JR09B:

RRS James Clarke Ross
Scotia Sea and Falkland Trough
Marine Geology
February 1995 - March 1995

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Natural Environment Research Council

British Antarctic Survey

Cruise Report

RRS *James Clark Ross*

Cruise JCRO9B
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Marine Geology
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CONTENTS

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1. INTRODUCTION (CJP)

Cruise JCR09B was planned to investigate the Quatemary history of the Antarctic Circumpolar Current in the Scotia Sea, by coring and the collection of oceanographic data. The Circumpolar Current is one of the most energetic current systems in the World Ocean. Its history is of great interest as (1) it links the other major ocean basins, transporting heat, salt, dissolved gases and chemical tracers eastwards at all depths down to the seabed, (2) it isolates the Antarctic continent, preventing poleward transport of heat. Sediments deposited beneath the Cimumpolar Current contain a record of changing biogenic productivity, water chemistry, terrigenous sediment sources and strength of current flow.

The Scotia Sea is a particularly important area because the current axis is geographically confined, in contrast to the South Atlantic, Indian and South Pacific Oceans where the current axis can migrate hundreds of miles N or S if the volume transport varies. In the Scotia Sea the current can only speed up or slow down. Furthermore, extensive geophysical surveys have identified areas of erosion and deposition controlled by the basement topography of continental fragments, fracture zones and dead spreading ridge segments. In some areas mounds or drifts of sediment up to 500-1000m thick have accumulated on ocean floor of Miocene age (15-22Ma). Highest sedimentation rates are in the centre of the mounds, with sub-bottom reflectors converging towards marginal scour zones. Core sites can thus be selected to sample rapid or slow sedimentation. It was particularly hoped to obtain expanded sections in Last Interglacial (Stage 5) sediments to see whether Stage 5 in the Southern Ocean showed similar variability to that documented from Northern Hemisphere ice cores. The proposed core sites formed a N-S transect from the axis of the Circumpolar Current in the Falkland Trough to the boundary with the Weddell Gyre in the southern Scotia Sea.

BAS has a programme of long-term (l-2 years) current meter moorings in the Scotia Sea and Weddell Sea. Current meter and sediment trap data from these moorings, with temperature and transmissivity data from accompanying CTD casts, aid our understanding of present-day water masses and sediment transport and hence our interpretation of older sediments. Cruise objectives included the recovery of three moorings which had been deployed from JCR04 in 1993, with a repeat CTD cast at each site.

The cruise was to be the first Antarctic use for the BAS Long Piston Corer (LPC). The LPC is a stationary-piston corer based on the French STACOR, intended to collect large-diameter (108mm), high-quality cores up to 30m long. It was designed at BAS and built by local subcontractors in 1991. We were unable to use it on the ***James Clark Ross in*** either the 1991-2 or 1992-3 seasons because of the poor performance of the 30-tonne traction winch. For 1994-5 the winch had been modified and the Superaramid cable repaired and pre-stretched. Because the LPC had only been tried once before, and that not at full length, JCR09B was bound to be in the nature of a trials cruise: it was necessary to develop effective and safe working routines to handle such a large piece of equipment.

Logistic constraints dictated a start in Cape Town, 2700 miles from the work area, which even with a fast passage left 12 days at the most to complete the coring and moorings programme. The first of 11 proposed sites was abandoned because of bad weather. At the second, two attempts with the LPC failed to recover usable sediment because the piston jammed inside the core liner. At the third we lost most of the LPC including parts for which we had no spares. Within the remaining 7.5 days of the cruise we were able to recover two out of the three moorings (the thiid failed to release). We also continued to address the scientific objectives of the cruise by taking the opportunity to sample sediments on the N side of the Falkland Trough. 3.5kHz profiles showed this area to be only thinly sedimented, and the expected firm seabed was suitable for the 3m Kasten corer, brought along for emergencies. Six Kasten cores were obtained. CTD casts were made at the mooring sites and one other site, and the LPC trigger mechanism was tested.

Underway data collection included magnetics (a long South Atlantic line from the Falkland-Agulhas Fracture Zone across the Mid-Atlantic Ridge to the South Sandwich Trench, and. crossings of several small basins in the Scotia Sea), bathymetry and 3.5kHz profiles, ocean-logger and meteorological data, and surface water samples.

Acknowledgements

Although cruise JCR09B can hardly be counted as a success in scientific terms, we did retrieve two moorings and learn how to handle the Long Piston Corer (and we did get some mud . ..). The situation would have felt a great deal worse had it not been for the tremendous amount of help and moral support forthcoming from all on board. Particular thanks to the Captain for his ship-handling, especially while dragging for mooring X, and for allowing the boat shed to be used as a scientific store; to John the Mate for finding all our bits of kit, for making sure people were always there when needed and for tolerating our mess in the core lab for days at a time; to Dave Cutting and the Engineers for getting us to the Scotia Sea so fast. To Hamish and Sean for the food, particularly the birthday dinners; to John and Simon for turning to at all hours to run the winches; to George and the crew for their skill during LPC deployments. To Steve, Andy and Neil, the scale of whose efforts will be obvious from reading this report; to Mark the electronics whizz, especially for fixing the 3.5kHz; to Dave and Rich for making sure we actually came home with some data.

We also thank RVS for the loan of a magnetometer, Kasten core head and Oceano deck unit, and BAS Logistics for ensuring that these items and all our other gear were on board at the right time. Ash Johnson and Lieve Vanneste at BAS HQ sent us vital bits of data at short notice.

2. NARRATIVE (CJP)

Mobilisation for JCR09B commenced in Cape Town on Feb 18 (Julian Day 049) with the installation of the Long Piston Corer (LPC) handling equipment. The davits were positioned at 17 and 29m aft from the corer pivot point. By the evening of Feb 20 the corer was assembled with 12 barrels (8 thick and 4 thin); after the ship had shifted from berth J to the Landing Wharf, a trial lift to the gunwale was done to test the handling system with its new electrical controls and to check there was enough clearance for the base plate. There was also time during the port call for those staying on from JCR09A to get some much-needed R&R.

The ship shifted again early on Feb 22 (053) to the container berth for clean bunkers, and sailed at 1615. During the 2700 mile passage across the South Atlantic to the work area we planned to collect underway geophysical and oceanographic data. Automatic logging of navigation data (gyro, EM log, Doppler log, GPS), depth (from the bridge Simrad EA5OO) and wind speed started as soon as we sailed. The uncontaminated seawater supply was turned on about 20 miles offshore, the Ocean Logger started at 2300 and the programme of surface-water sampling every 30' of latitude commenced. Scientific watches were set from noon on Feb 23. The magnetometer was streamed on Feb 24 (055) to obtain a trans-South Atlantic line south of the Agulhas Fracture Zone. The next morning the 10kHz PES and 3.5kHz sub-bottom profiler were turned on, using the hull-mounted transducers rather than the fish to save time. The scientific echo sounders interfered with the Simrad to the extent that it could not output digital depth, although the screen display and chart recorder still worked.

Our course was somewhat to the south of a Great Circle route to the first core site, partly to stay with the favourable Agulhas Current for as long as possible and partly to get south of the belt of consistently strong westerly winds and currents. We made a very fast passage to the work area, averaging 12.3 knots over 2650 miles. We logged 13-14 knots during the first three days, but a westerly gale on Feb 27-28 slowed progress considerably (and obliterated the seabed echo on the PES for about 12 hours, because the heavy pitching led to aeration under the hull). Ice was fiit encountered on Feb 28 (059). Corer assembly was completed during the passage with the insertion of the liners, piston and wires; two meetings and frequent informal discussions were held so that all concerned were familiar with the procedures to be used during core stations. The first phase of surface water sampling was completed at 57°s. The last 1% days of the long passage included a complete crossing of the South Sandwich back-arc basin at 59°S, a useful magnetics line. We passed between Montagu I. and Bristol I. at noon on March 2 (061), with good views of both islands and of the abundant birdlife,

The cruise plan upon leaving Cape Town included 11 core sites, 3 of which were also mooring + CTD stations. Although the higher-priority sites were towards the north end of the transect, the enforced Cape Town to Stanley itinerary meant that it used much less ship time to start in the south. We approached the first site in the afternoon of March 3 (062), recovered the magnetometer, hove to on station and considered the situation. With a rising wind and sea, a falling barometer and a forecast of gale-force winds, it was deemed unwise to attempt a first LPC station. Rather than wait on weather, we decided to run for the next site 120 miles to the west, thus getting away from the east-moving depression more quickly. The wind blew force 7-8 all night then backed SW and increased to 9-10 in the forenoon; both scientific echo sounders were turned off as they were showing no seabed return. Water came aboard from all directions, causing some minor damage to a davit control box and other gear on deck. The ship remained virtually hove to all day, pitching heavily and heading roughly in the direction of Signy Island.

The wind and sea started to moderate overnight, and at 0300 we were able to turn and run back to the site, arriving at 1030 by which time it was calm enough to attempt the first LPC deployment. The first station was a non-triggered piston core because this simplified the procedure so that those on deck could become familiar with one thing at a time. The procedure for corer deployment and recovery is given in section 3. The deployment took lhr:20min, the wire trips 2 hours each way and the recovery lhr:30min. From the wire tension and PES recoreds the core appeared to have been successful; however, on recovery the wires were observed to have broken, the baseplate had damaged the nosepiece fins, and the piston had jammed in the liner about 2m up from the base. This damage had been caused by particles of shot and swarf being washed down from the weightstand into the liner and jamming the piston as it started to travel up the liner; the wires broke as the piston was forced down into the sediment with the liner but the baseplate stayed at the seabed. No sediment was recovered.

The ship remained on station for 2 hours while the nose assembly was removed, the damage assessed and a start made on repairs. The night was spent in further 3.5kHz and magnetometer survey of the area; we arrived back on station at 0530 to finish washing and reassembling the corer. The second deployment did not begin until the early afternoon. One reason for the delay was that Steve Bremner damaged a finger, necessitating a few hours' hospitalisation. This was the only work accident of the cruise. The deployment took 1 hour this time, the wire trips 2 hours down and up, and the recovery 1 hour. Again the station appeared to have been succesful, but the equipment had failed in a similar way when the piston jammed a short distance up the liner, this time because the replacement piston rings which had been fitted were too tight in the liner. Again the wires broke, but this time the baseplate located correctly on the nosepiece fins and the corer was recovered without further damage. It also contained about 1.5m of sediment but this was very disturbed.

