
261		0500	4°13'N	52°28'	27.69	35.694	27.7	27.6	25.2	10.2	133	
262		0600	4°13'N	52°38'	27.63	35.702	27.7	27.7	26.2	10.6	133	
263		0700	4°13'N	52°49'	27.69	35.705	27.7	27.7	26.5	10.6	134	
264		0910	4°13'N	52°53'	27.83	35.687	27.6	27.6	26.7	10.4	128	
265		1000	4°09'N	52°49'	27.88	35.696	27.7	27.6	26.0	10.4	123	
266		1100	4°04'N	52°44'	27.98	35.705	27.8	27.8	23.6	10.6	124	
267		1200	3°59'N	52°38'	28.08	35.689	28.0	27.9	24.2	10.2	130	
268		1300	3°54'N	52°33'	28.18	35.665	28.1	28.0	24.2	10.7	121	
269		1405	3°48'N	52°26'	28.09	35.669	28.1	28.1	25.3	10.7	122	
270		1500	3°43'N	52°20'	28.08	35.598	28.0	28.0	24.2	10.7	125	
271		1600	3°37'N	52°13'	28.03	35.572	28.1	28.0	23.9	10.7	132	
272		1700	3°32'N	52°06'	28.06	35.542	28.1	28.1	24.1	10.6	139	
273		1800	3°26'N	52°00	28.06	35.532	28.2	26.3	24.6	10.5	150	
274		1900	3°21'N	51°52'	28.14	35.525	28.2	26.8	24.3	10.4	144	
275		1930	3°21'N	51°48'	24.50	35.012	24.5	23.8	23.7	10.4	150	
276		2000	3°26'N	51°48'	24.21	35.006	24.2	24.1	24.0	10.3	138	
277		2100	3°37'N	51°50'	28.06	35.527	28.2	26.8	22.2	10.5	129	
278		2200	3°48'N	51°50'	28.02	35.556	28.1	27.1	22.7	10.5	122	
279		2300	4°00'N	51°50'	27.78	35.578	27.9	27.9	23.5	10.4	128	
280	24.VI	0000	4°12'N	51°49'	27.80	35.584	27.8	27.7	23.5	10.4	125	
281		0100	4°23'N	51°48'	27.39	35.708	27.5	27.5	26.0	10.6	130	
282		0200	4°34'N	51°47'	27.28	35.628	27.3	27.3	25.0	10.5	127	
283		0900	4°53'N	51°38'	27.65	35.622	27.4	27.3	26.1	10.5	130	
284		1000	5°00'N	51°30'	27.65	35.654	27.6	27.5	23.7	10.8	128	

XBT List (cont'd)

TABLE 9 (cont'd)

