

# FRANKLIN

National Facility  
Oceanographic Research Vessel

## RESEARCH SUMMARY

Cruise FR 4/95

## INTERNAL TIDAL EVOLUTION ON THE NORTHWEST SHELF

### Itinerary

Sailed Dampier 0900 Tuesday 25 April 1995  
Arrive Femantle 0800 Wednesday 3 May 1995

### Principal Investigators

Dr Peter Holloway

Australian Defence Force Academy

Dr Peter Craig

CSIRO Division of Oceanography

Dr Tony White

Flinders University

Professor Matt Tomczak

Flinders University

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**Principal Investigators**

Dr P E Holloway	University College, University of New South Wales, Australian Defence Force Academy
Dr P Craig	CSIRO Division of Oceanography
Dr M Furnas	Australian Institute of Marine Science
Dr A White	Flinders University
Prof M Tomczak	Flinders University

**Piggy Back Projects**

1. **Measuring The Leeuwin Current by Electromagnetic Induction** (A White and F Lilley)
2. **Transport and Fluxes in the Indian Ocean** (M Tomczak)

**Scientific Program**

The internal tide evolution project aims to measure and describe the temporal and spatial evolution of tidally forced internal waves as they are generated and propagate across a shelf and slope region on the North West Shelf and also to measure the associated formation of high frequency internal wave trains. The project also aims to measure the variability in the primary production in this region and to attempt to relate this to the internal wave dynamics. These aims are to be met through the deployment of 10 moorings containing 19 current meters, 3 thermistor strings, 3 Acoustic Doppler Current Profilers (ADCP's) and 2 water level recorders. These

moorings were deployed on cruise FR 1/95 and are to be recovered on cruise FR 4/95. In addition, repeated (over 13 hours) CTD and ADCP stations are to be occupied at three locations.

Two magnetometer moorings are to be recovered off North West Cape, deployed from Franklin in August 1994 (White). In addition a magnetometer is to be lowered from the ship to the sea bed at a number of locations in order to measure the depth integrated velocity in the Leeuwin Current (Lilley).

Two current meter moorings off North West Cape were to be recovered and re-deployed, however, lithium battery packs were not available and the moorings were left. Ranging on the releases was decided upon in order to establish an accurate location of the moorings (Tomczak).

### **Cruise Narrative**

Franklin departed Dampier on time at 0900 on Tuesday 25 April and steamed directly to mooring site M3 arriving at 1730. The first 13 hour CTD sequence was started with CTD's carried out every 30 minutes and with nutrient samples at seven levels collected every 2 hours. On each cast two salinity samples were taken and one set of reversing thermometers were used.

The CTD station was finished at 0645 on Wednesday and the two moorings at this location recovered in a little over an hour. We then steamed to the furthest offshore mooring (M1 in 750 m water depth), carried out a single CTD cast and recovered the mooring between 1200 and 1330. Franklin then steamed to mooring M2, recovered this without any problems and then commenced the second 13 hour CTD sequence at 1500, with casts every hour in this deeper water (300 m).

On Thursday three moorings at Mooring site 4 (near North Rankin) were recovered, including a "U" mooring that was still intact after Tropical Cyclone Bobby. At this point we were about 6 hours ahead of schedule with mooring recovery going very smoothly. From here we steamed for 2 hours into the inshore mooring (M6) arriving at 1300. The mooring would not surface after a release command was sent (a SeaStar acoustic release) so we trawled for the mooring with a grappling hook. We must have hit the mooring line as the mooring eventually surfaced and was recovered by 1530.

By 1645 we were at the final "internal tide" mooring site (M5). The ADCP mooring was quickly recovered but the final thermistor chain mooring would not surface when released. As it was late in the day, this mooring was left and we steamed

to the North Rankin site to carry out the final 13 hour CTD sequence with casts every 30 minutes from 1900 to 0800 Friday (28/4/95). On completion, a small boat was deployed to allow Fran Sugden (CSIRO Communications Manager) to take some photographs of Franklin and the North Rankin Platform.

We steamed back to mooring M5, completed a single CTD cast and then trawled for the thermistor chain mooring. After about 3 hours we snared and recovered the final mooring, finishing at about 1400. From here we steamed for North West Cape to the magnetometer mooring sites.

