R.V. FRANKLIN

NATIONAL FACILITY
OCEANOGRAPHIC RESEARCH VESSEL

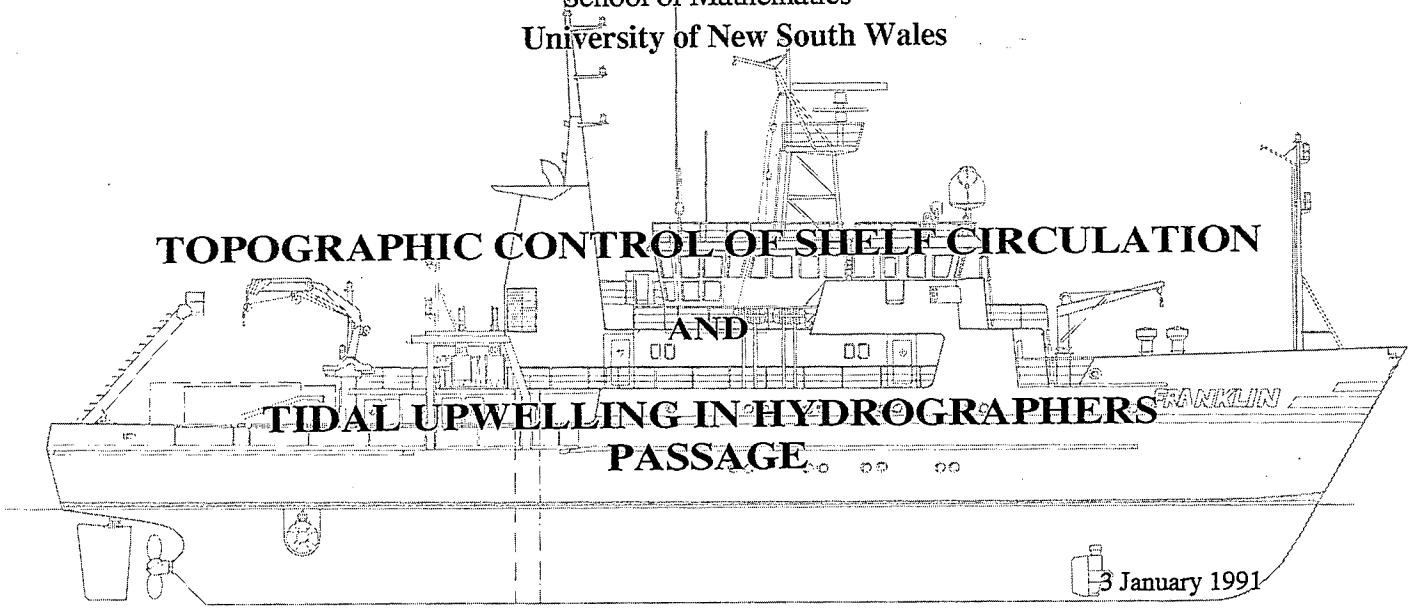
RESEARCH SUMMARY

CRUISE FR 9/90

Sailed Townsville 0700 Friday 16 November 1990
Arrived Sydney 0930 Monday 26 November 1990

Principal Investigator

Associate Professor Jason H. Middleton
School of Mathematics
University of New South Wales



TOPOGRAPHIC CONTROL OF SHELF CIRCULATION AND TIDAL UPWELLING IN HYDROGRAPHERS PASSAGE

3 January 1991

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AUSTRALIA

R.V. FRANKLIN IS OWNED AND OPERATED BY CSIRO

RESEARCH SUMMARY
RV Franklin Cruise FR 9/90

1 Itinerary

Sailed Townsville: 0700 16 November, 1990.
Arrived Sydney: 0930 26 November, 1990.

2 Scientific Programs

Topographic Control of Shelf Circulation

Scattering of Coastal Trapped Waves by Fraser Island

The objectives of this program were to determine the processes responsible for scattering of coastal trapped waves around Fraser Island and the Capricorn Channel.

