# RESEARCH PLAN FR 5/91

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|---|---|
| Depart Sydney | 0900hrs 24 May 1991 |
| Arrive Sydney | 1500hrs 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

School of Appl Geol
Faculty of Appl Sci
UNSW
PO Box 1
Kensington
NSW

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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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11 March 1991

# *FRANKLIN*

## RESEARCH PLAN FR 5/91

## SUBMARINE SLOPE FAILURE ON THE NSW CONTINENTAL MARGIN

**Itinerary:**

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|---|---|
| Depart Sydney | 0900 24 May 1991 |
| Arrive Sydney | 1500 30 May 1991 |

**Background to scientific program:**

Preliminary studies based on BMR seismic, OSI core sampling and photography, and on GLORIA imagery have demonstrated that sediment cover on the NSW continental margin is prone to slope failure or more colloquially, 'submarine landsliding' (Jenkins & Keene, in press; Jenkins & Lawrence, in prep.). This is especially true offshore of Newcastle, Sydney and Wollongong where large slides are detected in all the available seismic sections. The slides may be very large, of order 20 km across and 200 m thick, and commonly involve 1 km of downslope motion. Some parts of the slope have slid away completely to abyssal depths. The failures occurred on slopes of as little as 2 degrees and appear to have taken place in the Quaternary (2 Ma to present).

**Specific cruise aims**

The purpose of this cruise is to research the slope failures, in particular to:

(i) establish the geotechnical stability parameters of the slope sediments by testing cored/dredged samples;

(ii) obtain additional evidence of the age of sliding through a combination of 3.5 kHz profiling, seafloor photography and coring/dredging;

(iii) provide evidence on the causes, mechanisms and phenomena associated with the sliding.

The sampling and geophysics carried out in pursuit of these aims will also yield valuable new information on: (i) the stratigraphy of the margin involving subsidence and sealevel history; (ii) history of the East Australian Current; and (iii) processes of sediment transport, accumulation and erosion offshore of NSW.

Two 'piggyback' activities will also be carried out during the cruise:

(a) biostratigraphic sampling of the continental shelf;

(b) track and attitude GPS navigational experiments.

Six hours are set aside for the first; the second will not interfere with the ship's schedule.

**Detailed cruise plan**

On sailing from Port Jackson, transit will be made to a location on the continental shelf for sampling operations by UNSW (Albani; see 'Piggyback' plan 1); 6 hours are dedicated to this task.

After leaving this area, the 3.5 kHz profiler will be deployed in a high-resolution seismic transect of the outer shelf and upper slope. The vessel will return to locations along this transect for sampling by means of coring and dredging. This will reveal the composition, physical properties, age and depositional environment of sediments in the shelf-edge sediment wedge. A seafloor photographic traverse may be carried out, weather and current conditions permitting.

Following this will be a short transit to the head of 'Sydney Canyon' for dredge and core sampling of sediments in the upper slope seaward of and deeper than the shelf edge progradation. The sampling will primarily be of the 20-45 degree sloping, 500-1000 m high walls of the canyon down to 2500 m total water depth. Core or dredge samples of the canyon floor materials will also be sought. Again, sampling targets will be identified on the basis of SeaBeam bathymetry, BMR seismic and GLORIA imagery plus a short 3.5 kHz profile obtained immediately beforehand. A camera traverse of the canyon floor may be carried out if conditions are favourable.

The third target is the 'Bulli Slide'. Profiles over the slide will first be obtained to identify likely sampling locations and to test whether post-sliding sediment mantle exists. Coring of the crown scarp will provide insights into the nature of sediments within the slide mass. Photographic seafloor transects will be carried out over the compressional zone (2200-1300 m ) and tensional zone (1200 m-750 m ).

Small submarine canyons developed offshore of Jervis Bay will be sampled as a means of obtaining sediments from deep within the upper slope sediment wedge. These canyons have 50-200 m high walls at slopes of up to 45 degrees; dredging will target the walls and floor of the largest of these canyons between depths of 500-2500 m. Dredge target areas will be identified by means of existing SeaBeam, seismic and 3.5 kHz data.

The Ulladulla Slide presents an opportunity to sample the sediments actually at the failure surface of a large slide. This will be possible at a narrow zone where slide materials have slipped away completely to abyssal depths. Core and dredge operations will be preceded by 3.5 kHz profiling of the lower end of the slide.

