

Cruise Summary, ORV Franklin, FR06/00 2nd August – 10th August 2000

Itinerary

| | | | |
|---------|--------|-------------------------------------|------|
| Depart: | Broome | Wednesday 2 nd Aug, 2000 | 0800 |
| Arrive: | Broome | Tuesday 10 th Aug, 2000 | 0800 |

Title

The Continent-Ocean Transition of the Crust and Mantle across the North West Shelf (Leg 1)

Scientific Program Summary

The north west margin of Australia includes the Pilbara Archaean shield, the Phanerozoic Canning and Canarvon sedimentary basins and the Exmouth Plateau. Geophysical measurements of magnetic and electric fields onshore and offshore provide a means of imaging the crust and mantle structure in terms of electrical conductivity. The principal aims of the project are:

- to determine crust-mantle structure and anisotropy across the continental margin, from Archaean shield to ocean abyssal plain;
- to investigate the Canning Basin conductivity anomaly (CBA) across the margin and its relationship to extensional faults imaged from deep-seismic profiles of the Fitzroy Trough.

Cruise Track

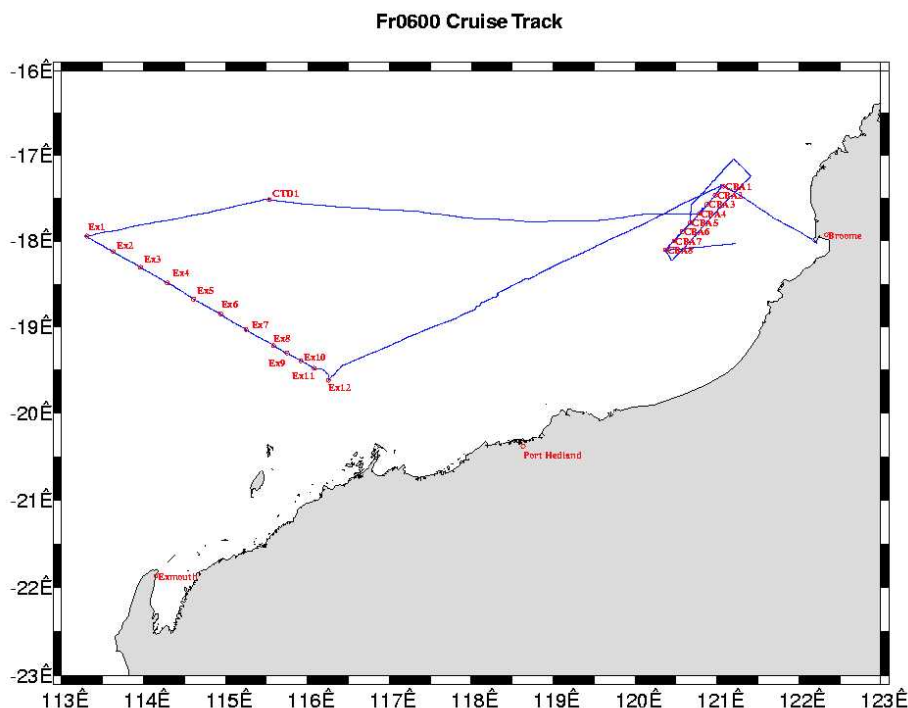


Figure 1: Ship tracks from Broome

Personnel List

Scientific

| | | |
|------------------------|---------------------|-------------------------------|
| Dr Graham Heinson | Adelaide University | Chief Scientist, geophysics |
| A/Prof Antony White | Flinders University | Project Leader, geophysics |
| Dr F.E.M. (Ted) Lilley | ANU | Geophysics |
| Ms Tina Perdesen | ANU | Geophysics |
| Mr Wayne Peacock | Flinders University | Geophysics |
| Dr Debbie Thiele | Deakin University | Cetacean observer |
| Ms Debbie Glasgow | Deakin University | Cetacean observer |
| Ms Lisa Nicholson | Murdoch University | Sea bird studies |
| Dr John Wallace | CSIRO | Cruise Manager |
| Mr Bob Beattie | CSIRO | Computing |
| Mr Phil Adams | CSIRO | Electronics |