After this second attempt at the same site it was considered necessary to move on to the next-but-one site northwards, given the shortage of time. The magnetometer was deployed and water sampling re-commenced at 30' intervals. The new core site was also the location of mooring XI. While repairs and modifications to the corer proceeded, we searched for, released and recovered the mooring. All went very smoothly and the recovery was completed within 3 hours of starting the search. Although there was appreciable algal fouling of all the instruments, both pyros had fired on the CR200 release and both current meters had recorded plenty of data; in fact the lower meter was still recording on recovery. The sediment trap collecting bottle was full.

By this time (1600/066) it was clear that to finish the corer and deploy it the same evening would require unreasonably long working hours, so it was decided to do the CTD, survey overnight and be ready to core at first light. Two more N-S 3.5kHz lines were run overnight across the sediment mound known as area K. Deployment began at 0720 and took 1hr:l0min; by now it was a routine procedure, and was confidently handled. The corer was run in from 20m up at 1 l0m/min as usual. Nothing untoward was noticed until the wire was hauled in, when instead of a pull-out there was only a pick-up to a weight which was less than before penetration of the sediment. The corer was raised to the ship's rail, where it was noted that below the neck only three barrels remained, with a short length of liner protruding below them We had lost 9 barrels, 9 collars, the nosepiece, piston, core catcher, core cutter, base plate and piston wires. The corer was recovered using one wire to the centre davit, at a rather obtuse angle but in reasonable safety.

When the wreckage had been secured and examined we got underway on a northerly course (the direction of the next mooring site) and considered our options. With the materials available on board it was not feasible to rebuild a shortened version of the corer (we could, at most, only have made a 10m gravity corer). Our only sampling device was therefore the 3m Kasten corer, brought along for emergencies. Within the remaining cruise time we had to recover moorings X and IX and get back to the Falkland Is; this left 3 days for Kasten stations and additional passage. This did not allow time to run for shelter at South Georgia to shift the LPC handling system, so the Kasten had to be deployed over the stem. A jury rig was devised using two large deals to guide the core head on deck, ropes to the two mooring winches to pull it outboard over the roller and the Gilson winch to pull it in.

Additional engine power was requested for this passage so that we would arrive in good time to recover mooring X in daylight. Surface water sampling was continued, and a revised cruise plan drawn up. On arrival at mooring X, although communications were established with both the acoustic releases, neither of them would release the mooring. We tried for 2½ hours then gave up for the night and headed for the first Kasten core site 18 miles away. At last we got some mud, the jury rig worked, if a little jerkily, and the Kasten came up full(muddy sand with abundant dropstones). The ship returned to the mooring site for a CTD cast.

Further attempts were then made to recover the mooring. Another 2 hours of acoustic signals failed to produce any response. Meanwhile the steel coring warp was moved to the midships gantry and a plan devised for dredging using a line of grapnels weighted by a dredge and chain (see section 4). The wire was veered to the seabed and continued to veer while the ship manoeuvred in a U around the mooring site. The wire was then hauled in, but failed to catch the mooring line. We left the mooring site on the evening of March 10(069), intending another Kasten core and CTD farther upslope to the NW. However we were then hit by a force 8-9 westerly gale, and did not have time to wait on weather at a location so far from the Falklands, so had little option but to head westwards.

The wind moderated in the morning and we ran a line along the N side of the Falkland Trough hoping for a possible core site at about 44°W, but there was none, so additional engine power was again requested and we made for mooring IX. Although when we reached it the weather was marginal for recovery (25-30 knots of wind and a strong NE set), the search, release and recovery were again completed within 3 hours. The upper current meter was still recording and the lower one had 12 months' data. The CTD at this site had to be re-started twice because the main connector came adrift, but all was finished in the early afternoon of March 12 (071).

The next Kasten core (KC096) lay 150 miles to the WNW in an area of thin ?Quatemary sediments on the N side of the Falkland Trough at 51°W. It required two attempts as the corer came up empty the first time, but we got a very interesting core of varied sands and muds with spectacular bioturbation and common dropstones. A further 150 mile passage brought us to the last group of four core sites at the western end of the Falkland Trough, ranging in depth from 3100 m in the bottom of the trough to 1200m on its N side. The weather was kind to us at last and we started to creep ahead of schedule. Cores KC097, 098 and 099 were all fairly similar with foraminiferal sand overlying diatom-bearing mud. A CTD was done at KC098 to confirm that we were coring in Circumpolar Deep Water, and a test of the LPC trigger (in 2700m of water) followed KC099. This was to check (i) that the new Oceano acoustic release could be commanded to disengage a safety catch, thus allowing the trigger mechanism to drop a weight when the trigger arm came up; (ii) that the Gceano release could also be used as a 12kHz pinger to obtain a pinger-bottom echo. This was successful on both counts.

By the evening of March 14 (073) we had enough time in hand to survey overnight and core in the morning (KC100, laminated well-sorted sands). This allowed us to process the core and begin packing up lab equipment while still at sea, the remaining 12 hours of scientific ship time being utilised for magnetic survey of a NE-SW trending anomaly SE of the Falkland Is. The magnetometer was recovered and data collection discontinued at 2230 on March 15, and the ship tied up at FIPASS, Port Stanley, at 0800 the next morning. All of our gear was stowed and the ship made ready for mobilisation for JCR10 by mid-afternoon.

3. CORING

3.1. Long Piston Corer (SB, CJP, PFB)

The BAS Long Piston Corer is a stationary-piston corer and was developed at the British Antarctic Survey for use on *RRS James Clark Ross.* The principle of the stationary-piston method is to extract an undisturbed core by keeping the piston in contact with the sea bed. The system is designed so that core barrel length and head weight can be adjusted according to the length of core required and the type of sediment to be sampled. Being of a modular construction, any configuration of barrel length to head weight within the scope of the equipment can be accommodated. For the purposes of this programme a 30 metre barrel length and a head weight of 4.3 tonnes was used. The calculated weight in water of the assembled corer was 6.6 tonnes.

Handling equipment	**Long Piston Corer**
30 tonne Traction Winch System	Weightstand c/w 8 weights (330kg each)
Midship gantry	Neck interface
29mm Super Aramid coring cable	12 x 2.5m barrels
	11 x barrel collars
Tilt and Transfer mechanism	Nosepiece
Weightstand cradle	Piston
Auxiliary winch	ABS core liner, total about 370m
4 tonne davit	Core catcher
2 tonne davit	Core cutter
12.5 tonne SWL swivel	Base plate
10kHz pinger	Piston wires (6mm)
	Trigger c/w Oceano acoustic release

Installation

The majority of the installation and provisional deployment testing was carried out whilst alongside in Cape Town, leaving only the final rigging to be completed at sea, It is crucial to reach this stage before leaving port, as nearly all of the tasks require the use of the after crane. The 4 tonne davit was positioned at 17m aft from the corer pivot point, and the 2 tonne davit at 29m aft. Although two days had been allocated for this work, it took three long days to complete. There were one or two minor problems with the control system which were quickly rectified. Installation was facilitated by having a 20 x 8ft container on the aft deck, housing many items of equipment and tools. All testing was completed satisfactorily and it was possible to raise the LPC to the horizontal position and just over the ship's side.

Rigging was completed on passage to the work area. The long passage allowed time to develop a reliable and repeatable rigging method, this was very useful as there was little previous rigging experience.

<u>Recommendations:</u>

1) A minimum of three days is required to install the equipment. Even taking into account the lack of experience, there is, at present, no allowance for problems.

2) Fortunately there was enough space to have the container on the aft deck. This is essential to the mobilisation and helped to speed up the operation.

3) Three ISG plus a deck officer is the minimum requirement during installation.

Coring

Before the first deployment a procedures list was drawn up and all staff involved were briefed. It was decided that for the first few core sites the LPC should be used in non-triggered (wire-controlled or gravity) mode. This would enable everyone involved to become familiar with the system without the extra handling problems associated with using the trigger.

After a delay resulting from bad weather, the first core station commenced early on March 5th. Conditions were good.There were one or two initial delays with the winch system but these were quickly rectified. Deployment went extremely well and was completed ahead of schedule. Wire out and wire tension were monitored and digitally recorded on the Seametrix system, and an analogue chart recorder also monitored wire tension. A pull-out tension of approximately 12 tonnes was recorded. This was in accordance with the expected tension, approaching 2x the all up weight of the assembled corer.

During recovery it was noticed that the piston wire had severed; this made handling slightly easier. On rotation to the horizontal it became apparent that both of the davit wires had been lowered too far down the barrel. A support rope from the mooring winch was slung around the barrel to take the weight while the davit wires were moved to the correct positions. It was also apparent that the base plate had not located properly on the nosepiece on pull out. This had to be rectified before the corer could be brought inboard; the corer was then recovered and secured. Even though there were problems, recovery was completed within the time estimated. During the operation the aft davit wire became severely twisted and kinked, damaging the wire. This is thought to have been caused by rubbing on the sheave block on haul.

There was some superficial damage to the nosepiece and base plate due to the base plate not being seated correctly. The piston wires had severed at the barrel nose. The presence of mud on the outside of the whole length of the barrel indicated that the LPC had achieved full penetration.

The cutter, catcher and nosepiece were removed. There was very little sediment in the core liner and the piston was jammed in the liner approximately 2m from the end. Efforts to pull the piston out were unsuccessful and it was necessary to cut the liner just above the piston. The piston was persuaded out of the section of liner, revealing a large quantity of debris which had become embedded in both the walls of liner and the PTFE piston rings. The debris was identified as particles of steel shot, commonly used as a preparatory process prior to zinc spraying. The weight stand, which had been zinc sprayed during the summer after modifications, had evidently not been cleaned out properly.

The partly-used liner was removed, cutting it at the solvent-welded joints so that the sections can be re-machined and reused. The whole of the inside of the corer was flushed out with the fresh water hose prior to the next deployment; this was performed with the LPC vertical on arrival to repeat the station.

The following improvements and repairs were made:

1) Replace aft davit wire and fit swivel in line.

2) Adjust the length of the davit wire ropes.
3) Support rope to be available during deployment and recovery in case of problems.
4) Straighten nosepiece sheave cover plates.
5) Replace piston rings.