We arrived at the first magnetometer mooring at 1100 on Saturday (29/1/95). This was recovered after about 2 hours, taking a little time to locate the mooring once it had risen to the surface. It was only 30 minutes steaming to the second magnetometer which was quickly recovered. These moorings used Benthos burn-wire releases. Following this recovery, several hours were spent ranging with the acoustic releases on two current meter moorings for M. Tomczak.

At 2000 Ted Lilley started his first magnetometer measurements. Four drops were completed at the first site, lowering the magnetometer from the surface to the sea bed in 800 m of water. This was done on the winch through the A frame over the stern with the ship's pinger attached to the line to get a height above the sea bed. This was completed at 2330 and a second site in 1100 m of water completed between 0000 and 0230 on Sunday (30/4/95). From here we steamed south towards the next magnetometer lowering en-route to Fremantle.

Three magnetometer stations were completed in the Leeuwin Current, each taking about 2 hours with 2 casts at each station. The locations were at 27° 30.00S, 112° 00.00E (1000-1130 Monday 1 May), 28° 15.00S, 112° 30.00E (1600-1800 Monday) and 29° 10.00S, 113° 10.00E (0000-0230 Tuesday 2 May). From here we steamed to Fremantle, docking at 0800 Wednesday 3 May.

### **Preliminary Results**

All moorings were recovered but a preliminary investigation of equipment revealed that some instruments did not operate correctly. Two of the three ADCP's did not log any data. All of the InterOcean "S4" current meters worked but two of the six Aanderaa current meters had no data on the storage units. It was not possible to check data from the other moored instruments while on the ship.

Results from the 13 hour CTD sequences revealed strong internal wave activity and some results from site B3 in 125 m water depth are shown in Figure 1.

During the current meter deployment period Tropical Cyclone Bobby passed over the region on 24 February 1995. Figure 2 shows a time series of current speed, direction and water temperatures at 40 m depth from one of the "S4" current meters at mooring M2 in 300 m water depth. The currents are seen to reach 175 cm/sec followed by inertial oscillations and a decrease in water temperature indicating vertical mixing.

The cruise track is shown in Figure 3.

## **Summary**

The main aim of the cruise was to recover 10 moorings from the North West Shelf and 2 magnetometers from North West Cape. All moorings were recovered, although it was necessary to trawl for two of the NWS moorings. In addition successful communications and ranging was achieved on two current meter moorings of M. Tomczak which are to be recovered on a later cruise. Finally, Ted Lilley successfully completed a number of trial runs of a magnetometer lowered through the water in order to measure depth-averaged current flow.

## **Acknowledgments**

The expert and willing assistance of the Master, Ian Sneddon, and crew of Franklin is greatly appreciated. We wish to acknowledge the assistance and cooperation of Woodside Offshore Petroleum, and in particular Mr. Dave Brennan, for giving permission to moor instruments and operate within the 5 nm protected zone around the North Rankin platform. Woodside lent 5 current meters and WIN Science and Engineering provided mooring components and a thermistor chain for the experiment.

## Scientific Personnel

Peter Holloway	Australian Defence Force Academy (Chief Scientist)
Peter Craig	CSIRO, Division of Oceanography
Kevin Miller	CSIRO, Division of Oceanography
Danny McLaughlin	CSIRO, Division of Oceanography
Fran Sugden	CSIRO, Division of Oceanography
Tony White	Flinders University
Ted Lilley	Australian National University
Neil White	CSIRO, ORV (Cruise Manager)
Phil Adams	CSIRO, ORV
Ron Plaschke	CSIRO, ORV

