P.O.L.

RRS 'James Clark Ross'

20 November - 14 December
1995

ACCLAIM: Sea level measurements in the Drake Passage

Cruise Report No. 25

PROUDMAN
OCEANOGRAPHIC
LABORATORY

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ACCLAIM: Sea Level Measurements in the Drake Passage

Mr G.W. Hargreaves and Dr C.W. Hughes

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ABSTRACT

ACCLAIM Bottom Pressure Recorders have been in place in the Scotia Sea since December 1988 and then in December 1992 they were transferred to the Drake Passage. The combined BPR/Inverted Echo sounder instruments are deployed under the ground track of the TOPEX satellite across the Drake Passage.

A Minipod BPR, which is housed entirely within a 17 inch glass sphere, was successfully deployed.

New data loggers were installed at the remote island Sea Level Recording stations of Faraday and Rothera, and the station at Port Stanley, Falkland Islands was serviced.

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KEYWORDS

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CRUISE PERSONNEL

POL Personnel

Scientific Officer	Geoff Hargreaves
Higher Scientific Officer	Chris Hughes

RRS James Clark Ross Personnel

Captain	Chris Elliot
Chief Officer	John Harper
2nd Officer	Stuart Wallace
3rd Officer	Brian McJury
Chief Engineer	Dave Cutting
2nd Engineer	Bill Kerswell
Radio Officer	Stephen Mee
Electrician	Norman Thomas
Bosun	Rob Watson

ACKNOWLEDGEMENTS

The authors would like to thank the Captain, Officers and crew of RRS James Clark Ross for their help in the deployment and installation of sea level equipment and the British Antarctic Survey for the opportunity to perform the work.

Thanks are also due to Bob Spencer and Peter Foden for all of the planning and preparation at POL and their technical support throughout this entire cruise.

BACKGROUND

The island tide gauges and Drake Passage BPRs (Bottom Pressure Recorders) are part of ACCLAIM (Antarctic Circumpolar Current Levels from Altimetry and Island Measurements), a project to measure sea level in the Southern Ocean as part of the U.K. contribution to the World Ocean Circulation Experiment (WOCE) Core project 2. The associated research at POL interacts with international work in the United States, South Africa, Australia, France and Germany, and involves studies of ocean scale and

mesoscale dynamics, changes in mean sea level, and comparisons with satellite altimetry. The data are made available to the international community via the Permanent Service for Mean Sea Level (PSMSL), and the ACCLAIM network is also a component part of GLOSS, producing accurate tidal information which is particularly valuable for these remote areas.

The BPR deployed on this cruise is a prototype instrument which will lead to the possibility of more numerous deployments of "disposable" instruments in the future. ACCLAIM BPRs have been deployed in the Drake Passage area since 1988, with regular recovery and redeployment.

POL CRUISE OBJECTIVES

1) To service the Sea Level Recorder (SLR) at Stanley and recover data. Install new software in the logger and check the DCP (Data Collection Platform) timing.

2) To deploy a prototype BPR in the Drake Passage. The BPR is to be wire tested first to check the acoustic release system and then prepared for deployment.

3) To remove Tidata and Seadata recorders at Faraday and install a new Sea Level Recorder. Recover the data and change the base logging system.

4) To service the Sea Level Recorder at Rothera. Recover the data and install a second recorder in parallel. Install a backup Aanderaa Water Level Recorder in the well.

PORT STANLEY SEA LEVEL RECORDER 23/11/95

The Sea Level Recorder located at FIPASS, Stanley was serviced and the software changed in the computer operating system. The raw and calibrated data were downloaded and saved to files STAN.RAW and STAN.CAL respectively. The SRAM memory card was replaced with a new one together with a new card holder interface. A 'CARDRAM' board was fitted which replaced the existing 'CARDMEM' board. The two boards look fairly similar but require different software to operate. The DCP timing was checked with the synchroniser unit and the time then corrected.

