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ACCLAIM: Sea Level Measurements in the Drake Passage

S Mack

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ABSTRACT 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) and deployed along the track of TOPEX/POSEIDON satellites that collect altimeter data from the area. During this cruise the BPR/IES were recovered and re-deployed in the Drake Passage The Sea Level Recorders at Stanley, Rothera were serviced. The system at Rothera had a sensor replaced and the equipment at Stanley had an upgrade to allow transmission of data via email.	
ISSUING ORGANISATION Proudman Oceanographic Laboratory 6 Brownlow Street Liverpool L3 5DA UK Director: Dr A.E Hill	TELEPHONE: (0151) 795 4800 FAX: (0151) 653 6269 TELEX: 628591 OCEAN BG
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CRUISE PERSONNEL

POL Personnel

Higher Scientific Officer	Steve Mack
Senior Scientific Officer	Michael Meredith

Ship Personnel

Captain	Jerry Burgen
Chief Officer	Dave Gooberman
Second Officer	Dave King
Third Officer	Paul Clarke
Chief Engineer	Duncan Anderson
Second Engineer	Colin Smith
Third Engineer	Jim Stevenson
Fourth Engineer	Tom Elliot
Deck Engineer	Doug Trewet
Radio Officer	Steve Mee
Bosun	Colin Lang

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OVERVIEW

ACCLAIM - Antarctic Circumpolar Current Levels from Altimeter and Island Measurements -is providing real time data from it's network of sea level stations in the Southern Ocean as a contribution to the World Ocean Circulation Experiment (WOCE). The associated research work at POL is an integral part of the many other UK contributions to Core 2, the Southern Ocean component of WOCE, and interacts with international work from the United States, South Africa, Australia, France and Germany. 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). These BPR's have supplied sea level data that has provided knowledge of tidal behaviour in this remote area.

ACCLAIM Bottom Pressure Recorders (BPR's) have been deployed since 1988, initially in the Scotia Sea and then later in the Drake Passage. Bottom Pressure Recorders are currently deployed in both locations to further aid the investigation of the ACC.

POL CRUISE OBJECTIVES

- 1) To service the Sea Level Recorder at Port Stanley, Falkland Islands.
- 2) To recover two COOCUS and one IES/BPR in the Drake Passage.
- 3) To re-deploy one IES/BPR and two CROCUS's in the Drake Passage.
- 4) To service the Sea Level Recorder at Rothera

SHIP PREPARATION

POL personnel, Steve Mack and Mike Meredith, joined RRS James Clark Ross at Port Stanley, Falkland Islands on December 18th 2002. The ship sailed within 6 hours for Rothera, , the equipment was located onboard the ship and prepared for use upon arrival at Drake North BPR position.

RECOVERY OF DRAKE PASSAGE NORTH IES/BPR (POL 8) 19/12/2002

EVENTS

1220 GMT	Vessel on station
1222 GMT	Acoustic release enabled
1224 GMT	Sent release command. No response
1300 GMT	No signal from radio beacon when pod should be on surface.
1400 GMT	Fired release again
1545 GMT	Still no response and still no sign on surface

Total time on station: 3 hrs 35 minutes

Drake Passage North IES/BPR (POL 8) Recovery Summary

No definitive response from unit. Blind fired twice but no sign of unit surfacing. Another attempt will be made on Northwards leg.

SERVICING ROTHERA SEA LEVEL RECORDER 22-24/12/2002

The system consists of two logging systems sited in the pumping station that supplies seawater to the reverse osmosis (RO) plant for making fresh water. The sensors are situated in the seawater intake well from where the water is drawn for the RO plant. It was known in advance that the full tide pressure sensor was not operating either due to a wiring fault or a flooded sensor housing. A replacement sensor and housing had been shipped to replace the existing one if necessary. On inspection the sensor was deemed to be flooded and so the replacement sensor was fitted. Both loggers data was downloaded and the loggers were both set-up with the new sensor in place. Note that the calibrated data from the loggers does not take into account the new sensor so is of no use. Raw data now has to be downloaded directly from the TDS. The Toshiba PC is now not being used. On subsequent inspection of the replaced sensor it had flooded, probably from the cable potting.