## Mooring Locations (Holloway and Craig)

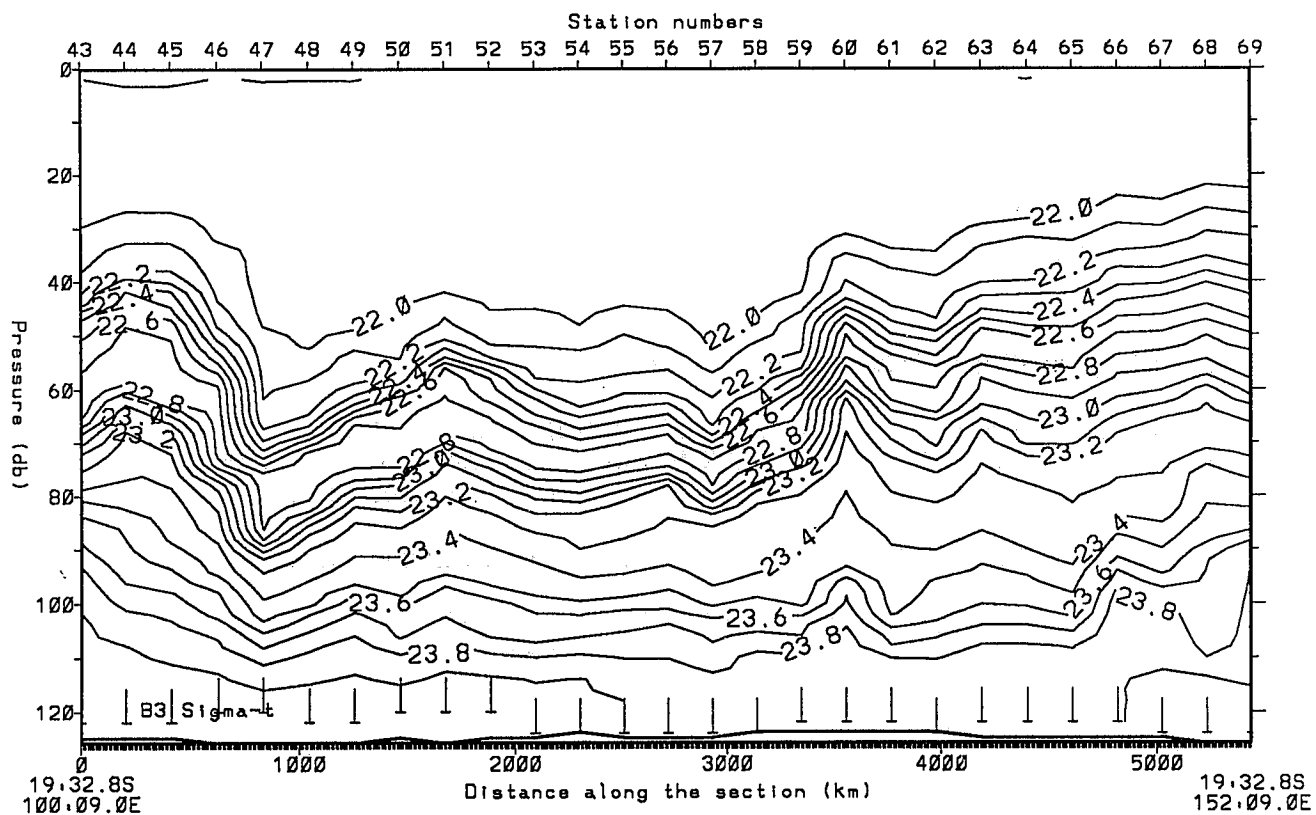
Mooring	Latitude	Longitude	Depth (m)	Instruments
M1	19° 04.94' S	115° 35.78' E	750	6 x Aanderaa current meters 1 x water level recorder
M2	19° 16.33'	115° 49.57'	300	6 x S4 current meters
M3	19° 25.73'	116° 00.42'	170	1 x ADCP
M3A	"	"	"	1 x thermistor string
M4	19° 33.10'	116° 08.97'	125	1 x ADCP
M4A	"	"	"	1 x thermistor string
M4B	"	"	"	5 x Steedman current meters
M5	19° 39.00'	116° 16.00'	85	1 x ADCP
M5A	"	"	"	1 x thermistor string
M6	19° 44.96'	116° 23.05'	68	2 x Steedman current meters 1 x water level recorder