BPR DEPLOYMENT AND SEA LEVEL RECORDER INSTALLATIONS

Ship Preparation

Two POL personnel, Geoff Hargreaves and Chris Hughes, joined R.R.S James Clark Ross at Stanley in the Falkland Islands on November 21, 1995. The equipment was unpacked and stowed ready for use. The BPR was assembled and prepared ready for a wire test to check the acoustic release system. The main data logger was set running and the glass sphere containing the equipment was sealed. The ship departed Stanley on 24/11/95 at 19:30 hours

BPR Wire Testing 25/11/95

The CTD wire was used for the wire test as in the previous year. The wire was unhooked from the CTD frame and attached to the BPR frame via shackles, a swivel and rope strops. The 17" glass sphere assembly was attached to the frame by steel bolts passing through a thick nylon collar. The frame was lowered to a depth of 900 metres and the acoustic release system was tested. The acoustic conditions were poor due to ship noise and it was not possible to detect the four ping acknowledgement that the release had fired. The frame was then hauled to the surface and ten minutes after sending the release command, a second command was sent to deactivate the burn wire. When the unit was recovered onto the deck of the ship, it was verified that the burn wire had operated correctly.

Acoustic Information

Serial Number	44712
Transmit frequency	12.0 kHz
Receive frequency	13.5 kHz
Release command	B

DEPLOYMENT OF BPR

The BPR was prepared for deployment after completion of the wire test. A few changes needed doing to the frame mounting arrangement before deployment could commence. Two of the strops were removed, together with the swivel and the remaining strop was removed and re-spliced so that it was ready for deployment. The steel bolts holding the BPR to the ballast frame were cut short of the nylon collar and corrodible bolts were fitted though the collar and attached to the steel bolts.

EVENTS

04:45 GMT	Vessel on station
05:05 GMT	BPR released into water
05:10 GMT	Overside transducer into water
05:12 GMT	Ship's echo sounder switched off
05:43 GMT	BPR on sea bed
05:45 GMT	Overside transducer brought inboard

Total time on station: 1 hour.

BPR Deployment Summary

The BPR was tested prior to deployment and the integrity of the ports in the glass sphere confirmed. The acoustics and new burn wire release system operated correctly when tested. The new design of deep sea recorder was deployed in good conditions and its descent to the sea bed was monitored. The modified deck equipment gave a visible of indication when this had been achieved. We were pleased with the equipment deployment.

INSTALLATION OF SEA LEVEL RECORDER AT FARADAY BASE

The ship arrived at Faraday on 28/11/95 and the equipment was put ashore on the first boat together with most of the cargo. The ship was only staying at Faraday for one and a half days, so there was no time to waste. The mechanical detail at Faraday remains undisturbed and can be found in cruise report (No 14). Two electronic Sea Level Recorder's already fitted at Faraday, a Tidata and a Seadata logger, were being removed to be replaced by one TDS microcontroller based Sea Level Recorder. Before removing the existing loggers, the time of a scan on the Seadata logger was monitored and noted.

Removing Existing Loggers

After noting the scan time and scan count on the Seadata logger, power was removed from the system and the disassembly commenced. The sea sensor cable was disconnected and removed from the enclosure. The housing was attached to the wall of the hut by two brackets, therefore removal proved to be an easy task. The external Cyclon battery pack

which was mounted below the logger was also removed. Once the housing was off the wall, the barometer mounted inside the enclosure and the temperature card inside the Seadata logger were removed, ready to be fitted inside the new logger.

Installing New Logger

The new logging system was housed in a similar enclosure to the system being removed. This was then fitted inside a wooden crate with polystyrene sheets acting as insulation. Due to the oversize nature of the new logger enclosure, it proved to be a difficult task to fit this into the tiny hut used for the Sea Level Recorder. The wooden crate had been fitted with protruding pieces to aid mounting, but these then made the box too big to be installed. These pieces were removed and the box tried again. This adjustment, together with the repositioning of a cable run inside the hut gave just enough room to fit the box to the wall. The original mounting bolts were used as these seemed to be very sturdy.