Servicing Rothera Sea Level Recorder Summary

The servicing of the Rothera Seal level Recorder went very well given the short amount of time we had on base and the amount of work that had to be carried out. The success was in part to the Rothera Research Station staff who, while already busy, were only too willing to help with crane work when necessary. All data was downloaded successfully and the gauges set up satisfactorily with new instructions being left with the Met staff for the new method of downloading data.

RECOVERY OF DRAKE PASSAGE SOUTH (POL 6) 27/12/2002

EVENTS

0430 GMT	Vessel on station waiting for daylight
0539 GMT	Released from the seabed
0600 GMT	On the surface

Total time on station: 90 minutes

Drake Passage South (POL 6) Recovery Summary

It was pre dawn when the ship arrived on station. It was agreed to wait until daylight before releasing the unit. The BPR released ok and weather conditions were good. It was easily spotted and radio beacon worked ok.

DEPLOYMENT OF DRAKE PASSAGE SOUTH (POL 6) 27/12/2002

EVENTS

1550 GMT	Vessel on station
1558 GMT	Released into the water
1620 GMT	On the seabed

Total time on station: 30 minutes

Drake Passage South (POL 6) Deployment Summary

The deployment went smoothly and both acoustic release units communicated well to the seabed.

RECOVERY OF DRAKE PASSAGE CENTRE (POL 9) BPR 29/12/2002

EVENTS

1025 GMT	Vessel on station
1030 GMT	Release command sent
1130 GMT	Re-tried release on all frequencies
1206 GMT	No response from acoustics on any frequencies
1315 GMT	No response and no sign on surface
1330 GMT	Did one mile box section around nominal position
1430 GMT	Back on station. No response and no sign on surface
1504 GMT	No response. Leaving area.

Time on station: 2hrs 30 mins

Drake Passage Centre (POL 9) Recovery Summary

No response at all from acoustics. All frequencies tried both digital and analogue. Did a box section search for BPR but still no response from acoustics and no sign on surface. Ship was very quiet, all echo sounders off and thrusters and prop off. Assumed batteries dead due to two years of deployment.

RECOVERY OF DRAKE PASSAGE NORTH IES/BPR (POL 8) 01/01/2003 SECOND ATTEMPT

EVENTS

0923 GMT	Vessel on station
0926 GMT	Release command sent
0949 GMT	No response from acoustics no sign of rising
1033 GMT	Still no response. No sign on surface.
1100 GMT	Did one mile box section around nominal position.
1200 GMT	No sign of release. No sign on surface.

Drake Passage North IES/BPR (POL 8) Recovery Summary

No definitive response from unit. Blind fired twice but no sign of unit surfacing. Got intermittent range of around 1289 meters but not definitive. No response after release commands sent. Did one mile box section but no response. No sign from direction finder. Again batteries may be too low for release.

SERVICING STANLEY SEA LEVEL RECORDER 02-03/01/2003

Arrived in Stanley in the morning. Went to tide gauge. Timed scan twice and downloaded data from TDS logger. Sea level recorder appears to have been working well. As well as regular servicing of the logger an additional frequency divider was installed to improve the resolution of the data being recorded by the CF1 logger system. The CF1 logger system was also upgraded to include a web-modem to enable emails to be automatically sent back to POL containing data. Interaction with POL was required during set-up of the new modem. The TDS logger was re-started successfully and checked after 24 hrs. The work was carried out successfully and a full record of the wiring and the frequencies was made. The DCP system was removed for shipping back to UK as it is no longer required.