## Magnetometer Moorings (White)

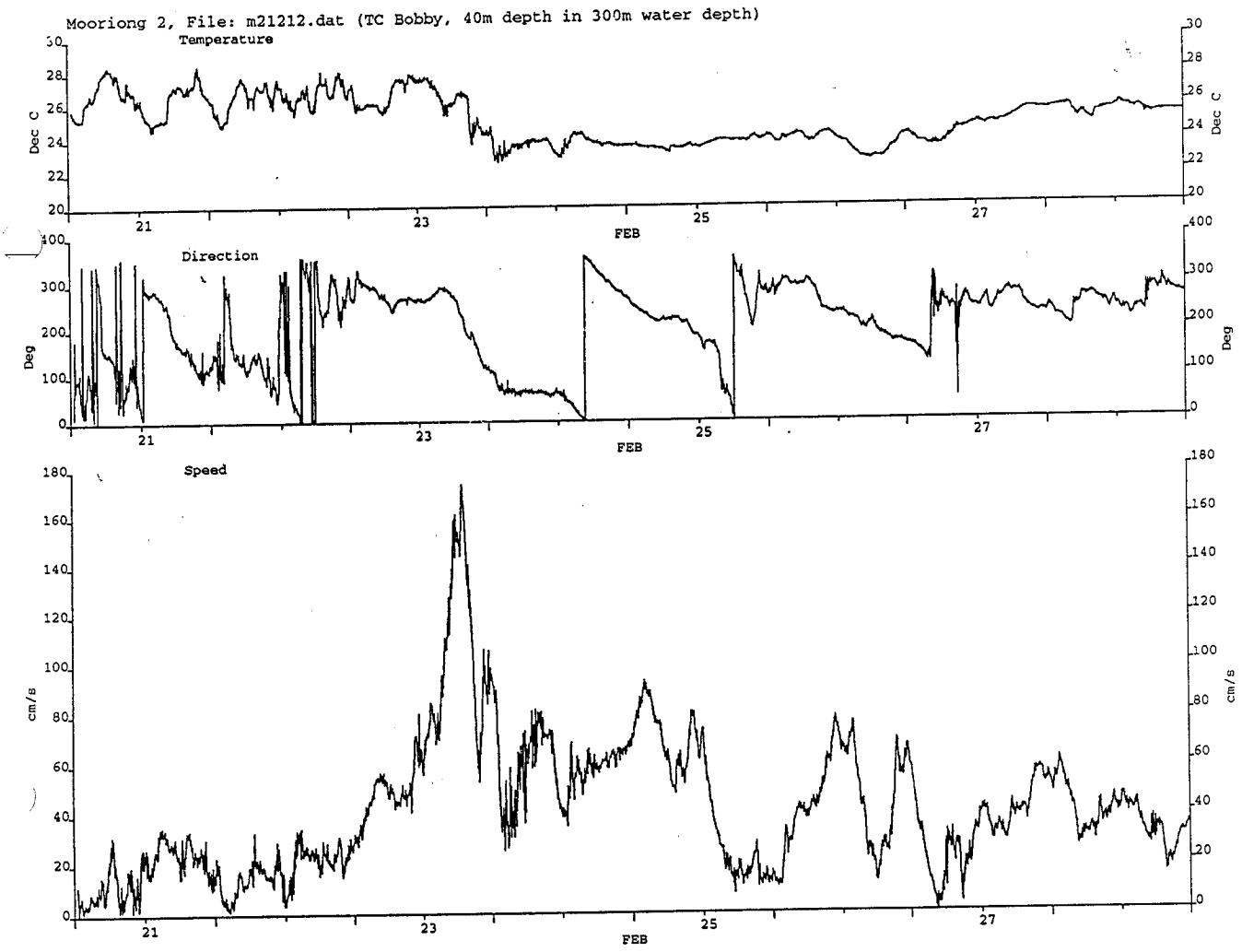
MAG01	22° 10.40'	113° 30.03'	1110	1 x magnetometer
MAG02	22° 12.15'	113° 37.50'	800	1 x magnetometer

