FRANKLIN

National Facility
Oceanographic Research Vessel

RESEARCH SUMMARY FR 5/91

Sailed Sydney 0900hrs 24 May 1991
Arrived Sydney 1400hrs 30 May 1991

SUBMARINE SLOPE FAILURE ON THE NSW CONTINENTAL MARGIN

Principal Investigators
C.J. Jenkins, J.B. Keene, G.H. Packham: O.S.I.,The University of Sydney

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BIOSTRATIGRAPHY OF THE CONTINENTAL SHELF OFF SYDNEY,

Principal Investigators
A.D. Albani, P.C.Rickwood: University of NSW
J.W. Taylor: Macquarie University

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PRECISION SHIP-TRACK AND ALTITUDE USING SHORE-BASED AND SHIP-MOUNTED GPS RECEIVERS

Principal Investigators
C. Rizos: School of surveying, University of NSW
R.J. Edwards: CSIRO Division of Oceanography

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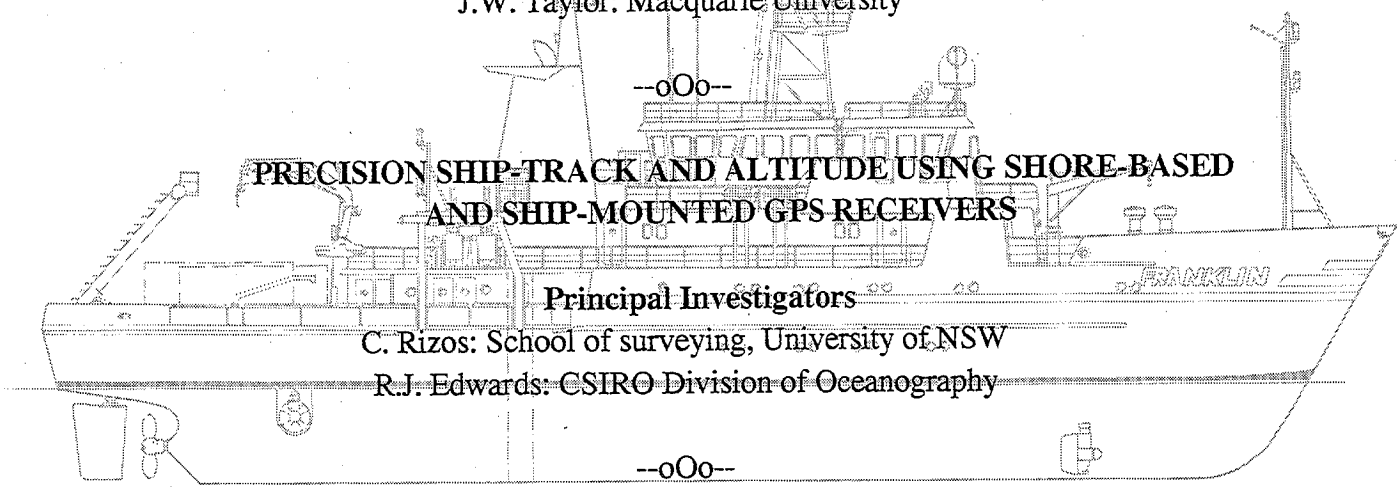

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2 September 1991

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AUSTRALIA

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FRANKLIN

RESEARCH CRUISE SUMMARY FR5/91

1. Itinerary

Sailed	Sydney	0900hrs	Friday	24/5/1991
Arrived	Sydney	1400hrs	Thursday	30/5/1991

2 Scientific Programs

a Submarine slope failure on the NSW continental margin.

The principal program aimed to investigate the large slope failures which have been detected in studies by Jenkins & Keene (in press), in particular to: (i) establish stability parameters from geotechnical testing of cored/ dredged samples; (ii) attempt to define the age of the slides by a combination of 3.5kHz profiling, seafloor photography and dating certain seafloor samples; and (iii) gather evidence on the possible causes and mechanisms of the sliding and of associated phenomena.

b Biostratigraphy of the continental shelf off Sydney, NSW

The aim of this project was to sample those areas of the seafloor adjacent to the Mt Woolnough volcanic complex where sub-S1 sediments were thought to be exposed at the seafloor. The S1 horizon is an important seismic stratigraphic unconformity under the continental shelf of NSW.

c Precision ship-track and altitude information for *Franklin* , using shore-based and ship-mounted GPS receivers

The aim was to test the use of a 2-antenna GPS setup, combined with shore GPS to derive the ship's position/attitude. The results will be compared with the records of the vessel's log, gyro and ADCP.

