RESEARCH SUMMARY

CRUISE FR 6/93

Sailed Cairns 2000 Thursday 24 June, 1993
Arrived Hobart 1000 Saturday 17 July, 1993

A DEEP MERIDIONAL SECTION THROUGH THE CORAL AND TASMAN SEAS

Principal Investigators

Steve Rintoul
John Church
CSIRO Division of Oceanography

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MARINE ART

Don Braben
Griffith University

September 1993

Franklin Research Summary
Cruise Fr 6/93

1. Itinerary

Departed Cairns 2000 Thursday June 24, 1993
Arrived Hobart 1000 Saturday July 17, 1993

2. Scientific Program and Objectives

A Deep Meridional Section through the Tasman and Coral Seas

To estimate deep circulation and water mass properties through the deepest parts of the Coral and Tasman Sea Basins using data collected from CTD sections; specifically, we want to estimate the zonal transports (at all depths) into the western boundary current region of the South Pacific and to estimate the transport of water between the Coral Sea basin and the Solomon Sea basin, between the Coral Sea basin and the Tasman Sea basin.

Principal Investigators

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Marine Art

To record a voyage of *Franklin* through drawing and painting.

Principal Investigator

Don Braben
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Faculty of Education
Griffith University
Brisbane, QLD 4111

3. Cruise Track

A completed cruise track is shown on the attached figure. CTD stations are shown as crosses.

4. Cruise Narrative

We departed Cairns 13 hours late because of the late delivery of the 24 bottle rosette frames and various other pieces of gear. We immediately sailed into 25 knot south-east trades which slowed the transit speed to about 8 knots and made the initial few days uncomfortable. A boat drill was completed at 1030 on Friday 25 followed by briefings by the Master and Chief Scientist.

On Friday June 25, we completed a test CTD cast with the new rosette frame and the new bottles. Unfortunately over half of the bottles leaked and the CTD salinity calibration was out by about 0.8 psu. We tightened the rubbers in the bottles we thought were leaking and did a second test cast

(on Saturday June 26), but this time with the second CTD unit. The CTD calibration was much better but again at least half the bottles (a different half) leaked. We then re-tightened all of the rubbers in the bottles and because we had already lost time started the Pocklington Trough Section firing several bottles at each depth. Analysis of the salinity samples showed that the bottles were still leaking. We immediately gave up all hope of using the small bottles and got the large rosette and the 5 litre bottles out of the hold (in marginal conditions) and did a third bottle test station (on Monday June 28). The 5 litre bottles did not leak and the rest of the cruise was done using them.

After completing the Pocklington Trough Section, we turned and headed south at 8 knots into the trades to commence the WOCE P11 section. At this speed, we did not look like we would complete the section. However, as the wind came more from the east and eventually weakened, our speed increased and we started to make up lost time. A short CTD section was completed across the deep water west of Cato Island on Sunday July 4.

We continued southward without major incident until Friday July 9 when strong (30+ knot) winds from the north were experienced. We commenced CTD 54 at 1215 in marginal conditions. After the CTD was down about 100 m, we aborted the station because wire was going very slack then snapping taut. We decided to drop an XBT and then sit waiting for more information on the weather and in the hope the weather would ease. Weather started improving dramatically at 2315. By 0300 (Saturday July 10), we were 10 nm south of the original station position and the weather had improved enough to complete a station. The next station was moved 8 nm south and all subsequent stations moved 5 nm south. We lost about 15 hours because of the bad weather.

We then continued south and completed the last of the planned 155°E CTD stations on Wednesday July 14. I decided to complete one more CTD station on 155°E so that the northernmost of the *Aurora Australis* 155°E stations was repeated. We then completed the section back to the coast at a broader stations spacing so that the number of stations was the same. We were slowed by thick fog for part of Tuesday July 13 and Wednesday July 14. The final CTD station was completed at 1730 on Friday, July 16. We then completed to ADCP runs across the western part of the 43°S section and transducer alignment tests. We then steamed to Hobart and were alongside at 1000 Saturday July 17.

5. Cruise Results

A Deep Meridional Section through the Tasman and Coral Seas

The station locations, the near surface (50 m depth) currents measured from the ADCP, and the temperature section between stations 11 (Louisiade Archipelago, Papua-New Guinea) and station 70 (43°:15'S) are shown on the attached figures. At the northern end of this section, the surface currents show an eastward flowing boundary current. The temperature section indicates that the eastward currents are not surface trapped but that geostrophic shear extends deep into the water column (at least to 2000 m).