## ICM6 Current Meter Moorings (Tomczak)

ICM6 1	22° 13.19'	113° 43.95'	250	
ICM6 2	22° 12.47'	113° 39.79'	630	

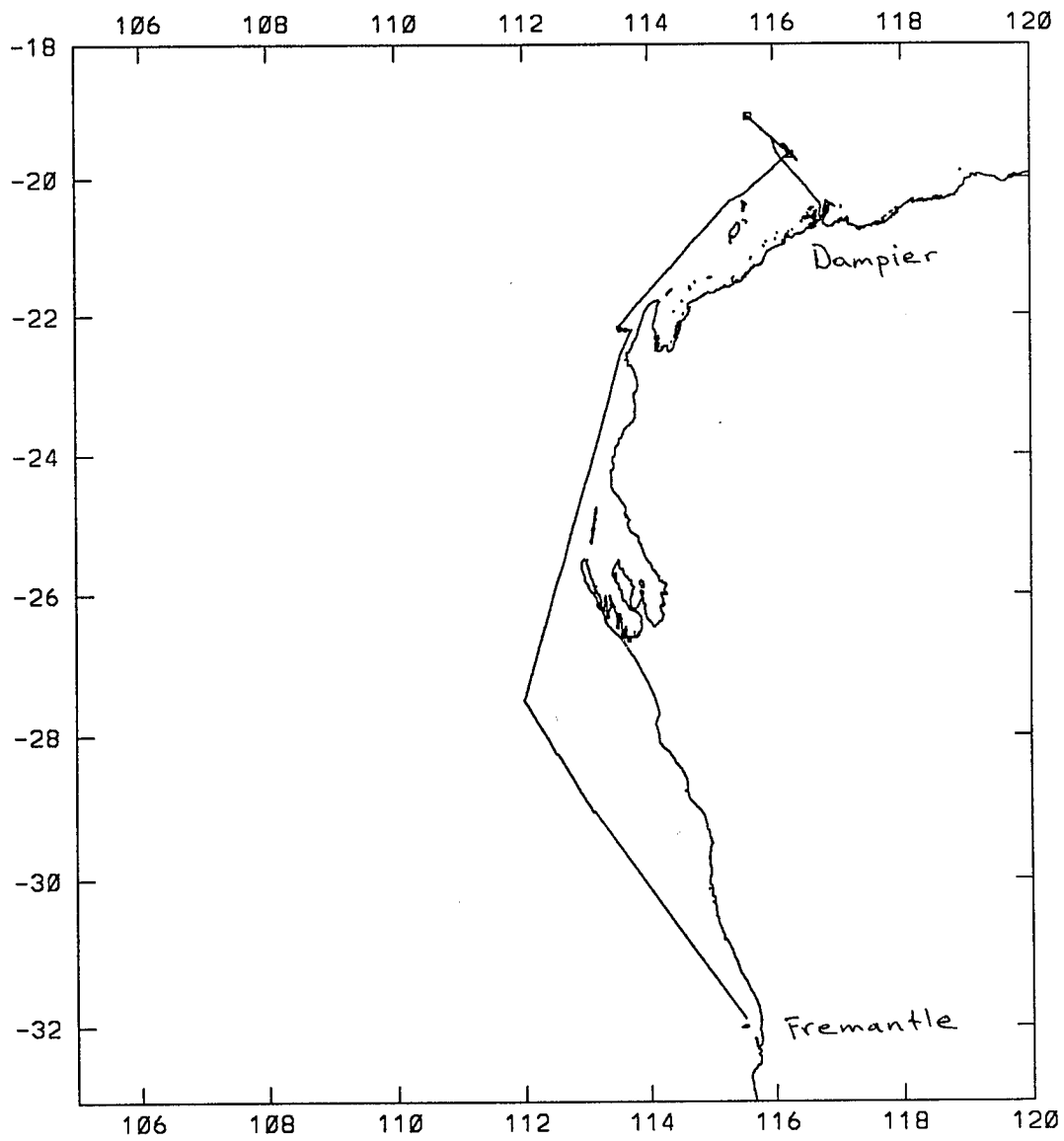


**Figure 1** Time series of isopycnal displacements over a 13 hour period in 125 m water depth at location B3. Strong internal wave activity is revealed.



**Figure 2** A time series of current speed, direction and water temperature measured at 40 m depth in 300 m water depth under the influence of Tropical Cyclone Bobby .





**Figure 3** Cruise track of FR 4/95 from Dampier to Fremantle.