CONCLUSIONS

Despite the fact that it was not possible to recover two of the BPR's the rest of the trip was very successful. Drake South was successfully recovered and redeployed continuing the long time series from the Drake Passage. The problems with releasing were thought to be due to lack of battery life caused by two years deployment with acoustics that consume higher than normal current. The work at Rothera was carried out successfully given the short time scale and the work that had to be carried out due in part to the assistance of the Rothera base staff. The new installation at Stanley of equipment to provide emailing of data from the seal level recorder was done and was successful when set-up from POL.

APPENDIX 1 - BPR TECHNICAL INFORMATION

STANLEY SEA LEVEL RECORDER INFORMATION

The system at Stanley consists of a tide logger storing samples every fifteen minutes to a memory card (SRAM) and also a CF1 logger which replaced the old system which used a Toshiba Libretto laptop. The CF1 system is contactable from the UK via a phone line and data can be downloaded and software updates implemented.

Replacement boards were taken to the Falkland Islands by Steve Mack and also a web modem to enable emails to be automatically sent back to the UK via the phone line.

The tide logger was still working perfectly and this was serviced.

Timebase scan

Expected	Actual
133000 GMT on 02/01/2003	132938 GMT on 02/01/2003

The calibrated data were downloaded from the memory card and stored as stanleycal.dat and the raw data stored as stanleyucal.dat

The SRAM memory card was replaced with another card fitted with a new backup lithium battery. A Binary dump of the SRAM card was done and recorded to Stanley.bin

Sensors fitted.

Full Tide	DQ 47594
Half Tide	DQ 47598
Barometer	DQ 39239

The logger was re-started and the timebase reset.

The timebase was re-started at 181500 GMT on 02/01/2003

First scan at 183000 GMT on 02/01/2003

Web Modem was set-up with new cards in CF1 logger. Logger was sampling at 10 second intervals . Web modem unable to dial out, probably due to incorrect number for Internet Service Provider (ISP). This can be checked and sorted over the phone from POL.

A divide by 100 circuit was installed between the signal from the pressure sensor and the CF1 card. It was installed on the temperature channels to the CF1 logger.

Measured Frequencies:

At Panel (Co-Ax).	T1 = 170.586 kHz
	P1 = 38.370 kHz
	T2 = 171.310 kHz
	P2 = 37.490 kHz

At TDS Card:	T1 = 17.059 kHz
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P1 = 38.355 kHz
 T2 = 171.312 kHz
 P2 = 37.490 kHz
 TB = 169.963 kHz
 PB = 35.210 kHz

At CF1 Card: TB = 169.963 kHz
 (Before divide PB = 35.210 kHz
 by 100 fitted) P2 = 37.489 kHz
 P1 = 38.355 kHz
 T1 = 170.589 kHz

Location of frequency inputs on TDS card: T1 P1 T2 P2 TB PB

Location of frequency inputs on CF1 card: T1 TB PB gnd () P2 P1 ()
 PL2 PL3

() = no frequency input on connector.

Mesured frequency at CF1 card after divide by 100: T1 = 0.1706 kHz
 TB = 0.1700 kHz

On **03/01/2003** the CF1 part of the Sea Level Recorder was set up by Pete Foden at POL and email now being sent every hour (can be monitored by watching web modem and listening for dial out). Logging now set to 15min intervals. There was a slight problem with the email time stamps but this can be sorted out back at POL.

DRAKE PASSAGE NORTH BPR (POL 8) INFORMATION

Location details - *Latitude 54°56.618' S*
Longitude 058°21.224' W
Depth 1241m

Vessel on station - 1220 GMT on 19/12/2002
 Sent release command. No response - 1224 GMT
 Still no response and - 1545 GMT
 still no sign on surface

Acoustic Information

Benthos TR7000 acoustic release (61227) with command codes
 ID 02, Tx 12.0kHz, Rx 11.0kHz, Enable A, Disable B, Release C, Pinger D
 Release type - Burnwire.

