

**RRS James Clark Ross Cruise  
JR164**

**December 4, 2006- December  
19, 2006**

**ACCLAIM: Sea Level  
Measurements in the Drake  
Passage**

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and S. Mack**

**2007**



## DOCUMENT DATA SHEET

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<b>ABSTRACT</b> <p>ACCLAIM Bottom Pressure Recorders have been used for making measurements of the Antarctic Circumpolar Current (ACC) since 1988, initially in the Scotia Sea and then later across the Drake Passage between the Falkland Islands and the Antarctic peninsula. Some of the Bottom Pressure Recorders (BPRs) are combined with Inverted Echo Sounders (IES).</p> <p>During this cruise, one BPR and one BPR/IES were recovered and re-deployed in the Drake Passage.</p> <p>The Sea Level Recorders at Stanley, Falkland Islands, Vernadsky and Rothera Research Stations in Antarctica, were serviced.</p>	
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## **CRUISE PERSONNEL**

### **POL Personnel**

Principal Scientist	Geoff Hargreaves Steve Mack
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### **BAS Personnel**

Doug Willis  
Mark Preston  
Manos Tsentides

### **Ship Personnel**

Captain	Jerry Burgan
Chief Officer	Tim Page
2nd Officer	Dave King
3rd Officer	Jo Cox

Radio Officer	Mike Gloistein
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Bosun	Dave Peck
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The authors would also like to thank the base personnel of the Ukrainian Antarctic Research Station at Vernadsky for their continued help in the operation and maintenance of sea level equipment.

## **OVERVIEW**

The remote island sea level stations provide valuable data for ACCLAIM (Antarctic Circumpolar Current Levels from Altimeter and Island Measurements) which is supplemented by Bottom Pressure Record (BPR) measurements.

The principal objective is to study variations in the flow of the Antarctic Circumpolar Current (ACC) on large time and space scales; however the ACCLAIM network is also a component of GLOSS (Global Sea Level Observing System). The BPRs have supplied sea level data that has provided knowledge of tidal behaviour in this remote area.

ACCLAIM Bottom Pressure Recorders have been deployed since 1988, initially in the Scotia

Sea and then later in the Drake Passage. The data is made available to the international research community through the Permanent Service for Mean Sea Level (PSMSL).

## **POL CRUISE OBJECTIVES**

- 1) To service the Sea Level Recorder at Port Stanley, Falkland Islands.
- 2) To recover a BPR and BPR/IES from the Drake Passage.
- 3) To deploy a BPR and BPR/IES in the Drake Passage.
- 4) To service the Sea Level Recorder at Vernadsky Antarctic Research Station.
- 5) To service the Sea Level Recorder at Rothera Antarctic Research Station.

## **SHIP PREPARATION**

POL personnel, Geoff Hargreaves and Steve Mack, joined RRS James Clark Ross at Stanley, Falkland Islands, on 4/12/2006. The equipment was quickly located and arranged in the lab. The Bottom Pressure Recorder loggers, the Inverted Echo Sounder and the SeaBird Microcat loggers were all started. The acoustic releases were tested and the external battery packs assembled. The ship sailed on the morning of 7/12/2006, heading for Rothera.

## **STANLEY SEA LEVEL RECORDER 27/11/2006**

The system was monitored and the time of the last scan was noted. The data were downloaded and the system then restarted. During the download, it was noted that towards the end of the data record, some corruption occurred. On 28/11/2006, the time base was stopped and a new SRAM card installed. The system was then restarted. A new modem was installed to replace the Jekyll line powered modem. This is a US Robotics modem. The configuration file was modified to reflect the change to the modem installed. The telephone line was found to be very noisy and it was difficult to obtain a connection to the local internet provider to send emails. A request was placed with Cable & Wireless to perform a line test. This was performed but nothing unusual was found. A further test was conducted called line balancing. This was found to be very poor and the connection was repaired.

## **RECOVERY OF DRAKE PASSAGE NORTH BPR (POL 8) 08/12/2006**

### **EVENTS**

11.57 GMT	Vessel on station
12.00 GMT	Release command transmitted

12.10 GMT                Released from seabed

12.32 GMT                On the surface

Total time on station: 35 minutes

#### Drake Passage North BPR (POL 8) Recovery Summary

The recovery went very smoothly. Acoustic conditions were quite noisy, but good communication was achieved with the sea units. The four pings response of the sea units was clearly visible on the computer display. The new TT burnwire activated in about half of the time required when using Benthos burnwires.