Tidal Upwelling into Hydrographers Passage

The objectives of this program were to determine the tidally induced mixing processes on the continental slope near the Hydrographers Passage.

3 Principal Investigator

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4 Results

The main component of the scientific program which is concerned with the scattering of coastal trapped waves will utilise the analyses of the data from the current meters retrieved during this cruise. As a consequence, little can be said of the results prior to the current meter data analysis. In addition, the interpretation of the CTD and ADCP data will be undertaken simultaneously with the current meter data with regard to scattering mechanisms. It is worthwhile noting, however, that all moorings for which recovery was attempted were in fact recovered. Three other moorings were recovered inadvertently by trawlers and returned to us, and one mooring was recovered from a hired vessel directly after the cruise.

As indicated in the Cruise Summary for cruise FR4/90 which was undertaken in May, an understanding of the general physical oceanography of the region is, however, necessary to put the main program into perspective. In this regard the May data have indicated the way in which the topography controls the general circulation, including the East Australia Current, and the interaction of shelf and slope water masses through mixing processes. In fact, during both cruises the EAC is seen to flow around the Marion Plateau, leaving the shelf break at the southern tip of the Swain Reefs, and rejoining the shelf adjacent to Fraser Island. NOAA radiometer images acquired during both cruises show the EAC to be much warmer during the November cruise.

The tidal mixing processes themselves form a major component of the cruise objectives, and Hydrographers Passage was chosen because the tidal currents are known to be stronger here than at any other accessible location in the southern Great Barrier Reef. This component of the program produced very interesting results during both cruises. Analyses of CTD data indicate that upwelling processes can draw water from about 160 m depth up the continental slope to the 80 m depth contours, where the associated strong tidal currents flowing over topography cause the water to mix thoroughly. This well mixed water is subsequently drawn over the sill (at 30 m depth) and into the slightly deeper waters inside the outer line of reefs. In waters offshore from Hydrographers Passage fluorescence maxima were located just above the pycnocline. These subsurface maxima occurred at depths where nitrate concentrations began to increase rapidly with depth. During the flood tide, waters over the shelf break had fluorescence maxima in near-bottom waters although the water column was well mixed in terms of density. Over the shelf, fluorescence generally showed little variation with depth. Chlorophyll a concentrations in waters collected from the fluorescence maxima will be used to estimate chlorophyll a from fluorescence. Analyses of the nutrient data and the fluorescence data from the profiling fluorometer, in conjunction with the CTD and ADCP data, will be correlated to determine the relationship between physical, biological and chemical parameters.

5 Cruise Narrative

All times indicated in this diary are ship's time which corresponds to Eastern Summer Time.

Friday 16th November. We departed Townsville at 0700, however, at 0930 it was evident that the VAX could not be booted, so we returned to Townsville to seek help from the DEC engineer. After some time a cable for the system disk and the entire user disk were replaced, and other computing equipment tested, and we departed again from Townsville at 1730.

Saturday 17th November. At 0930 a practice CTD was held at the inside end of Hydrographers Passage, and at 1030 Abandon Ship and General Emergency drills

were held. We proceeded through Hydrographers Passage and at 1430 arrived at 20 S and began an ebb flow ADCP run out of the Passage into Coral Sea waters. CTD stations 2 and 3 were held outside the passage, and we then returned into the Passage to 20S. At 1920 a CTD survey through the Passage was begun. Stations 4-13 were then conducted through the Passage, providing sections centred on the flood and ebb tides, high tide at Bugatti being at 2238.

Sunday 18th November. On completing the flood tide section to station 13, stations 14-16 were undertaken back inshore. These stations were timed so as to complete a short low tide section which was comprised of stations 13-16. Low tide Bugatti Reef was at 0423. A second flood tide section was then undertaken with CTD stations 16-21, this being completed at 1319. We then departed directly for mooring N3 which was located near Saumarez Reef.