The second core station was a repeat of the same site. Deployment commenced at 1345 on March 6th, in good weather conditions. This was completed in approximately 1 hour, about 45 minutes quicker than the first deployment and with no problems. A pull out of approximately 12 tonnes was recorded.

Recovery went very well and was also completed in 1 hour. The piston wires had again broken. The davit wire ropes were still not quite the right length and had to be adjusted further (probably because of stretch in the rope). This time the baseplate had located correctly, making recovery very much easier. Again there was mud outside the full length of the barrel. There was also mud in the core catcher and nosepiece and in the first metre of liner, but the mud was highly disturbed and watery. The piston had jammed again, this time about 2.5m up the liner. The mud-filled section of liner was cut, end-capped and stored. On removing the piston there was no sign of any obstruction, but the piston was extremely tight in the liner. The piston rings were measured and found to be oversized. This was attributed to the rings having to be stretched to fit over the piston during fitting; this should only happen with a new set of rings, which should then contract to their normal size given time. It was also realised that the manufactured internal diameter of the rings was too small, so that they were not a sufficiently free fit on the piston.

The following repairs and modifications were made during passage to the next site:

1) Adjust piston and rings to correct diameter. The long term solution to this problem is to modify the piston so that rings can be fitted without having to stretch them
2) Adjust davit wire rope to allow for stretch.
3) Chamfer inside diameter of liners on male ends to ensure a smooth passage for the piston.

The third core station was at a new site, coincident with a Kasten core and a mooring deployment on a previous cruise. Deployment was scheduled to commence at 0500 on March 8th. This was delayed by two hours due to electrical problems with the control system. The cause was identified as a short circuit in the Tilt and Transfer junction box caused by a leaking seal. Deployment then went as planned

"Pull-out" was monitored at 4.5 tonnes. This was not consistent with previous records and the readings were more comparable with a lift than a pull out. At the surface it was obvious that most of the barrels and the base plate were missing. Recovery of the remainder of the system would now be more difficult as we could no longer use both davits. The corer was recovered using one wire to the centre davit, at a rather oblique angle but in reasonable safety. It was necessary to maintain tension on the auxiliary wire to the core head, because the centre of gravity of the corer was now forward of the pivot point.

The top of the core head contained some soft sediment, showing that the upper part of the corer had been lying on its side at the seabed. The top barrel appeared to be undamaged, the second was badly bent at the interface with the collar, probably as a result of severe side loads imposed on the system. The third barrel had fractured near the base, at a shallow circumferential groove arroximately 30mm from the interface with the third collar (which was missing). On inspection of the broken barrel there was evidence of compressive and tensile fractures around the annulus, diametrically opposite to each other.

The corer must have broken while the wire was still being veered, since there was no extra increase in tension on haul (no pull-out). The fracture is consistent with lateral stress consequent on a sudden deceleration of the corer. We consider that the corer probably broke on impact while the base was at or just below the sediment surface. For more details, see the LPC Loss Report.

During dismantling the barrels would not rotate fully and tightened after approximately 15-20° of rotation in either direction. It was necessary to use the hydraulic splitter device to separate the barrels from the connectors, which proved very successful. On close inspection of the mating surfaces of the barrels and connectors there were signs of deformation around the lower half of the tangential connecting pin slots on the barrel shaft. There was no sign of deformation of the bore of the connectors. This type of damage is not unusual and is to be expected with the use of hardened steel dowels in relatively soft housings.

Because of the loss of so much of the equipment, no more LPC coring could be attempted.

Trigger Test

The original messenger-type trigger safety release could not be reconciled with the long Superaramid termination, given the geometry of the ship's midships gantry. A new safety release had been designed, incorporating an Oceano 12kHz acoustic release. Although this had been tested on land (i.e. transmitting signals to it at close range in air), it had not been tried in deep water. The trigger test was conducted using the aft gantry and the 19mm diameter coring wire. The water depth was approximately 2750 metres. The aims were to test the communication link in deep water and the operation of the 12kHz pinger facility on the acoustic release.

The test weight to be dropped was about 660 kg (two weights from the LPC core head) and was shackled to the release hook on the trigger. The trigger arm weight was 20 kg, attached using 3m of chain. The Oceano release was fitted to the trigger, attached to the safety catch and primed for release. The 10 kHz pinger was also attached to the wire 50m above the trigger, as a back up to the 12 kHz pinger on the acoustic release. Both pingers were monitored using the PES which can be switched to receive either 10 kHz or 12 kHz signals.

The test was conducted as follows:

1) Lower trigger to 150m above the seabed. Monitor 12 kHz signal using PES during lowering.
2) With pinger switched off, release safety catch on the trigger using acoustic release.
3) Lower to-the sea bed to release weight.
4) Rotate release motor with pinger switched on.

All components of the test were completed successfully.

Demobilisation

Most of the more manageable equipment was packed away on passage to Port Stanley during the last few days of the cruise. Having the container on the aft deck made this job a lot easier. On arrival at FIPASS the rest of the LPC and handling system was dismantled and stowed away. This job was considerably shortened, consequent on the earlier loss.

Conclusions and Recommendations

The mobilisation of the equipment was particularly time-consuming for ISG mechanical support personnel. Two days were originally set aside for this work alongside in Cape Town. Although things went reasonably well with few problems, installation took three long days (at least 12 hours each). This left little time to spare if there had been any major problems. In future three full days must be allocated to this task, assuming that all three ISG staff are available. More time would be required in the event of reduced manning.

The first two deployments were very encouraging and proved that the handling system was more than capable of deploying and recovering a 30 metre corer. In both cases there was full penetration of the seabed, but unfortunately without yielding cores. There were some initial problems with the corer on the first two deployments, mainly with the piston becoming jammed. However, it was felt that these had been rectified and all were optimistic that the third deployment would prove to be successful.

Knowledge of the system was limited at the start of the cruise, especially amongst the ship staff, but things progressed well. We developed a reliable and repeatable method of operating the handling system and made many significant improvements to the overall procedure. The times taken for deployment and recovery were reduced, which is very important when handling equipment of this size at sea.

Many improvements were made to the techniques for rigging and unrigging the system on deck. Prior to the cruise a lot of these procedures had not been perfected. By the third rigging this had become routine and could be completed in a reasonable time. Many good ideas stemmed from the cruise for minor modifications to parts of the equipment and new ways of handling the LPC. These only became apparent because-of the cruise and would not have been obvious otherwise.

Although the LPC programme was cut short, it became obvious that the whole coring procedure from rigging through deployment, recovery and unrigging was very labour intensive. There will be periods during all future coring cruises when the programme requires 24-hour support, where core sites are close together. Because the LPC programme was stopped after three stations it was not possible to develop the use of non-technical staff for the less technically demanding tasks. In future, however, it will be essential to institute an “ISG plus others” shift system for 24-hour working, given the limited number of engineering staff on board.

The following recommendations need to be considered before the next cruise.

1) Spares. It is clear that spares are essential to this programme. Had the loss of the equipment happened in the first week of a 4 week cruise there would have been no real fall back position and the cruise would probably have had to be cut short. At the high cost of running the ship and mobilisation for cruises, the cost of reasonable spares for this project is not excessive. Certain items may have to be considered as consumable items, for example: Barrel nose, barrels, cutter, catcher and baseplate.

2) Dedicated trials. These should be carried out at a known site with ideal conditions for coring. A range of cores should be taken of various lengths and weights using the trigger. It would be useful to incorporate an instrument package to provide a reliable record of events. The package might monitor attitude (tilt), acceleration and ambient pressure (depth). The use of a camera might also be considered.

3) The following parts need to be modified in minor ways:

a) Piston
b) Sheaves
c) Barrel nose
d) Neck
e) Liners

4) The handling system will need a thorough overhaul before being used again. This has been budgeted for in the coming financial year. Some parts need to be marinised to a higher specification than at present.

5) Lifting eyes need to be fitted to the Tilt and Transfer unit and the two davits.

6) A lightweight, portable platform is required for standing on when attaching the trigger to the LPC.

7) Ship's staff are concerned about the effect on the deck sockets of the load imposed by the auxiliary winch during deployment and recovery. At maximum corer weight and length (up to 8 tonnes in air), this winch is acted on by a total upward force of about 7.5 tonnes. It is secured by bolts in 10 sockets of the deck matrix, each of which has a specified SWL of 1 tonne in any direction. Although this use is within specification, concern was expressed about the ability of the underlying deck area to support a concentrated load of this size. It depends on how Swan Hunter interpreted the specification: if generously there is no problem, but if unthinkingly or minimally then additional deck strengthening might be required.

3.2. **Kasten Coring** (CJP, JAH)

Deployment

The Kasten corer consisted of a l-tonne core head and 3.25m barrel. It had to be deployed over the stern as the midships gantry area was full of LPC equipment. A launching and recovery system was devised by the ship's staff. Two deals were bolted to the deck, aligned fore and aft and the width of the core head apart Sheets of plywood were also laid on the deck to protect the deck timber from damage. Starting with the corer assembled and the barrel pointing aft, it was hauled outboard by a mooring rope each side, attached to the core head by wire strops (fig. 1). As it tipped down over the stem roller the weight was taken on the main coring warp, with the Gilson winch wire also being used as a preventer. The Gilson wire and wire strops were removed and the main wire veered 50m. The pinger was attached and the core station done in the usual way. Run-in speed was 60m/min where a hard seabed was expected and 50m/min where it was softer.

On recovery the pinger was removed, the core head brought to the stem roller and the Gilson wire attached. The Gilson winch was used to drag the corer in over the roller on to the deck, with the deals guiding it into position. Both the mooring winches and Gilson winch tended to be jerky in their operation, not being designed for precise control. The core head was damaged on one deployment because it was dragged sideways and one of the wire strops tore through a piece of stainless steel sheet. Otherwise the system worked.