#### **DEPLOYMENT OF DRAKE PASSAGE NORTH BPR (POL 8) 08/12/2006**

##### EVENTS

13.00 GMT                -        Vessel on station

13.02 GMT                -        Released into the water

13.23 GMT                -        On the seabed

#### Drake Passage North BPR Deployment Summary

The sea conditions were very good. Communication was achieved with both of the acoustic releases to the seabed.

## **RECOVERY OF DRAKE PASSAGE SOUTH (POL 6) 12/12/2006**

### EVENTS

14.04 GMT	Vessel on station
14.07, 14.20, 15.08 GMT	Release command transmitted
15.55 GMT	Released from the seabed
16.20 GMT	On the surface

Total time on station: 136 minutes

### Drake Passage South (POL 6) Recovery Summary

This was a difficult recovery. Both acoustic releases were functioning normally and showing all of the appropriate signs of having activated the release command. However, the frame remained on the seabed. Using the visual display available, it was possible to verify that the release command had been received and that the frame was still on the seabed. After one hour and fifty one minutes, the frame eventually released from the seabed.

## **DEPLOYMENT OF DRAKE PASSAGE SOUTH (POL 6) 12/12/2006**

### EVENTS

18.41 GMT	Vessel on station
18.43 GMT	Released into the water
19.03 GMT	On the seabed

Total time on station: 22 minutes

### Drake Passage South (POL 6) Deployment Summary

Everything went very smoothly and both of the acoustics were monitored to the seabed.

## **VERNADSKY 14/12/2006**

POL personnel were transported to the base in a RIB (Rigid Inflatable Boat) and set to work recovering the data from the tidegauge logger. The data were successfully recovered and the existing EPROM card was left in-situ. The timebase was left running and was not restarted.

It was good to see that the commercial OTT tidegauge that was delivered during the visit last year had been installed. The firmware in the Logosense logging unit and also in the HDR satellite transmission unit were upgraded. The antenna was checked for accurate alignment.

## **ROTHERA**

The ship arrived at Rothera at around 16.00 GMT on 15/12/2006 and the ships personnel set about offloading the cargo from the aft deck. This was given priority as the deck needed to be clear for the Marguerite Bay mooring work to be performed by technicians from NOC. POL personnel recovered the data from the tidegauge and restarted the logger. It was noted that the housing for the Gumstix logger had been installed but that the unit wasn't inside it and also there was no power supply to it. Shore leave expired at 19.00 GMT as the ship was supposed to sail at 20.00 GMT. The ship eventually left the wharf at 22.00 GMT on 15/12/2006

The ship arrived back at the wharf at 20.00 GMT on 17/12/2006.

On 18/12/2006 the No2 logger at Rothera was opened up, timed and stopped. The data were recovered but was found to have stopped at day 72. The processor card was removed and taken back to the ship for modification. The board was modified and the firmware updated. The processor board was reinstalled and for testing purposes, the sampling rate increased to 28.5 seconds. The system was started and the serial data output monitored. Once the system was functioning correctly, the system was stopped, the correct sampling interval reinstated and the system restarted.

Before closing the logger back up, a serial lead was installed and fed through a gland to sit external to the enclosure. This will be used to connect to the Gumstix logger.

Midway through the morning of the 18/12/2006, the news reached the ship that the Dash 7 aircraft, which had been experiencing mechanical problems, had taken off heading for Rothera. Once it became apparent that the flight was going to arrive at Rothera that evening, scientific staff onboard were informed that they would be disembarking the ship and flying to Stanley, Falkland Islands on the morning of 19/12/2006. This left very little time to complete the work on logger number 2, pack the equipment away and consign the equipment for a return back to the UK. This was completed at around 23.00 GMT

## **CONCLUSIONS**

The scientific objectives were met.

## APPENDIX 1 - BPR TECHNICAL INFORMATION

### STANLEY SEA LEVEL RECORDER INFORMATION

The Sea Level Recorder at Stanley consists of three independent logging systems. The first two systems use high precision pressure sensors to measure pressure and temperature of the sea water, whilst the third system uses radar technology to measure water height.