Monday 19th November. Arrived at the N3 mooring site in 350 m depth at first light, and positioned the ship for release. The transducer was lowered, the mooring range was suitable, and the mooring released at 0636. The entire mooring was aboard at 0700. We departed immediately for N2, in 110 m depth. After positioning the ship and locating the mooring the release signal was sent, and the release indicated it had released, but it had not. Multiple release signals were sent, however, it soon became clear that other methods would be necessary. Dredging with the tow wire lost two grapnels on the rough bottom, so we tried again, this time bending the tines of the last grapnel. A weak meteorological front went through and winds increased to about 30 knots, eliminating any further chances of recovery, however, some time was spent using the release's ranging feature to locate the mooring to within about 30 m. We left at 1830 for the Lady Musgrave moorings, planning to arrive at first light.

Tuesday 20th November. Moorings C3 and C2 were recovered from 350 m and 110 m of water, respectively, directly offshore Lady Musgrave Island. We then went inshore to C1 and could not get any response from the release. Mooring C1 was later found to have been one of the moorings which was trawled by trawlers. At 1730 we left for N2 to try again.

Wednesday 21st November. Arrived at mooring N2 once more at 0600 and tried to release once more, but had no luck. A drifting line technique was then planned to snag the mooring. Two down lines of 80 m each were weighted with chain, and joined at the bottom by 170 m of polypropylene rope. The drifting line was accurately deployed using careful GPS navigation, in a situation of 0.3 knot current to the southwest, and 10 knots wind from the southeast. The floats came together very slowly, and it became apparent that the mooring was snagged. The rescue boat was launched, and the down lines hauled in by hand. The polypropylene rope was then tied off with floats attached, and a large shackle run down the pair of lines to noose the mooring. The rescue boat

was recovered, and the ship then recovered the mooring by winch. CTD stations 22-25 were then undertaken out to Saumarez Reef, and the ship returned to Capricorn Channel.

Thursday 22nd November. Arrived at mooring M at 0600 and began a hydrophone search. The release was fired, however, the mooring did not surface. At about 0830 the ship's Greaser, who had taken ill the previous day, took ill once more and the Captain decided to put him ashore at the nearest port of Gladstone. We arrived at the Gladstone Pilot station at 1530, the new Greaser came aboard from the Pilot Boat, and the sick Greaser left with the Pilot Boat. At 1730 we departed for mooring M to try once more to recover it.

Friday 23rd November. Arrived at mooring M location at 0100, and using GPS and the two depth sounders, began a search. The mooring was finally located to within 0.01 of a minute (latitude and longitude), and was identified positively on the depth sounders. We laid a cable all the way around the mooring with one grapnel at the end, and then hauled in the cable. The mooring was recovered by 0730. Since the time constraints were now pressing we departed immediately for mooring F off Fraser Island. En route to mooring F a fault which had been identified earlier in the ADCP was fixed, allowing use of the ADCP in bottom depths exceeding those suitable for bottom tracking. We arrived at mooring F at 1700, the hydrophone clearly received the pinger signal from the mooring, and it was subsequently released and recovered. ADCP and XBT surveys over the slope and shelf were undertaken enroute to mooring S3.

Saturday 24th November. Arrived offshore mooring S3 at 0600, ranged and sent the signal to release, but the mooring did not surface even though the Seastar release indicated that it had. This mooring was in 350 m of water, with a 2-3 knot current to the south. Recovery chances seemed small. A drifting line was deployed and snagged the mooring, however, the current was so strong that the drifting line floats were dragged under. The grapnel was streamed at 4 knots with 300 m of cable to snag the drift line, however, only one end of the drift line was snagged and it snapped on recovery. A final effort was made to grapnel the mooring itself with 400 m of cable, however, the remaining drift line end was instead snagged. Fortunately, one of the current meters from the mooring was snagged by the drift line weights, and the entire mooring was subsequently recovered. At 1230, we left for Sydney.

Sunday 25th November. Enroute to Sydney, we found a strong south flowing EAC current which appeared to give us an additional 2 knots.

Monday 26th November. We arrived offshore Sydney at 0200, and began an ADCP survey. This was completed and we subsequently arrived at the Pilot Station at 0730, and the Pilot joined us. We docked at No. 6 White Bay at 0930.