DRAKE NORTH NOT RECOVERED.

DRAKE PASSAGE MIDDLE (POL 9) BPR INFORMATION

Location details - *Latitude* 58°22.25' S
Longitude 056°21.22' W
Depth 3855m

Vessel on station - 1025 GMT on 29/12/2002
Release command sent - 1030 GMT
Did one mile box section - 1330 GMT
around nominal position
No response. Leaving area. - 1504 GMT

Equipment fitted:

Benthos TR7000 acoustic release (61217) with command codes,
ID 07, Tx 12.0 kHz, Rx 13.0 kHz, Enable A, Disable B, Release C, Pinger D.
Logger P1 with sensor DQ 68489
Benthos Radio Beacon 154.585 MHz

DRAKE MIDDLE NOT RECOVERED.

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

Location details - *Latitude* 60°51.03' S
Longitude 054°42.80' W

On station - 0430 GMT on 27/12/2002
Release command transmitted - 0539 GMT
On the surface - 0600 GMT

Equipment fitted to frame

Benthos XT6000 acoustic releases, 46481(14.5/C) and 47178(11.5/C)
Logger SSDL 3 with sensors DQ 49189, DQ 46251, DQ 43513
Inverted Echo Sounder with POL ADC board and 1.4Gb disk drive
Benthos Radio Beacon 154.585 MHz
Benthos Flashing Light

Logger

Timebase scan

Expected
074500 GMT on 27/12/2002

Actual
075005 GMT on 27/12/2002

Timebase was 5mins 5 secs seconds slow.

The data were downloaded to drake_s_replay.dat

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	Temperature (DQ 52026)
8	Pressure (DQ 52026)

Inverted Echo Sounder

IES pinged at 201659 GMT on 27/12/2002

Number of datafiles recorded to disk is 6101. The IES is fitted with a Hitachi 1.4Gb disk and is storing three samples per datafile.

The data was downloaded in two parts. drake_s_1.dat datafiles 0 -3050
drake_s_2.dat datafiles 2051-6101

Batteries

Acoustic release 46481	-	Red 12.10V Orange 12.00V
Acoustic release 47178	-	Red 12.13V Orange 12.16V
Release battery 46481	-	9.60V
Release battery 47178	-	9.55V
Logger battery	-	14.21V
IES batteries	-	12.45V, 12.47; 12.44V, 12.46V; 12.46V, 12.45; 12.46V, 12.45V

NB:

- 1) Both the external battery pack for the Acoustics had damaged connectors (cables). They had not leaked but the electrical connection wasn't being made. Acoustics were therefore fitted with blanking plugs.
- 2) The acoustic 47178 had leaked though the connectors internal contact and was therefore replaced with 46421. Although it had leaked the acoustic still fired and operated correctly.

DRAKE PASSAGE SOUTH DEPLOYMENT (POL 6) INFORMATION

Location details - *Latitude* **60°51.00' S**
Longitude **054°42.77' W**
Depth **1000m**

On station - 1550 GMT on 27/12/2002
 Release into the water - 1558 GMT
 On the seabed - 1620 GMT

Acoustic Information

Benthos XT6000 46421 - Rx 14.0kHz, Tx 12.0kHz, Release D
 Benthos XT6000 46481 - Rx 14.5kHz, Tx 12.0kHz, Release C
 Both acoustics fitted with pyro release system.

Logger

Logger SSDL 2 with sensors QT 49187, DQ 46251 and DQ 43513
 Timebase started at 124500 GMT on 27/12/2002
 First scan at 130000 GMT on 27/12/2002

Inverted Echo Sounder

IES fitted with POL ADC board and Hitachi 1.4Gb disk drive.
 IES started at 175942 GMT on 21/12/2002
 First Chirp at 185958 GMT on 21/12/2002

Set-up parameters

Chirp interval 60 minutes
 Samples per datafile 2
 Lockout time (1/100 s) 0
 Start file number 1
 Serial number 8
 Deployment number 1
 Comment Drake South 2002-3

Recovery Equipment

Benthos radio beacon - 154.585 MHz, Channel A.
 Benthos flashing light.