Immediately to the south of this boundary current, from about 13°S to 19°S, there is a westward flow into the Coral Sea. Both the ADCP data and the temperature section indicate the strongest inflows occur near stations 20-21 east of the southern end of the Queensland Plateau (latitude of about 17°S). Offshore from the southern end of the Great Barrier Reef there is an eastward flow with a further westward flow near Cato Island (23°S).

Both the ADCP data and the temperature section indicate increasing variability from 20°S to 35°S. There are two major outflows at about 31°S and 34°S. South of 34°S, the variability is much weaker.

The CTD data also indicate the Antarctic Intermediate Water flowing westward at 17°S has a lower salinity than the outflow to the north and the waters of the Tasman Sea (north of 38°S). South of 38°S, there is a tongue of low salinity Antarctic Intermediate Water penetrating north along the section. There is much more variability (interleaving) in this Antarctic Intermediate Water. In the thermocline waters of the Coral Sea, the T/S curve is almost linear between temperatures of 6°C and 18°C. Further south, the salinity, at a given temperature, is increased and as a result the T/S curve is no longer linear.

The temperature section clearly indicates the sill depth into the Coral Sea is at about 3000 m and as a result the deep waters of the Coral Sea are much more weakly stratified than the waters of the Tasman Sea. They are also lower in oxygen (older). The oxygen minimum near depths of 2000 m is most intense in the northern Coral Sea.

With the exception of nutrients from a few stations, I believe we collected an excellent data set. When combined with the data set collected on board *Aurora Australis* in May between 43°S and Antarctica, it will be a very valuable contribution to the World Ocean Circulation Experiment.

MARINE ART

The project objective has been partially accomplished. The period of the voyage provided the opportunity to make preliminary drawings and paintings together with a photographic record. The visual resources from this voyage will be used to create a series of paintings depicting *Franklin* and associated activities and events. However, some of the works completed on *Franklin* may be included in the body of work. A total of thirty paintings is the target and these will be exhibited at the Strickland Gallery in Hobart from January 3 to January 24.

6. Action Items/Recommendations

The new rosette was good. However, the new Niskin bottles leaked (even after the rubbers springs were correctly tensioned) and we were forced to switch to the old rosette frame and the 5 litre Niskin bottles. The new Niskin bottles need attention and testing before they are an essential part of any cruise.

I recommend that a new log for Niskin bottles be kept. While the information on bottles is often available on CTD log sheets this is not as readily available throughout the cruise and from one cruise to the next as a separate Niskin bottle log would be. This log would be kept aboard *Franklin* from one cruise to the next and if available on the computers could be immediately available to give information on the history of different bottles.

Having the audio tape backup for the CTD was useful during this cruise for replaying stations when the CTD deck unit gave problems and for diagnosing faults with the deck unit.

7. Personnel

Scientific personnel

J. Church (Chief Scientist)	CSIRO DO
John Wilkin	CSIRO DO
Peter McIntosh	CSIRO DO
Neil White	CSIRO ORV
Phil Adams	CSIRO ORV
David Terhell	CSIRO ORV
Gary Critchley	CSIRO ORV
Les Drury	CSIRO ORV
Jeremy Harris	Antarctic CRC
Don Braben	Griffith University

Ship's Crew

Paddy Lorraine (Master)
Dick Dougal
Bryce Bathe
Max Cameron
Ian Hayward-Bryant
Don Roberts
Jannik Hansen
Kris Hallen
Norm Marsh
Bluey Hughes
Phil French
Gary Hall
Bob Clayton
Reg Purcell

I would like to thank all the scientific staff and the ship's crew and officers for the excellent work they completed during the cruise.

I would also like to thank the Steering Committee and User's sub-committees for their efforts to ensure that the *Franklin* cruise was as close as possible in time to the *Aurora Australis* Voyage that extended this section to Antarctica.

John Church
Chief Scientist

Appendix A.

Hydrochemistry Voyage Report :
Fr 6/93

Summary:
80 CTD stations were completed.

Analyses carried out:

Salinity -	1811
Dissolved Oxygen -	1763
Nitrate -	1763
Silicate	1763
Phosphate -	1763

Data entry completed up until: 80

Standard ranges run for nutrients:

Nitrate -	0 - 35 umole
Silicate -	0 - 140 umole
Phosphate -	0 - 3 umole

Thermometry:
Temperatures were measured at surface and second from bottom with mercury in glass deep sea reversing thermometers.