6 Summary

All moorings for which recovery was attempted were successfully recovered, with the apparent loss due to instrument failure of only two time series from the 21 possible. The Hydrographers Passage work went extremely well, and the only planned work which was not undertaken were several short CTD sections off Lady Musgrave Island, Fraser Island and Double Island Point and recovery of mooring N1. These activities were not able to be attempted as a result of the loss of time through the events outlined in the Cruise Narrative. I am pleased with the overall success of the cruise, particularly in view of the difficulty in recovering moorings whose releases failed to operate. The ship proved suitable for all operations, even the operationally difficult tasks of conducting dragging and drift line operations to an accuracy comparable to the ship's length. The GPS played a major factor in the success of the recovery operations. All moorings were recovered in a safe manner.

In all, 7 moorings with 15 current meters and 1 tide gauge were recovered, 24 CTD stations were taken and 20 XBT's deployed. Nutrients were collected at selected depths (0, 25, 50, 75, 100, 125, 150, 175, 200 and 300 m) on all stations except a few stations in Hydrographers Passage where rapid deployment was a logistic necessity. The weather was kind, and R.V. Franklin crew and CSIRO scientific personnel were helpful and friendly.

7 Personnel

Jason Middleton	(UNSW)	Chief Scientist
Gregory Nippard	(UNSW)	
Mark Merrifield	(UNSW)	
David Griffin	(UNSW)	
Andrew McTaggart	(UNSW)	
Anthony Macks	(UNSW)	
Rick Royle	(UNSW)	
Dave Vaudrey	(CSIRO-ORV)	Cruise Manager
Phil Adams	(CSIRO-ORV))	
Jeff Dunn	(CSIRO-ORV)	
Val Latham	(CSIRO-ORV)	

8 Appendices

A cruise track is appended, with CTD stations designated by a square, and XBT stations by a cross. Mooring locations are indicated by a circle. Also, a temperature section from CTD stations taken through Hydrographers Passage is appended, the section being taken so as to coincide with a high tide at Bugatti Reef which is located at the inner end of the section.

Computing Report.
Fr 09/90

Dave Vaudrey and Jeff Dunn

VAX 11/750

Upon initial startup at beginning of the cruise it was found that the VAX would not boot from DUA0: and upon further investigation it was found that it did not appear to spin up to speed and would not start. An attempt was made to boot from DUA1: but that device was not recognised. At this point, following consultation with the Chief Scientist, it was decided to return to Townsville, as we where only a couple of hours out, to enable a DEC Engineer to rectify the problems. The engineer met the ship on arrival and was quickly able to isolate the fault with DUA0: to a cable fault. This may have been the cause of earlier problems booting from DUA0: experienced on previous cruises. The VAX was then rebooted and DUA1 came up and was generally accessable but following testing by the DEC engineer it was discovered that some of the tracks where inaccessable and otherv faults appeared to be associated with head allignment so after changing a board and not solving the problem the HARD Disk was changed. Exersizing indicated no further faults apparent. An Image of the system from DUA0: was then written to DUA1:.

Some problems were associated with getting the EXABYTE reading the backup of the user disk, together with the VAX being shutdown due to the over temperature alarm when the water supply pump to the A/C tripped out and some confusion overnaming conventions of the backup savesets the full user disk was restored.

VAX Console Letterwriter

The Control key does not work.

Drawing Office VT240

During attempts to get the VAX restarted and correctly configured after being foiled by the above lack of a control key on ther console printer, an attempt was made to use the VT240 in the Adjacent drawing office but no response could be received from the the machine.

