

PROUDMAN OCEANOGRAPHIC LABORATORY

CRUISE REPORT NO. 41

**RRS JAMES CLARK ROSS
JR88**

MAY 12, 2003 – JUNE 17, 2003

GRACE Evaluation Experiment

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2003

DOCUMENT DATA SHEET

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ABSTRACT <p>GRACE is a USA/German experiment consisting of two polar orbiting satellites, 220km apart, connected by a microwave link that measures their separation to one hundredth of a millimetre. As the gravitational pull of a mass on the earth attracts first one satellite, then the other, a characteristic change in their separation occurs, which allows the earth's gravity field to be mapped. Changes in the gravity field allow mapping of changes in the earth's surface mass distribution. Over the ocean, this is equivalent to bottom pressure.</p> <p>To provide in-situ data to calibrate computer models, three BPRs deployed in the Argentine basin around the Zapiola Ridge were to be recovered.</p>	
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CRUISE PERSONNEL

POL Personnel

Principal Scientist Geoff Hargreaves

BAS Personnel

Pete Lens
Mark Preston

Ship Personnel

Captain	Jerry Burgan
Chief Officer	Dave Gooberman
Second Officer	Dave King
Third Officer	Paul Clarke
Chief Engineer	Duncan Anderson
Second Engineer	Colin Smith
Radio Officer	Mike Gloistein
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OVERVIEW

GRACE is a joint US/German satellite gravity mission launched on 17th March 2002, which promises to be capable of detecting changes in ocean bottom pressure over a five-year period. It consists of a pair of satellites, 220 km apart and 500 km above the earth, with a microwave link measuring their separation to a precision of one hundredth of a millimetre. As the gravitational pull of a mass on the earth attracts first one, then the other satellite, a characteristic change in their separation occurs, which allows the earth's gravity field to be mapped. Changes in the gravity field allow mapping of changes in the earth's surface mass distribution. Over the ocean, this is equivalent to bottom pressure.

The potential of this new observing system as the only method of monitoring global changes in the abyssal ocean circulation is enormous. There is, however, one major obstacle. The satellite will complete enough measurements for a global solution over a period of about 30 days. Any bottom pressure changes with shorter periods will alias into that solution unless they can be modelled and subtracted out.

In order to see whether the models are accurate enough, and to check whether the resulting satellite pressure measurements agree with the actual pressure signal, in-situ pressure measurements are required in a region where a significant signal is expected. The largest bottom pressure signals in models are in three areas in the Southern Ocean - the SE Pacific, SE Indian, and SW Atlantic (Argentine basin). The Argentine basin is also of interest because of a high frequency (about 25 day period) barotropic signal which has been detected using altimetry. It has only recently been recognised that such barotropic signals, other than tides, are a cause of significant aliasing in altimetry measurements, and an unambiguous, temporally resolved confirmation of this inference would be of great interest to the altimetry community.

In order to unambiguously identify the spatial structure of the 25 day signal, and to provide an estimate of the spatial coherence of this and other bottom pressure signals for comparison with GRACE results, a set of three bottom pressure recorders are to be recovered from the Argentine basin, in a triangle centred on the amphidrome of the 25 day wave as inferred from altimetry, and wide enough to sample the amplitude maximum of the wave. This configuration also approximately matches the spatial resolution of GRACE, permitting validation of satellite measurements and models.

POL CRUISE OBJECTIVES

- 1) To recover three BPRs from around the Zapiola Ridge

SHIP PREPARATION

POL personnel joined RRS James Clark Ross at Port Stanley, Falkland Islands on May 10, 2003 together with some AMT cruise personnel, since the ship time was being shared between two cruises, JR88 and JR90. All of the POL equipment was eventually located after an extended search, despite having been left assembled by POL personnel on the previous cruise. The equipment had been dismantled and removed from the wet and main laboratories by AMT personnel who had arrived at the ship a day earlier. The equipment was then safely stowed on the floor of the rough workshop for later use and empty cases placed in the scientific hold.

ATTEMPTED RECOVERY OF BPR (GRACE 1) 15/5/2003

EVENTS

07.30 GMT	Vessel on station
07.34 GMT	First release command transmitted
09.15 GMT	Last release command transmitted
11.25 GMT	Leave site

Total time on station: 3 hours 55 minutes

BPR (GRACE 1) Attempted Recovery Summary

As soon as the ship was on station, the BPR acoustic system was interrogated but the responses were not conclusive. A couple of readings were obtained that may have been correct, however most replies were obviously incorrect. The release command was tried several times, allowing between 20 and 30 minutes between each transmission. This should have allowed enough time for the burn-wire release system to operate.

RECOVERY OF BPR (GRACE 2) 16/5/2003

07.00 GMT	Vessel on station
07.04 GMT	Release code transmitted
10.30GMT	On the surface

Total time on station: 3 hours 30 minutes

BPR (GRACE 2) Recovery Summary

The response from this unit was fairly good when the ship arrived on station. It was possible to obtain readings in the range 5100m -5600m. It was not possible to obtain more consistent readings than this, but this was better than at the first deployment site. As the unit ascended to the surface, it was possible to determine that it had released and to estimate a time that it would be on the surface. When the unit was on the surface, it was tracked using the radio beacon because it had surface about one mile from the ship.

