BRITISH ANTARCTIC SURVEY

AND

UNIVERSITY OF BIRMINGHAM

ANTARCTIC MARINE GROUP

Cruise Report

RRS John Biscoe
Marine Geophysics Cruise
February to March 1987

Marine Earth Sciences and Physical

Oceanography in the Weddell Sea

April 1987

RRS John Biscoe Marine Geophysics Cruise 1987.

Cruise Report - Initial distribution list.

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R.R.S. John Biscoe Marine Geophysics Cruise

Birmingham University Antarctic Marine Group

February to March 1987

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INTRODUCTION

The cruise was concerned with two projects; firstly a study of Weddell Sea Bottom Water and its influence on sedimentation in the Weddell Sea, and secondly an investigation of a young intra-oceanic ridge crest - trench collision zone just to the south of the present South Sandwich Island Arc.

Weddell Sea Bottom Water

The objective for this cruise was to lay four current meter moorings and do eight CTD soundings along a transect across the Weddell Sea gyre. This transect is along a multi-channel seismic line (Line AMG845-15) shot during Discovery cruise 154 in 1984/5. This transect had also been extensively cored during Discovery cruise 154.

South Sandwich Ridge Crest - Trench Collision Zone

In this collision zone a spreading centre segment of the South American - Antarctic Ridge has collided with a southern extension of the South Sandwich island arc subduction zone. It is one of only two modern examples of collision of a mid-ocean ridge with an island arc subduction zone (the other one being in the Solomon Islands).

A detailed bathymetric, magnetic and MCS survey of the collision zone had been made and the main topographic features of the area had been identified and dredged during Discovery cruise 154.

The objectives for this cruise were: 1) a magnetic survey of the oceanic areas to the east and south of the collision zone

- to try to obtain identifiable magnetic anomaly profiles and hence determine the age of collision, 2) to dredge some of the topographic features of the collision zone from which previous dredges had produced ambiguous results - these topographic features are referred to as Ridge G, Ridge A, Area B and Area C, see figure 1.

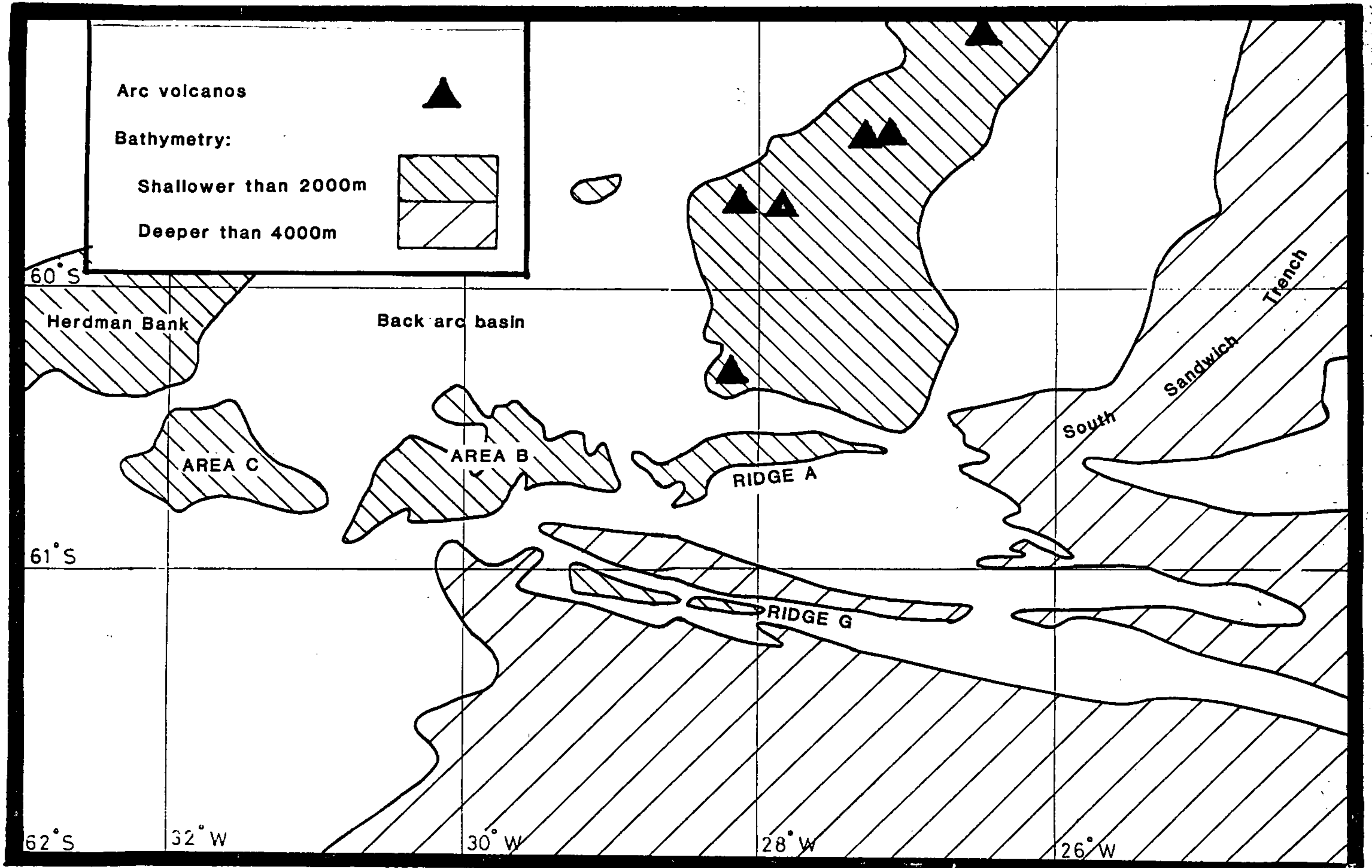


Figure 1. RCT COLLISION ZONE - Scale 1:2M at 57°S

SCIENTIFIC NARRATIVE

The Biscoe sailed from Stanley at 11.30 am on Thursday 5th February. Our departure had been delayed because the ship had not been able to move alongside the F.I.C. jetty until Tuesday evening. One major technical problem had already appeared, and not been solved: sea-water had leaked into the load-cell which we had planned to use to monitor wire tension during dredging operations. The load-cell appeared to be damaged beyond repair.