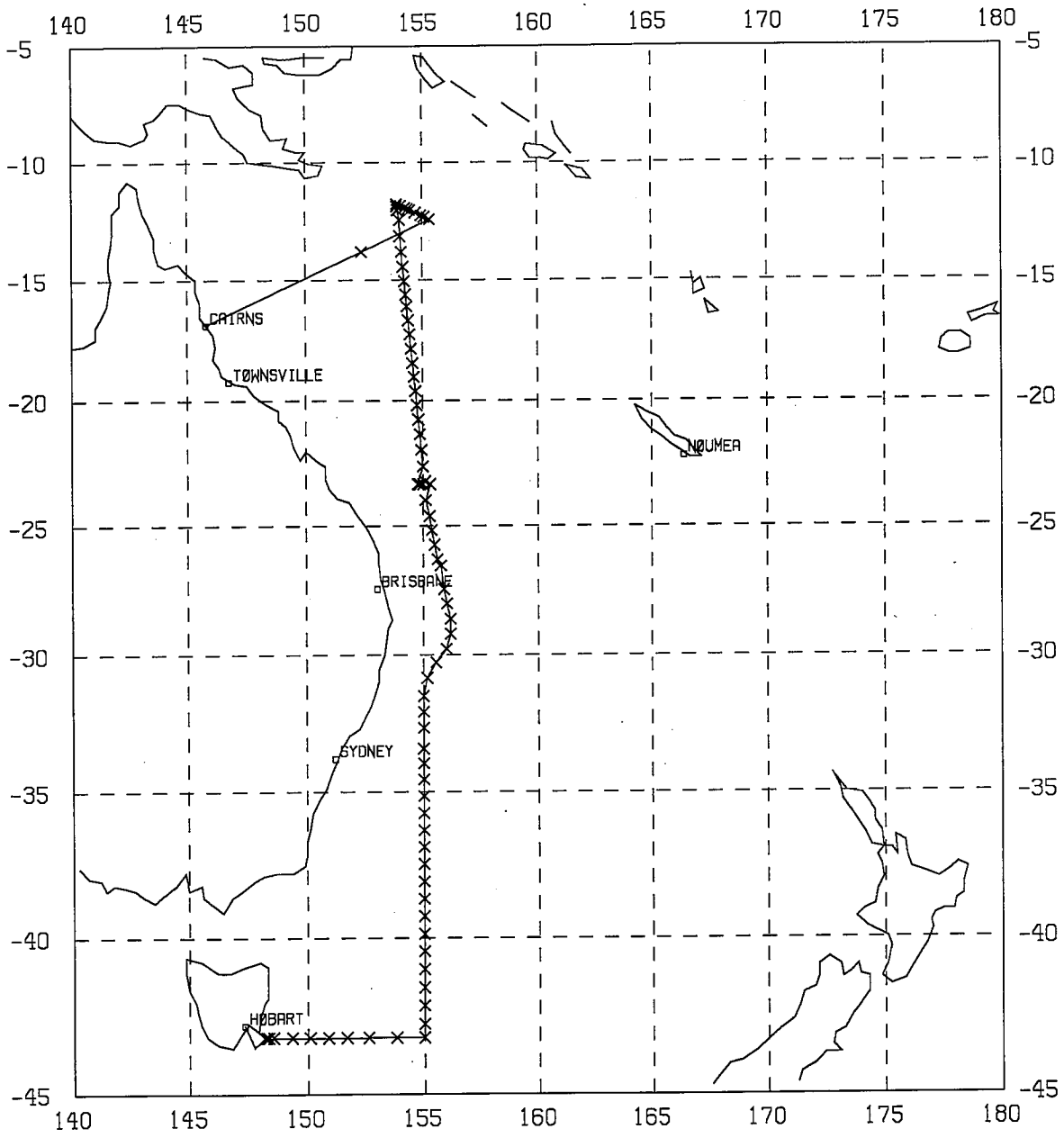
Rosette :
A new 24 bottle rosette, built for the new 3.5l. sampling bottles, was used for the first 7 casts. The larger 24 bottle rosette was used for the remainder of the cruise as the G.O. 5l. bottles could not fit on the new frame.

Water sampling bottles :
New 3.5l. sampling bottles used for the first 7 casts were found to leak erratically and were replaced by 5l. General Oceanics Niskin bottles. Apart from some bottles leaking, the G.O. bottles performed fairly well.

Additional sampling :
For this cruise C-14 sampling was conducted.

Water Distillation
The ship has a new vacuum distillation system for making fresh water. This works extremely well at producing very clean water. The Romer still, that is used to make water suitable for the milli Q system, works on conductivity through the water being distilled to generate the heat required to boil the water. As the ships water is now so clean, the Romer still does not work very efficiently at all. The Romer still was not able to produce water at a fast enough rate during the voyage. It was decided with the generous help and input from the ships chief engineer, that we try using the water straight from the ships vacuum distillation system to fill the 100 litre tank. Prior to doing so this water was tested for nutrients and effect on DO analysis and found to be as good as our normal distilled water. It was therefore used for the remainder of the trip.