Consec No.	Date	Time GMT	Lat.	Long E.	Bucket T°C	Bucket S°/oo	From XBT Record T (0m)	T (50m)	T (100m)	T (400m)	20°C depth (m)	Remarks
285	24.VI	1600	5°11'N	51°17'	27.50	35.664	27.5	27.5	26.3	10.7	142	
286		1700	5°17'N	51°08'	27.53	35.662	27.6	27.5	26.4	10.9	134	
287		1800	5°23'N	50°59'	27.58	35.590	27.6	27.6	24.0	10.8	128	
288	25.VI	0800	5°34'N	50°48'	27.78	35.619	27.6	27.5	23.2	11.2	120	
289		0900	5°38'N	50°38'	27.79	35.604	27.7	27.6	21.0	11.2	109	
290A		2215	5°53'N	50°11'	27.42	35.642	27.5	23.2	18.3	12.3	67	
291		2300	5°58'N	50°04'	27.50	35.620	27.5	23.5	18.3	12.2	73	
292	27.VI	0600	6°23'N	49°40'	26.38	35.548	26.2	21.5	18.0	11.0	62	
293		0700	6°36'N	49°38'	26.34	35.539	26.2	23.2	18.4	11.0	74	
294		1200	6°54'N	49°42'	26.30	35.563	26.3	25.1	18.3	11.7	74	
295		1230	7°00'N	49°42'	25.98	35.501	26.0	24.3	18.0	-	80	
296		1330	7°09'N	49°49'	26.44	35.572	26.5	25.5	18.2	11.1	84	
297		1500	7°19'N	49°51'	26.12	35.518	26.1	25.0	17.2	-	71	
298		2200	7°26'N	50°12'	26.85	35.663	26.8	26.8	18.2	10.8	82	
299	28.VI	1220	7°18'N	50°32'	26.48	35.330	26.4	26.4	20.2	11.6	101	
300		2300	7°18'N	50°54'	26.52	35.336	26.6	26.6	22.2	11.3	123	
301	29.VI	0000	7°19'N	51°04'	26.48	35.346	26.8	26.8	24.7	10.9	129	
302		0700	7°22'N	51°26'	26.89	35.390	26.8	26.8	25.2	10.7	134	
303		0803	7°21'N	51°37'	26.82	35.425	26.8	26.8	25.9	11.1	144	
304		0900	7°20'N	51°47'	26.91	35.458	26.9	26.8	25.7	10.6	141	
305		1600	7°29'N	52°06'	26.81	35.441	26.8	26.8	25.5	11.7	158	
306		1700	7°39'N	52°12'	26.81	35.417	26.8	26.8	25.3	11.9	150	
307		1810	7°50'N	52°20'	26.55	35.423	26.7	26.7	26.0	11.5	163	
308	30.VI	0000	8°00'N	52°29'	26.68	35.371	26.6	26.6	26.0	11.5	165	
309		0100	8°08'N	52°34'	26.60	35.354	26.7	26.7	26.6	11.3	157	
310		0210	8°19'N	52°40'	26.50	35.334	26.5	26.4	26.0	-	158	No XBT record below 210m
311		0900	8°33'N	52°52'	26.46	35.345	26.3	26.3	26.0	11.6	157	
312		1000	8°42'N	52°56'	26.29	35.340	26.2	26.1	25.1	12.0	154	
313		1100	8°52'N	53°00'	26.26	35.370	26.2	26.1	24.6	11.9	147	
314	2.VII	0400	8°25'N	53°02'	26.67	35.467	26.7	26.6	26.3	12.1	177	
315		0706	8°23'N	52°53'	26.50	35.634	26.6	26.5	26.2	11.9	175	
316		1000	8°24'N	52°48'	26.78	35.559	26.6	26.6	26.2	11.8	181	
317	2.VII	1324	8°26'N	52°42'	26.68	35.517	26.7	26.7	26.0	11.8	167	
318		1600	8°26'N	52°34'	26.52	35.554	26.6	26.6	26.5	11.6	190	
319		1904	8°28'N	52°24'	26.50	35.566	26.6	26.6	25.9	10.0	168	
320		2200	8°31'N	52°10'	26.38	35.540	26.4	26.3	25.6	11.6	154	
321	3.VII	0000	8°33'N	52°02'	26.29	35.541	26.3	26.2	24.3	11.6	183	
322		0200	8°36'N	51°54'	26.26	35.520	26.3	26.3	22.7	11.5	122	
323		0400	8°39'N	51°50'	26.92	35.805	26.9	26.9	19.7	11.3	97	
324		0712	8°43'N	51°42'	26.72	35.797	26.7	26.7	19.5	-	94	record only to 150m
325		1000	8°50'N	51°29'	26.50	35.787	26.6	26.3	18.3	-	78	record only to 350m
326		1200	8°54'N	51°18'	25.74	35.599	25.5	21.6	17.3	11.5	62	
327		1300	8°56'N	51°12'	25.19	35.599	25.1	21.5	17.1	11.2	68	
328		1408	8°58'N	51°05'	24.10	35.497	24.1	20.7	17.2	11.3	53	
329		1502	9°00'N	50°59'	22.59	35.436	22.7	20.0	15.0	10.0	50	
330		1600	9°11'N	51°00'	20.38	35.403	19.8	17.3	14.8	11.4	-	
331		1700	9°24'N	51°05'	18.78	35.409	18.8	17.6	15.2	-	-	Bottom 225m
332		1800	9°35'N	51°10'	18.32	35.450	18.4	16.7	15.0	-	-	" 235m
333		1900	9°46'N	51°14'	18.45	35.397	18.4	17.3	15.8	-	-	" 200m
334		2003	9°57'N	51°17'	18.18	35.443	18.0	17.8	15.7	-	-	
335		2104	10°08'N	51°21'	18.10	35.443	18.0	17.3	-	-	-	
336		2200	10°17'N	51°26'	18.36	35.512	18.3	17.8	-	-	-	
337		2300	10°27'N	51°29'	18.84	35.588	18.8	17.3	-	-	-	
338	4.VII	0000	10°38'N	51°28'	19.29	35.611	19.2	19.2	-	-	-	
339		0100	10°49'N	51°26'	20.80	35.643	20.4	19.0	17.4	-	25	
340		0207	11°01'N	51°24'	21.87	35.751	22.2	21.5	18.1	-	57	
341		0300	11°11'N	51°22'	22.71	35.847	22.8	22.2	13.7	-	65	