The PES fish was deployed in the shelter of Port William, and the magnetometer was streamed once we reached 50m water depth. A PES fish had not previously been deployed from the Biscoe and it took several experiments over the next two days before a satisfactory deployment and towing method was found. It had been planned to use an RVS Schatt davit mounted at the aft starboard corner of the well deck. This did not work because there was insufficient rail clearance to get the fish outboard. Next the ship's cargo derrick was used to lift the PES fish into the water, and the Schatt davit for towing. This was unsatisfactory because the wire from the cargo davit (which had to be left attached to the fish) was vibrating as it pulled through the water and generating excessive noise. Eventually the fish was launched and towed using only the cargo derrick.

Ice reports indicated that a tongue of ice extended northwards between the S. Shetlands and the S. Orkneys so we decided not to dredge off the Antarctic Peninsula and run a magnetics line across Powell Basin as had originally been considered, but instead to head straight for the current meter / CTD transect.

Several technical problems had to be solved during the passage southwards. The PES record was initially very poor. There were two causes of this; firstly prop/engine noise and secondly incorrect wiring of the inboard connector. We experimented with various combinations of prop pitch and engine speed and found a satisfactory combination which reduced the noise to an acceptable level with only a slight decrease in the ship's speed. The inboard connector was rewired, and thenceforth the PES produced a good record.

The interface between the gyro-compass and the RVS sat-nav was faulty, so we decided to log the bridge sat-nav instead.

We arrived at the first CTD station early on the 9th February after a good passage south.

The next five days were spent laying the four current meter moorings and doing eight CTD soundings, generally in reasonably good weather. One CTD needed to be repeated after three water bottles failed to fire, otherwise this part of the cruise went smoothly and with no undue problems. See section B.

We had been in radio contact with the ODP drillship the SEDCO/BP 471, and decided to rendezvous with them after the last CTD had been completed. The SEDCO/BP 471 was drilling hole W5 (site 694), about 50 miles SE of the last CTD station. The purpose of the rendezvous was to use the drillship workshop facilities to attempt to repair our load-cell, or failing that to try to borrow a replacement. We made a rendezvous with the drill ship on the 14th February. The load-cell could not be repaired and it was not possible to borrow a suitable replacement. However a discussion between Bill Graham and the engineers on the drill ship produced an idea for an alternative ad-hoc wire tension meter. The drill ship supplied us with a hydraulic jack and a length of pressure hose with suitable connectors. The hydraulic jack was mounted in the casing of the original load-cell and connected via pressure hose to the pressure sensor of the CTD. A d.c. output from the CTD was connected to a Servoscribe chart recorder.

We left the SEDCO/BP 471 in the afternoon of February 14th and headed northwards to the South Sandwich RCTCZ area. During the passage northwards the new load-cell system was put together and a method of transferring load from the main warp to the load-cell was devised. The warp was passed through a snatch-block which was connected via the load-cell to a bridle rigged across the base of the A-frame.

During the passage northwards the weather deteriorated. The rest of the cruise was characterized by consistently poor weather - with only short spells of good weather between prolonged and often severe storms. The problems of poor weather were compounded by the presence of numerous ice-bergs and growlers, and by frequent spells of poor visibility especially at night.

We arrived at the first dredge site on ridge G at 1.00 pm on the 16th February and attempted to dredge the very steep northern scarp of this ridge. This attempted dredge (Dredge 117) was a disaster. The main warp became irretrievably stuck and eventually broke with the loss of 2000m of wire, the pinger and the dredge bag. See section C.

We decided to do some magnetic survey and give ourselves time to reflect on our dredging technique. We steered 100°T to 22° W and then returned westwards on a parallel line to the eastern edge of the densely surveyed collision zone area. We then made a long zig-zag to the south to attempt to delineate fracture zone ridges before heading for the second dredge site on Ridge A. Dredge 118, on 19th February was successful and a sack of freshly broken off basalt was recovered - definitely in situ.

Confidence in our dredging technique was restored and we decided to head for dredge sites in Area B. Unfortunately the weather deteriorated to the point where we were forced to heave to; and then got even worse! The wind reached force 12 for five hours during the night of 19th-20th February. The PES inboard cable on the well deck was broken during this night. It is not possible to work on the well deck in heavy seas, and repair of the PES cable would require recovery of the PES fish - to inspect the connector at the end of the outboard cable. We decided to head towards South Georgia in the hope of finding better weather, or if necessary shelter at South Georgia. We were hove to until the morning of 21st February. By the evening the heavy seas had abated sufficiently to partially recover the PES fish and inspect the damage. Sea water had only penetrated about one metre of cable and it was possible to cut out the damaged section and replace it. With the PES working again we headed south to dredge sites in Area B.

We dredged a NW facing scarp in Area B during the evening of the 22nd February (Dredge 119), recovering only erratics and mud. We then moved south to try a different dredge site, making very little progress overnight due to poor visibility. Dredge 120, early on 23rd February produced only one rounded boulder of conglomerate.

The results of the first two magnetics lines (east of the collision zone) did not look very promising, so we decided to try some magnetics to the south of the collision zone. The 23rd to the 26th February was spent on two long parallel lines to the south of the collision zone. These line were designed to run parallel to fracture zone ridges inferred from previous cross lines.

Having completed these lines we went back to Area B to try another dredge site on the 26th February. Dredge 121 yielded a full dredge bag - mostly erratics but also a possible in situ lithology - ?chert or siliceous volcanics.

We planned to use the remaining four days or so for more magnetics lines east of the collision zone. We ran the first line along the axis of the deep trough immediately north of Ridge G and then due east to 21.5°W. We then came back westwards on 280 degrees to the eastern edge of the collision zone. We steamed south to the start of the final magnetics line, a 290 - 280 degrees line leading to the crest of Ridge G. We reached the site of dredge 117 in the afternoon of 1st March having made good progress on the magnetics lines. We had enough time left to try another dredge so we had another go at the same scarp as dredge 117, dredging very cautiously this time. We were probably too cautious though - only a handful of gravel was recovered.

We then completed the magnetics line along the crest of Ridge G, by which time it was time for us to head for Montevideo. The course northwards was chosen to fill in gaps in the survey of Area B and to cross a possible northern extension of Herdman Bank. The PES and magnetometer were kept running until we reached 48° S on 6th March.

CRUISE STATISTICS

a.	Cruise length, Port Stanley to Montevideo		34.0 days
	time on passage north of 48°S		5.0 days
b.	Working time, passage plus survey plus stations		29.0 days
	distance steamed, all cruise	5,450 miles	
	distance steamed, working	4,610 miles	
c.	underway bathymetry time		20.8 days
	underway bathymetry distance	4,165 miles	
	total magnetics time		20.1 days
	total magnetics distance	4,095 miles	
d.	Total time lost		4.1 days
	hove-to for weather		2.3 days
	diversion to repair P.E.S.		1.3 days
	diversion to SEDCO/BP 471		0.5 days
e.	Total station time		4.3 days
	current meters time (inc. wire tests)		1.5 days
	no. of stns. 4		
	no. of wire tests 3		
	CTD time		1.6 days
	no. of stns. 8		
	no. of soundings 9		
	dredging time		1.2 days

no. of stations 6

XBT launches 37

Notes: 1. bathymetry distance is less than total working distance because of initial problems in setting up P.E.S. (days 036-037) and because of time P.E.S. was out of action due to storm damage (days 051-052).

