R.V. FRANKLIN

NATIONAL FACILITY
OCEANOGRAPHIC RESEARCH VESSEL

RESEARCH SUMMARY

RV FRANKLIN

FR 1/89

Sailed Hobart 2000 Thursday 5 January 1989
Arrived Adelaide 1300 Monday 16 January 1989

Principal Investigators

John Hunter
Cliff Hearn
Curtin University of Technology

Observations and real time numerical modelling of a part of the South Australian Upwelling Zone

---

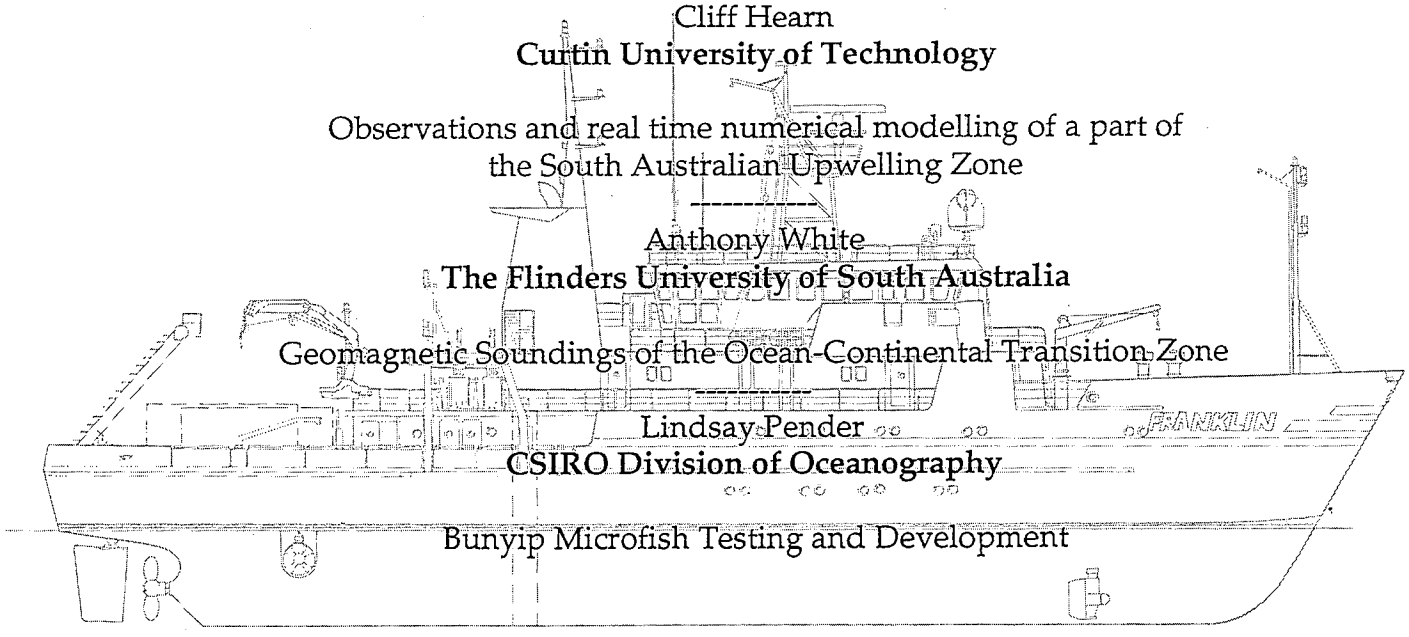
Anthony White
The Flinders University of South Australia

Geomagnetic Soundings of the Ocean-Continental Transition Zone

---

Lindsay Pender
CSIRO Division of Oceanography

Bunyip Microfish Testing and Development



January 1989

For further information contact

ORV Operations Manager
c/- CSIRO Division of Oceanography
GPO Box 1538, Hobart, Tas. 7001
Telephone (002) 20 6222
Telex AA 57182

AUSTRALIA

R.V. FRANKLIN IS OWNED AND OPERATED BY CSIRO

CRUISE SUMMARY

FR 1/89

ITINERARY

Departed Hobart 2000 5 January 1989
Arrived Adelaide 1300 16 January 1989

SCIENTIFIC PROGRAMS

To collect a comprehensive observational data set concerning possible wind-driven upwelling events in the South Australian Upwelling Zone, using primarily the "Seasoar" undulator and the acoustic doppler current profiler (Hunter/Hearn).