New Battery Information

Acoustic release 46481	-	Red	14.57V
		Orange	14.57V
Acoustic release 46421	-	Red	14.56V
		Orange	14.57V
Release 46481	-		9.55V
Release 46421	-		9.60V
Logger	-		14.75V

The external acoustic release battery packs were not fitted due to damaged leads. Blanking plugs were fitted to the acoustic units.

ROTHERA SEA LEVEL RECORDER INFORMATION

The sea level recorder at Rothera consists of a sensor assembly installed in the sea water intake well for the reverse osmosis (RO) plant on the base. The logging electronics are housed in the nearby pump building. There are two independent loggers sited inside the pump building, each logging the sensor output signals.

Timing Information

Logger Number 1

Timebase scan

Expected	Actual
230000 GMT on 22/12/2002	225854 GMT on 22/12/2002

The timebase of logger number 1 is 66 seconds fast.

The data were downloaded to rothtg1cal.dat for calibrated data and rothtg1ucal.dat for raw data.

Timebase started 183000 GMT on 23/12/2002

First scan at 181500 GMT

Logger Number 2

Timebase scan

Expected	Actual
233000 GMT on 22/12/2002	232821 GMT on 22/12/2002

The timebase of logger number 2 is 99 seconds fast.

The data was downloaded to rothtg2cal.dat for calibrated data and rothtg2ucal.dat for raw

data.

Timebase started at 231500 GMT on 23/12/2002

First scan at 233000 GMT

Replacement of full tide sensor

The full tide sensor which was replaced in 2000 (DQ65759) was replaced with the sensor DQ47942.

The arrangement of the sensors is as below:

Top of Steelwork (pip) to top of Steelwork = 28mm

Top of Steelwork to Half tide sensor inlet (DQ47452) = 2215mm

Half tide sensor inlet to Full tide sensor inlet(DQ47942) = 2049mm

Rothera Tide Gauge Sensor Summary:

BAROMETER (in pump house) = DQ65487

HALF TIDE SENSOR = DQ47452

FULL TIDE SENSOR = DQ47942

Sensor Frequencies:

Out of Well.

HALF T = 171.372 kHz

DQ 47452 F = 36.766 kHz

NEW FULL T = 171.391 kHz

DQ 47942 F = 38.492 kHz

In Water.