RECOVERY OF BPR (GRACE 3) 17/5/2003

EVENTS

07.00 GMT Vessel on station
07.05 GMT Release command transmitted
10.10 GMT On the surface

Total time on station: 3 hours 10 minutes

BPR (GRACE 3) Recovery Summary

The BPR was fairly difficult to reliably communicate with on the seabed because of spurious replies being received by the deck unit. However, by making copious notes of the readings being received and by setting the deck unit to interrogate the BPR at regular intervals, it was possible to determine that the BPR had released and was ascending to the surface. The BPR surfaced approximately one mile from the ship and was tracked using the radio beacon.

CONCLUSIONS

Two of the three deployed BPRs were recovered. Mechanical failure is the most likely reason for the loss of the third BPR.

APPENDIX 1 - BPR TECHNICAL INFORMATION

BPR (GRACE 1) ATTEMPTED RECOVERY INFORMATION

Location details - *Latitude* 46 °46.24' S
Longitude 043 °26.89' W
Depth 5587m

On station - 07.30 GMT on 15/5/2003
Release command transmitted - 07.34 GMT
Last release command transmitted - 09.15 GMT
Leave site - 11.25 GMT

Acoustic Information

Benthos XT6000 67000 - Rx 11.0 kHz, Tx 12.0 kHz, Release C
The release is a burnwire mechanism that gives a four ping acknowledgement once the burn command has been received.

Logger

Logger PG1 fitted with DQ87200 and DQ 87202

Recovery Equipment

Benthos radio beacon - 154.585 MHz, Channel A

An attempt was made to recover this Bottom Pressure Recorder, but it was not successful. The unit never gave any positive indication that it was responding to interrogation attempts. Upon arrival at the deployment site, a range of readings was obtained, of which only a couple could have been true responses. However, given the depth of the BPR, this could have been the result of the ship transducer not detecting the reply signal. Several attempts were made to release the BPR from the seabed, with the last command being transmitted at 09.15 GMT. The ship stayed over the deployment position for a further two hours whilst attempts were made to contact the BPR. At no time were any responses obtained to positively indicate that the BPR was either present or had released from the seabed.

BPR (GRACE 2) RECOVERY INFORMATION

Location details - *Latitude* **44 °25.197' S**
Longitude **040 °22.185 ' W**
Depth **5114m**

On station - 07.00 GMT on 16/5/2003
Released command transmitted - 07.04 GMT
On surface - 10.30 GMT

Acoustic Information

Benthos XT6000 (67021) - Rx 11.5 kHz, Tx 12.0 kHz, Release C
The release is a burnwire mechanism that gives a four ping acknowledgement once the burn command has been received.

Logger

Logger PG2 with sensors DQ 87195 and DQ 87198

Recovery Equipment

Benthos radio beacon - 154.585MHz Channel A

Battery Information

Acoustic battery - Red 14.46V
Orange 14.46V
Burnwire battery - 28.5V
Logger battery - Red 14.47V
Orange 14.46V

BPR (GRACE 3) DEPLOYMENT INFORMATION

Location details - *Latitude* **43 °11.90' S**
Longitude **045 °18.10' W**
Depth **5141m**

On station - 16.47 GMT on 16/5/2002
Release into the water - 16.52 GMT
On the seabed - 18.15 GMT

The BPR is fully contained within a 17” glass sphere and mounted in a tripod ballast frame. The deployment went very smoothly and it was possible to monitor the acoustic release to the seabed. Communication became difficult below 3500m and only one reading was obtained when

the unit was on the seabed.

Acoustic Information

Benthos XT6000 67012 - Rx 10.5kHz, Tx 12.0kHz, Release C
The release is a burnwire mechanism that gives a four ping acknowledgement once the burn command has been received.

Logger

Logger PG3 with sensors DQ 87193 and DQ 87194

DQ 87193	-	Temperature frequency	172.022 kHz
		Pressure frequency	33.079 kHz
DQ 87194	-	Temperature frequency	170.022 kHz
		Pressure frequency	33.038 kHz

Timebase started at 00.15.00 GMT on 7/5/2002

First scan at 00.30.00 GMT on 7/5/2002

Recovery Equipment

Benthos radio beacon - 154.585 MHz, Channel A.

Battery Information

Acoustic release	-	Red 14.47V
		Orange 14.48V
Burnwire	-	28.5V
Logger	-	Red 14.47V
		Orange 14.46V

GLOSSARY

ACCLAIM	-	Antarctic Circumpolar Current levels from Altimeter and Island Measurements
BPR	-	Bottom Pressure Recorder
EPROM	-	Erasable Programmable Memory
FIPASS	-	Falkland Islands Passenger and Sea Service
GMT	-	Greenwich Mean Time
GRACE	-	
POL	-	Proudman Oceanographic Laboratory
SLR	-	Sea Level Recorder
SRAM	-	Static Random Access Memory
TDS	-	Triangle Digital Services