To investigate the use of real-time numerical models, running on-board ship, as an aid to the direction of an oceanographic cruise (Hunter/Hearn).

To deploy two current meter moorings at the northwest boundary of the upwelling zone, for recovery during a later cruise (FR 2/89, Lennon, Nunes) (Hunter/Hearn).

To deploy four magnetometers along a cross-shelf transect off Robe (White).

Trials of Bunyip Microfish (Pender).

PRINCIPAL INVESTIGATORS

John Hunter, Cliff Hearn,
Curtin University of Technology,
Kent Street, Bentley, WA 6102

Antony White,
The Flinders University of South Australia,
Bedford Park, SA 5042

Lindsay Pender,
CSIRO Division of Oceanography,
Hobart

RESULTS

Observational Program in South Australian Upwelling Zone

A comprehensive set of oceanographic data was collected. It was originally envisaged that the prime mode of data collection would be via the Seasoar CTD and the acoustic doppler current profiler. However, during an early Seasoar transect, the Seasoar twice fouled craypot moorings, which were numerous in some areas. It became evident that it was

only safe to use Seasoar in such areas when the sea was sufficiently calm to allow visual sightings of craypot moorings and subsequent avoiding action. Hence worsening weather caused us to terminate Seasoar operations after about 15 hours of data collection and to revert to a comprehensive coverage using the conventional CTD (at about 60 stations) and a few XBT casts. Towards the end of the cruise the weather moderated and a further 13 hours of Seasoar data were collected. The Seasoar system performed excellently throughout.

The acoustic doppler current profiler was operational throughout the cruise. Data corrected by RDI bottom-tracked velocities appeared to be satisfactory; however GPS-corrected data showed evidence of significant error, possibly due to incorrect synchro-to-digital conversion of the gyro signal. This error appeared to be reduced in some instances by the application of a previous calibration algorithm. This problem requires further investigation.

It had been hoped that satellite sea surface temperature images would have been relayed from Hobart using the Inmarsat facility. However much trouble was experienced in receiving the first SST image, and subsequent efforts in this direction were abandoned.

The meteorological package and the thermosalinograph functioned satisfactorily throughout the cruise.

The cruise period was characterised by an initial period of winds that were unfavourable to the occurrence of upwelling (ie. winds from the west) followed by a period of upwelling-favourable winds (from the east) (see Figure 1, which shows longshore and onshore wind components (direction to)). The oceanographic structure generally reflected this type of forcing - ie. isothermals sloping down towards the shoreline during the early part of the cruise, but sloping upwards towards the shoreline during the latter parts. The longshore current (measured with the acoustic doppler current profiler) generally followed the longshore component of the wind. When the longshore current reversed after the onset of upwelling-favourable winds, the current turned earlier near the shore.

Real-Time Hydrodynamic Modelling

A nonlinear four-layer stratified hydrodynamic model of the upwelling region was run continuously and interactively on the Franklin VAX 11/750 during the cruise. The major inputs were the suface winds, derived from both the Franklin meteorological system and from facimile weather charts. Minor problems were experienced due to :

1. The grid size (5 km x 2.5 km) was in places larger than the baroclinic radius of deformation. The model was hence not "eddy resolving" and required an enhanced

lateral eddy viscosity to ensure stability. It was found necessary to increase this eddy viscosity once during the cruise to ensure stable predictions.

2. The model displayed many eddy-like features. While it is believed that these are in general realistic, it was felt that one particularly persistent eddy may be an artefact of a spurious bathymetric feature introduced by an automatic gridding algorithm used in the original model development. This problem will be rectified in future implementations of the model.

The model results were generally in line with the observations, as described above. Figure 2 shows a simulated cross-shelf transect west of Portland at 0000 UTC on 15 January. The temperatures of the four model layers are 12.5, 13.0, 14.5 and 16.5 deg. C. Upwelling of 13 deg C water is indicated at the coast. Detailed intercomparison will follow during 1989/90.