The metal enclosure was then fitted inside the polystyrene lined crate and held in place with four nylon bolts, which protruded through the crate and into the logger housing. The logger assembly had been partly set up at POL before shipping and had been completed on board ship before arrival at Faraday. The sea sensor cable was then fed through to the inside of the enclosure and connected up.

Temperature Sensor

The temperature sensor used at Faraday is a thermistor bead and in order to maintain continuity, the interfacing electronics were transferred to the new system.

Barometer

The barometric information for the new system is derived from a Digiquartz pressure sensor, similar to the one measuring the sea pressure. The pressure sensor was removed from the existing system and reorganised to suit the new system. Calibrations are applied by the computer in the Sea Level Recorder to obtain real values.

Faraday Sea Level Recorder Summary

The majority of the Sea Level Recorder installation took place on 28/11/95. The old system was removed and the new system installed. The barometer was not fitted until the 29/11/95. The logger was operated overnight since we were allowed to sleep on the base. The software program running on the Toshiba was changed and was monitored the next morning. On the morning of the 29/11/95, the Toshiba computer was checked and found to be working correctly and the Sea Level Recorder had performed well. The barometer

was fitted into the logging system and the logger restarted. A spare Toshiba computer, two EPROM boards, serial leads, manual and computer disks were left behind. As time was limited, the operation of the system could not be demonstrated to the base personnel, but it is not too dissimilar to the old system and a manual was left in place.

SERVICING OF ROTHERA SEA LEVEL RECORDER

The ship arrived at the quayside at Rothera on 1/12/95 and started discharging cargo. The mechanical detail at Rothera remains unchanged. The existing Sea Level Recorder remains in place and another Sea Level Recorder is to be connected in parallel. An Aanderaa water level recorder is to be placed down the sea water supply well.

Servicing Existing Sea Level Recorder

The existing Sea Level Recorder at Rothera was opened up and the time difference was noted between the expected scan time and the actual scan time. The raw and calibrated data were then downloaded and saved to files ROTH.RAW and ROTH.CAL respectively.

Installation of Second Logger

A second Sea Level Recorder was installed in the pumphouse near to the existing Sea Level Recorder. This Sea Level Recorder is slightly different to the existing one in that it is also enclosed in a wooden crate with polystyrene insulation. There was much more space to work with inside the pumphouse than at Faraday, but again this was limited to a few areas due to accessibility problems. The wooden crate was mounted on the wall and the metal enclosure fitted inside. This time there was no need to remove the wooden pieces which protrude from the side as these were used to mount the box on the wall. The two loggers were joined together by approximately three metres of screened twisted pair cable. This cable was connected to the logging system via BNC co-axial cable at both ends. To enable the signals from the sea sensors and the barometer to be tapped off easily for the parallel logger, all of the signals were fed into BNC co-axial cables and BNC T pieces used. Then the BNC connectors on the twisted pair cable were connected to the T pieces allowing the signals to reach both loggers.

Installation of Aanderaa Water Level Recorder

The Aanderaa WLR was started on 30/11/95 before the ship arrived at Rothera. This scans once an hour and was monitored in operation before the unit was sealed. A long piece of rope was attached to the WLR and it was then lowered into the well by the rope

until it reached the bottom. Part of the surface of the well was frozen, but there was just enough room to get the WLR into the water. The rope was then secured to the ladder in the well, which in turn is set in concrete. A notice was placed nearby telling of the importance of the rope.

Sea Temperature Signal

Before leaving the UK, the data from Rothera had been getting monitored and it was noticed that the data on the temperature channel was not giving a correct reading. This was believed to be a result of a bad connection in a BNC lead. After the successful installation of the parallel Sea Level Recorder and the Aanderaa WLR, this problem was investigated. A frequency meter was first placed on the output of the BNC cable and then connected directly to the sea sensor cable. The output received was not correct. The supply voltage to the sensors was increased but this did not produce the correct frequency, just a different one. When an oscilloscope was placed on the sea temperature channel, there was no real signal present. Due to time running out, It was not possible to remove the sensor head from the well to examine it.