Crew

| | | |
|-------------------|--|--------------------------|
| Mr Ian Taylor | | Master |
| Mr Arthur Staron | | 1 st Mate |
| Mr John Boyes | | 2 nd Mate |
| Mr Ian Murray | | Chief Engineer |
| Mr Rob Cave | | 1 st Engineer |
| Mr Hugh McCormick | | Electrical Engineer |
| Mr Phil French | | Greaser |
| Mr Bill Hughes | | Bosun |
| Mr Tony Hearne | | AB |
| Mr Terry Gamin | | AB |
| Mr Norm Irvine | | AB |
| Mr Ron Culliney | | Chief Steward |
| Mr Gary Hall | | Chief Cook |
| Mr Wayne Hatton | | 2 nd Cook |

Cruise Details

1 Geophysics Experiment

1.1 Exmouth Plateau Experiment

Twelve low frequency magnetotelluric (MT) instruments were deployed in a transect across the Exmouth Plateau.

| Site | Instrument | Latitude | Longitude | Depth (m) | Data Type |
|------|------------|---------------|----------------|-----------|-----------|
| EX1 | Jonah | 17° 56.636' S | 113° 18.299' E | 1902 | E and B |
| EX2 | Quartet | 18° 07.598' S | 113° 37.840' E | 1819 | B only |
| EX3 | Charlie | 18° 18.491' S | 113° 57.724' E | 1549 | E and B |
| EX4 | Twosome | 18° 29.330' S | 114° 17.370' E | 1420 | B only |
| EX5 | Dodo | 18° 40.907' S | 114° 36.624' E | 1604 | E and B |
| EX6 | Tertius | 18° 51.190' S | 114° 56.620' E | 1732 | B only |

| | | | | | |
|------|--------|---------------|----------------|------|---------|
| EX7 | Horace | 19° 02.417' S | 115° 15.226' E | 1512 | E and B |
| EX8 | Solo | 19° 13.000' S | 115° 35.170' E | 542 | B only |
| EX9 | Igor | 19° 18.329' S | 115° 45.137' E | 314 | E and B |
| EX10 | Gonzo | 19° 23.647' S | 115° 55.139' E | 214 | B only |
| EX11 | Fuzzy | 19° 29.003' S | 115° 05.103' E | 132 | E and B |
| EX12 | Ernie | 19° 37.201' S | 115° 15.488' E | 104 | E and B |

Table 1: Instrument site, name, location, depth and data. In the last column, B stands for magnetic field data and E for electric field data.

All instruments were deployed successfully. Instruments at sites EX2, EX4, EX6 and EX8 have Benthos acoustics, and all other sites have Scripps Institution of Oceanography acoustics. In all but one case, the instruments were monitored to the seabed, and those in shallow water had their acoustics disabled before leaving site. The one exception was site EX7 (instrument Horace) that stopped responding to the acoustics at a depth of 1200 m after 45 minutes. We were unable to subsequently ping on the instrument from a variety of ship locations surrounding the drop point. The lack of contact suggests that the instrument may not longer be functioning, but we will try again on the recovery leg at the end of September.

1.2 Canning Basin Experiment

Four new high-frequency MT instruments were deployed in two cycles (CBA1-4, followed by CBA5-8). The first deployment lasted for five days, followed by a second deployment of two-days duration. Locations for the instruments are given in Table 2.

| Site | Instrument | Latitude | Longitude | Depth (m) | Data |
|------|------------|---------------|----------------|-----------|---------|
| CBA1 | HF4 | 17° 20.959' S | 121° 03.902' E | 102 | E and B |
| CBA2 | HF3 | 17° 27.962' S | 120° 58.790' E | 99 | E and B |
| CBA3 | HF2 | 17° 40.854' S | 120° 52.705' E | 112 | E and B |
| CBA4 | HF1 | 17° 34.459' S | 120° 46.705' E | 112 | E and B |
| CBA5 | HF4 | 17° 47.210' S | 120° 40.618' E | 114 | E and B |
| CBA6 | HF3 | 17° 53.555' S | 120° 34.556' E | 106 | E and B |
| CBA7 | HF2 | 17° 59.989' S | 120° 28.450' E | 106 | E and B |
| CBA8 | HF1 | 17° 06.043' S | 120° 22.233' E | 106 | E and B |

Table 2: Instrument site, name, location, depth and data.

All instruments were deployed and recovered successfully. Before the first deployment at CBA1 a test deployment was carried to check on a modification to the acoustic recall system. An instrument was tethered by line to two surface floats and enable, disable and release acoustic codes were successfully sent at a variety of different slant angles and ranges.