The Kasten corer was recovered full or nearly full at all sites (Table 1) except 96 which required a second attempt, presumably because the corer hit a hard patch. There was

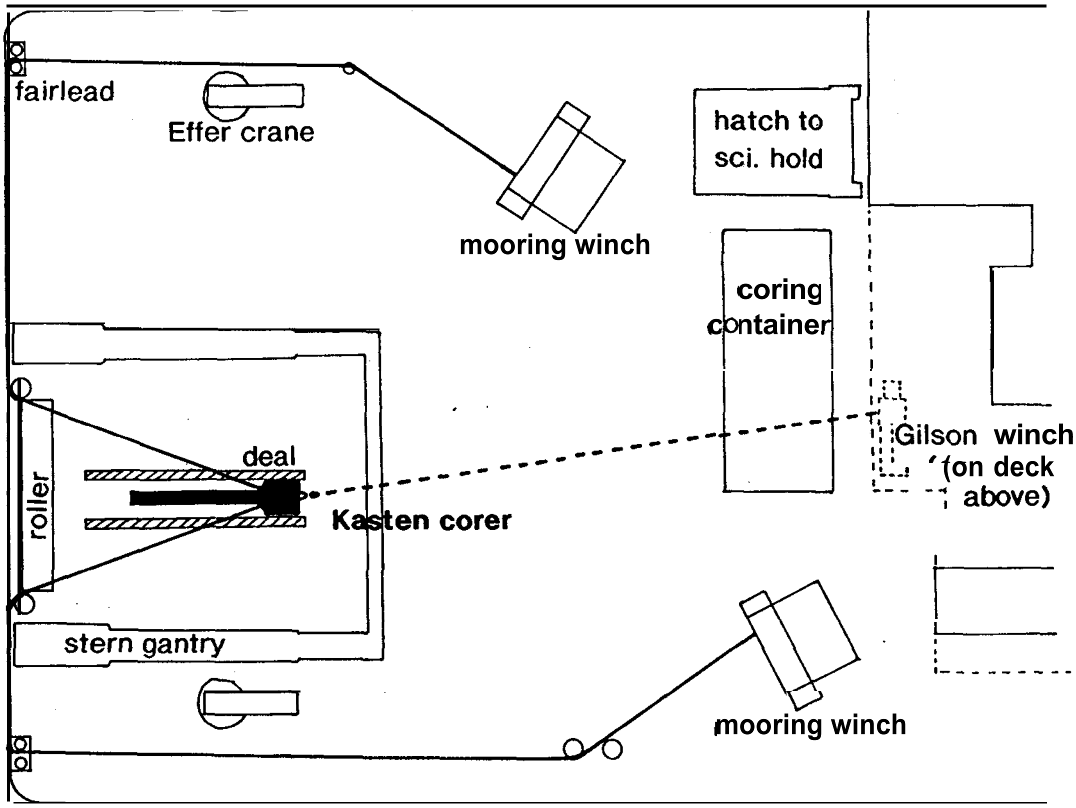


Figure 1. **Arrangement of jury rig for deploying and recovering Kasten corer.**

some damage to the core catcher at several sites; this was repaired using parts from the spare catcher. The present design of catcher is not robust enough for repeatedly coring sands or any sediment containing ice-rafted cobbles. Fortunately the components lasted until the last site when the catcher was damaged beyond repair. The barrel was also slightly bent near the top at two sites, but we were able to straighten it.

Core Lab Processing

The core barrel was unbolted from the head and manhandled into the Main Lab. This is not a very satisfactory procedure as the barrel when full is extremely heavy and there are several obstructions including the sorting table in the Wet Lab. Kasten cores have to be processed promptly because there is no liner and the barrel must be completely emptied, washed and reassembled for the next deployment. The procedure was the same as for JCR04:

- Remove core catcher and store vertically
- Remove lid (approx. 60 screws) and support free sediment ends
- Remove screws from false bottom and insert threaded T-bars
- Raise false bottom by approx. 2cm, slice with cheese-wire, discard protruding sediment and clean surface. Do visual description, take photographs.
- Raise false bottom by 5cm and take 2 parallel channel samples (one 7.5x5m, one 5cm square). The 7.5cm wide one is labelled **A** for archive, the other is labelled **B. The** upper section is **1** and the lower is 2. A complete label is **KC095-1A.** Very large dropstones were removed and labelled before the channels were inserted.
- Raise false bottom by lcm, cheese-wire and discard protruding sediment leaving another smooth surface.
- Raise bottom by 3cm and take series of slab samples (15xl0cm) downcore. Each slab is cut with a cheese wire, wrapped in clingfilm and stored in a plastic sandwich box. Poorly cohesive sands had to be shovelled on to the clingfilm using a small steel plate.
- Discard remaining sediment, wash and re-assemble corer.

On JCR04 we had continual problems with sediment particles getting stuck in screw threads. Diatom ooze can be particularly destructive to threads. This year we used an ultrasonic bath to clean the screws and T-bars, which was very effective.

Core storage

The channel samples, with ends taped on, were stored in what is nominally the -20°C freezer but which is to be maintained at +4°C this season. The slab samples were stowed in cardboard boxes in the same space. This room is larger and easier of access than the cool store.

Table 1 Core sites

Core No.	Latitude	Longitude	Depth	length	Time/date
945PC092	59°23.0'	41°55.0'	3911	0	1 100-2100/064
PC093	59°23.0'	41°55.0'	3911	1.6m	0900-2300/065
PC094	56°44.3'	42°58.1'	3657	0	0830-1650/067
KC095	51°56.5'	41°30.4'	3402m	3.lm	2255/068-0150/069
KC096	52°28.1'	50°29.9'	3274	3.lm	0735- 1245/072
KC097	53°21 .O'	54°41.0'	3058	2.9m	0220-0445/073
KC098	53°20.0'	56°16.0'	2430	3.2m	1200- 1400/073
KC099	53°30.0'	57°02.8'	2727	3.lm	1930-2125/073
KC100	52°50.8'	57°01.3'	1219	2.6m	1120-1300/074

3.3 **Winches and Wires** (SAW)

This is the first cruise in which Geoscience has been able to use the vessel with the winch system in its working form, since JCR04 was before the modifications had been carried out. The winches performed well without any major problems. There were some minor problems such as leaks, but these led to minimal down time (in the region of 30 minutes over all deployments) required to diagnose a problem before proceeding with the deployment.

30-tonne Traction Winch

On the first LPC deployment it was noted that the required speed of 38 m/min could not be obtained initially. Veering was continued at a lower speed for about 10 minutes while the fault was diagnosed to be the loading solenoid for No.1 main winch pump and the coil replaced. The winch was then stopped, the pump loaded and the deployment continued at the required speed.

The pipe work to the motor on No.3 sheave leaked periodically during the deployments, but did not delay operations. This was more of a problem when operating with four driven drums ie running in at 108 m/min. This will require further attention.

While veering at LPC station 93, No. 1 sheave stopped turning. The winch was stopped and checked, as no immediate cause was found the operation was continued on five driven drums, having ensured that all six drums would haul after pull-out. The speed of operation was then restricted to the agreed speed by the winch driver.

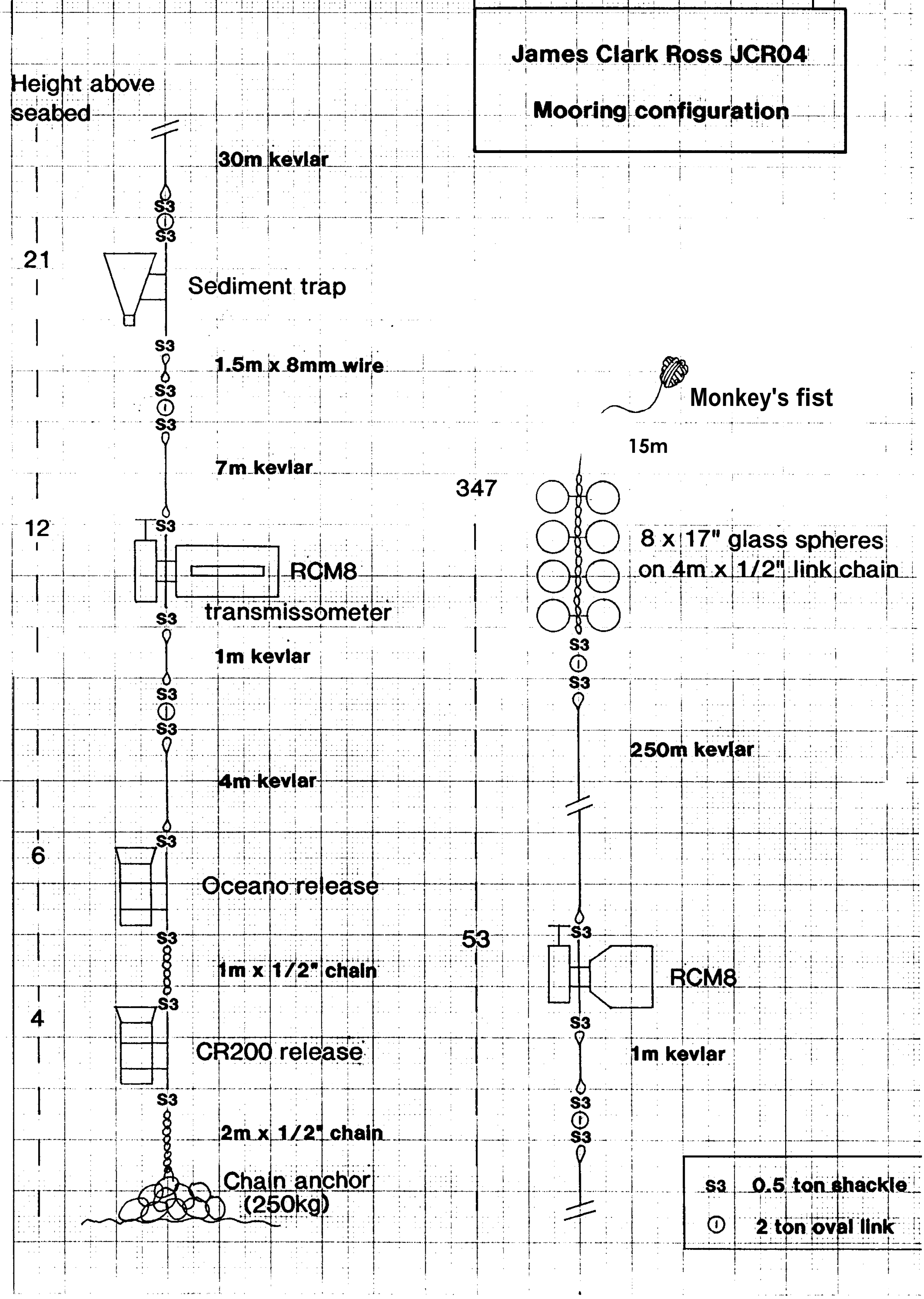
While running at 108 m/min a bolt from the clutch assembly on No.2 sheave came loose when free wheeling. After pull-out the bolt was replaced and tightened before continuing to haul.