2. magnetics distance is less than total working distance mainly because there were short periods of steaming between stations (not included in station time) where it was not worthwhile streaming the magnetometer (or where we already had magnetic data).

3. bathymetry time includes data collected on diversions listed under 'time lost', hence the sum of station time, underway bathymetry time and time lost amounts to slightly more than total working time.

4. The average underway speed, while we were working, was 8.4 kts. At normal cruising pitch it was found that the feathering prop. caused excessive noise on the P.E.S., so most daytime underway work was carried out with reduced pitch at 9.5 kts. The average speed was lower than this due to slower steaming in bad weather and during hours of darkness.

EQUIPMENT PERFORMANCE

(A) CTD AND WATER ROSETTE SYSTEM

On each CTD sounding we attempted to collect 11 or 12 water samples (2.5 litres each) for silica analysis and for determination of the concentration of suspended sediment. Water samples were attempted at the following depths: 20, 400 and 1000m below sea surface and 10, 60, 110, 160, 210 and 500m above the seabed, plus 2 or 3 samples at intermediate depths. A high success rate was achieved, with only 7 water bottle failures during the whole program. 3 of these were on one sounding (CTD 7). This sounding was repeated and all the bottles fired successfully. On each of the other soundings where a water bottle failure occurred it was the deepest sample which was lost. This was unfortunate because the deepest samples were the most important. It is thought that the reason for these failures was wear on the CTD rosette. 2 bottles were fired at maximum depth on each of the last 3 CTD soundings as insurance against failure of the final bottle.

The Grundy CTDs worked very well this year with no problems whatsoever. The rosettes, however, were not so reliable. Because of the extreme pressures the firing of bottles proved to be slightly suspect on one or two occasions. This was observed first when the last bottle (12) did not fire on two consecutive drops. The rosette was then taken apart and given thorough maintenance to rid the system of the grit causing the intermittent firings at the high pressures involved. The last bottle was most prone to misfiring from past wear and so when it was shown that this was a problem area this last bottle was fired twice to ensure a water sample being collected. In one instance three bottles were indicated to be not fired but on recovery only 2 had not fired. This difference in real and predicted behavior is due to the rosette confirm pulse being indicative of the rosette state only if the pulse does not occur, hereby indicating a firing failure not neccesarily vice-versa. Therefore it is usually better to repeat drops with more than one failure unless the samples can be sorted via some other method such as comparison between the ctd salinity readings and the salinity of the water samples taken.

In all, however, the system worked better than I have ever seen it before, especially considering the great depths and low temperatures involved.

(B) CURRENT METERS

Four moorings were deployed, each consisting of three Aanderaa RCM5 deep water instruments, at depths of 5, 50 and 500m above the sea floor. In addition a sediment trap belonging to WHOI was attatched to rig 3 at 510m above the sea floor.

The cable used for the moorings was a 7mm diameter aramid fibre rope (Kevlar) developed by Bridon Fibres. Kevlar cable was chosen rather than wire for its high strength to weight ratio (thus improving rig dynamics) and its resistance to environmental damage.

The moorings will be located and recovered after 12 months deployment using the acoustic command system developed at IOS Wormley. Each mooring was fitted with a 10kHz acoustic command sea unit. Extensive alterations to the electronics of the command beacons were undertaken at RVS to allow them to be used in the cold water conditions found in the Weddell Sea. Before deployment of the units on the moorings tests were done to establish the range of frequencies to which each unit would respond. The tests were done using the hydrographic (midships) winch to lower the units down to the depth at which they would be deployed. These wire tests were time consuming - taking about two days in total.

The bottom RCM on each mooring was fitted with a Sea Tech transmissometer which was attached to the current meter vane and interfaced with the current meter by an E.O. connector fitted to the top of the current meter.

The top two current meters of each mooring were fitted with low temperature thermometers (-2.64 C to 5.62 C).

The top current meters of rigs one and three were fitted with a pressure sensor which will allow some estimate of depth, permitting rig dynamics to be assessed.

The four current meters fitted with transmissometers were also fitted with conductivity cells.

The buoyancy for the moorings was glass spheres encased in hard plastic covers and attatched to half inch link chain.

Each mooring was anchored with 500lbs of chain which will be left on the bottom when the release mechanism is fired.

Deployment of the moorings was anchor first, stopping off into the meter line to insert the instruments. When the rig was outboard it was held until a good sat-fix was obtained and then released and allowed to sink to the bottom . The rig's descent was monitored by using the PES to display the command beacon