This exercise indicated that a reasonably sophisticated numerical model can be run interactively in real-time on the Franklin's on-board computer facilities. After the model had been "run in" for a few days to remove initial transients, the computational requirements were about 20% of the VAX 11/750. In addition, model results were plotted using the NEC APC IV and the NEC Silentwriter, recently installed on the Franklin.

Meterological Data

Wind data input to the real-time model came initially from facimile weather maps. When the Franklin had reached the area covered by the model, wind data was obtained from the on-board meterological system. This latter data was filtered to remove oscillations of period shorter than about 3 hours.

The current and prognostic facimile charts were also important for continual updating of the cruise plan to suit the weather conditions. Unfortunately, the facimile transmissions were rather unreliable and of poor quality.

Current Meter Deployment

Two current meter moorings were deployed at sites to the northwest of the upwelling zone, on a transect near Robe, as indicators of shelf waves entering the region. Two current meters were attached to each mooring (a Steedman near the surface and an Aanderaa near the bottom). The deployments were generally satisfactory, although there may have been a

minor entanglement of the surface recovery line on one mooring while on the other mooring the recovery beacon was not fully submerged. The sites were as follows :

Site	Position				Depth
	Lat. S		Long. E		(m.)
	Deg.	Min.	Deg.	Min.	
CM1	37	23.18	139	19.30	133
CM2	37	10.22	139	31.43	48

It is planned that these moorings will be recovered during the next cruise of RV Franklin (FR 2/89).

Magnetometer Deployment

Four sea floor magnetometers were successfully deployed on a cross-shelf transect off Robe. These magnetometers will be recovered during cruise FR 3/89 of RV Franklin. Details of the sites are as follows :

Site	Position				Depth	Time on Surface for Recovery
	Lat. S		Long. E		(m.)	
	Deg.	Min.	Deg.	Min.		
AW4	37	30.11	139	30.27	142	0630 EDT 16 Mar.1989
AW3	37	51.33	139	12.23	1829	0936 " " " "
AW2	38	13.18	138	55.94	3101	1332 " " " "
AW1	38	33.42	138	38.02	4950	1738 " " " "

Trials of Bunyip Microfish

Previous experience with the Bunyip microfish suggested that vibrational problems, which have plagued the usage of the instrument's shear probes, may have originated from vibration transmitted down the interconnecting cable to the main fish. In an attempt to solve this, an elastic element was inserted in the microfish tow staff, and another on the interconnecting cable at the mainfish. In addition, the fairing on the microfish tow staff was allowed to weathervane, whereas the original tow staff carried fixed fairing.

On 6 January, the microfish was deployed for a period of 90 minutes to test the above modifications. It was immediately apparent that the vibration levels were higher than previously found. Subsequent analysis of the data showed a resonant vibration at approximately 200 Hz, which was absent prior to the modifications. Further analysis of this problem is required to fully resolve its source.

CRUISE NARRATIVE

After two vessel-related delays, the Franklin left Hobart at 2000 (local time) on 5 January 1989. The course went east of

Tasmania, through Bass Strait and thence to the upwelling region.

During the early hours of 6 January, trials of the Bunyip system were carried out to the east of Tasmania (43 deg. 2'S, 148 deg. 17'E). At a nearby deepwater site (42 deg. 48'S, 148 deg. 23'E) an intercalibration of the Seasoar CTD and conventional CTD was carried out.

In the afternoon of 7 January tests of the Seasoar altimeter system were carried out in Bass Strait (39 deg. 44'S, 144 deg. 48'E). A further intercalibration of the CTDs was carried out at this site.

In the early morning of 8 January a Seasoar transect was started at a point in the southeast part of the upwelling region (38 deg. 24'S, 141 deg. 57'E). This transect was carried through to a station 175 km to the northwest (37 deg. 41'S, 140 deg 6'E), over a continuous tow of 13 hours. This was followed by a further intercomparison of the two CTDs.

The two current meter moorings were deployed late on 8 January at sites to the northwest of the survey area.