At the end of the operation to dredge for mooring X the powered rollers started to skid on the wet and greasy cable, causing a groove to be cut in their surface before being discovered. This required the rollers to be replaced with the spares; they will require re-tyring this summer.

Super Aramid Cable

The cable performed well within the winch system, as expected after the stretching exercise last September. The only problem was caused by slight wrinkling that occured with slack cable during stretching. As this was worked heavily through the winch while deploying and recovering the corer, the damage worsened with operations although this was not a cause of concern to those familiar with this kind of cable. The damage does cause a certain difficulty when handling the cable and so it is proposed to remove the outboard 70m and reterminate in the approved manner.

Figure 2. Moorings deployed on JCR04 and recovered on JCRO9.



4. CURRENT METER MOORINGS (PFB,MP)

Cruise objectives included recovery of three current meter moorings deployed on JCR04 in 1993. Each mooring comprised a chain anchor, two acoustic releases (IOS CR200 and Oceano), Anderaa RCM8 current meters at 12 and 52 m and a sediment trap at 21 m above the seabed, with glass floats at about 350 m (Figure 2).

Moorings IX and XI in the Scotia Sea (see track chart) were recovered easily. In both cases a box search using the PES fish located the mooring to within 200m or less. The IOS CR200 releases (the lower of the two in each case) which are controlled by a module in the PES behaved perfectly, changing modes and releasing exactly as requested. The floats surfaced close to the ship and the rigs were grappled and brought on board, all inside three hours. All components (floats, sediment trap, current meters and releases) were in good condition when recovered, with no leaks but appreciable algal growth compared with moorings recovered from farther south in the Weddell Sea. The Oceano releases were not tested in situ, but one tested on deck (after warming up and not under load) released when commanded to do so.

The lower meter on both moorings included a transmissometer. These meters had recorded good data for 12-13 months from deployment. The upper current meters had done even better - both were still recording good data after two years, right up to the time they were recovered (Table 2). The sediment traps each contained about 300ml of organic-rich material.

Mooring X, on the southeastern margin of the Falkland Plateau, was not recovered. Its CR200 release responded to a channel 1 command, pinging at a two second rate as expected. The box-search was then performed and the ship hove to on the site. The release was then switched successfully to its channel 2 mode (pinging at a one second rate) ready to be released. At this point transmitting the channel 2 frequency for between 30 and 60 seconds is usually enough to fire a release. This release though failed to respond to this and longer transmissions. Transmissions in excess of 10 minutes were made, and these included not only the centre frequency of the receiver filter but 1,2, and 3Hz either side. (This is done in case the centre frequency has slightly drifted with time).

After two hours it was decided that the CR200 was not going to fire and should be abandoned, concentrating effort on the Oceano. These releases are controlled in a different way and utilise a deck unit controller and dunking transducer lowered over the side of the ship. With this done a ***range*** command was sent to the release. The deck unit then displays the range in meters between the transducer and the release. The range displayed corresponded well with the known water depth and position of the ship. Next a ***release*** command was sent and in response an ***executed*** signal was received suggesting that the mooring was rising to the surface. Further ***range*** commands showed this not to be the case. A series of release and range commands were then sent but under no situation did the mooring show the slightest inclination to rise to the surface. This behaviour of an Oceano release mirrored that experienced on JCROl in the Weddell Sea, when it was found afterwards that the release arm had not moved. After further interrogation of the CR200 and Oceano releases to no avail several hours later, it was decided to try and drag for the mooring.

The ship then attempted to drag for Mooring X, laying on the seabed a 1200m-long weighted length of steel coring wire armed with 5 ship's grapnels, and manoeuvring so as to loop the wire around the 350m-high mooring. In worsening weather the first attempt failed, and it was decided not to repeat it. The mooring was intact when left, and remains a viable target for dragging with suitable equipment and in reasonable weather. We have every reason to believe that the mooring components are undamaged and the data preserved. Clearly, the sooner this is attempted, the better: the mooring will eventually disintegrate, the battery protecting the data will eventually fail and the data will be of greater value in the near future than subsequently.

It is recommended that the ship acquire and retain a stock of gear to allow it to drag for moored equipment without risking the main warps. We suggest:

(a) 14mm steel wire pennants to a total length of 1500m (say 3 x 500m lengths, perhaps on Gilson winch drums).

(b) leading chain weights (say 2 x 500kg

(c) 3 or 4 heavy duty grapnels of special design, which may vary according to the moored equipment to be recovered, it may be more appropriate to borrow or hire these items.

It is also recommended that an opportunity be sought within the 1995-6 season to drag for Mooring X. Allow 1.5 days maximum on site.

Table 2 Mooring Recovery

Mooring IX
Position 53°55.9' s 48°03.1' W Water depth 3956 m.
Deployed 1422/038/93.

Recovery 07 l/95:
0950 Start search
1050 Released
1146 Surfaced
1205 Grappled
1250 Inboard
Upper meter RCM 9909 at 52 m. Valid records 1500/038/93 to 0900/071/95
Lower meter RCM 9904T at 12 m. Valid records 1500/038/93 to 2300/032/94
Sediment trap at 21 m.

Mooring X
Position 52°08.3' S 41°09.2'W Water depth 3763 m.
Deployed 1658/043/93.

Attempted recovery 068-9/95:
1824 Start search
1910 Try to release CR200
2040 Try to release Oceano
2100 Give up
0750 Try Oceano
0810 Try CR200
1030 Try Oceano
1100-2040 Attempt to drag for mooring. Not recovered
Upper meter RCM 9419 at 52 m.
Lower meter RCM 9418T at 12 m.
Sediment trap at 21 m.

Mooring XI
Position 56°44.45' S 42°58.1' W Water depth 3657 m.
Deployed 1703/048/93.

Recovery 066/95:
1630 Start search
1706 Released
1800 Surfaced
1818 Grappled
1904 Inboard.
Upper meter RCM 9911 at 52 m. Valid records 1800/048/93 to 1600/66/95
Lower meter RCM 9903T at 12 m. Valid records 1800/048/93 to 1700/069/94
Sediment trap at 21 m.

5. CTD (MP, CJP)

Some preparation work was undertaken during JCR09A. Earlier in the year problems with the conductivity cell were reported. The sensor was changed for a borrowed spare after the sensor head was modified by enlarging a particular hole (later manufacture conductivity cells were made with a larger base than earlier sensors). The sensor head was disassembled and removed according to the instructions, except that three wires that were to be disconnected from some components inside the sensor head were cut rather than de-soldered, Later when the wires were rejoined they were soldered and then covered with heat shrink sleeving and a small blob of glue to hold them in place.

The '0' ring seals were inspected and deemed serviceable; silicon grease was used in the re-assembly. The cell was then tested by using water from the uncontaminated sea water supply. All appeared to function correctly.

At the start of JCR09B the CTD frame was assembled with a transmissometer, battery pack and pinger. There were 11 serviceable 2.5 litre water bottles so no. 8 was omitted from the 12-bottle rosette as it is the least accessible. Reversing thermometers were fitted to holders on bottles 2 and 10. Cast locations arc given in Table 2, casts were normally made to within 10m of the seabed (measured by pinger-bottom separation). During casts the CTD logger, deck unit and Level-A performed as required with no problems. Near the start of cast 86 (700m wire out) the acquisition program signalled that no data was received from the instrument. The CTD was immediately recovered and the main connector was seen to have come apart It was re-fitted but the same thing happened on the repeat cast at 300m wire out. On recovery this time some extra cable was pulled through the bight so that the connector no longer came under tension.

The rosette bottle firing unit did cause initial concern since the indicator dial on the front of the unit failed to register the firing of some bottles. Fortunately it was the case that the bottles had fired correctly but the indicator was in error, all bottles fired on all casts. If the indicator failed to rotate as it should, it was turned manually so as to keep track of progress. The reversing thermometers worked correctly except for one on the final cast. One other slight question mark over the CTD was that of calibration. Presumably, since the conductivity sensor has been changed, the calibration for this sensor is now incorrect. This was expected and can be post calibrated against bottle samples. However it was not expected that the temperature would be in error, as it appeared to be. Calibration certificates for the instrument (conductivity, pressure, temperature) were available, but when a new Cal-file was created using these calibration coefficients it resulted in wildly inaccurate results. The previous values were re-installed and operation resumed. The correct calibration files need to be assembled so that the data can be post-processed correctly and so that data acquired in the future will be processed accurately.

Water bottle samples were taken on the up-cast, mainly from the lowest 200m of the water column, i.e. within the nepheloid layer identified from the transmissivity profile on the down-cast. A total of 9 salinity samples were taken and the rest of the water filtered for the study of suspended particulate matter.

Table 3: CTD **stations**

No.	Lat. S	Long. W	Depth	Time on station	
945CTD083-4	56°44.2’	42°57.9’	3657m	2000-2240/066	Moorin gXI
085	52 8.3’	41’08.8’	3763	0410-0715/069	Mooring X
086-8	53°56.3’	48’01.1’	3955	1300-1717/071	MooringlX
089	53 19.5’	56 15.7’	2430	1400-1558/073	

Notes: 1) 084 is the up-cast of 083

2) 086 and 087 were stopped at 700m and 300m respectively because the connector came adrift.

6. OTHER DATA AND EQUIPMENT

6.1 Navigation (RJH)

During this cruise the level 'abc' logging system logged navigational data from the following instruments:

Trimble 4000 GPS locator
Gyro
EM log
Doppler Log

Speed data from the Doppler and EM logs, plus headings from the gyro compass, were logged every 5 seconds. GPS fixes were logged every 30 seconds and stored in the stream **gps_trim.** Relative motion data are collated into a stream known as relmov using the Level C routine relmov. The Level C routine bestnav then combines GPS fixes with relative motion data, dead-reckoning the ship's, track between fixes, to produce the final navigation file **bestnav.** This file contains position and 'ground-speed' data sampled every 30 seconds. On previous geophysics cruises (JR04 and JR09A) where a gravity meter was in use, it was found that this method of navigation had an adverse affect on the calculated Eotvos Correction. This was an effect of deliberately introduced errors in the GPS transmissions. To overcome this, the fixes had to be averaged and sub-sampled every 15 minutes, the track being dead-reckoned using relative motion data between each 15 minute fix. This meant that the navigation data had to be back-processed in 12 or 24 hour batches. On this cruise, as gravity data were not acquired, this was not deemed necessary so the level C routines **relmov** and **bestnav** ran automatically throughout the whole cruise.