3 Principal Investigators (by project)

a C.J. Jenkins, J.B. Keene and G.H. Packham, Ocean Sciences Institute, University of Sydney;

b A. Albani and P.C. Rickwood, Department of Applied Geology, University of NSW; J.W. Taylor, Macquarie University;

c C. Rizos, School of Surveying, University of NSW; R.J. Edwards, CSIRO Division of Oceanography.

4 Results

Project a.

The cruise was extremely successful in sampling those upper continental slope sediments which have been involved in slope failure. Comprehensive laboratory testing (at sea and post-cruise) has established, in quantitive terms, the stability of sediments on the continental slope.

Total core recovery was 33m. Initial sedimentary logging and analysis of the 15 successful piston and gravity cores was carried out on board. Hundreds of geotechnical strength tests were performed on freshly collected cores and 10 core sections are prepared for triaxial testing. Some lithologies were recovered which appear to have been subject to strain disruption of fabric.

The 100kg of dredgings includes early Cenozoic units which are being subject to palynological dating.

About 70km of 3.5kHz profiling was carried out, together with three seafloor camera traverses. The profiling showed that no younger deposits mantle the Bulli slide, suggesting that in geological terms it is an exceedingly young structure. The seafloor photographs from the submarine canyon floors showed mud deposits without evidence of instability or recent movement. It appears that the canyons are not at present active conduits for transport of coarse materials.

In summary, the cruise has greatly advanced our knowledge of the continental slope of NSW, in terms of large-scale active processes such as sliding, and also in terms of the stratigraphy. The samples and data which were obtained will be the basis of several years analysis leading to a number of publications.

Project b (Piggyback)

The area previously thought to have sub-S1 strata exposed at the seafloor appears to be composed of hard pavement, impenetrable to coring techniques and probably composed of ferruginised /phosphatised basaltic cobbles as dredged at Fr5/91-2DB1. A re- assessment of the seismic profiles indicates that the area is a volcanoclastic apron to Mt Woolnough. Younger sediments of soft olive-grey muddy sand were also collected (4DB2).

Project c (Piggyback)

Two Trimble-4000 antennae were fixed on top of the foremast and funnel of *Franklin* L1 and L2 phase data were collected each day from 0000-0400 hours and were preprocessed. The two GPS receivers worked normally and about 70 Mbytes of data were written to tape. The gyro, log, pitch-roll and doppler data were also collected. All data will be filtered in post-cruise processing to obtain corrected track information.

5 Cruise narrative

0900-1800 24/5/1991 Directly upon leaving Sydney, a 3 hour transit was made to the Mt Woolnough area 31km east of La Perouse. Operations were limited to north of Mt Woolnough to avoid charted submarine cables. Coring at this site was not successful and dredging revealed that cobbles of furruginised/phosphatised basaltic breccia composed the seabed. After over 6 hours of attempts to sample in diverse ways, to fulfill piggyback (b) aims, the ship proceeded to a nearby part of the upper slope.

1800-0400 24-25/5/1991 Subbottom 3.5kHz profiling of this upper slope area established that mesa-like topography previously mapped with SeaBeam was an instrumental artefact of that system.

In this early part of the cruise, the flow of the East Australian Current was only 1.5kt - not large enough to seriously hamper station-keeping for the geological sampling. Sea conditions were very good (sea state 2) for all of the cruise except the last 12 hours when piston coring had to be abandoned.

0600-1500 25-26/5/1991 Taking care to work well south of the telecommunication cables marked on navigation maps, dredging and gravity coring proceeded to sample the walls of Sydney Canyon. The target stratigraphic levels were those involved in the large slide which occupies the upper slope shoreward of the canyon. The sampling strategy was evolved using previous SeaBeam bathymetric map, a GLORIA image of the region and BMR seismic profiles. Two camera traverses were made in the very floor of the canyon at about 2400m water depth. Finally, a 3.5kHz box-survey was run over the most intensely sampled areas.

1600-2200 26-27/5/1991 The vessel then moved south to the Bulli Slide. An initial 3.5kHz profiler survey NW-SE down the slide axis revealed the extent of the crown scarp and of the transported, disrupted sediments. Piston coring and dredging of both these areas then proceeded, and in the crown scarp appears to have recovered old stratigraphic levels in the Cenozoic stratigraphy including pure pelagic limestones and also ferrugineous sandstones. Following a 3.5kHz traverse of the middle of the slide, the *Franklin* moved to offshore of Jervis Bay.