SURFACE CURRENTS CR. 102 leg 1

Date 1979	Time Z	Lat	Long	Speed (kt)	Dir °T	Remarks
10.V	1134	3 56.5S	55 26.3E	.43	041	
	1406	3 30.6	55 22.2	2.15	043	
	1552	3 23.2	55 05.1	.87	092	
	2214	3 06.4	53 59.6	.45	121	
11.V	0000	3 02.1	53 40.6	1.08	113	
	0134	2 58.6	53 24.8	.69	114	
	0318	2 54.5	53 06.6	.56	119	
	0817	2 44.0	52 13.8	.54	174	
	1020	2 40.1	51 51.2	.46	185	
	1138	2 37.6	51 36.8	.35	255	
	1300	2 34.4	51 21.2	.15	204	
	1444	2 33.6	51 14.7	.87	026	
	2152	2 10.2	50 06.6	1.83	349	
12.V	0008	1 59.9	49 36.2	1.75	338	
	0212	1 56.6	49 12.7	1.76	343	
	0356	1 59.3	48 59.6	1.88	335	STN 10014
	1524	1 54.1	48 59.2	1.65	323	
	2042	1 13.3	48 58.9	1.40	325	STN 10015
13.V	0010	1 12.9	48 59.0	1.68	323	
	0104	0 59.5	48 58.5	.89	311	
	0250	0 38.5	48 58.1	.42	000	STN 10016
	1022	0 21.7S	48 59.5	.29	339	
13.V	1146	0 05.7S	48 58.9	.42	147	STN 10017,10018,10019
15.V	0220	0 04.8N	48 49.8	.59	102	* STN 10020
	0810	0 19.2	48 59.8	.49	175	* STN 10021
	1154	0 28.9	49 01.8	.84	123	*
	1348	0 39.3	49 01.4	.43	140	*
	1534	0 58.2	49 00.4	.64	127	* STN 10022
16.V	0026	1 00.5	48 58.3	.42	138	*
	0112	1 06.6	48 53.0	.54	137	*
	0258	1 20.3	48 40.7	.71	090	* STN 10023
	1426	1 26.6	48 35.6	.78	048	*
	2108	1 46.9	48 16.2	.91	059	* STN 10024
17.V	0840	1 48.2	48 18.6	.91	060	*
	1110	2 03.1	47 58.2	1.12	073	* STN 10025, Mooring 272
	2152	2 06.5	48 01.4	2.01	081	*
	2250	2 11.8	47 53.8	2.51	078	*
	2340	2 16.5	47 47.9	2.99	068	*
18.V	0036	2 22.4	47 41.6	3.49	071	STN 10026
	1542	2 28.8	47 44.1	4.22	067	
	2348	2 43.6	47 17.0	4.64	060	
19.V	0122	2 49.3	47 14.5	4.39	068	STN 10027
	1436	2 48.9	47 15.1	3.35	062	
	2020	2 58.6	47 02.3	2.73	065	STN 10028
	2202	2 58.9	47 03.7	2.26	064	
	2348	3 04.2	46 56.7	1.11	060	
20.5	0200	3 03.9	46 57.4	.68	067	STN 10029
	0752	3 43.6	47 26.2	.78	083	
	0852	3 52.2	47 34.6	.69	063	
	1328	3 58.6	48 24.1	.84	032	
	1514	4 00.7	48 44.3	.98	006	
	1928	4 01.3	49 32.4	.29	081	
	2114	3 58.8	49 52.5	.38	146	Mooring 273
21.V	1406	3 57.3	50 13.4	1.02	169	
	1836	3 57.6	51 04.7			