The first four recoveries (CBA1-4) carried back a significant amount of sand in the framework, and parts of the instruments were damaged. We assume that the

instruments were subject to very high currents at the seabed. The second round of recoveries (CBA5-8) looked much less affected by currents at the seabed.

1.3 Towed Magnetometer and SP Instruments

A magnetometer and a string of eight electrodes were towed behind the Franklin for two days at a rate of 4 kn. The first transect started about 8 nm South East of site CBA8 and continued parallel to the CBA line to about 16 nm beyond site CBA1, to the North East. A port turn was made and a transect perpendicular to the CBA line made, over about 16 nm. Finally, another port turn took us parallel to the CBA line in a South West orientation, until we reached site CBA4.

The magnetometer was towed about 100 m behind the ship at the sea surface. Data were recorded by a PC on the ship from the Proton Precession instrument, with a sample interval of about 3 s, to give a spatial sample of about 6 m in water depth of 100 m. The magnetometer was towed with a cable attached to a rope, with a small stainless steel ballast close to the magnetometer.

The electric field instrument consisted of eight electrodes, with pairs separated by 3 m. These electrodes were connected to a 16-bit A/D converter, and data were recorded on board with a PC. The converter, in a pressure housing, was towed at a depth of about 40 m by using a depressor plate. Sampling was made at a rate of 2 Hz, to give a spatial sample of about 1 m.

Data were lost from the electric field instrument due to a break in the wire, probably where the wire passed over the A-frame block. Repairs took about 5 hours from 0600 to 1100 on the 8th August. It was redeployed at about 1100 and continued to work successfully until 0800 the following morning. Initial analysis of the data showed very clear oceanographic signals, and we are optimistic of geological signals associated with the Canning Basin Anomaly.

1.4 Cetacean Observations

The first in a series of three piggyback cetacean sighting surveys using the RV Franklin as a platform was conducted on FR06 by Dr Deborah Thiele of the School of Ecology and Environment, Deakin University, Warrnambool. The surveys are being conducted in Australia's northern waters, and particularly the NorthWest Shelf in 2000 to contribute scientific data to the knowledge management objectives of the Commonwealth Government. The next two surveys will be conducted on the Darwin to Dampier transit and FR08/00, and are funded by the Marine Group, Environment Australia. These surveys form part of a network of cetacean research projects by national, regional and international agencies that will take place in the region in the near future.

Two observers (D. Glasgow and D. Thiele) used the ORV Franklin bridge wings to survey for cetaceans, and other marine wildlife during daylight hours. Searching was conducted by eye and with hand held binoculars, and a laptop-based sighting and tracking program was used to log data. Survey conditions were fair to good on most days, with approximately two days lost to high winds and seas. One extremely calm day made up for these, providing the research team with perfect sighting conditions

and the opportunity to obtain considerable individual photo and video identification material for the large number of humpback groups encountered. These data will be of considerable value to humpback research groups in Australia and the Antarctic for mark-recapture photo catalogue-based studies, as well as contributing to cetacean distribution and abundance records for the region.

The total number of cetacean groups sighted on the survey was 45.

- 36 humpback groups
- dolphin groups
- 7 unidentified whale groups

1.5 Sea Bird Observations

Sea bird observations were made during the cruise. During daylight hours, a watch was set up during ship transits of about 30 minutes during each hour. The observations formed part of the Ph.D. research of Ms Lisa Nicholson. Approximately ten different bird types were observed during the cruise.

Cruise Narrative (times and dates in Local Time)