A second GPS receiver (a Shipmate system) is used by the ship's officers for the day to day navigation of the ship. This is directly linked to the PC-based Voyage Management System **(VMS).** Waypoints were routinely entered into the VMS before and during each sub-survey. PC repeaters showing the ship's position and proposed track are located in the UIC room and Main Lab. These performed well throughout the cruise. However it was noted that the Shipmate receiver was more prone to losing fixes than the Trimble 4000. The Bridge's main VMS system broke down on March 6th so the back-up system was used. Although this was fine for navigating the ship it is not networked, which meant that plans could no longer be copied between locations; waypoints had to be entered twice.

An Epson printer was installed in the UIC room and connected to the Trimble's spare output port This produced a continual written record (1 every 30 seconds) of GPS fixes throughout most of the cruise. It proved particularly useful during mooring recovery. However, it is impossible to have both output ports of the Trimble outputting data at different intervals. In effect this means that fixes can only be logged by the ABC system every 30 seconds whilst the printer is running.

6.2 Echo Sounders (MP)

10 kHz Echo Sounder

This equipment was used extensively during JR09B, after the first 3 days of Simrad EA500 operation. With one exception it ran well. The exception occurred when switching from 2.8 to 1.4msec pulse length one night; the instrument briefly emitted a buzzing noise and a small puff of smoke. Otherwise equipment still appeared to be working! It was found that a Tantalum bead de-coupling capacitor had failed. This was replaced with a new capacitor and operation continued. Although the fault and remedy were easily found this time, this may be seen as a warning over the reliability of the equipment. All faults may not be so easy to repair, and the documentation is very incomplete.

3.5 kHz Profiler

On JCR09A the Raytheon Line Scan Recorder intermittently suffered from loss of sync by the main drive motor. Despite hours of investigation, the cause of the fault and its precise nature remained elusive. Prior to the 1994-5 season the unit had been returned to Raytheon on two occasions, only to be returned to the ship with the diagnosis of “no fault found”. The loss of synchronisation (which can be likened to a TV with no line sync) sometimes happened once every 30 seconds for a few minutes then not again for several hours. The only way to stop it was to do a power off reset.

At the beginning of JCR09B a new stepping motor was supplied to the ship and fitted to the Raytheon LSR, as the motor was considered to be a likely cause of the fault. The equipment was put on test; within the first hour the problem had reappeared. At this point, it was found that the fault could be generated by removing and replacing the fuse to one of the cooling fans. Presumably this action caused a spike on one of the power supply rails. With the fault now reproducible, diagnosis could proceed more quickly. After a number of hours it was found that the addition of a 1000µF capacitor of a suitable voltage rating across the +5v line cured the problem. The 3.5kHz profiler was used for almost the whole of JR09B, and this fault never reappeared. The original stepping motor was added to the 3.5kHz spares. We conclude that the equipmant is extremely sensitive to mains interference and caused one of the internal power regulators to become unstable. This instability could be damped by the addition of capacitance, allowing the equipment to run in the relatively noisy ship environment.

The 3.5 kHz system consists of three parts: 1) The Raytheon line scan recorder, 2) Ocean Data Equipment power transceiver, 3) IOS correlator, annotator and interface equipment. The power of the output pulse is controlled from the transceiver which is marked 03 -24 -18 -12 -6 and 0 dB. Occasionally, if the output power is increased above -6 dB, the unit shuts down, showing a transducer impedance mismatch. This problem seems to come and go annually and for no good reason. This year however it seems to be here to stay. Diagnosis is not helped by lack of documentation for both the power transceiver and for the transducers. Two things are possible: 1) the preset level at which the shutdown occurs might have drifted with time, or 2) there is a genuine transducer problem. The documentation for the power transceiver does not describe how to set up the mismatch circuit, and the manufacturers seem to have ceased trading so seeking advice from them is impossible. Also, the IOS documentation does not specify the DC resistance of the transducers so it is difficult to ascertain if there is a problem there. Basically two variables and no equations.

This piece of equipment was vital to JCR09B, so without further information about the transducers or the setup for the transceiver it was considered wrong to attempt a remedy. The load mismatch circuit is there to protect the output stage, so if this protection circuit is adjusted when the fault lies elsewhere it might well prove fatal to the power output stage. This would render the equipment totally useless, whereas at a power level of -6dB it does produce an acceptable record.

6.3 **Pingers** (MP)

One of the 10 kHz pingers was attached to the CTD frame at the start of JCR09B. When the other was recovered from the Scientific Hold cage for work with the LPC, it was found that the pinger signal was weak. A flat battery was suspected so the unit was opened up and the battery changed. Before reassembly it was tested, but the weak signal persisted. On closer examination it was found that the housing had leaked some time ago and that salt water had removed the majority of most of the tracks on both circuit boards.

Firstly everything was dismantled as far as possible and cleaned, removing salt water, verdigris and corrosion by-products. Although most of the tracks on the boards were still visible their resistance had risen to such a degree that the circuit no longer functioned correctly. Tinned copper wire was then soldered on to all of the tracks (a painstaking task) to restore their conductivity and the correct operation of the circuit. To a degree this was achieved, the pinger signal was no longer weak, but the unit drew noticeably more current than the undamaged unit. Obviously there was still a problem, but in an emergency it could be used.

During reassembly of the housing it was noticed that the protective anodising on some of the sealing surfaces was damaged, producing a risk of leakage. Since the fully functional unit had been opened to compare circuit waveforms, its seals and surfaces were inspected too. In all, one barrel and one pressure switch end plate were damaged and one of the pressure switches was stuck in the on position.

The units were re-assembled with the functional electronics in an undamaged housing with a working pressure switch. This pinger was used for both the CTD and corer work, being transferred as needed. This was an unsatisfactory situation but the best that could be done since the second unit now had faulty electronics, a stuck pressure switch and two damaged sealing surfaces.

Recommendations

If a pinger or any other piece of electronic equipment is observed to be faulty it should **not be** left for the next cruise without attention being drawn to the fault. We have been informed that this pinger gave trouble during a short science cruise in November 1994. It should have been opened for investigation immediately. Whatever the original fault, prompt opening and cleaning would have prevented all the subsequent corrosion damage. If the unit had been returned to the UK at the port call in mid-December it could easily have been refurbished in time for JCR09B.

6.4 **Magnetics (PFB)**

The towed proton precession magnetometer from RVS was operated for most of the passage sections of the cruise (see track chart), with no significant deviation from shortest track. These sections included the long great circle route from Cape Town to the South Sandwich Trench (after crossing the Falkland/Agulhas Fracture Zone), an East Scotia Sea transect and useful crossings of several small basins in the central Scotia Sea. In addition, a 12 hour period at the end of the cruise was spent in detailed examination of the lineated anomalies SE of the Falkland Is. For processing of magnetic data, see section 7.3.

The sensor was the spare, refurbished on board at the end of JR09A following loss of a sensor in ice. It was towed on a 200m cable from the port quarter at speeds through the water of between 5 and 13 knots. The record was noisy initially, but appeared to improve as the field steepened and increased in strength. At the highest ship speeds a short-period cyclicity (1 minute period, 10 nT amplitude) was superimposed on the geomagnetic field, probably the result of rotation of the towed fish in the ship's wake. There was a minor instrument malfunction concerning the tuning circuit for the sensor precession signal: at times a less noisy record was produced by tuning slightly away from the maximum displayed signal amplitude.

6.5 **Ocean Logger** (MP)

The Ocean Logger was run for the whole of JCR09B, from the first evening (offshore Cape Town) to the morning of the last full day of the cruise. Good data were obtained from sensors on the hull and in the uncontaminated seawater supply, except for two occasions when the filters became blocked and the seawater pump automatically shut down. Sea surface temperature data were used to guide water sampling.

On two occasions it was noticed that the Ocean Logger level-A clock was not incrementing at the usual one second rate. All the instruments, thermosalinograph, barometer etc, were turned off one at a time and in doing so it was found that the PAR sensor seemed to be the cause of the problem. Once it was switched off in the instrument setup, the clock worked correctly. Switching the power supply to the Rho-point modules on the foremast off and back on again cured the problem Presumably the PAR Rhopoint module had hung.