The four sea floor magnetometers were deployed during the morning of 9 January, at an offshore transect off Robe.

A part of the afternoon of 9 January was spent with operations involving unspooling the CTD wire in deep water for modifications to the spooling gear.

It was planned that a series of cross-shelf transects would be made using the Seasoar. Due to the inherent dangers of such operations in shallow water, each Seasoar transect was to be preceded by an echo sounder survey, and was only to be made in the direction of deepening water (ie. offshore). The survey plan hence involved a series of transects each consisting of a preliminary echo sounder survey from the "ocean" towards the coast, followed by a Seasoar survey away from the coast. The first of the echo sounder surveys was accomplished early in the morning of 10 January, on a transect near Portland, at the southeast end of the upwelling region. Seasoar was subsequently deployed on the landward end of this transect, but, after a tow of about 2 hours, became entangled in a craypot mooring, causing some damage to the cable fairing. This was repaired, but the subsequent deployment resulted almost immediately in another fouling of a craypot mooring and consequent cable damage. In view of the danger imposed by the large numbers of such moorings in the area, and of the worsening weather conditions (making visual observation of craypot mooring floats virtually impossible) it was decided to abandon Seasoar operations, and to proceed with a combination of XBT and conventional CTD observations. One CTD station was then followed by a period of 15 hours with the vessel hove to, awaiting an improvement in the weather.

After the weather had improved somewhat, three XBT casts were made on the morning of 11 January, in the southern part of the survey area. Then followed a series of 57 CTD casts over a region covering approximately the southeastern half of the originally planned Seasoar survey area. The stations in this region were covered twice during the period 11 January to the morning of 14 January.

The weather had now improved sufficiently for Seasoar operations to be resumed, supported by a strict regime of visual observations for the possible presence of craypot moorings. During the early afternoon of 14 January a further intercomparison of the two CTDs was carried out, followed by two cross-shelf Seasoar transects near Portland, finishing at dusk on 14 January.

In the early hours of 15 January, the Seasoar was deployed for an alongshore transect on the "ocean" boundary of the upwelling region (ie. in water off the continental shelf). The prime motivation for these observations were : the requirements for suitable boundary conditions for any future modelling effort; and the perceived occurrence of a quite complex series of interleaving layers (each of quite distinct thermohaline characteristics) in this region.

This was followed by a further intercomparison of the Seasoar CTD and the conventional CTD, and another cross-shelf transect. At the end of this transect (the last planned observations of the cruise) the microcomputer that was logging the Seasoar data failed.

At about midday on 15 January the Franklin headed for Adelaide where it docked around midday on 16 January.

SUMMARY

A comprehensive suite of data pertaining to the upwelling region has been collected. The cruise was characterised by an initial period of weak downwelling, followed by a period of weak upwelling. Inclement weather and the occurrence of numerous craypot moorings precluded the completion of the full Seasoar survey that was originally planned. However, 28 hours of Seasoar observations were made, yielding an invaluable data set, supported by a considerable quantity of CTD and XBT data.

Throughout the cruise, the acoustic doppler current profiler was operational. The results were broadly in accordance with our present understanding of upwelling systems, and will add greatly to our future studies of upwelling processes in this region.

The Seasoar and conventional CTD performed satisfactorily throughout the cruise. Towards the end of the cruise, the acoustic doppler current profiler indicated problems due to gyro-related errors.

The feasibility of running a quite sophisticated hydrodynamic model in a real-time interactive mode on RV Franklin was demonstrated.

Trials of the Seasoar/Bunyip system were successfully completed.

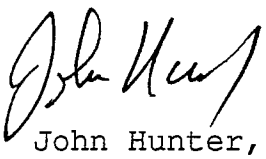
Two current meter moorings and four sea floor magnetometers were successfully deployed.

The observational and modelling programme is the subject of a current two-year grant (Hunter/Hearn) from the Australian Research Council.

It is a pleasure to record the excellent support and participation afforded by both the CSIRO and vessel personnel during the course of this cruise.