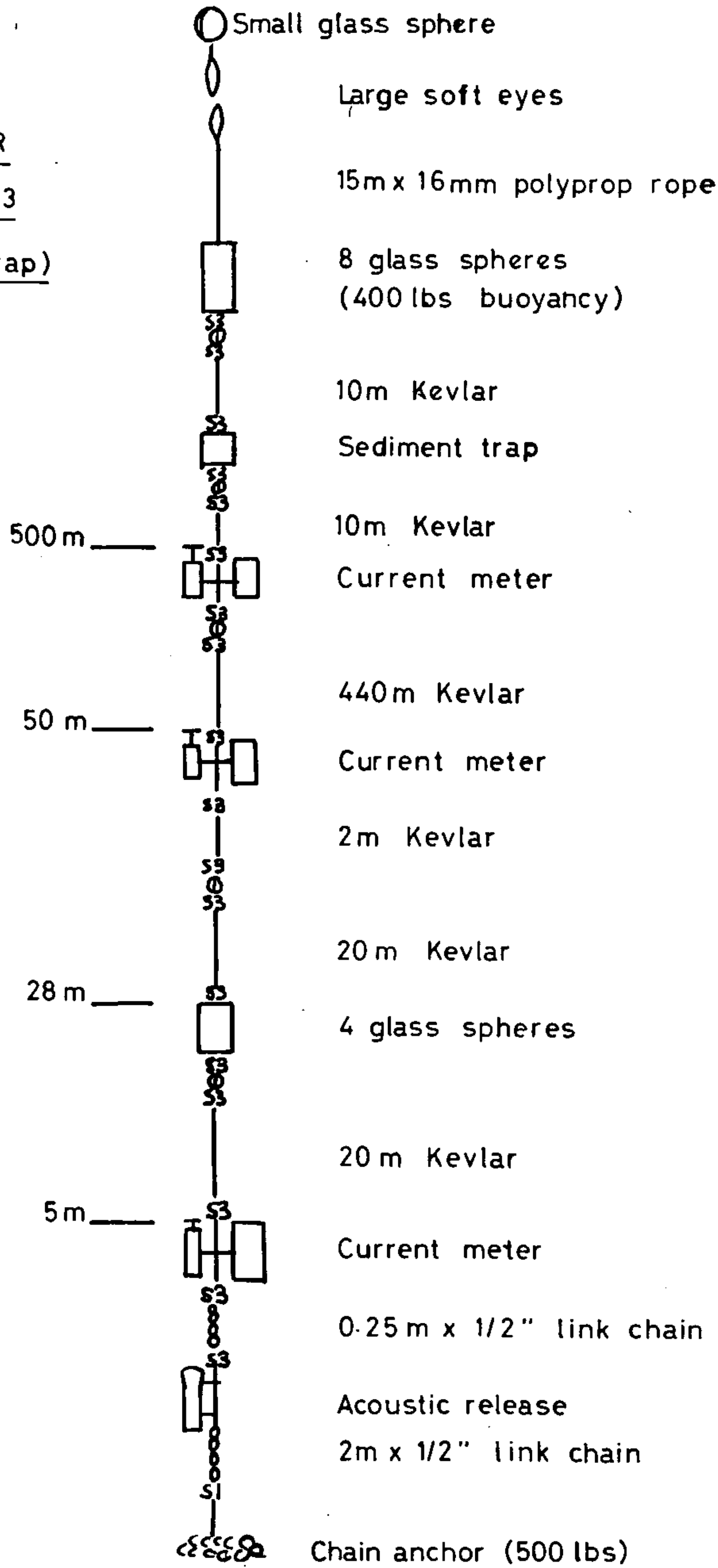
FIGURE 2

CURRENT METER

MOORING - RIG 3

(with sediment trap)

not to scale



signal. After the rigs reached the seabed the ship kept position until the beacons were seen to have timed out.

POSITIONS AND TIMES OF CURRENT METER DEPLOYMENT

The following tables give details of navigation during current meter deployment. The tables give: time ship was on station, time current meter rig was released, time rig landed on seabed, and time command unit timed out. Also a complete list of satellite fixes for the period when the ship was on station. All times are G.M.T. (Z)

RIG 1

Depth = 3855m

Ship on station	041/1030
Rig released	041/1324
On bottom	041/1403
Timed out & moved off station	041/1430

Satellite fixes

Time	Lat.	Long.	Elev.	Iter.	Type of fix
041/1026	63 11.317	42 45.207	49	3	2-D
041/1129	63 11.172	42 45.604	41	3	2-D
041/1150	63 11.130	42 45.758	25	3	2-D
041/1216	63 11.148	42 46.434	19	3	2-D
041/1316	63 10.782	42 46.353	73	5	2-D
041/1403	63 10.698	42 46.019	43	3	2-D

RIG 2

Depth = 4580m

Ship on station	042/1250
Rig released	042/1441
On bottom	042/1527
Timed out and moved off station	042/1548

Satellite fixes

Time	Lat.	Long.	Elev.	Iter.	Type of fix
042/1433	63 31.233	41 45.843	63	3	VN
042/1550	63 30.811	41 45.902	17	3	2-D

RIG 3

Depth = 4575m

Ship on station 042/1930

Rig released 042/2229

On bottom 043/0013

Timed out and moved off station 043/0041

Satellite fixes

Time	Lat.	Long.	Elev.	Iter.	Type of fix
042/1930	63 57.177	40 53.979	64	3	2-D
042/2118	63 56.890	40 53.473	24	3	2-D
042/2214	63 56.763	40 54.273	25	3	2-D
042/2243	63 56.653	40 53.734	37	4	2-D
042/2340	63 56.602	40 54.288	11	3	2-D
043/0004	63 56.542	40 53.793	65	3	VN
043/0028	63 56.299	40 53.589	16	5	2-D

RIG 4

Depth = 4770m

Ship on station	044/1350
Rig released	044/1700
On bottom	044/1750
Timed out and moved off station	044/1820

Satellite fixes

Time	Lat.	Long.	Elev.	Iter.	Type of fix
044/1654	65 55.099	35 49.668	43	3	2-D
044/1755	65 55.215	35 49.251	38	3	2-D

(C) DREDGING

Dredging had not previously been done from the Biscoe and there were a number of problems involved:

1) The trawl warp is not as strong as we would have liked (a section tested at Cambridge before the cruise broke at 9.8 tons).

2) The Biscoe's bow-thrusters are not very powerful, making it difficult, in strong winds, to hold the ship's heading in any direction off the wind.

3) We did not have an adequate wire tension meter. The load-cell which we had planned to use had suffered salt water damage before the start of the cruise. An ad-hoc load-cell was devised by Bill Graham using a hydraulic jack and pressure hose obtained from the SEDCO/BP 471 combined with the pressure sensor of the CTD apparatus. This system was fairly successful, but we could not calibrate it for loads greater than 0.8 tonnes, and it did not always behave as expected.

4) The weather was almost invariably bad.

We attempted six dredges. Two of these (D118, D121) yielded probable in situ rocks, three (D119, D120, D122) yielded only erratics and mud. Dredge 117 resulted in the loss of 2000m of wire plus the pinger and dredge bag.

The failure of dredge 117 was caused by a combination of failing to control the ship's upslope movement adequately (we were attempting to dredge southwards in a force 9 westerly wind), and losing the bottom echo on the PES. The combination of these factors resulted in us having 3000m of wire out when we reached 1500m water depth. A bight of warp probably became wrapped around a projection on the seabed and hence irretrievably stuck.

Load Cell

Early in 1987 this load cell was seen to be nonfunctional and the investigation showed that water had seeped into the signal cable. This problem was corrected and the cell worked for a little while afterward before breaking again. When looked at this time it was seen that the actual cell had water inside. As the cell was sealed it did not appear feasible to open it up and risk destroying the delicate sensor inside but when there was obviously no way of drying the unit out without opening it the task was attempted with no success. A later visit to the SEDCO/BP 471, however, enabled the unit to be opened with less than terminal damage, only to find that the sensor was in fact damaged beyond repair (one of the arms of the sensor bridge had failed). The SEDCO/471 did, however, have a substitute in the form of a small hydraulic jack which, by forcing oil onto the pressure transducer of the CTD via a pressure hose, gave an indication of pressure through the CTD deck unit's analogue output port for depth. This jack was installed in the cheeks which held the original load cell and the CTD output directly drove the Servoscribe chart recorder to give a relative indication of load.