6.6 **Surface Water Samples** (DB)

Samples of near-surface plankton were collected during JCR09B by filtering water from the uncontaminated seawater supply in the Prep. Lab. Two sampling programmes were carried out. The first was conducted during the passage from Cape Town to the work area and was intended to supplement the limited amount of existing data on the abundance of coccoliths in the South Atlantic Ocean. This programme was carried out on behalf of Dr. Jacques Girardeau (University of Bordeaux). Samples were collected every half degree of latitude between Cape Town and 52°S, then every degree to 59°S. Sample spacing was decreased where the Ocean Logger temperature data showed we were near an oceanic front (fig. 3). Samples were spaced more widely south of the Antarctic Convergence because of the expected decrease in coccolith abundance there. 10 litre samples were collected and screened to remove the coarser than 150 micron fraction. The water was then filtered through a 0.8 micron pore size Metricel membrane filter, with the aid of a vacuum pump. In most cases the

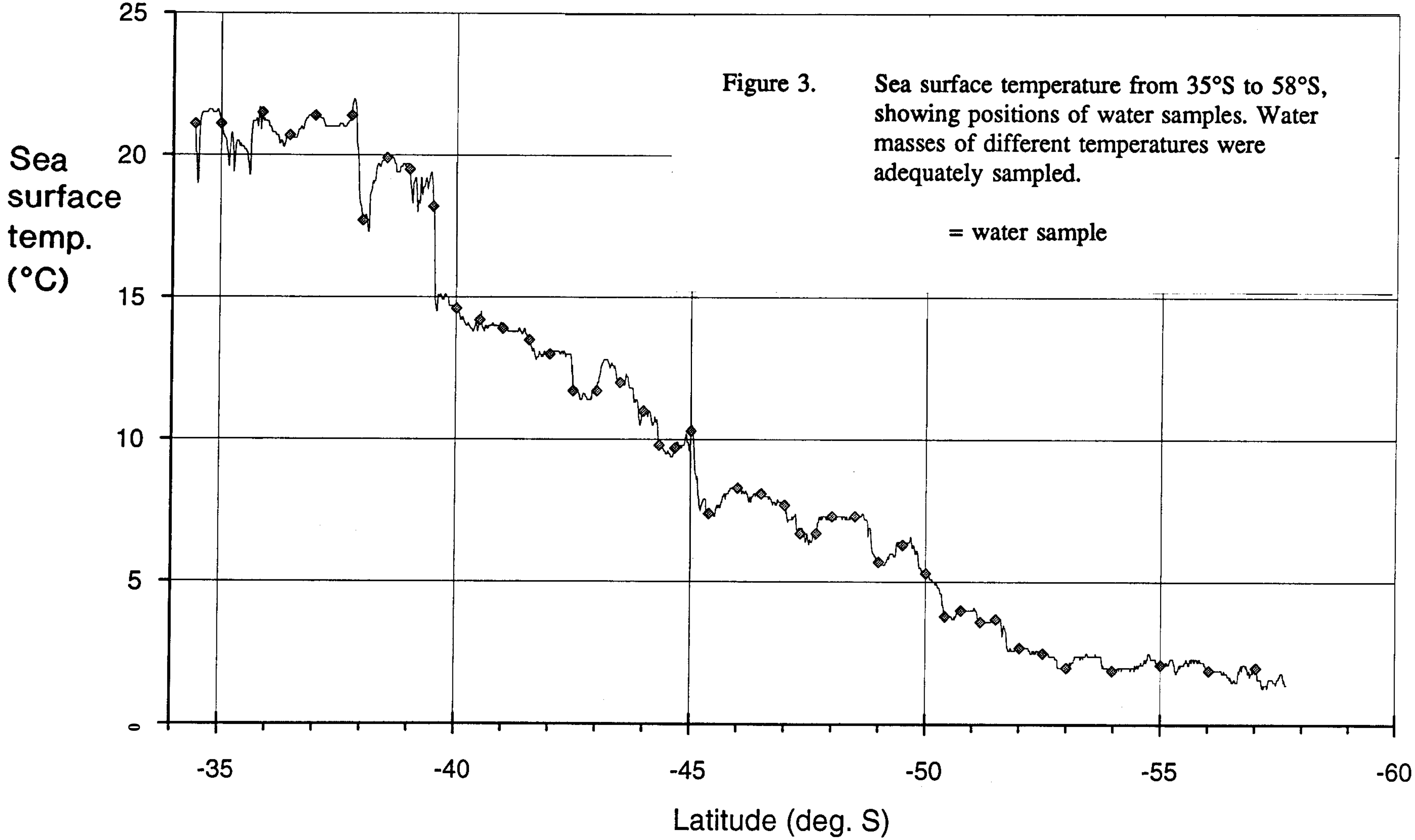


Figure 3. Sea surface temperature from 35°S to 58°S, showing positions of water samples. Water masses of different temperatures were adequately sampled.

The second sampling programme was carried out in the Scotia Sea to continue gathering data on surface diatom assemblages. Sampling was conducted along the N-S tracks (see cruise track chart) at intervals of 0.5° latitude, with additional samples being taken at core sites (table 5). 5 litre samples were filtered through pre-weighed 0.4 micron Whatman cellulose nitrate filters, without pre-filtering of the coarser than 150 micron fraction. Filter papers were rinsed in the manner previously described.

Table 4 Surface water samples (programme 1)

Sample	Lat. S	Long.	Water depth	Amount filtered	Time/date
1	34 10'	18 06'E	200	3.91	1645/053
2	35 00'	17 26' E	2600	10.01	2130/053
3	35 53'	16 51'E	4300	7.01	021 1/054
4	36 26'	16 20 E	4500	8.51	0535/054
5	37 00'	15 55°E	4700	7.01	0827/054
6	37 46'	15 27'E	4850	10.01	1157/054
7	38 00'	15 19°E	4850	3.01	1301/054
8	38 30'	15 01°E	4600	5.01	1518/054
9	39 00'	14 39'E	4800	10.01	1745/054
10	39 30'	14 17'E	4850	3.51	2015/054
11	40 00'	13 55'E	4500	4.21	2254/054
12	40 30'	13 32'E	4850	4.61	0130/055
13	41 00'	13 11'E	4600	3.91	0359/055
14	41 30'	12 51'E	3550	3.91	0633/055
15	42 00'	12 30'E	5150	4.51	0919/055
16	42 30'	12 OO'E	4600	6.01	1215/055
17	43 00'	11 17'E	4400	6.71	1549/055
18	43 30'	10 37'E	4450	6.01	1915/055
19	44 00'	9 52'E	4650	5.91	2246/055
20	44 20'	9 21'E	4650	6.01	0107/056
21	44 40'	8 49'E	4600	6.01	0327/056
22	45 00'	8 13'E	4550	5.81	0608/056
23	45 24'	7 30'E	4400	5.91	0930/056
24	46 00'	6 34'E	2888	10.01	1355/056
25	46 30'	5 46'E	4426	8.81	1718/056
26	47 00'	5 OO'E	4460	7.81	2034/056
27	47 20'	4 27'E	4600	8.81	2255/056
28	47 40'	3 54'E	4462	10.01	0113/057
29	48 00'	3 19'E	4378	10.01	0342/057
30	48 30'	2 29'E	4121	10.01	07 17/057
31	49 00'	1 40'E	3955	10.01	1036/057
32	49 30'	0 46'E	3930	10.01	1413/057
33	50 00'	0 02'W	3680	7.31	1734/057
34	50 25'	0 47'W	3090	7.31	2041/057
35	50 45'	1 24'W	2670	7.51	23 1 1/057
36	51 10'	2 06'W	2770	7.81	0209/058
37	51 30'	2 43'W	2738	10.01	0457/058

36	51 10’	2 06’W	2770	7.81	**0209/058**
37	51 30’	2 43’W	2738	10.01	0457/058
38	52 00’	3 36’W	2537	9.01	0903/058
39	52 30’	4 47’W	2920	9.01	1359/058
40	53 00’	6 11’W	2315	7.51	1950/058
41	53 59’	9 04’W	3333	8.51	091 1/059
42	5500’	12 06’W	4110	7.81	22561059
43	56 01’	15 12’W	4328	7.91	0900/060
44	57 01’	18 15’W	4643	7.81	1753/060

Table 5: Surface water samples (programme 2)

Sample	Lat. S	Long.	Water depth	Amount filtered	Time/date
PC092 45	59 23.2’	41 54.7’W	3962	51	1544/065
46	58 59.5’	42 17.9’W	3947	51	0156/066
47	58 30’	42 26.5’W	3210	51	0506/066
48	57 30’	42 48.4’W	3070	51	1120/066
49	57 00’	43 02’W	3765	51	1400/066
PC 094 50	56 44.3’	42 57.8’W	3700	51	1510/067
51	56 29’	43 00 W	4389	51	1829/067
52	56 00’	43 05’W	3390	51	2120/067
53	55 30’	43 13’W	2640	51	0010/068
54	55 00’	43 18’W	3409	51	0250/068
55	54 30’	43 13’W	3325	51	0536/068
56	54 00’	42 46’W	2740	51	08 18/068
57	53 30’	42 19’W	230	51	1110/068
58	53 00’	41 54’W	3204	51	1350/068
59	52 30’	41 28’W	3640	51	1625/068
60	51 38’	42 19’W	2010	51	0450/070
61	52 38’	45 39’W	3360	51	2309/070
KC096 62	52 32’	50 5O’W	3409	51	0520/072

7. DATA LOGGING AND PROCESSING DJR, RJH)

7.1. General Comments

cThe computer systems worked very well throughout the cruise and no significant problems were encountered with either data logging or processing. Some development work was carried out on the proposed new satellite communications system which will be based around Unix computer systems and use the serial internet protocol called point to point protocol (PPP). Some problems concerning its operation with modems calling via satellite systems were resolved but it was still not possible to establish a successful link to Cambridge. It is hoped that any remaining problems can be resolved in the near future.

7.2. The Level A-B-C System

Details of LevelB tapes from JCRO9B (5 DC6150 tapes)

Tape 1	95 **053 14:15** to 95 059 09:09	99% Full
Tape 2	95 059 09:09 to 95 064 06:20	93% Full
Tape 3	95 064 06:20 to 95 069 14:04	100% Full
Tape 4	95 069 14:04 to 95 074 18:45	99% Full
Tape 5	95 074 18:45 to 95 075 13:24	16% Full

LevelC raw binary data file details

gps_trim
CONTENTS: Position information from Trimble 4000 DL GPS receiver.

sim500
CONTENTS: Depth information from SimradEA500 echo sounder.
COMMENTS: This was only used intermittently and most depths were recorded by hand from the IOS 10kHz PES.

em-log
CONTENTS: Ship's speed information from the Chernikeef EM log.

transit
CONTENTS: Ship's position information from the ShipmateRS5100 transit satellite receiver.
COMMENTS: Positions from this instrument are currently unreliable.

oceanlog
CONTENTS: Oceanic and atmospheric data.

gyro
CONTENTS: Heading given by ship's gyros.
COMMENT: These were reported to be reading one degree high.

dop-log
CONTENTS: Ship's speed given by Sperry doppler log.

gps_ash
CONTENTS: Position and attitude of ship from the Ashtech 3D GPS system

COMMENTS: Attitude data may be unreliable due to uncertainties in the system setup.

magnet
CONTENTS: Geomagnetic field strength data derived from the towed magnetometer system
COMMENTS: Needed some editing due to instrument introduced spikes (see below).

rawdep
CONTENTS: Depth data entered by hand from manual readings of the IOS 10kHz PES system.
COMMENTS: Main source of bathymetry.

anemom
CONTENTS: Wind speed and direction data from the ship's anemometer.

tsshrp
CONTENTS: Ship's attitude data from the TSS solid state heave, roll and pitch sensor.