Rothera Sea Level Recorder Summary

The installation of both the parallel Sea Level Recorder and the Aanderaa WLR went well. The sea temperature signal remains a worry. It was thought initially that the problem was just a bad BNC connection, but this was not the case. Next it was thought that a circuit inside the sensor head was working close to its power limit, so the supply was increased, without success. This leaves two possibilities; there is a bad connection in the cable between the sensor head and the logger, or there is a fault in the circuit inside the sensor head. Either way, the true nature of the fault will not be known until next year when the site is serviced again. However we will be able extract the sea temperature signal from the data logger in the well and correct the pressure sensor retrospectively.

APPENDIX 1 - SLR, BPR AND WLR TECHNICAL INFORMATION

STANLEY SLR INFORMATION

Timebase scans

Expected	Actual	Error
13:45:00	13:44:53	-00:00:07
14:00:00	13:59:52	-00:00:08
14:15:00	14:14:52	-00:00:08
14:30:00	14:29:52	-00:00:08

RTC clock time on TDS

Expected	Actual	Error
14:32:00	14:39:38	00:07.38
14:33:30	14:41:08	00:07.38

RTC date on TDS

Expected	Actual
23/11/95	23/11/95

The software EPROM was updated in the TDS - stan95.tds

The SRAM card holder was changed from a CARDMEM board to a CARDRAM board. A new SRAM card was put in the card holder and the system powered up. When trying to configure the system again, the new set-up would not store the correct date or time. It would accept the input ok, but it would not display it correctly. The CARDRAM board was removed, it worked ok. The CARDRAM board was replaced and the SRAM card was removed, everything worked ok. The CPU card was replaced with a spare and the same CARDRAM and SRAM cards were used. The system then worked.

The timebase was started on 23/11/95 at 17:30:00 GMT
The first scan was timed at 17:45:00 GMT
The second scan was timed at 18:00:00 GMT

There was a battery pack to keep the RTC alive in case of power failure. This was disconnected since a 1MΩ SIL resistor was connected in its place to tie down any floating input lines.

The DCP time was checked and found to be 5 seconds fast. It was then reset.

BPR INFORMATION

Battery Voltages	-	14.38V Acoustic Battery
	-	14.38V Logger Battery
	-	28.21V Burn Wire Battery
Current Consumption		
Logger	-	42.5mA Operational mode
	-	1.93mA Standby mode
Acoustics	-	763µA Standby current
Pressure sensor fitted	-	DQ41077, 0 - 6000 psia
Pressure frequency output	-	32.17326 kHz
Temperature frequency output	-	170.03933 kHz
Acoustic Transponder S/N	-	44712
Transmit frequency	-	12.0 kHz
Receive frequency	-	13.5 kHz
Release command	-	B

Logging system consists of TDS microcontroller, timebase board and EPROM storage board. The TDS software is SLOG.TDS

Timebase board:	Channel 1	-	Temperature
	Channel 2	-	Pressure
	Channel 3-6	-	Not used

Timebase was started at 23:40:00 GMT on 24/11/95
First scan was noted at 00:00:00 GMT on 25/11/95
Second scan was noted at 00:15:00 GMT on 25/11/95

The release fitted to this BPR is a Benthos burn wire which is being tested for the first time. The Benthos standard release circuit is **not** being used with this BPR, instead a POL development which was tested successfully in Bermuda is being used. This circuit involves the use of a counter to capture and latch the release pulse from the Benthos board. The latched output of the counter then activates a relay which switches in the power to the burn wire. The signal to the burn wire remains until deactivated by sending a release comand again. The advantage of this system is that separate batteries are used for the burn wire and there is no chance of a leakage current activating the burn wire.