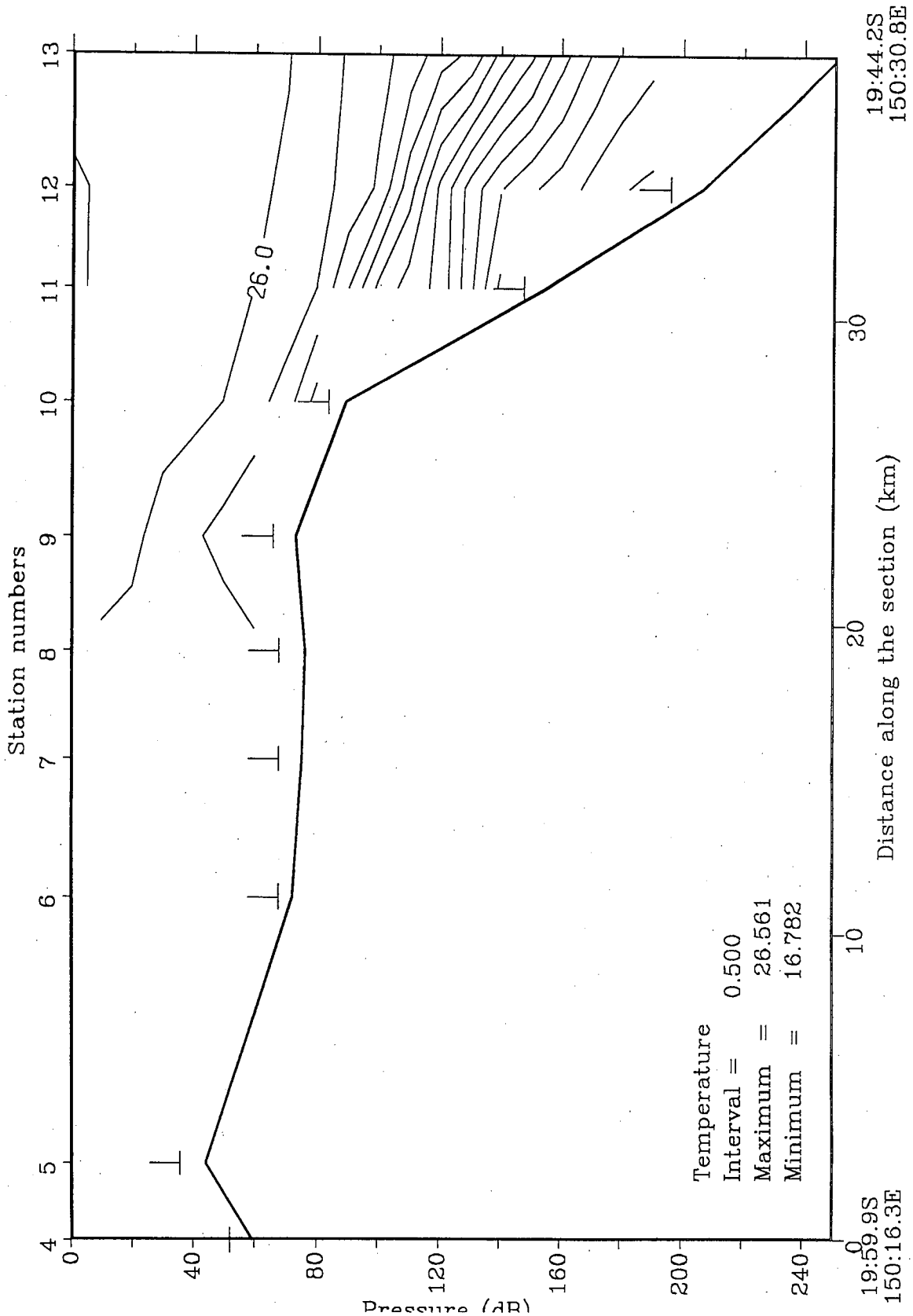

Figure 2. A temperature section from the outer edge of Hydrographers Passage taken during high tide at Bugatti Reef (located near station 4). On the flood tide, colder, nutrient rich waters are drawn up from below 100m onto the shelf near station 9. Turbulent mixing which occurs as a consequence of the strong 4-6 knot tidal currents causes the water column to be well mixed inshore from station 8, and the mixed nutrient rich waters are then drawn into Hydrographers Passage throuh the gap in the reefs which occurs between stations 5 and 6.