(D) ECHO SOUNDER

RVS PES MK3 no.FN11. 10kHz, 600 Watt into 8 element towed transducer; single element selectable for acoustic release purposes.

Deployment

It was envisaged that a davit installed on the well deck would be used for launching and towing. This proved to be inadaquate since with the wide-throated block fitted there was insufficient rail clearance, and the tow cable lead to a suitable hoisting arrangement (drum end) was at the wrong angle.

Finally the ship's cargo derrick was used. The fish was deployed by connecting a rope to the towing/hoisting point and leading it via a deck-mounted wide-throated block to a drum end. When the fish was positioned correctly by use of tow cable and derrick positioning, the tow point was secured to a suitable deck fitting via a wire stopper. The fish was towed at an approximate depth of 7m. This towing arrangement proved successful and the fish was deployed for the whole of the cruise except for a short period for cable repair.

Operation

With the ship's propellor set to design pitch the noise generated severely affected the record. It was found empirically

that 16 degree pitch setting gave the optimum speed / noise ratio and this was therefore used throughout the voyage.

The fish towed well through some very rough seas and at no time was signal lost due to transducer motion.

Faults

1) Receiver pre-amp failure.

2) Inboard cable wrongly wired, single element was wired in series with the eight elements and attenuated transmitted signals. Rewired early in the cruise.

3) Dry paper meant poor marking (the paper had been stored

next to a light fitting, not in a cool place) and in the case of high current marking blew the +12V fuse.

4) Sea damage to tow cable / inboard cable. A new length of cable had to be installed from the junction box to the tow cable.

(E) EXPENDABLE BATHYTHERMOGRAPH STATIONS

The XBT system was used this year in an attempt to chart the polar convergence and sub-antarctic front, delineated by the 2 °C and 4 °C isolines respectively. The characteristic of the polar front is the cold Antarctic waters meeting the warmer Atlantic waters as a tongue of cold water between warmer upper and lower waters (inversion). Unfortunately a great many XBTs were missed due to severe wind and sea conditions so that a complete transect is not available.

The stations are listed below and their station codes, information on these drops can be obtained from:

R.B.Heywood

British Antarctic Survey

High Cross

Madingley Road

Cambridge

CB3 0ET

Tel:0223 61188

(F) MAGNETOMETER

Varian type 4937

Worked well throughout the trip. Deployed through stern gate (with gates closed). Two fish were carried but only one was used.

(G) NAVIGATION

The Biscoe has a Magnavox single channel sat-nav on the bridge, which is normally logged using the BAS nav-logger micro computer. This sat-nav has two drawbacks: 1) it is a single channel system and so inherently less accurate than a dual channel system, 2) very little information on fix quality is available other than satellite elevation.

To improve the accuracy of the navigation an RVS Magnavox RX 702A-3 dual channel system was installed while the ship was in Grimsby. Unfortunately the aerial could not be placed in an ideal location; it was mounted at the aft starboard corner of the boat deck.

For best retrieval of ship's track from navigational data the following inputs are required: 1) satellite fixes, 2)continuous record of ship's heading, 3) continuous record of ship's speed. The Biscoe is fitted with a doppler log (of dubious reliability) to indicate speed through the water. It was not possible to arrange for the doppler log and gyro compass to be logged directly by a data logger, but we planned instead to use the BAS nav-logger to log the printer output from the RVS sat-nav which was interfaced to the doppler log and gyro, and provided a filtered speed and heading output. In the event the gyro / satnav interface was unreliable so we used the nav-logger to log the ship's satnav once per minute (the maximum rate available). The disadvantage of this is that although the ship's sat-nav provides a speed and heading output, this output is interrupted if the sat-nav is switched out of its normal mode of operation, e.g. for entering waypoints or obtaining alerts.

Good fixes from the RVS sat-nav were selected and typed into the Birmingham micro-computer. For rapid retrieval of ship's track during the cruise (the nav-logger data were not available during the cruise) speed and course were typed in also. Speed and course were obtained from a log kept by the bridge officers. This log will also be useful in assessing the quality of the final navigation data - especially since the doppler log does not appear to be very reliable.

Final retrieval of ship's track will be done using good satellite fixes from the RVS sat-nav and course and speed logged by the BAS nav-logger to provide retrospective dead-reckoning between good fix positions.

Magnavox RX 702A-3 dual channel

HP computer 2100A

Software: MX72 - VN - U - 7223

Worked well throughout the voyage. Required reprogramming once. Suspect heading input from gyro interface required watchkeeper to keep an eye on the heading information. Faulty switch on mains monitor was a nuisance. Aerial should have been better placed; compared with single channel bridge sat-nav the dual channel receiver didn't lock on as fast. The most annoying fault was the faint output from the KSR43 printer; even 'new' tape cartridges in sealed packages proved to be dry. WD-40 eventually cured the fault when sprayed on the felt pad in the ribbon carrier.

(H) SEDIMENT TRAP DEPLOYMENT

A sediment trap was deployed on Current Meter Rig 3, 500 metres off the seabed at a depth of 4500 metres. The trap was a

PARFLUX MARK VI owned by Woods Hole Oceanographic Institution.

Essentially the trap consists of three basic parts. The frame and funnel form one integral part into which the carousel slots. The rotating carousel is driven by a stepper motor controlled by a programmable timer unit housed in a pressure casing. At the appropriate time (see Table 1 for bottle exposure times) the stepper motor is activated by the timer unit and the next bottle is brought round under the funnel.

On arrival at the ship, the trap was dismantled and cleaned. On inspection a broken capacitor was found in the timer unit. This was repaired and a three event programme loaded into the timer unit via a portable Epson computer. The test programme worked correctly.

When the deployment site was reached the CTD rig was lowered down to a depth of 1000 metres and all the bottles fired. The returned water was used to fill the collection bottles. To ten litres of water, 350 grams of Sodium Choride and approximately 30 grams of Mercuric Chloride were added. One litre of the mixture was retained for analysis. The actual programme (table 1) to be used was loaded into the timer and the trap was reassembled and placed under cover on the after deck. Just before deployment the bottles were screwed into the carousel, with Teflon tape around the threads to ensure a snug fit. The trap was connected to the current meter rig by three one metre steel strops at either end of the trap.