Level C processed binary data file details

relmov
CONTENTS: Ship relative motion data derived from doppler log and gyro data

bestnav
CONTENTS: Navigation data derived from the relative motion data and the GPS position fixes.

bestdrf
CONTENTS: Ship drift data derived from GPS fix data and relative motion data.

Prodep
CONTENTS: Carter corrected depths derived from raw bathymetry information.

promag90
CONTENTS: IGRF corrected geomagnetic field data.

Level C Filesystem Partitions: End of cruise status

/	**4487 kBytes**
/usr	**64327 kBytes**
/rvs	**8914 kBytes**
/rvs/raw_data	**212108 kBytes**
/rvs/pro_data	**75487 kBytes**
/nerc	**171357 kBytes**

Backup Tapes produced at end of cruise

2 x dump of JRUB on 8mm Exabyte, dump order as above.

1 x tar of JRUB ./raw-data and ./pro-data areas on 8mm Exabyte.

1 x tar of mgd77 format file containing all cruise data on 4mm DAT.

1 x tar of mgd77 format file containing all cruise data on DC6150 tape.

1 x tar of compressed mgd77 files on 3.5 inch floppy disk.

1 x dump of JRUA, main user computer, on 4mm DAT.
Partition dump order was:

/	12661 kBytes
/usr	166222 kBytes
/Var	29240 kBytes
/local	1265150 kBytes
/local	966164 kBytes
/opt	135166 kBytes

7.3. **Underway Data Processing**

Magnetics

Total field data from the Varian Magnetometer were logged into the stream **magnet** every 6 seconds. The level A attached to the magnetometer is incorrectly configured and tends to give data 'SUSPECT' status in areas of high magnetic gradient. This can lead to large-scale data-loss in the final MGD77 file if not corrected. o avoid this, all the logged data were initially given a 'GOOD' status using the level C routine '**edstatus**'. This was done routinely every 24 hours (usually for the period 1200 - 1200). The data for that 24 hour period were then edited using the graphical status editor '**editor**'. Spikes in the data (and the data from this particular sensor were usually very spikey) were effectively removed by giving them a 'REJECT' status. At this stage the IGRP was removed using the **promag** routine. The anomaly data were held in the stream **'promag90'** (one record every 30 seconds). At the start of the cruise it was found that the anomaly data still contained several gaps where the status had been made 'SUSPECT' this time by the **promag** routine - again for some reason this tended to occur over areas of steep gradient. To correct for this the anomaly data were all given a 'GOOD' status using **edstatus.** he final stage of processing was to use the graphical status editor on the anomaly data, to give any obvious bad data points a 'REJECT' status.

Anomaly data were plotted against time (along with uncorrected depth and sea-surface temperature) on a daily basis (1200 - 1200) using the level C routines **xyprep** and **tplot.**

Bathymetry

Bathymetric data from the Simrad EA500 were logged automatically during the first three days of the cruise. However, interference from the 10 KHz PES and the 3.5kHz profiler invariably causes the Simrad to lose the sea bed for minutes at a time (for digital output; the chart and screen displays still work), so on day 056 it was decided to stop logging the Simrad data and switch to depths manually entered every 5 minutes from the PES. These were routinely plotted out every 24 hours as a 2D profile against time. Obvious errors in the data could then be spotted and corrected - either by altering the data itself (where appropriate) or by altering the status to 'REJECT'. At the end of the cruise the Simrad data were concatenated with those of the PES and the whole data set was corrected for variations in the speed of sound in seawater, by Carter area using the **prodep** routine.

8. CRUISE STATISTICS (DB)

Total cruise time (Cape Town to Stanley)	21.9 days
Station time	**3.5** days
of which:	
Coring with the LPC	1.3 days
Kasten coring	0.7 days
CTD	0.5 days
Mooring recovery	0.9 days
LPC trigger test	0.1 days
Survey and passage time	
From Cape Town to work area	9.2 days
Passage between stations	9.2 days
Underway data collection	
Ocean Logger	20.6 days
10 kHz PES	14.7 days
3.5kHz profiler	14.9 days
Magnetometer	12.8 days
SIMRAD	2.8 days

9. CREW LIST

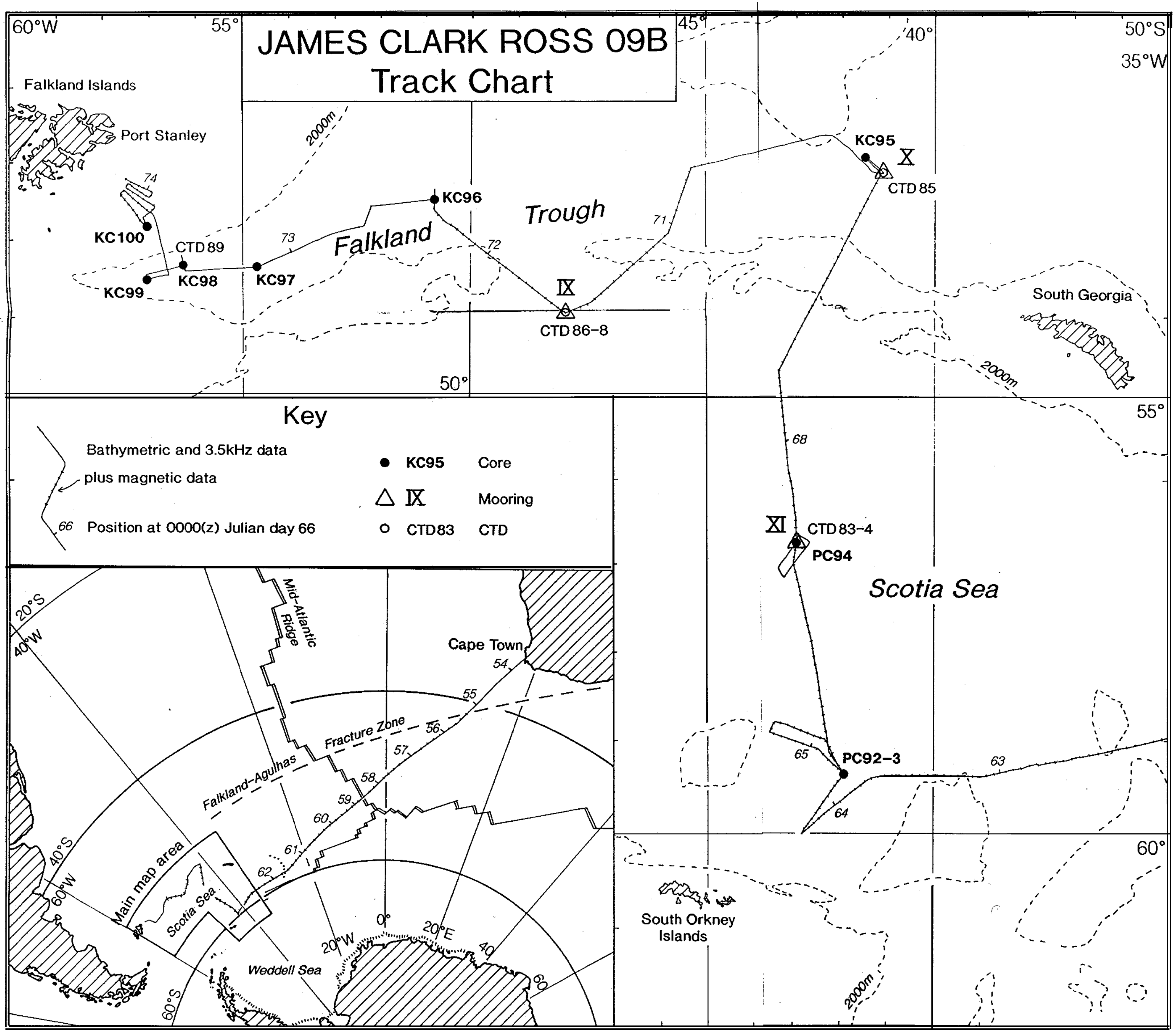
Officers:

Christopher Elliott	Master		
John Marshall	Chief Officer	David Cutting	Chief Engineer
Stuart Wallace	2nd Officer	William Kerswell	2nd Engineer
Antonio Gatti	3rd Officer	Robert Caldwell	3rd Engineer
Michael Gloistein	Radio Officer	Malcolm Inch	3rd Engineer
Hamish Gibson	Purser	Norman Thomas	Electrical Officer
John Summers	Science Deck Officer	Simon Wright	Science Engineer

crew:

George Stewart	Bosun	Derek Summers	Motorman
Anthony Gill	Bosun's Mate	Angus Macaskill	Motorman
Keith Beck	Seaman	Sean Hewitt	Chief Cook
Albert Bowen	Seaman	Michael Davis	2nd Cook
Charles Chalk	Seaman	Craig Besley-Clark	Steward
Howard Owen	Seaman	Jose Charlton	Steward
David Peck	Seaman	Nicholas Greenwood	Steward
		Joseph Hanley	Steward

Scientific Party:	Carol Pudsey	BAS Geoscience	Principal Scientist
	Peter Barker	-------"-------	
	John Howe		
	Richard Hunter	"	
	David Bull	University of Southampton	
	Neil Audley	BAS ISG	
	Steven Bremner		
	Mark Preston		
	David Richmond		
	Andrew Tait		
	Fionnbar Lenihan	BASMU	


JAMES CLARK ROSS 09B
Track Chart
60°W
55°
50°
45°
40°
50°S
35°W
55°
60°
Falkland Islands
Port Stanley
KC100
KC99
KC98
KC97
KC96
KC95
CTD 89
CTD 86-8
CTD 85
CTD 83-4
PC94
PC92-3
Falkland
Trough
South Georgia
Scotia Sea
South Orkney
Islands
2000m
74
73
72
71
68
65
64
63
IX
X
XI
Key
Bathymetric and 3.5kHz data
plus magnetic data
66
Position at 0000(z) Julian day 66
KC95
Core
IX
Mooring
CTD83
CTD
20°S
40°W
40°S
60°W
60°S
Mid-Atlantic
Ridge
Cape Town
Fracture Zone
Falkland-Agulhas
Main map area
Scotia Sea
Weddell Sea
20°W
0°
20°E
40
60
54
55
56
57
58
59
60
61
62