* Gyro corrected for zero error

SURFACE CURRENTS CR. 102 leg 1 continued

Date 1979	Time Z	Lat	Long	Speed (kt)	Dir °T	Remarks
21.V	1836	3 57.6N	51 04.7E	.81	179	
	1928	4 00.0	51 14.5	.67	175	
	2114	3 59.1	51 34.5	.65	158	
	2210	3 59.8	51 45.3	.56	164	
	2308	4 00.6	51 56.3	.45	144	
22.V	0130	4 01.5	52 23.7	.16	097	
	0702	4 00.6	53 00.7	.21	029	STN 10031
	1130	4 03.3	52 58.7	.44	022	STN 10032, tide gauge
	1446	4 13.7	52 51.8	.29	044	
	1932	4 23.2	52 26.9			
			GYRO FAULT			STN 10033
23.V	0208	4 27.3	52 18.2	.18	121	
	0848	4 49.7	51 43.9	.37	159	STN 10034
	1040	4 49.1	51 44.3	.15	123	
	1136	4 53.3	51 38.1	.97	161	
	1840	5 04.5	51 22.6	.80	186	STN 10035
24.V	0658	5 09.9	51 05.7	.85	192	
	0844	5 22.1	50 53.3	.77	169	STN 10036
	1416	5 19.4	50 54.4	.23	204	
	1934	5 43.7	50 25.1	.09	249	STN 10037, mooring 274
25.V	0704	6 03.4	50 00.9	1.09	029	STN 10038
26.V	0216	6 08.8	50 02.3	1.62	024	
	0654	6 20 8	49 48.8	1.73	022	STN 10039
27.V	0708	6 28.2	49 51.3	2.01	023	STN 10040
	1240	6 43.5	49 42.2	2.25	016	Tide gauge
	1426	6 59.9	49 28.0	2.37	029	STN 10042
	1846	7 09.5	49 49.4	2.19	029	
	2032	7 11.7	50 01.2	1.84	039	
	2148	7 13.9	50 16.4	.90	038	
	2336	7 18.3	50 36.6	.42	059	
28.V	0146	7 18.6	50 40.7	.25	003	Mooring 275
	0920	6 43.4	51 14.1	.36	248	
	1106	6 27.7	51 29.5	.81	271	
	2004	5 06.9	51 11.3	.64	286	
	2100	4 58.4	51 03.7	.95	258	
	2334	4 34.5	50 42.8	.26	027	
29.V	0040	4 25.1	50 35.3	.09	237	
	0226	4 08.5	50 23.9	.84	310	
	0712	3 24.4	49 50.3	.44	024	
	0858	3 12.1	49 35.3	1.68	083	
	1018	3 00.3	49 27.7	2.00	084	
	1210	2 43.1	49 17.8	2.64	090	
	1356	2 26.8	49 09.5	2.61	094	
	1848	1 40.1	48 46.7	1.86	101	
	2156	1 15.6	48 23.3	1.07	134	
	2244	1 09.5	48 16.0	1.03	119	
30.V	0120	0 48.4	47 54.7	.54	152	
	0306	0 31.5	47 41.2	.79	223	
	0620	0 01.1N	47 13.5	1.32	226	
	0828	0 19.8S	46 54.5	1.52	245	
	1018	0 37.8	46 38.1	2.13	255	
	1248	1 02.4	46 14.1	1.97	263	
	1432	1 19.0	45 57.9	2.72	266	
	1942	2 10.5	45 09.3	2.83	268	
	2106	2 25.4	44 58.5	2.70	260	
	2252	2 45.6	44 46.6			

SURFACE CURRENTS CR. 102 leg 1 continued

Date 1979	Time Z	Lat	Long	Speed (kt)	Dir °T	Remarks
30.V	2252	2 45.6S	44 46.6E	2.22	264	
	2340	2 54.6	44 41.5	2.55	260	
31.V	0014	3 01.2	44 37.8	2.25	253	
	0200	3 22.1	44 26.7	1.67	227	
	0716	4 03.6	44 02.4	1.41	225	STN 10045
	1030	4 04.4	44 01.3	1.76	230	
	1324	4 05.3	43 46.0	1.77	216	
	1510	4 04.1	43 24.8	1.96	204	STN 10046
1.VI	0626	4 04.6	43 17.8	1.93	206	
	0812	4 03.3	43 09.9	2.09	211	
	0842	4 03.9	43 04.6	1.99	204	
	0940	4 03.9	42 53.8	1.87	207	
	1028	4 03.5	42 44.9	1.57	210	STN 10047
	1402	4 05.3	42 40.7	1.31	213	
	1944	4 04.6	42 10.6	1.01	218	STN 10048
2.VI	0720	4 02.1	42 11.4	1.31	233	
	0852	4 02.5	42 04.2	1.07	246	
	0940	4 02.3	41 55.5	.22	255	
	1126	4 03.0	41 42.1	.22	321	STN 10049
	1440	4 03.1	41 42.8	.20	337	
	2038	4 03.0	41 12.8	.68	005	STN 10050
3.VI	0208	4 00.8	41 13.7	.79	016	
	0814	4 03.7	40 53.1	1.54	024	STN 10051
	1334	4 00.2	40 45.3	1.96	026	
4.VI	0900	4 00.0	40 29.4	2.41	023	
	1412	4 01.8	40 26.1	2.30	017	
	1854	4 02.5	40 01.8	2.31	004	
	2308	3 56.3	40 04.8			