0230-1200 28/5/1991 Small submarine canyons east of Jervis Bay presented an opportunity to sample early Cenozoic sediments and 'basement'. A feature of the operations here was the 'pinpoint' sampling of seafloor areas only 500-300m wide. This has now become theoretically possible with the recent acquisition of GLORIA and SeaBeam imagery of the region and advent of 24 hour GPS coverage; the challenge was to accomplish this sampling under sea conditions. The accomplishment of this aim by *Franklin* during 5/91 marks a distinct 'step-up' in local marine geoscience capabilities. Dredge hauls from the hard Jervis Bay canyon floor obtained sandstones which probably represent an early Cenozoic facies.

1400-0400 28-29/5/1991 Transit was then made to the Ulladulla slide area. Here operations were hampered by unusual and unpredictable current conditions, perhaps a result of EAC interaction with a major indent in the continental slope. Piston coring and dredging obtained samples of the slide front scarp.

0800-0900 29/5/1991 On the way to Sydney a renewed attempt was made to sample certain targets. The Jervis Bay canyon floor was again dredged successfully, but at a depth where seismic profiles suggested early Cenozoic sediments might be present. The dredging was apparently successful in this regard.

1400-1500 29/5/1991 Closer to Sydney, piston cores were obtained of the upper continental slope sediments not involved in the sliding. One extra core was obtained in the crown scarp area.

1600-0900 29-30/5/1991 Finally, piston coring and (when rough weather set in) gravity coring of slopes in the upper reaches of Sydney Canyon were carried out.

1100 30/5/1991 As the weather deteriorated further it became clear that operations would have to cease and a course was set to return to Sydney.

6 Summary

The cruise was very successful in terms of the core and dredge samples recovered and the geophysical data obtained. We were very pleased with: (i) the way we were able to sample target areas of the seafloor only 100-300m wide in submarine canyon terrains at water depths >1000m; the target areas had been identified from GLORIA acoustic backscatter imagery and SeaBeam bathymetric mapping; (ii) the joint science/engineering approach to the question of sediment stability on continental slopes, with extensive on-board geotechnical testing performed on fresh cores; and (iii) recovery of older Cenozoic sediments from the continental slope.

These successes would not have been possible without the expert ship-handling of the crew of the *Franklin* in the difficult current conditions of the East Australian Current.

7 Personnel

Project a:
C.J. Jenkins[1] (Chief Scientist)
J.B. Keene[1]
T.Hull[2]
T.C.T. Hubble[1]
D. Mitchell[1]
T. van der Linden[1]
B. Walker[1]

CSIRO
R.J. Edwards3
E. Madsen3

Project b (Piggyback):
K. List[4]
M. de Mol[4]

Project c (Piggyback):
F. Wan[5]

1 Ocean Sciences Institute, University of Sydney
2 Centre for Geotechnical Research, University of Sydney
3 CSIRO Division of Oceanography
4 Department of Applied Geology, University of New South Wales
5 School of Surveying, University of NSW .

Appendix

Suggested operational improvements.

1. Aft deck communications. Hand-held radio links with the bridge were usually inaudible and the installed intercom speaker is one-way (bridge to deck only). Operations on the aft deck require special care, especially with dredging and piston coring. At present, it is not possible to communicate clearly and quickly with the bridge without a sprint to the wet lab/CTD space. This deficiency in communications could prove vital in an emergency.

Under present procedures it is necessary to send a person to the aft deck and container lab to check that the deck and lab are clear of personnel during dredging. We recommend that an extension of the intercom network be installed near the doorway of the container lab.

(ii) Vax information screen. This system has serious problems which were particularly annoying during geophysical and seafloor photography traverses. (a) The screen updates at very irregular periods and some variables do not update at every refresh. (b) The ship's log speed sometimes held at 10kts even while the vessel was drifting; it is suggested that bow thruster flows interfere with the reading. Suggestion: the lines heading and speed on the VAX screen could be abbreviated (combined, e.g., '1.5kt 232o) to allow a GPS derived SOG/COG line to be inserted. (c) The unreliability of the log speed raises the question: What speed is used in the backcorrection algorithms applied to the GPS/SatNav navigation ?