The logging systems using pressure sensors have three installed for each system; the 'full tide' sensor, a 'half tide' sensor and a barometric sensor. The full tide sensor is mounted such that it is permanently below the water level, even at the extreme low tide event. The half tide sensor is mounted alongside the full tide sensor and is fitted with a feed pipe to the pressure inlet port that is taken from a point at the middle of the tidal range. Thus as the tide falls below this point, the pressure being measured by the sensor should remain constant, with a value equal to the head of water retained in the feed pipe. This then provides a datum level for determining the full tide level. The barometric sensor is used to measure air pressure and temperature. This information is used to correct the full and half tide pressure measurements, removing the barometric influences.

The output from these six sensors is fed into two independent logging systems. The first system (TDS Logger) continuously integrates the frequency output of the sensors and stores this information every fifteen minutes to a Static RAM (SRAM) card. The second logging system (CF1 Logger) works in a similar way, except the information is stored every second, thus allowing wave data to be collected and analysed. This second logger also sends data back to the UK in quasi real time, via the telephone network, in the form of an email. This system can also be dialled-up and data be collected manually.

The third measuring system uses radar which bounces electromagnetic waves off the sea surface. The radar is positioned so that it points vertically downwards and several readings are taken, with the average of these being logged. These measurements are then transmitted via the Orbcomm satellite communication network in the form of an email.

#### TDS Logger

Timebase scan

Expected

10.45.00 GMT on 27/11/2006

Actual

10.44.07 GMT on 27/11/2006

The calibrated and raw data were downloaded from the memory card and stored as stan0506.cal and stan0506.raw respectively.

Sensors fitted.

Full Tide DQ 47594

Half Tide DQ 47598

Barometer DQ 39239

During the data download, it was noticed that from day number 250 to day number 321, data

corruption was occurring. The corruption was occurring in blocks, with some blocks of good data. It is assumed that the SRAM card is defective.

The timebase was restarted at 16.00.00 GMT on 27/11/2006

The old SRAM was used, as a replacement was not available at the time. On 28/11/2006, the tide gauge was visited again to replace the SRAM card with a new one.

The timebase scanned at 14.15.00 GMT on 28/11/2006.

The data were downloaded to stan06321.cal and stan06321.raw

The timebase was then restarted at 14.30.00 GMT on 28/11/2006

The first scan was at 14.45.00 GMT on 28/11/2006

### CF1 Logger

The CF1 logger was stopped and the compact flash card removed. A copy of this was made and stored onto the laptop. The file SIMPCAL.DAT was edited and the email addresses changed from [stanley@unixa.nerc-bidston.ac.uk](mailto:stanley@unixa.nerc-bidston.ac.uk) and [tidetest@unixa.nerc-bidston.ac.uk](mailto:tidetest@unixa.nerc-bidston.ac.uk) to, [stanley@pol.ac.uk](mailto:stanley@pol.ac.uk) and [tidetest@pol.ac.uk](mailto:tidetest@pol.ac.uk). The modem used for dialling into the system was replaced with a US Robotics 56K Fax modem. This required that the system be set to communicate at 9600 baud and not 2400 baud. Also, a setup parameter needed changing so that the system knew it was now communicating with a US Robotics modem and not a Jekyll line powered modem. Once these had been set correctly, the system was restarted.

### Sensors fitted

Full Tide	QX 99099
Half Tide	QX 99450
Barometer	QX 97890

On 21/12/2006, the firmware of the CF1 logger was upgraded. This took a couple of hours to complete but everything seemed to be working OK on our departure.

### Orbcomm

The Orbcomm satellite transmission module was changed on 27/11/2006 to a different one. On 20/12/2006 the original Orbcomm transmission unit was reinstated as the replacement unit was being remotely disabled. The original unit didn't suffer from this problem.

## DRAKE PASSAGE NORTH BPR (POL 8) RECOVERY INFORMATION

*Location details* - *Latitude* 54°56.59' S  
*Longitude* 058°21.41' W  
*Depth* 1090m

On station - 11.57 GMT on 8/12/2006  
Release command transmitted - 12.00 GMT  
Released from seabed - 12.10 GMT  
On the surface - 12.32 GMT

### Acoustic Information

BenthosXT6000 (58434) - Tx 12.0 kHz, Rx 14.5 kHz, Release B  
Benthos XT6000 (63804) - Tx 12.0 kHz, Rx 10.0 kHz, Release A

The releases consist of burnwire mechanisms that give a four ping acknowledgement once the burn command has been received. The burnwires are made by TT engineering and were being used for the first time. It was found that they activated in about half of the time of the Benthos burnwires previously used.