END OF LEG 1

SURFACE CURRENTS CR. 102 leg 2

Date 1979	Time Z	Lat	Long	Speed (kt)	Dir °T	Remarks
9.VI	1956	3 11.6S	40 27.5E	3.08	027	
	2050	3 01.9	40 35.6	3.02	042	
	2152	2 52.1	40 46.0	2.77	038	
	2236	2 45.3	40 53.0	3.04	042	
10.VI	0710	1 57.9	41 33.0	3.00	042	STN 10055, STN 10057
	0856	2 07.4	41 41.4	2.38	030	STN 10056
11.VI	0640	2 14.3	41 42.1	2.12	029	
	0802	2 19.9	41 54.8	1.61	023	
	0924	2 25.9	42 06.2	.97	027	STN 10058
	1322	2 25.5	42 07.4	.42	281	
	1812	2 47.5	42 33.9	.73	238	STN 10059
12.VI	0548	2 50.6	42 28.7	.94	239	
	0836	2 59.5	42 53.8	.93	274	STN 10060
	1400	2 58.5	42 59.9	.89	302	
	1840	2 49.9	43 45.2	1.41	321	
	2010	2 48.5	43 59.6	1.21	331	STN 10061
13.VI	0128	2 45.8	44 01.3	1.30	321	
	0610	2 38.2	44 40.3	1.26	329	
	0746	2 38.2	44 56.3	1.64	349	STN 10062
	1254	2 34.4	45 11.2	1.42	323	
	1744	2 27.5	45 57.5	1.20	335	STN 10063
	2208	2 28.4	46 00.0	1.00	310	
14.VI	0022	2 24.6	46 23.0	.60	291	
	0206	2 23.0	46 41.6	.41	244	
	0550	2 21.7	47 01.5	.48	258	STN 10064
	0758	2 21.3	47 02.0	.58	232	
	1146	2 15.4	47 37.8	1.03	230	
	1332	2 11.0	47 55.9	.72	220	STN 10065
	1910	2 09.0	48 11.0	.67	200	
	2120	2 05.8	48 34.5	.89	205	
15.VI	0100	2 01.2	49 01.4	.83	204	STN 10066
	0606	1 54.7	49 03.1	.90	190	
	0856	1 30.1	48 59.0	.66	187	STN 10067
	1740	1 01.2	48 58.8	.46	168	STN 10068
	2116	0 56.0	49 00.6	.72	164	
	2352	0 31.7	49 00.5	.49	139	STN 10069
16.VI	0136	0 32.9	49 00.4	.87	103	
	0650	0 02.8S	49 04.2	.74	076	STN 10070
17.VI	0748	0 13.3N	48 56.6	.99	082	
	0904	0 27.6	48 59.7	1.06	075	STN 10071
	1156	0 29.0	49 00.2	1.32	074	
	1734	1 00.5	49 01.8	1.91	070	STN 10072
	2124	0 59.6	49 03.2	2.22	076	
	2322	1 12.6	48 52.8	2.54	075	
18.VI	0108	1 20.4	48 40.8	2.61	075	STN 10073
	1234	1 19.3	48 40.0	2.79	076	
	1730	1 36.8	48 26.2	3.53	678	STN 10074
	2138	1 39.3	48 24.2	4.23	075	
19.VI	0558	2 01.6	48 08.4	4.38	068	STN 10075, Mooring 272
	1916	2 04.5	48 04.2	5.22	068	
20.VI	0558	2 21.7	47 37.9	5.19	064	STN 10076
	1010	2 25.2	47 37.3	5.51	067	
	1734	2 33.2	47 28.7	6.15	063	
	2002	2 44.5	47 16.8	6.44	061	STN 10077
21.VI	1058	2 50.9N	47 22.7			

SURFACE CURRENTS CR. 102 leg 2 continued

Date 1979	Time Z	Lat	Long	Speed (kt)	Dir °T	Remarks
21.VI	1058	2 50.9N	47 22.7E	6.73	055	
	1724	3 07.0	47 01.5	6.26	052	STN 10078
	2142	3 09.7	47 06.2	5.06	058	
22.VI	0500	3 51.4	48 23.2	5.13	067	
	0728	3 49.9	48 58.0	4.96	075	
	0916	3 51.4	49 24.7	4.60	079	
	1138	3 57.2	49 58.4	4.47	083	Mooring 273
	1738	3 59.5	50 24.6	3.90	100	
	1908	4 00.1	50 45.9	2.16	304	
	2010	4 02.3	50 55.4	1.75	297	
	2054	4 04.1	51 02.3	1.26	297	
	2302	4 07.8	51 23.4	.56	328	
23.VI	0046	4 09.2	51 41.8	.25	155	
	0508	4 13.5	52 29.3	.45	168	
	0640	4 13.0	52 45.7	.68	115	Tide gauge
	1030	4 06.8	52 46.3	.60	104	
	1214	3 57.8	52 36.9	.41	098	
	1646	3 32.8	52 07.9	.81	089	
	2108	3 38.4	51 49.9	.45	291	
24.VI	0416	4 45.6	51 45.0	.88	271	STN 10079
	0738	4 47.4	51 45.9	.93	294	
	1108	5 07.3	51 20.2	1.25	308	STN 10080
	1254	5 07.2	51 20.9	1.48	321	
	1810	5 24.5	50 57.2	2.00	327	STN 10081
25.VI	0732	5 30.9	50 53.3	3.00	327	
	1146	5 41.0	50 23.4	3.15	325	STN 10082, Mooring 274
	2014	5 45.8	50 27.5	3.20	328	
	2310	5 59.8	50 02.1	3.28	337	STN 10083
26.VI	1040	6 02.3	49 49.3	3.33	346	
	1744	6 19.1	49 45.2	3.30	347	STN 10084
	2348	6 18.0	49 48.0	2.75	005	
27.VI	0542	6 19.6	49 37.7	2.88	356	
	0656	6 35.4	49 40.6	2.96	004	STN 10085
	0802	6 41.2	49 43.4	2.75	005	
	1118	6 45.0	49 44.4	2.98	020	
	1302	7 05.5	49 45.2	3.44	024	
	1652	7 20.2	50 00.7	3.90	028	STN 10086
	2022	7 23.9	50 04.8	3.84	025	
	2240	7 26.1	50 12.9	3.74	033	Hove to
28.VI	0448	7 23.1	50 16.9	3.33	020	
	0634	7 17.5	50 20.9	3.16	024	STN 10087
	1010	7 19.6	50 23.1	2.72	020	
	1602	7 21.2	50 40.8	2.49	016	STN 10088, Mooring 275
	2120	7 19.7	50 46.0	2.02	015	STN 10089
29.VI	0624	7 22.1	51 20.1	1.32	006	
	1048	7 17.7	52 00.0	1.02	358	STN 10090
	1234	7 17.0	51 59.3	.86	012	
	1656	7 38.2	52 11.6	1.16	065	STN 10091
	1842	7 53.2	52 21.9	1.17	067	
	2356	7 59.2	52 28.6	2.00	091	
30.VI	0424	8 25.6	52 44.7	2.23	085	STN 10092
	0802	8 23.9	52 48.0	2.98	092	
	1128	8 56.3	53 01.3	3.30	094	STN 10093
1.VII	0034	8 53.0	53 10.4	2.75	107	
	0520	8 36.4	53 15.9	2.22	106	
	0858	8 30.9	53 11.3	2.09	099	
	1812	8 26.6	52 57.8			