| Date | Experiment | Notes |
|----------------|----------------------------|--|
| 02/08 | | Departed Broome at 0800 LT |
| | | Transit to site CBA1 |
| | Canning Basin Experiment | Site CBA1 : Deployed instrument HF1 at 1500 LT using a 150 m rope and two floats to test acoustic transponders at the sea bed. The transponders had been a problem on cruise FR08/99 and some modifications to the pingers' gains had been made. The instrument was winched 100 m to the seabed and then left with surface moorings. However, due to strong tidal currents of 2 kn, the floats were dragged underwater. The instrument was released using the burn wire and came to the surface at about 1640 LT. It was recovered through the A-frame without further problems. The test was successful in that the acoustics worked well. After the test, the four high-frequency MT instruments were deployed at sites CBA1 – CBA4, which were separated by about 10 nm. The last deployment was made at about 2130 LT. |
| 02/08 | | Transit to CTD test site |
| 03/08 | CTD wire test | The new CTD wire was tested to a depth of just greater than 3000 m. No major problems were encountered during the spooling. Site location 17° 31.183' S 115° 31.943' E, water depth 3014 m, time 0003 LT 4/8/00. |
| 04/08 to 05/08 | Exmouth Plateau Experiment | Deployed 12 MT instruments across the Exmouth Plateau, in a line from the edge of the continental margin (>2000 m) to the inner continental shelf (<100 m) over a 36 hour period. Each instrument was surveyed to the seabed using acoustics, with the exception of one (at site EX7) that disappeared from the acoustics at a depth of about 1200 m. The instruments were left on the seabed to record time variations of magnetic and electric fields for six weeks. Recovery will be from the RV Franklin at the end of September 2000 (FR08/00). |
| 05/08 to | Transit and Cetacean | Transit to site CBA1. A few extra hours during the transect allowed the cetacean observers to deviate the cruise a little to follow a number of |

| | | |
|----------------|--------------------------|---|
| 06/08 | observations | groups of humpback whales. The weather was excellent and some very good sightings were made. |
| 07/08 | Canning Basin Experiment | Arrived at site CBA1 at 0600 LT. Recovered instruments at sites CBA1 – CBA4 in about 5 hours. All recoveries went well in calm seas, however acoustic contact was sometimes difficult due to the shallow depth of deployments. All the instruments showed signs of damage, probably due to strong currents at the seabed. Large amounts of sand were present in the framework. |
| 07/08 | Canning Basin Experiment | Redeployed the four instruments at sites CBA5 – CBA8 between 1400 and 1800 LT. |
| 07/08 to 09/08 | Canning Basin Experiment | Tow of self-potential (SP) and magnetometer along transects parallel to the CBA line. The total length of line was about 110 nm, with the initial leg south of CBA8 to beyond CBA1, followed by tow port turns over 16 nm to continue the transect back to CBA5. Generally, data quality was good and should generate some interesting results. The magnetometer recorded for the whole duration of the tow, but the SP instrument experienced difficulties that stopped its operation from 0600 – 1100 LT on the 08/08/00. The problem was due to a broken wire in the towing cable, probably where the cable passes over the A-frame block. Weather at this time was getting worse, with 30-40 kn winds and rough sea conditions. A calibration of the instrument's pressure sensor was tried at 0830 LT, but surface currents produced too much stress on the cable. |
| 09/08 | Canning Basin Experiment | Arrived at site CBA5 at 0900 LT. Instruments at sites CBA5-CBA8 were recovered without any major problems from 0900 to 1430 LT. All instruments were intact on recovery and had less sand in their framework, suggesting that the seabed currents had reduced from the previous week. |
| 09/08 | | Transit to Broome started at 1430 LT. Weather conditions moderating but still reasonably rough. |
| 10/08 | | Arrived Broome 0800 LT |

Preliminary Results

Eight deployments were made along a transect across the Canning Basin Anomaly, and all returned data for the entire period of deployment. The MT instruments were of a new design that had only been deployed using a surface mooring previously, so we are very pleased with the success.

The first four recoveries showed some signs of damage, indicating strong currents at the seabed. A brief look at the data indicated that the instruments had moved during the deployment, but we are optimistic of recovering some good sections of data from the deployment. Our second set of four deployment-recoveries was much more stable on the seabed and returned with little damage. Data looked good, although one instrument (CBA5) appears to have malfunctioned in the magnetometer sensor for unknown reasons.

The remaining twelve instruments deployed across the Exmouth Plateau will be recovered at the end of September, and results will be discussed in the cruise report FR08/00.

Summary

Cruise FR06/00 on the ORV Franklin was a great success, and we fulfilled (and surpassed) our pre-cruise expectations. As always, the experience and expertise of the Master, Mr Ian Taylor, and the crew of the ORV Franklin were much appreciated. Their cheerful and friendly approach made deployment and recovery of instruments smooth and uneventful. The CSIRO personnel (Dr John Wallace (Cruise Manager), Mr Bob Beattie (Computing) and Mr Phil Adams (Electronics)) were always helpful and co-operative, and we are very grateful for their guidance throughout the cruise.