### Logger

Logger P2 with sensor DQ 68483

### Timebase scan

Expected	Actual
16.30.00 GMT	16.32.47 GMT on 08/12/2006

The timebase is 167 seconds slow.

Data were downloaded to dpn0506.raw.

### Data Arrangement

The raw data are made up of six columns

Column	Data
1	Scan number
2	Time
3	Pressure (DQ 68483)
4	Temperature (DQ 68483)
5	Blank
6	Blank

### Recovery Equipment

Benthos radio beacon - 154.585MHz Channel A

## DRAKE PASSAGE NORTH DEPLOYMENT (POL 8) INFORMATION

*Location details* - *Latitude* 54°56.59' S  
*Longitude* 058°21.41' W  
*Depth* 1218m

On station - 13.00 GMT on 8/12/2006  
Release into the water - 13.02 GMT  
On the seabed - 13.23 GMT

### Acoustic Information

Benthos XT6000 (63801) - Rx 11.5kHz, Tx 12.0kHz, Release B  
Benthos XT6001 (69675) - Rx 13.5kHz, Tx 12.0kHz, Enable F, Release D

63801 fitted with a Benthos burnwire, 69675 fitted with a TT burnwire.

63801 acoustic release had its bulkhead connectors replaced with Impulse connectors from the SeaCon FAWL connectors that were fitted. It is also fitted with an external backup battery supply.

### Logger

Logger P3 with sensors DQ 68485  
Timebase started at 00.15.00 GMT on 6/12/2006  
First scan at 00.30.00 GMT on 6/12/2006

### CTD Equipment

Seabird Microcat - Serial number 37SMP34870-3023  
First sample at 20.00.00 GMT on 7/12/2006  
Sampling interval – 900 seconds

### Recovery Equipment

Benthos radio beacon - Nominal frequency - 154.585 MHz,  
Channel A.

### New Battery Information

Logger - 14.69V

## DRAKE PASSAGE SOUTH BPR/IES (POL 6) RECOVERY INFORMATION

*Location details* - *Latitude* 60 °51.00' S  
*Longitude* 054 °42.77' W  
*Depth* 1090m

On station - 14.04 GMT on 12/12/2006  
Release command transmitted - 14.07, 14.20, 15.08 GMT  
On the surface - 16.20 GMT

### Acoustic Information

Benthos XT6000 (46457) - Tx 12.0 kHz, Rx 15.0 kHz, Release B  
Benthos XT6001 (69678) - Tx 12.0 kHz, Rx 13.0 kHz, Enable F, Release D

### Logger

Logger SSDL2 with sensors, DQ44935, DQ46267

### Timebase scan

Expected	Actual
16.30.00 GMT on 13/12/2006	16.30.09 GMT on 13/12/2006

Timebase was 9 seconds slow.

The data were downloaded to dps0506.raw.

### Data Arrangement

The raw data are made up of eight columns

Column	Data
1	Time
2	Date
3	Temperature (DQ 44935)
4	Pressure (DQ 44935)
5	Temperature (DQ 46267)
6	Pressure (DQ 46267)
7	blank
8	blank

### Inverted Echo Sounder

IES chirped at 18.12.24 GMT on 13/12/2006.

The data were recovered and stored in the file dps0204.v12

Number of datafiles recorded to disk is 4478.

### Recovery Equipment

Benthos radio beacon - 154.585MHz Channel A

## DRAKE PASSAGE SOUTH DEPLOYMENT (POL 6) INFORMATION

*Location details* - *Latitude* 60 °51.03' S  
*Longitude* 054 °42.81' W  
*Depth* 999m

On station - 18.41 GMT on 12/12/2006  
Release into the water - 18.43 GMT  
On the seabed - 19.03 GMT

### Acoustic Information

Benthos XT6000 (63803) - Rx 10.5kHz, Tx 12.0kHz, Release A  
Benthos XT6001 (70772) - Rx 11.0kHz, Tx 12.0kHz, Enable F, Release D  
Release 63803 is fitted with a Benthos burnwire. Release 70772 is fitted with a TT burnwire.

### Logger

Logger P1 with sensors DQ 68489  
Timebase started at 20.15.00 GMT on 5/12/2006  
First scan at 20.30.00 GMT on 5/12/2006

### CTD Equipment

Seabird Microcat - Serial number 37SMP34870-3024  
Started at 20.00 GMT on 7/12/2006  
Sampling interval - 15 min

### Inverted Echo Sounder

IES started at 12.59.40 GMT on 6/12/2006  
First Chirp at 14.59.59 GMT on 6/12/2006

### Set-up parameters

Chirp interval 120 minutes  
Samples per datafile 2  
Lockout time (1/100 s) 0  
Start file number 1  
Serial number 11  
Deployment number 5  
Comment Drake South 2006-2007

### Recovery Equipment

Benthos radio beacon - Nominal frequency - 154.585 MHz,  
Channel A.