TABLE 10 (cont'd)

SURFACE CURRENTS CR. 102 leg 2 continued

Date 1979	Time Z	Lat	Long	Speed (kt)	Dir °T	Remarks
1.VII	1812	8 26.6N	52 57.8E	1.85	095	
2.VII	0614	8 23.0	52 54.7	2.13	072	
	1752	8 27.3	52 27.9	2.60	061	
	2056	8 29.5	52 15.8	2.83	051	
3.VII	0336	8 38.6	51 50.8	3.49	052	
	0952	8 49.9	51 30.2	4.05	052	
	1136	8 53.8	51 21.0	3.31	048	
	1656	9 23.5	51 04.7	.35	068	
	2008	9 58.0	51 17.1	.21	094	
4.VII	0430	11 28.1	51 21.2			

WINDS

Date	Time Z	Lat.	Long.E.	Speed (kts)	Direction from (°T)
10.V	12	3°51'.5S	55°26'.4	10	159
	18	3°17'.5S	54°43'.1	9	132
11.V	00	3°2'.1S	53°40'.6	10	145
	06	2°48'.8S	52°38'.0	12	157
	12	2°36'.7S	51°32'.6	10	136
	18	2°23'.6S	50°41'.0	11	136
12.V	00	2°0'.5S	49°37'.6	12	148
	06	1°56'.0S	48°58'.4	8	168
	12	1°58'.3S	48°59'.4	6	115
	18	1°21'.8S	48°58'.0	4	305
13.V	00	1°12'.5S	48°59'.3	9	207
	06	0°32'.1S	48°59'.4	7	205
	12	0°3'.2S	48°58'.7	13	205
	18	0°0'.8S	49°0'.8	14	208
14.V	00	0°2'.1S	48°57'.6	16	209
	06	0°2'.6S	48°56'.3	12	199
	12	0°6'.0S	49°2'.5	12	203
	18	0°2'.2N	48°54'.1	12	196
15.V	00	0°1'.1S	48°56'.3	10	193
	06	0°7'.8N	48°57'.9	16	184
	12	0°28'.8N	49°1'.6	12	197
	18	0°57'.9N	49°0'.7	11	205
16.V	00	0°57'.0N	49°1'.2	13	178
	06	1°23'.6N	48°37'.8	10	188
	12	1°24'.2N	48°36'.6	12	195
	18	1°47'.2N	48°17'.9	10	210
17.V	00	1°47'.9N	48°17'.1	10	172
	06	1°49'.1N	48°16'.0	8	238
	12	2°2'.3N	48°0'.1	11	219
	18	2°1'.4N	48°6'.4	10	227
18.V	00	2°18'.6N	47°45'.6	14	210
	06	2°25'.6N	47°39'.8	10	216
	12	2°29'.3N	47°41'.0	10	218
	18	2°30'.6N	47°47'.0	10	192
19.V	00	2°43'.4N	47°15'.6	8	220
	06	2°49'.1N	47°13'.9	13	249
	12	2°51'.1N	47°18'.7	13	229
	18	2°57'.4N	46°59'.6	11	211
20.V	00	3°4'.2N	46°56'.4	10	225
	06	3°27'.3N	47°10'.5	8	240
	12	3°57'.4N	48°7'.3	13	200
	18	4°1'.3N	49°15'.8	12	207
21.V	00	3°58'.4N	49°59'.8	11	194
	06	3°57'5N	50°0'.7	14	192
	12	3°57'.5N	50°3'.1	17	230
	18	3°57'.4N	50°57'.9	10	242
22.V	00	4°1'.3N	52°6'.3	20	221
	06	4°0'.6N	53°0'.2	6	223
	12	4°6'.2N	52°53'.9	10	209
	18	4°17'.8N	52°43'.0	7	181