PERSONNEL

John Hunter	Chief Scientist	Curtin University
Cliff Hearn		"
Greg Bush		"
Tim Pauly		"
George Cresswell		CSIRO Oceanography
Antony White	Project Scientist	Flinders University
Brenton Perkins		"
Jan Peterson	Cruise Manager	CSIRO-ORV
Lindsay Pender		"
Ian Helmond		"
Erik Madsen		"
Dave Terhell		"



John Hunter, Chief Scientist
15 January 1989

WIND COMPONENTS MEASURED ON RV FRANKLIN

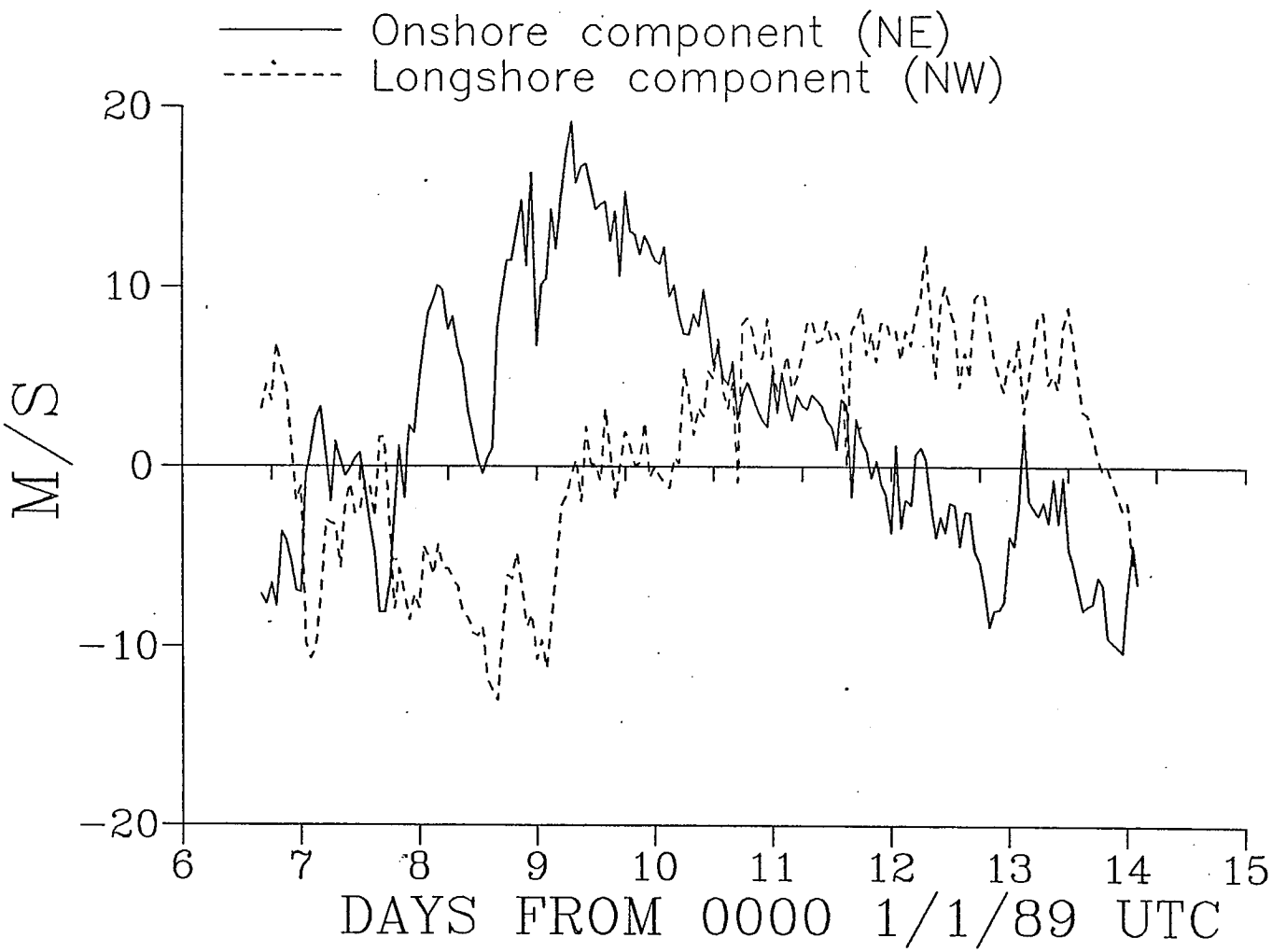


FIG. 1

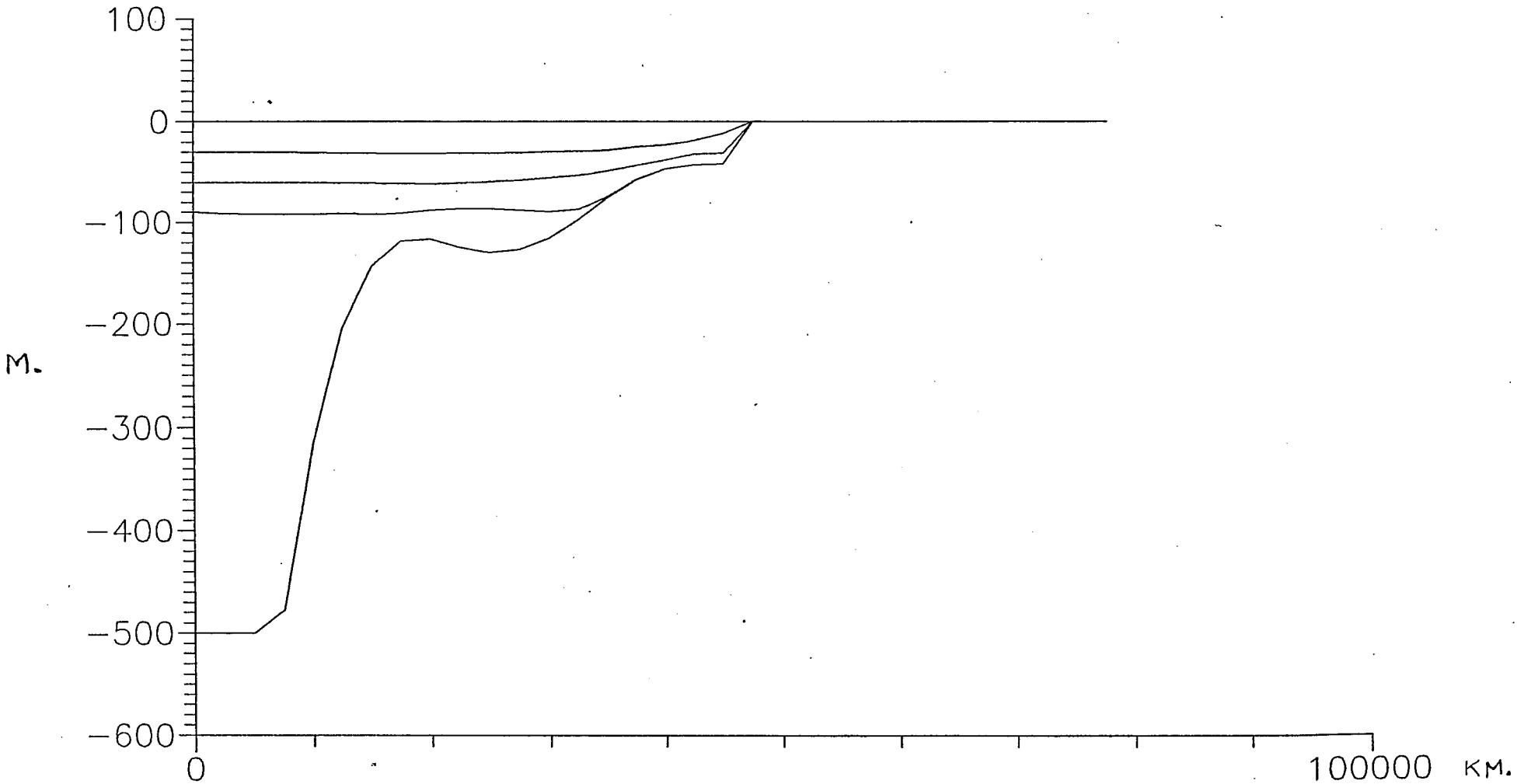


FIG. 2