SILICA ANALYSES

Using a seawater driven filter pump each CTD water sample was filtered through a pre-weighed filter paper to extract suspended sediment and microorganisms (especially diatoms). The amount of water filtered (usually about 2 litres) was recorded so that the concentration of suspended material can be calculated once the filter papers have been reweighed. Only the shallowest water sample on each sounding deposited sufficient suspended matter to be obvious to the unaided eye. Each used filter paper was placed in a small plastic container and refrigerated to -20°C. A 250ml sample of the filtered water was placed in a plastic bottle and this too was refrigerated to -20°C for transport back to the U.K. Another 250ml sample of the filtered water was kept for shipboard silica analysis. The remaining water was discarded.

Silica analyses were carried out by adding 2 reagents to the filtered water samples:

1) acid molybdate solution (ammonium molybdate and hydrochloric acid),
2) reducing solution (metol-metabisulphite, oxalic acid and sulphuric acid).

On adding these reagents seawater samples develop a blue colouration, the intensity of the colour increasing with increasing silica content (Strickland J.D.H. & Parsons J.R., A Practical Handbook of Seawater Analysis, 1968 Canada Fisheries

Research Board Bulletin 167, Queens Printer, Ottawa) A reference solution, consisting of deionised water treated with the same reagents, was prepared along with each batch of samples. 5ppm and 10ppm silica standards were also prepared with each batch of samples.

The samples were allowed to stand for 3 hours after adding the reagents and then the transmittance of each sample relative to the reference solution was measured using a Cecil CE 2303 spectrophotometer. Transmittance measurements were made at both 490nm and 810nm. During the cruise a calibration curve was plotted by preparing and measuring a range of silica standards.

A preliminary inspection of the results from these analyses reveals silica depletion of the surface water in all the CTD soundings. On most of the soundings there is also a less marked tendency towards silica depletion near the seabed.

SHIPBOARD COMPUTER PROCESSING OF BATHYMETRY, MAGNETICS AND NAVIGATION DATA

Computer Hardware

An NEC Advanced Personal Computer (APC) belonging to the University of Birmingham Antarctic Marine Group (UBAMG) was used on the cruise together with the following peripherals;

NEC hard disk

NEC pinwriter P2 printer

Hewlett-Packard 7475A plotter

TDS LC20 digitizing tablet

The principal use for this system was to place bathymetric and magnetic data into digital storage as soon as possible after they had been acquired. In the case of bathymetry this was achieved by keyboard input. Magnetic data were input using the digitizing tablet. In Birmingham the NEC APC is easily and routinely connected to the University's mainframe computer (a Honeywell 'Multics' system), so transfer of data should be a formality.

The other main use for the system was for retreiving and displaying data from previous cruises. Data files for all previous satellite-navigated geophysical cruises (both University of Birmingham and other institutions) in the region are kept on floppy disks. This allows (using UBAMG software) existing data to be plotted in the form of track charts and profiles at any chosen scale. In the same way the system was also used to display data from this cruise once it had been digitized and had some preliminary processing applied (see 'software' section below). Hence it was possible to monitor the progress of the bathymetric and magnetic survey and make better-informed decisions when planning the later part of the survey.

Computer Software

Before and during the cruise a range of programs were developed for digitizing, archiving and correcting bathymetric and magnetic data. Programs were also written for input of satellite fix and course/speed data. These data were used to calculate a preliminary cruise track so that new bathymetric and magnetic data could be combined into a standard UBAMG cruise datafile. Once this had been done it was possible to use our existing software to display the data in the form of track charts and profiles.

The following is a list of programs developed specifically for this cruise:

DEEP - for keyboard input of uncorrected bathymetry data

DARC - for archiving uncorrected bathymetry data

DECOR - for applying Carter corrections to bathymetry data

MAGIC - for digitizing magnetometer chart-rolls

MARC - for archiving uncorrected magnetics data

MCOR - for applying IGRF corrections to magnetics data

FIXIT - for keyboard input of satellite fix data

CORSET - for keyboard input of course and speed data

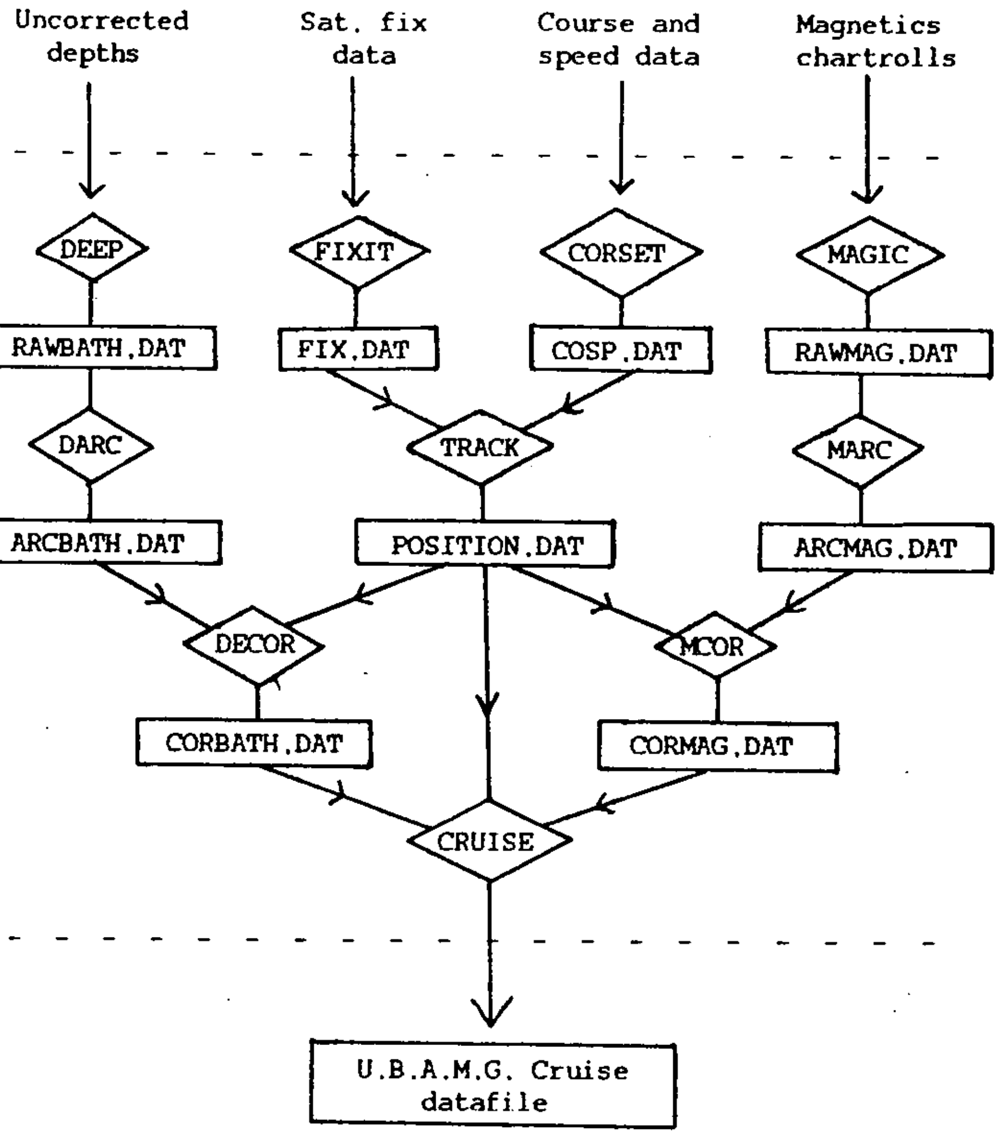
TRACK - for generating file of position v. time from fix, course and speed data