WINDS (cont'd)

Date	Time Z	Lat.	Long.E.	Speed (kts)	Direction from (oT)
23.V	00	4°27',4N	52°17'.3	8	184
	06	4°49'.5N	51°43'.3	11	209
	12	4°55'.4N	51°34'.6	9	223
	18	5°5'.2N	51°22'.2	15	209
24.V	00	5°3'.9N	51°20'.3	16	211
	06	5°5'.2N	51°14'.5	16	223
	12	5°20'.6N	50°53'.8	16	228
	18	5°42'.1N	50°26'.9	22	195
25.V	00	5°42'.3N	50°25'.0	22	218
	06	5°56'.4N	50°8'.5	20	228
	12	6°6'.5N	50°0'.7	23	202
	18	6°8'.5N	50°2'.8	20	204
26.V	00	6°8'.4N	49°57'.8	27	211
	06	6°20'.4N	49°48'.6	19	222
	12	6°21'.6N	49°50'.6	19	183
	18	6°23'.0N	49°42'.4	20	182
27.V	00	6°24'.5N	49°50'.3	20	212
	06	6°25'.0N	49°51'.0	17	230
	12	6°42'.0N	49°42'.6	15	184
	18	7°8'.3N	49°47'.4	17	193
28.V	00	7°19'.3N	50°41'.0	15	201
	06	7°12'.4N	50°45'.1	14	230*
	12	6°19'.8N	51°36'.8	18	258
	18	5°26'.2N	51°28'.5	12	207
29.V	00	4°30'.8N	50°39'.8	17	215
	06	3°35'.7N	49°58'.9	8	201
	12	2°44'.6N	49°18'.7	11	207
	18	1°47'.8N	48°50'.4	8	200
30.V	00	1°0'.3N	48°4'.6	9	186
	06	0°4'.2N	47°16'.3	11	159
	12	0°54'.5S	46°21.8	7	150
	18	1°53'.6S	45°25'.1	10	126
31.V	00	2°58'.5S	44°39'.4	6	143
	06	4°3'.7S	44°3'.0	11	125
	12	4°5'.2S	44°0'.2	10	136
	18	4°5'.0S	43°19'.1	13	159
1.VI	00	4°7'.3S	43°22'.9	11	176
	06	4°3'.7W	43°18'.0	16	122
	12	4°2'.7S	42°41'.2	12	154
	18	4°7'.2S	42°26'.4	22	143
2.VI	00	4°5'.3S	42°10.7	19	155
	06	4°9'.3S	42°8'.9	26	162
	12	4°3'.1S	41°42'.3	23	146
	18	4°3'.5S	41°26'.8	17	160
3.VI	00	4°2'.8S	41°12'.4	18	189
	06	4°5'.9S	41°13'.3	14	163
	12	4°1'.1S	40°44'.3	11	164
	18	4°0'.3S	40°30'.8	20	166
4.VI	00	4°3'.6S	40°34'.7	22	172
	06	4°3'.3S	40°27'.5	17	186
	12	4°2'.3S	40°25'.9	20	188
	18	4°2'.2S	40°7'.2	23	179

*(* from bridge met. log)*

WINDS (cont'd)