Due to limitations of *Franklin's* winching capabilities, dredging will be restricted to soft lithologies at less than 2500 m water depth. Pipe dredges of smaller weight and size than dredges normally employed for marine geoscience will be used, perhaps in a paired arrangement - one (blocked) for sloppy sediments, one (netted) for more lithified materials. Since geotechnical laboratory testing usually requires samples of 50 mm size, a 3 m long 70 mm bore corer will be used, operated either in gravity- or piston-mode. Also, at some locations a duplicate core may be taken.

The OSI deep-sea camera has been successfully employed from *Franklin* previously (FR 7/86) and the same deployment procedures will be used (see Jenkins & others 1986). The DSTO has kindly loaned a 3.5 kHz sounder for use by *Franklin*; OSI was involved in the initial DSTO deployment of this system (Lawrence 1990; Jenkins 1991). The towfish is usually deployed alongside the (stationary) vessel and profiling is done at 5 kts.

## ORV Equipment required

Standard navigation and depth systems will be required, but no call will be made on specialized physical oceanographic facilities other than the Doppler Current Profiler and occasionally, XBT's. The ORV 'IBM' compatible and Macintosh computers will be utilized for report writing and data compilation. Navigational data is requested written to magnetic tape: 9 track ASCII, 6250bpi with fixed block (80 recs) and record lengths (80rec, 124chr). A cruise track plot will be required at the end of the cruise.

There will be a need to split certain sediment cores and to conduct shipboard geotechnical testing and we propose this could be done in the 'Containerized Deck Laboratory'. Core stowage in refrigerated conditions (2$^{o}$C) will be required. The stored 1.5 m core lengths will be double-sealed in plastic.

All the OSI sampling and photographic equipment has been deployed previously from *Franklin* and is suited to deployment from the *Franklin* A-frame and winch. The DSTO 3.5 kHz sounder will have been deployed during FR 2/91.

## Summary of time estimates for cruise

Compiled on basis of: 60 m/min cable speeds; dredges on bottom for 1 hr; camera on bottom for 1.5 hrs; site location and positioning of vessel 0.5 hr per site; transit speeds 12 kts; 3.5 kHz profiling 5 kts.

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|---|---|
| Transit from Port Jackson | 3hrs |

**Piggyback Program 1 - Albani - Continental Shelf sampling of S1/S2 reflector ~34°01'S 151°40'E**

| | |
|---|---|
| Dredging/coring | 6hrs |

**Upper Slope Scarps ~34°10'S 151°31'E**

| | |
|---|---|
| Transit | 1 |
| Downslope 3.5 kHz profiling to 2500m 4 | |
| Returning to sampling locations along transect | 3 |
| 4 Dredgings and corings in to 2000m 4x(0.5+1) 6 | |
| 1 Seafloor camera traverse 0.5+1.5 | 2 |
| Total: | 16hrs |

**Sydney Canyon ~34°10'S 151°50'E**

| | |
|---|---|
| Transit to site | 2 |
| 3.5 kHz profile | 2.5 |
| Repositioning to sampling sites | 3 |
| 6 Dredgings/corings of walls to 2500 m 6x(0.5+1) | 9 |
| 1 Dredging & 2 corings of canyon floor 1.5+2 | 3.5 |
| 2 Seafloor camera traverses 2x(1.5+1.5) | 6 |
| Total | 26hrs |

**Bulli Slide ~34°20'S 151°40'E**

| | |
|---|---|
| Transit to site | 3 |
| 3.5 kHz profile ( 300-2500 m) | 4 |
| Repositioning to sampling locations | 3.5 |
| 6 Corings at 300-2500 m - 6x1.0 | 6 |
| (? 1 dredging of crown scarp) - 2x(1.0+1.0) | 4 |
| 3 Seafloor Camera traverses - 3x(1.0+1.5) | 7.5 |
| Total | 28hrs |

**Jervis Bay Canyons 35°10'S 151°10'E**

| | |
|---|---|
| Transit to site | 5 |
| Repositionings to sampling sites | 3 |
| 6 Dredgings of canyon walls and floors 6x(1.0+1.0) | 12 |
| Total | 20hrs |

| | | |
|---|---|---|
| **Ulladulla Slide** | **34°30'S 150°50'E** | |
| Transit to site | | 3 |
| 3.5 kHz profiling | | 2 |
| Relocate to sampling sites | | 3 |
| 6 Dredgings or corings at 2000m | 6x(1.5+1.0) | 15 |
| Total | | **23hrs** |
| | | |
| Transit to Sydney | | **18hrs** |

**References cited**

Jenkins, C.J. 1991. Geological and geophysical studies in support of acoustic experiments in the Indian Ocean northwest of Australia. Univ. Syd. Ocean Sci. Inst. Rep., 42, 1-299.