New Battery Information

Logger - 14.69V

**VERNADSKY 14/12/2006**

The tide gauge at Vernadsky consists of three independent systems. The oldest tide gauge is the Munro float tide gauge and chart recorder. This consists of a float down a stilling well which rises and falls with the tide. A line is drawn on chart paper by a pen, recording the tidal variation. The paper is advanced using a mechanical clock

The second tide gauge is a TDS electronic system that uses digiquartz pressure sensors and stores the data on an EPROM card. The card has the capacity to store four years worth of data.

The third system is a commercial system from OTT that uses strain gauge pressure sensors and transmits the data back via the GOES East satellite.

Upon arrival on the base, we were escorted to the tide gauge and the data downloaded from the TDS logger.

Timebase

Expected scan	Actual scan
14.45.00 GMT on 14/12/2006	14.44.56 GMT on 14/12/2006

Data downloaded to vern0606.raw

The EPROM card had only been installed in March 2006, so it was decided to leave this card in place. Therefore, the timebase was left running during the data download.

During the data download from the TDS logger, the OTT system was upgraded.

At the tide gauge hut, the Logosens firmware and configuration file were updated. The configuration file was updated to Vernadsky\_5\_avg.bin which is a 5 minute sampling version.

The power was cycled and the configuration file checked. All indicated ok.

At the base, the HDR satellite transmitter was checked and firmware upgraded.

Checked GPS and got a lock in less than 1 minute.

Time indicated 154100 UTC 2006-12-14

GPS position 64.25655W 65.24568S 25.44m

The azimuth and elevation for the HDR antenna were also checked with the information given by the HDR software based on the GPS position.

The values indicated were as below:

Satellite: GOES E 75

Azimuth: 348.2°

Elevation: 16°

Magnetic Variation: +17°

Magnetic North: 365.2°

These values agree with the actual settings when the antenna was installed by the Ukrainians.

The HDR bin file was updated using HDR EasyUse software.

The serial link from the Logosens to the HDR was checked and agreed with the OTT manual.

The power was cycled to the HDR unit and all indicated ok.

## **ROTHERA**

The tide gauge at Rothera consists of three pressure sensors, a full tide sensor, a half tide sensor and a barometer. The full tide sensor is positioned to be submerged at all times, whilst the half tide sensor is positioned above the full tide sensor at the middle of the tidal range. The half tide sensor act as a reference point for the full tide sensor and allows accurate surveying of the installation to be undertaken.

The output signals from these sensors are fed into two independent logging systems. Logger 1 is the main logging system. It is this system that the base meteorologists interact with to recover the tide data and email it back to POL. Logger 2 is a backup system recording the same information as Logger 1. Both systems use a TDS logger and store data to a SRAM card.