HALF T = 171.353 kHz Measured current = 2.44 mA

DQ 47452 F = 36.728 kHz

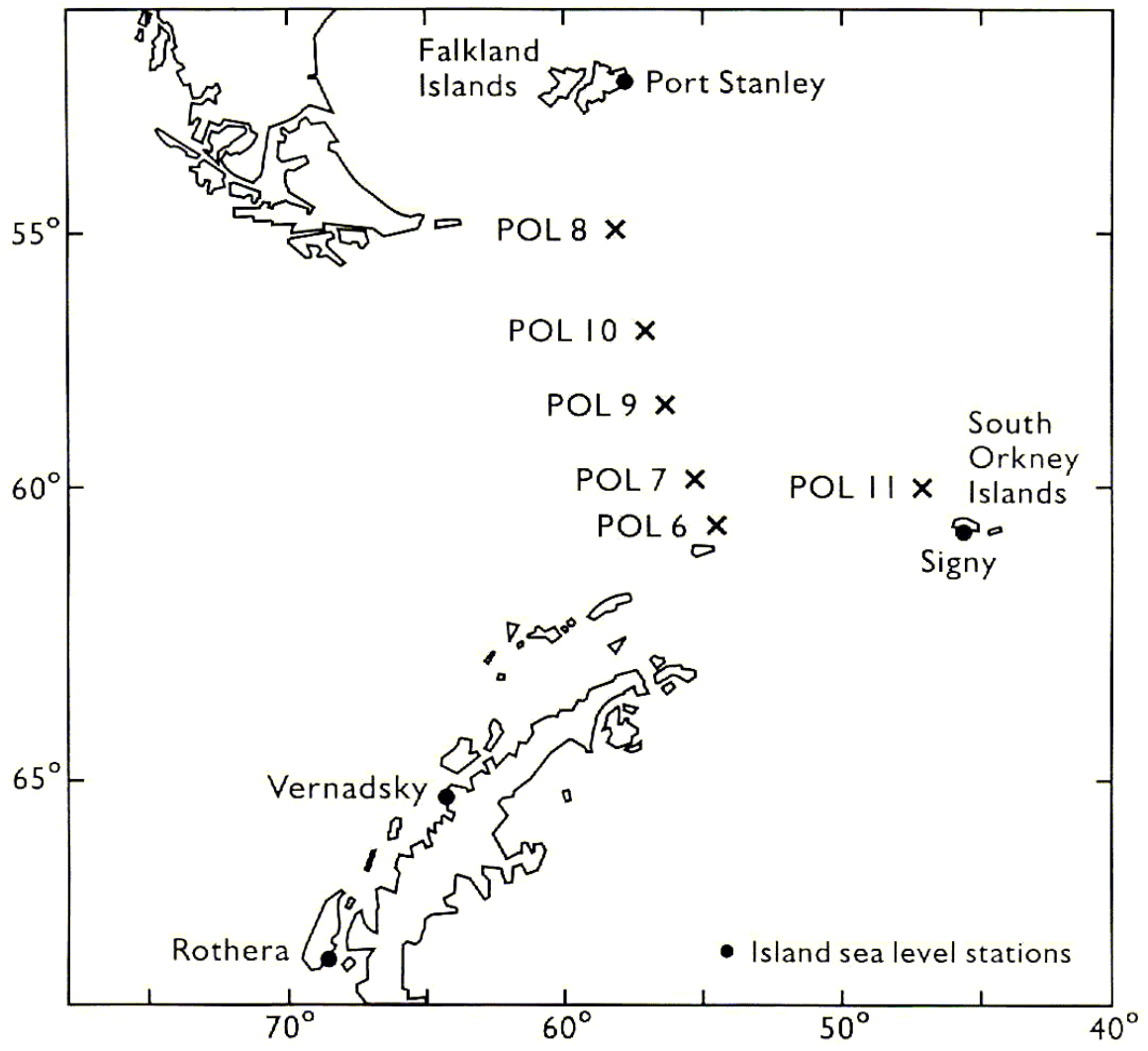
NEW FULL T = 171.332 kHz Measured current = 2.93 mA

DQ 47942 P = 38.090 kHz

Due to problems with TDS ROM. The calibrated data for the new full tide sensor cannot be downloaded. (TDS ROM still set for old sensor).

Therefore data is to be manually downloaded from the TDS rather than the Toshiba PC.

MAP OF DEPLOYMENT POSITIONS



GLOSSARY

ACCLAIM	-	Antarctic Circumpolar Current levels from Altimeter and Island Measurements
ADC	-	Analogue to Digital Converter
BPR	-	Bottom Pressure Recorder
CROCUS	-	Capsule for the Recovery of Ocean Circulation Under the Sea
DCP	-	Data Collection Platform
EPROM	-	Erasable Programmable Memory
FIPASS	-	Falkland Islands Passenger and Sea Service
GMT	-	Greenwich Mean Time
IES	-	Inverted Echo Sounder
POL	-	Proudman Oceanographic Laboratory
SLR	-	Sea Level Recorder
SRAM	-	Static Random Access Memory
TDS	-	Triangle Digital Services
WOCE	-	World Ocean Circulation Experiment