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Lawrence, M.W. 1990. Geoacoustic Studies Northwest of Australia. Init. Rep. Def. Sci. Techn. Org., Mater. Res. Lab., Underw. Systs Div., 1-16.

**Piggyback Program 1**

## BIOSTRATIGRAPHY OF THE CONTINENTAL SHELF OFF SYDNEY, N.S.W.

**Investigators:** Drs A.D. Albani, P.C. Rickwood - Dept Applied Geology, Centre for Marine Science, University of New South Wales

**Background to Scientific Programme**

Although since 1980 we have undertaken extensive acoustic and magnetic surveys of the continental shelf near Sydney we have not so far been able to sample the material that occurs on the sea floor. In the vicinity of Mt Woolnought (34°01'S, 151°40'E) there exists a depression in the sea floor, at a water depth of 500-600 m, in which a major acoustic

reflector surface intersects the depression walls. This reflector, coded S1, is only to reach the sea floor at this one locality in the vicinity of Sydney. The significance is that it is a unique location at which it should be possible to obtain material both younger than S1 and older than S1, for elsewhere it is probably technologically impractical to core through S1.

**Specific Aims:** For *Franklin* cruise 5/91 we will be able to obtain two cores, one on the upper slope of the depression where the material obtained will be younger than S1, but not by very much, and the other towards the bottom of the depression where the material will be older than S1. The large volume of data already acquired cannot be fully evaluated and presented for publication without this additional information. Once the age of the reflector in question is obtained a number of far reaching conclusions can be drawn.

On returning to the laboratory with the cores, we proposed to place the greatest emphasis on the evaluation of the foraminiferal assemblage (pelagic), with the intention of undertaking a detailed analysis at 15 cm intervals. This will give information concerning the biostratigraphy of the sediments and allow estimation of the age of the material. If the samples prove suitable, i.e. in possessing appropriate mineral phases, we will undertake some radiogenic dating in collaboration with staff at other institutions.

**Equipment:** Ocean Sciences Institute (Sydney University) piston and gravity corers.

## Piggyback Program 2

### PRECISION SHIP-TRACK AND ALTITUDE INFORMATION FOR *FRANKLIN*, USING SHORE-BASED AND SHIP-MOUNTED GPS RECEIVERS

**Investigator:** Dr Chris Rizos, School of Surveying, University of New South Wales

**Objectives:** *Franklin* cruise 5/91 will be used to test the use of a 2 antenna GPS setup on the ship, combined with shore GPS to derive the ship's position/velocity and altitude. Compare results with recorded ship's log, gyro and ADCP data. In addition, there may also be an opportunity to test the new GPS commercial product giving attitude determinations. An earlier experiment of this type was conducted on an earlier cruise (in November 1989), but the results were inconclusive.

**Equipment requirements:** Two mounting points for light weight GPS antennas (one on extension pole at bow, one on funnel). Previous experience is available from CSIRO technical personnel. Possibly another mounting point for ASHTECH multi-antenna array (1x1 metre), if this instrumentation is used.

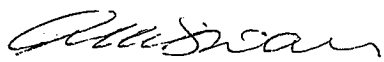
Equipment will consist of PC computer, two GPS Trimble receivers (0.3x0.3x0.1 metre) with antennas and cables. Possibly additional ASHTECH instrument.

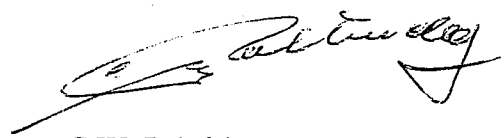
**Personnel:**

| | | |
|---|---|---|
| C.J. (Chris) Jenkins | OSI (SU) | Chief Scientist |
| T.C.T. (Tom) Hubble,Scientific | DGG (SU) | |
| A. (Alison) Cole - Scientific | OSI (SU) | |
| D. (David) Mitchell - Technical | OSI (SU) | |
| T. Hull (Tim) or | | |
| D. (David) Airey - Geotechnical | CGR (SU) | |
| P.C. (Peter) Rickwood - Scientific | CMS (UNSW) | |
| R. (Bob) Edwards | CSIRO | Cruise Manager |
| E. (Erik) MasdenShipboard technical | CSIRO | |

**OSI:** Ocean Sciences Institute
**DGG:** Department of Geology & Geophysics
**CGR:** Centre for Geotechnical Research
**CMS:** Centre for Marine Sciences.

This research plan is in accordance with the directions of the National Facility Steering Committee for the oceanographic research vessel *Franklin.*





A.D.McEwan
CSIRO Division of Oceanography

G.W. Paltridge
National Facility Steering Committee

March 1991