CRUISE - for combining data into standard UBAMG cruise datafile

The programs are written in Fortran and were compiled using a Prospero 'Pro-Fortran' compiler. With the exception of MAGIC, which uses some system-specific graphics and communications subroutines, these programs should be easily adaptable for use on another system or with a different Fortran compiler.

With the exception of the output file from CRUISE, the names of all the data files used are fixed and they contain no reference to the year of data acquisition. The programs are not designed to cope with a change of year, but this should not present any major problems in the event of their use on a cruise continuing from December into January. All that would be required would be the renaming of the December files at the end of the month and the creation of a new set for January. The year of data acquisition is required by programs MCOR and CRUISE and in both cases is supplied in a data statement at the head of the program.

SHIPBOARD COMPUTER PROCESSING FLOW DIAGRAM



Items above the top broken line are input data. Below the lower broken line is the output from the system, a UBAMG cruise datafile. Names in diamond shaped boxes represent programs and names in rectangular boxes represent datafiles.

ACKNOWLEDGMENTS

Thanks are due to the entire ship's company, who kept the ship going in persistently horrible conditions. We were very impressed by the friendly and helpful atmosphere on the Biscoe. The Captain and officers did an impressive job of navigating the ship safely through iceberg and growler infested waters in poor weather conditions. The deck personnel provided invaluable assistance in deploying equipment.

Thanks to Clive Harker, the ship's doctor, who helped with the watch-keeping.

The three technicians from RVS and BAS did a fine job of setting up and running their equipment as well as coping with a number of unexpected problems.

We would also like to thank all those people at BAS, RVS and Birmingham University who provided advice, technical and logistical support.

Thanks also to those people on the SEDCO/BP 471 who helped with the load-cell.

The entire cruise was funded by BAS (partly through a contract to Birmingham University) apart from the sediment trap which was supplied by Woods Hole Oceanographic Institute.

Event	Date	Time	Purpose of Event
0	02/11	21:00	move open hole under funnel
1	02/12	12:00	move bottle one under funnel
2	03/11	12:00	move bottle two under funnel
3	04/07	12:00	move bottle three under funnel
4	05/04	12:00	move bottle four under funnel
5	05/31	12:00	move bottle five under funnel
6	06/27	12:00	move bottle six under funnel
7	07/24	12:00	move bottle seven under funnel
8	08/20	12:00	move bottle eight under funnel
9	09/16	12:00	move bottle nine under funnel
10	10/13	12:00	move bottle ten under funnel
11	11/09	12:00	move bottle eleven under funnel
12	12/06	12:00	move bottle twelve under funnel
13	01/02	12:00	move bottle thirteen under funnel
14	01/29	12:00	move open hole under funnel

TABLE 1 SCHEDULED PROGRAM FOR SEDIMENT TRAP CM3 BIS867

IDENTIFIER	POSITION WHEN DREDGE ON BOTTOM LATITUDE	LONGITUDE	DEPTH (m) START	END	TIME DREDGE ON BOTTOM
D117	61°08.52'S	28°09.26'W	2100	1600	1805/047
D118	60°35.36'S	28°02.28'W	1620	1508	1140/050
D119	60°26.82'S	29°40.18'W	2080	1950	2249/053
D120	60°40.85'S	29°33.68'W	1650	1550	1018/054
D121	60°38.48'S	30°03.54'W	1355	1180	1838/057
D122	61°08.09'S	28°14.68'W	1650	1750	0100/061