The release system was tested in air before the wire test. It was fired and the four ping acknowledgement received. It was fired again to deactivate the release and the four ping acknowledgement was received. However when the release was tested, it was found to still be in the fire mode. Another release transmission was made and this finally deactivated the release. After a few more tests, the operational sequence is:

Number of command transmissions	Burn Wire status
0	Off
1	On
2	On
3	Off
4	On
5	On
6	Off

BPR Deployment

Into the water	-	05:05 GMT
On the sea bed	-	05:43 GMT
Latitude	-	56° 50.15'S
Longitude	-	57° 30.09'W
Depth (uncorrected)	-	2896m
Barometric pressure	-	922.1 mBar
Air temperature	-	4.5 °C
Sea temperature	-	4.6 °C

FARADAY SLR INFORMATION

Seadata logger scan time	-	16:32:50 GMT on 28/11/95
Seadata scan number	-	120510
Sea sensor cable connections		
Black/Black	-	Pressure
Red/White	-	Positive supply
Screen	-	Negative supply
Green	-	Thermistor
Black	-	Thermistor
Thermistor resistance	-	82 kΩ

Temperature frequency	-	85 Hz
Pressure frequency	-	35.516 kHz

Barometer DQ 40423

Pressure frequency	-	37.334 kHz
Temperature frequency	-	170.867 kHz

Timebase started on 29/11/95 at 14:45:00 GMT
First scan noted at 15:00:00 GMT
Second scan noted at 15:15:00 GMT

The Toshiba computer had new software installed called FAR95.EXE to go with the new logger. A new rechargeable battery was installed.

ROTHERA SLR INFORMATION

Timebase scan on 1/12/95

Expected	Actual	Error
15:00:00	14:59:40	-00:00:20

The TDS RTC

Actual time	TDS time
14:49:00	14:50:32

The RTC is fast by 1min 32 secs

The parallel logging system was installed near to the existing one. The two systems were connected using twisted pair cable.

White	-	Barometric temperature
Grey	-	Barometric pressure
Orange	-	Sea temperature
Yellow	-	Full tide
Green	-	Half tide
Screen	-	Ground

Barometric pressure	-	32.248 kHz
Barometric temperature	-	171.965 kHz
Half tide	-	36.339 kHz
Full tide	-	35.135 kHz
Sea temperature	-	35.4 kHz (should be approx 17 kHz)

Current consumption of sea sensors

6V supply	-	4.95mA
9V supply	-	5.90mA

The sea temperature signal varied quite a bit. When it was first measured a reading of 30 Hz was obtained. It was clear that there was a problem.

There is a small frequency divider circuit in the sensor head which has a voltage regulator fitted. The normal supply voltage is 6V, this was increased to 9V to see if this solved the problem. It had no effect.

Both logger timebases were started together at 19:30:00 GMT on 2/12/95
Both loggers third scan was monitored and both scanned at 20:15:00 GMT

The original logger had the data downloaded to a file and the SRAM card was re-initialised. The timebase was not re-started.

First data scan on the SRAM card is now 22:45 GMT on 5/12/95

The Aanderaa Water Level Recorder was started at 17:00:00 GMT on 30/11/95
The first scan was seen at 18:00:40 GMT