### **Sensors fitted**

Full tide DQ 47942

Half tide DQ 47452

Barometer DQ 65487

### **Logger 1 timebase scan**

Expected Actual

16.30.00 GMT on 15/12/06 16.29.36 GMT on 15/12/2006

Data were downloaded to ro1\_0506.raw

The timebase was restarted at 17.30.00 GMT on 15/12/2006

The first scan was at 17.45.00 GMT on 15/12/2006

Logger 2 timebase scan

Expected

13.30.00 GMT on 18/12/2006

Actual

13.29.17 GMT on 18/12/2006

Data were downloaded to ro2\_0506.raw

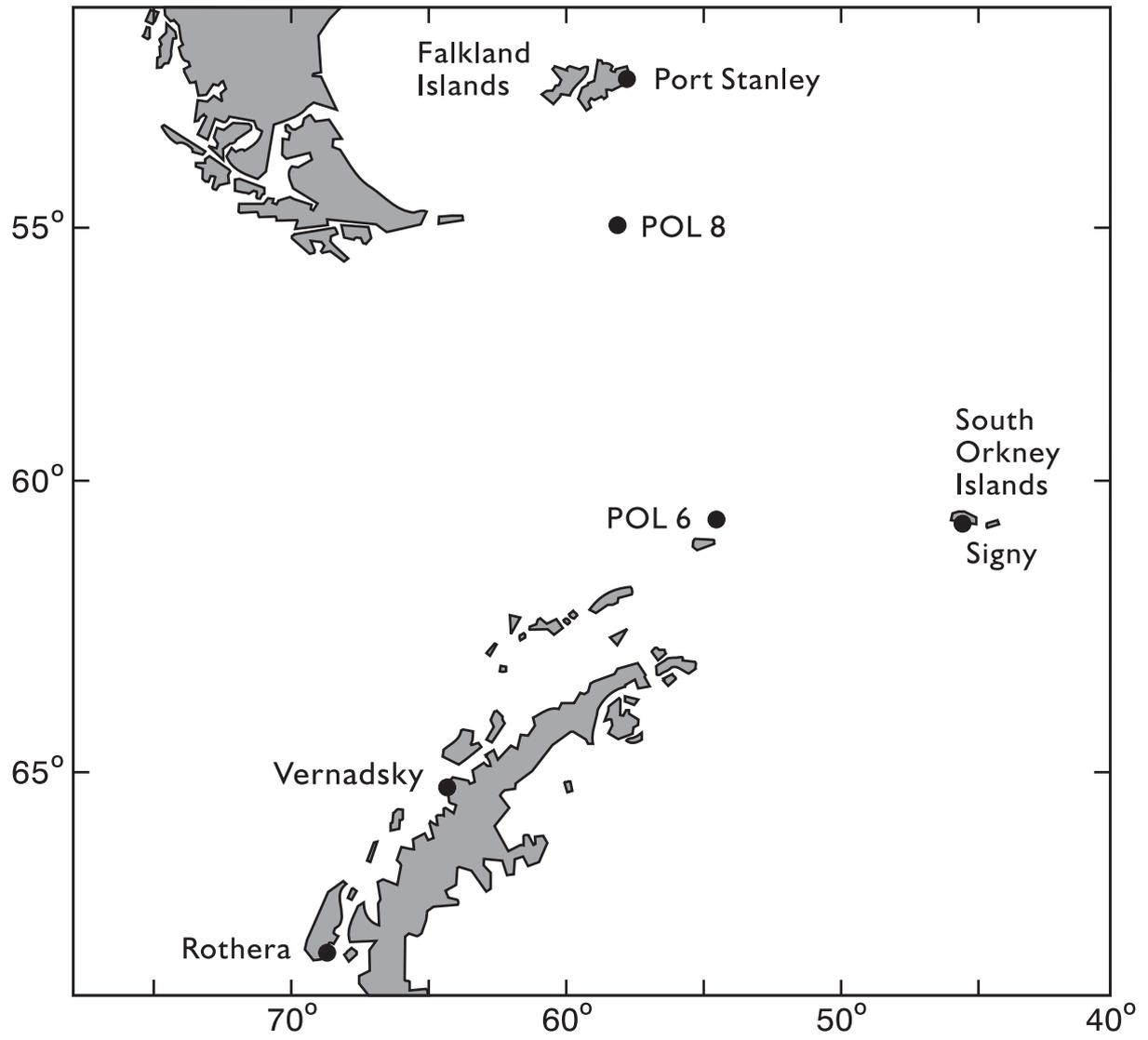
The data started at day number 353 but ended at day 075

The EPROM firmware was updated. The logger was set to 28.5 second sampling for testing purposes. A second serial lead was installed and fed through the access gland. This lead was checked for data from the logger. Data was appearing on this lead every time the logger scanned. The logger was then stopped, set to sample every 900 seconds and restarted.

Logger 2 timebase started at 16.45.00 GMT on 18/12/2006

First scan at 17.00.00 GMT

# MAP OF DEPLOYMENT POSITIONS



## GLOSSARY

ACCLAIM	-	Antarctic Circumpolar Current levels from Altimeter and Island Measurements
ADC	-	Analogue to Digital Converter
BPR	-	Bottom Pressure Recorder
EPROM	-	Erasable Programmable Memory
GMT	-	Greenwich Mean Time
GPS	-	Global Positioning System
HDR	-	High Data Rate Satellite Transmitter (OTT)
IES	-	Inverted Echo Sounder
Logosens	-	OTT sensor logger
POL	-	Proudman Oceanographic Laboratory
SLR	-	Sea Level Recorder
SRAM	-	Static Random Access Memory
TDS	-	Triangle Digital Services