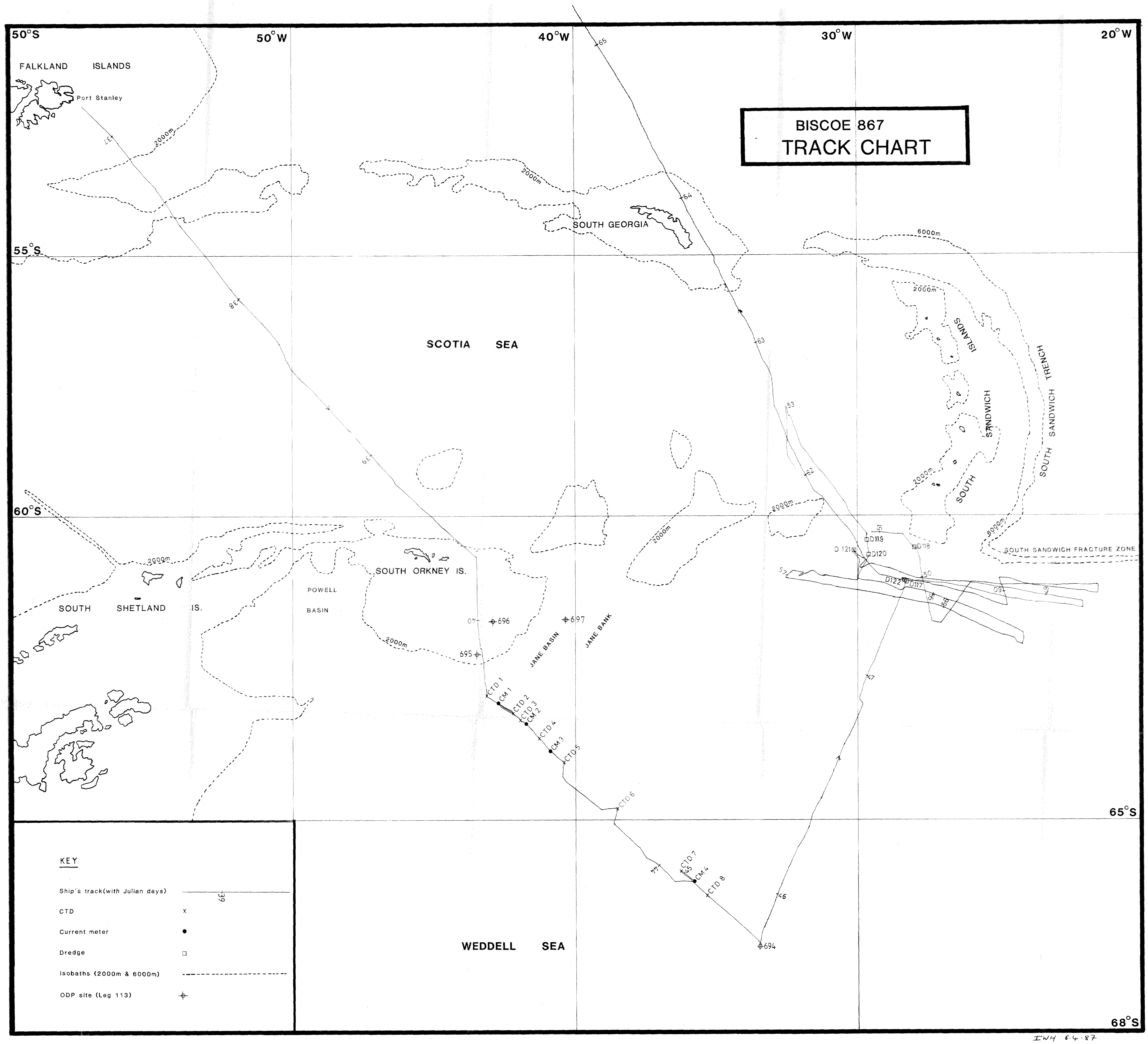
TABLE 2 DREDGE LOCATIONS, DEPTHS AND TIMES

IDENTIFIER	POSITION WHEN ON BOTTOM LATITUDE	LONGITUDE	DEPTH (m)	TIME DEPLOYED	ON BOTTOM
0001	63°04.2'S	43°08.7'W	3965	1123/040	1251/040
0002	63°20.5'S	42°11.9'W	3850	0451/041	0637/041
0003	63°27.4'S	41°56.0'W	4790	1754/041	2019/041
0004	63°46.2'S	41°20.4'W	4570	0707/042	0902/042
CM3	63°57.3'S	40°52.9'W	4570 (1000)	1935/042	2003/042
0005	64°07.8'S	40°24.0'W	4660	0241/043	0441/043
0006	64°50.1'S	38°31.7'W	4850	1345/043	1549/043
0007 (no water)	65°44.7'S	36°18.7'W	4770	1034/044	1212/044
0007a	65°44.9'S	36°17.3'W	4775	2012/044	2204/044
0008	66°08.1'S	35°20.2'W	4763	0311/045	0509/045

TABLE 3 CTD LOCATIONS, DEPTHS AND TIMES

XBT STATIONS

STAT	LAT	LONG	DATE	TIME
BTG015	054° 45.9'S	053° 24.3'W	6/2/87	1601
BTG016	056 02.0S	051 40.1W	7/2/87	0117
BTG017	056 08.7S	051 26.3W	7/2/87	0228
BTG018	056 16.1S	051 14.4W	7/2/87	0332
BTG019	056 23.1S	051 00.4W	7/2/87	0434
BTG020	056 30.6S	050 47.7W	7/2/87	0534
BTG021	056 39.2S	050 36.7W	7/2/87	0639
BTG022	056 47.1S	050 26.9W	7/2/87	0732
BTG023	056 55.3S	050 17.6W	7/2/87	0833
BTG024	057 06.0S	050 13.6W	7/2/87	0937
BTG025	056 06.0S	050 05.2W	7/2/87	1039
BTG026	057 22.3S	049 52.6W	7/2/87	1136
BTG027	057 30.1S	049 52.6W	7/2/87	1247
BTG028	057 38.6S	049 22.7W	7/2/87	1401
BTG029	057 45.6S	049 09.6W	7/2/87	1505
BTG030	057 53.2S	048 55.9W	7/2/87	1609
BTG031	057 59.9S	048 44.3W	7/2/87	1657
BTG032	058 06.1S	048 35.6W	7/2/87	1745
BTG034	061 01.0S	043 27.7W	7/2/87	1756
BTM027	057 19.6S	033 05.5W	3/3/87	1847
BTM034	051 13.5S	038 26.5W	5/3/87	1842
BTM035	051 17.3S	038 35.5W	5/3/87	1949
BTM036	050 56.3S	038 43.1W	5/3/87	2042
BTM039	050 29.3S	039 08.0W	5/3/87	2350
BTM040	050 19.9S	039 17.1W	6/3/87	0056
BTM041	050 12.9S	039 24.6W	6/3/87	0146
BTM042	050 06.7S	039 31.3W	6/3/87	0245
BTM043	049 54.1S	039 43.7W	6/3/87	0357
BTM044	049 44.0S	039 51.9W	6/3/87	0500
BTM045	049 33.9S	040 01.4W	6/3/87	0600
BTM046	049 23.2S	040 10.3W	6/3/87	0706
BTM047	049 14.7S	040 18.7W	6/3/87	0800
BTM048	049 05.7S	040 28.8W	6/3/87	0910
BTM049	048 58.7S	040 35.8W	6/3/87	1002
BTM050	048 51.3S	040 43.4W	6/3/87	1056
BTM051	048 41.6S	040 50.8W	6/3/87	1203
BTM052	048 38.1S	040 53.9W	6/3/87	1230


BISCOE 867
TRACK CHART
50°S
50°W
40°W
30°W
20°W
55°S
60°S
65°S
68°S
FALKLAND ISLANDS
Port Stanley
SOUTH GEORGIA
SCOTIA SEA
SOUTH SANDWICH ISLANDS
SOUTH SANDWICH TRENCH
SOUTH SANDWICH FRACTURE ZONE
SOUTH SHETLAND IS.
SOUTH ORKNEY IS.
POWELL BASIN
JANE BASIN
JANE BANK
WEDDELL SEA
2000m
6000m
CTD 1
CM 1
CTD 2
CTD 3
CM 2
CTD 4
CM 3
CTD 5
CTD 6
CTD 7
CM 4
CTD 8
694
695
696
697
D 121
D120
D119
D118
D122
D117
KEY
Ship's track(with Julian days)
CTD
Current meter
Dredge
Isobaths (2000m & 6000m)
ODP site (Leg 113)
IWH 6.4.87