Date	Time Z	Lat.	Long.E.	Speed (kts)	Direction from (oT)
10.VI	00	2°31'.0S	41°6'.1	17	184
	06	1°59'.7S	41°31'.5	11	185
	12	2°11'.4S	41°46'.8	12	170
	18	2°11'.9S	41°46'.9	12	186
11.VI	00	2°7'.4S	41°38'.7	15	163
	06	2°15'.1S	41°40'.4	16	173
	12	2°25'.9S	42°7'.2	12	197
	18	2°47'.6S	42°33'.8	12	182
12.VI	00	2°47'.5S	42°33'.3	13	172
	06	2°51'.55	42°30'.0	14	174
	12	2°58'.7S	42°58'.4	8	194
	18	2°51'.6S	43°38'.6	11	203
13.VI	00	2°46'.5S	44°0'.8	16	167
	06	2°38'.5S	44°38'.6	16	173
	12	2°37'.0S	45°2'.9	13	202
	18	2°27'.5S	45°57'.5	13	185
14.VI	00	2°25'.1S	46°19'.1	10	216
	06	2°21.7S	47°1.6	5	184
	12	2°14'.7S	47°40'.2	10	232
	18	2°10'.2S	48°2'.1	20	217
15.VI	00	2°0'.1S	49°0'.6	16	200
	06	1°56'.0S	49°3'.1	18	208
	12	1°31'.2S	49°0'.2	15	202
	18	1°1'.1S	48°59'.0	16	212
16.VI	00	0°31'.8S	49°0'.5	20	210
	06	0°11'.8S	49°3'.6	19	202
	12	0°0'.4N	49°1'.2	20	210
	18	0°0'.3S	49°1'.4	18	204
17.VI	00	0°0'.3N	48°57'.9	17	212
	06	0°2'.5N	48°54'.3	13	225
	12	0°29'.0N	49°0'.2	18	213
	18	1°0'.3N	49°1'.7	18	202
18.VI	00	1°16'.2N	48°48'.5	18	192
	06	1°20'.6N	48°42'.4	16	204
	12	1°20'.2N	48°41'.2	19	214
	18	1°38'.8N	48°23'.8	21	202
19.VI	00	1°39'.8N	48°28'.2	29	222
	06	2°2'.0N	48°7'.4	28	200
	12	2°2'.6N	48°4'.6	25	210
	18	2°3'.1N	48°3'.7	21	210
20.VI	00	2°23'.5N	47°44'.0	31	188
	06	2°21'.6N	47°37'.6	21	202
	12	2°23'.7N	47°38'.1	21	222
	18	2°35'.0N	47°26'.5	23	206
21.VI	00	2°46'.9N	47°16'.9	25	209
	06	2°47'.8N	47°21'.0	22	210
	12	2°55'.3N	47°20'.2	25	205
	18	3°7'.8N	47°2'.7	21	207
22.VI	00	3°24'.5N	47°19'.4	20	220

WINDS (cont'd)

Date	Time Z	Lat.	Long.E.	Speed (kts)	Direction from (oT)
22.VI	06	3°50'.2N	48°37'.1	18	237
	12	3°56'.5N	50°1'.6	19	228
	18	3°59'.7N	50°20'.7	18	217
23.VI	00	4°8'.6N	51°33'.7	24	220
	06	4°13'.4N	52°38'.5	23	215
	12	3°59'.0N	52°38'.2	22	222
	18	3°25'.8N	51°59'.6	19	207
24.VI	00	4°11.6N	51°49'.4	22	192
	06	4°46'.2N	51°45'.6	22	214
	12	5°7'.2N	51°20'.2	15	236
	18	5°23'.4N	50°58'.8	26	211
25.VI	00	5°27'.9N	50°53'.3	26	218
	06	5°27'.6N	50°55'.6	22	222
	12	5°41'.1N	50°23'.3	13	227
	18	5°43'.6N	50°27'.5	27	213
26.VI	00	6°1'.8N	50°0'.7	28	233
	06	6°2'.2N	49°58'.2	27	228
	12	6°1'.9N	49°54'.8	29	214
	18	6°19'.1N	49°45'.5	28	218
27.VI	00	6°18'.4N	49°48'.1	31	226
	06	6°23'.4N	49°39'.5	24	224
	12	6°53'.5N	49°42'.5	35	203
	18	7°20'.5N	50°1'.3	30	209
28.VI	00	7°26'.8N	50°14'.6	36	228
	06	7°17'.5N	50°21'.5	23	227
	12	7°19'.0N	50°29'.4	19	225
	18	7°18'.0N	50°43'.7	32	212
29.VI	00	7°18'.6N	51°4'.2	29	225
	06	7°21'.8N	51°17'.3	28	233
	12	7°17'.2N	51°59'.4	30	230
	18	7°48'.5N	52°18'.6	30	220*
30.VI	00	7°59'.7N	52°28'.9	30	200*
	06	8°24'.3N	52°46'.4	35	220*
	12	8°59'.4N	53°1'.8	32	230
	18	8°58'.7N	53°5'.5	34	201
1.VII	00	8°53'.9N	53°9'.0	30	218
	06	8°34'.4N	53°16'.6	30	228
	12	8°28'.7N	53°5'.8	29	222
	18	8°26'.8N	52°57'.6	28	209
2.VII	00	8°24'.5N	53°3'.5	29	217
	06	8°23'.1N	52°55'.5	32	221
	12	8°25'.1N	52°44'.6	33	221
	18	8°27'.4N	52°27'.5	31	207
3.VII	00	8°33'.1N	52°02'.1	31	216
	06	8°41'.2N	51°45'.3	36	231
	12	8°54'.5N	51°18'.5	30	190
	18	9°34'.9N	51°9'.5	24	210
4.VII	00	10°38'.4N	51°28'.0	26	190
	06	11°45'.8N	51°22',4	24	178

*(* from bridge met. log.)*

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** NIO CR: National Institute of Oceanography, Cruise Report.

*** IOS CR: Institute of Oceanographic Sciences, Cruise Report.

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