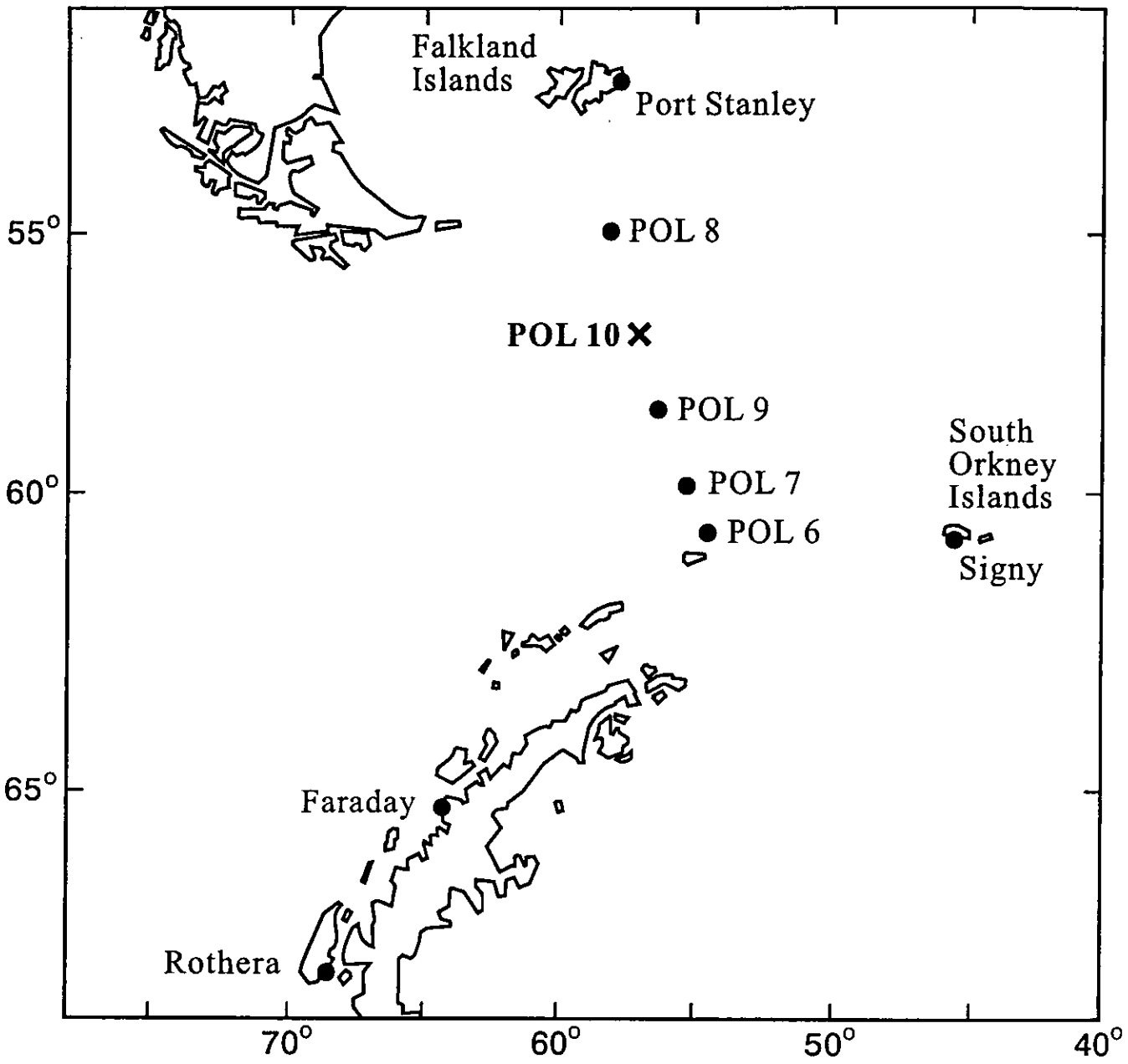
The Aanderaa was placed in the well at Rothera at 19:15 GMT on 1/12/95.

GLOSSARY

ACCLAIM	-	Antarctic Circumpolar Current levels from Altimetry and Island Measurements
BPR	-	Bottom Pressure Recorder
CTD	-	Conductivity, Temperature and Depth Profiler
CPU	-	Central Processing Unit
DCP	-	Data Collection Platform
FIPASS	-	Falkland Islands Passenger and Sea Service
RTC	-	Real Time Clock
SIL	-	Single In-Line
SLR	-	Sea Level Recorder
SRAM	-	Static Random Access Memory
TDS	-	Triangle Digital Services
WLR	-	Water Level Recorder
WOCE	-	World Ocean Circulation Experiment

CARDMEM and CARDRAM are trademarked names of adaptor cards for using SRAM card memory modules.

Position of BPR Ref POL 10 (✕).
Deployed on RRS James Clark Ross November1995.



● Deep sea pressure recorders deployed November 1994 & island sea level stations.