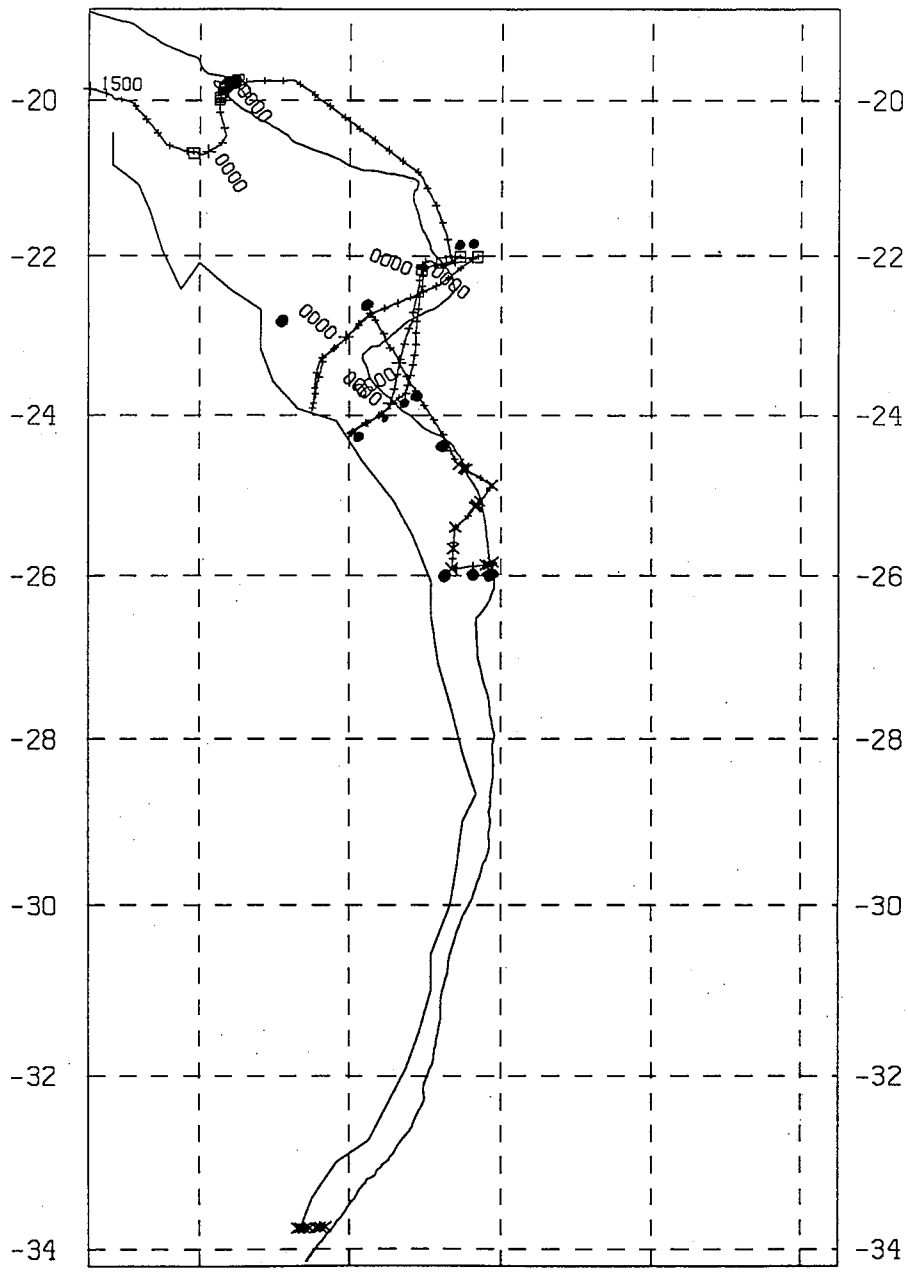

Figure 1. A plot of the cruise track for Fr9/90, showing departure from Townsville, work in the Hydrographers Passage at about 20 S, and the subsequent track to pick up the current meters deployed dring Fr4/90. Locations of moorings are denoted by a dot.