The chief engineer has recommended that a line be placed between the VAP system and the 100 litre tank so that when the VAP water is of sufficient quality it can be used to fill the tank. Perhaps we should also look at buying a still which does not use conductivity of the water to heat the water in the still. An RO cartridge should be placed on board as an emergency backup. It is also recommended that the RO unit be repositioned so that the pre filter and RO cartridge can be fitted in the recommended way with convenient access.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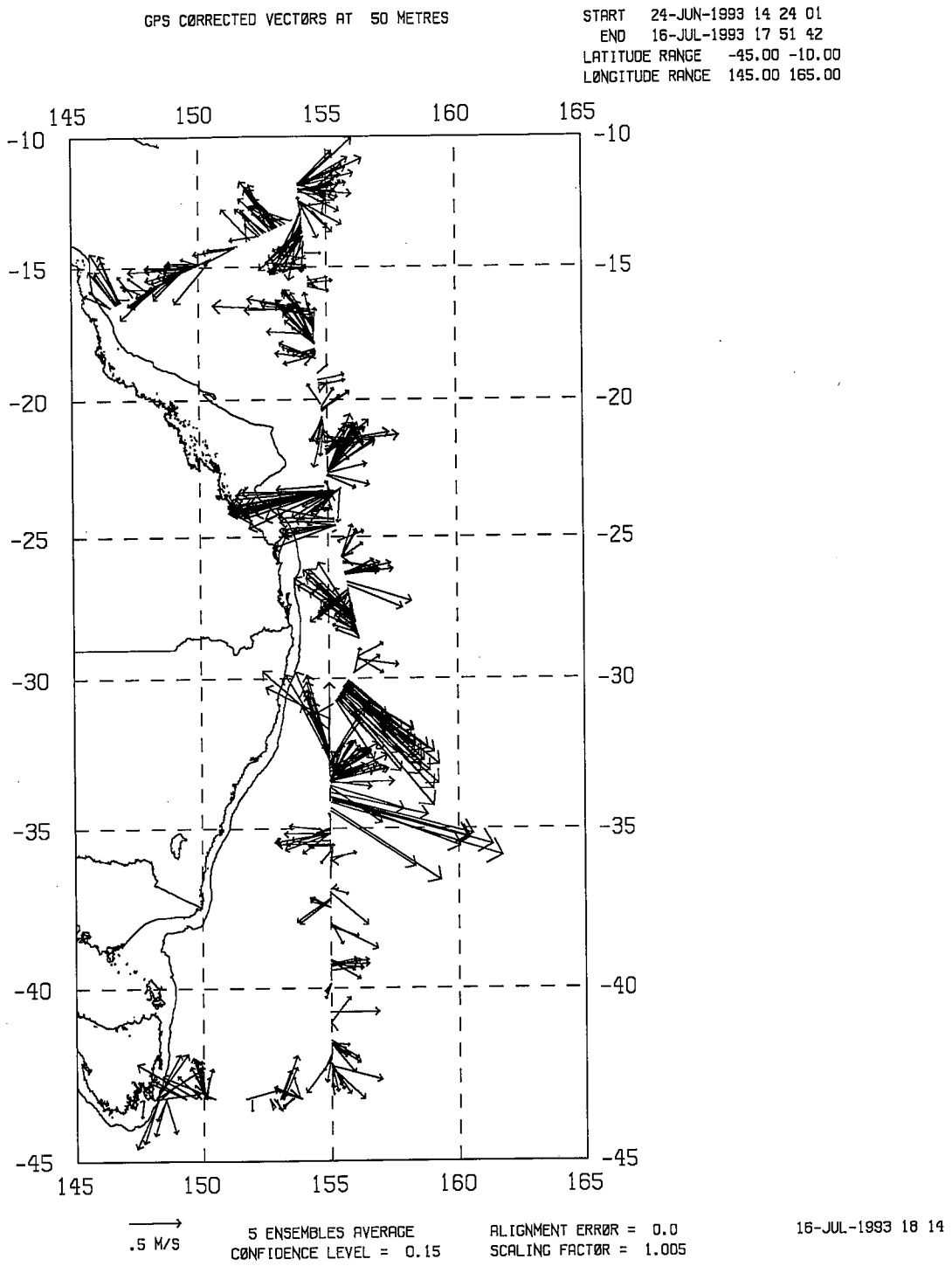
BRISBANE
SYDNEY
HOBART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END 16-JUL-1993 17 51 42
LATITUDE RANGE -45.00 -10.00
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145
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SCALING FACTØR = 1.005
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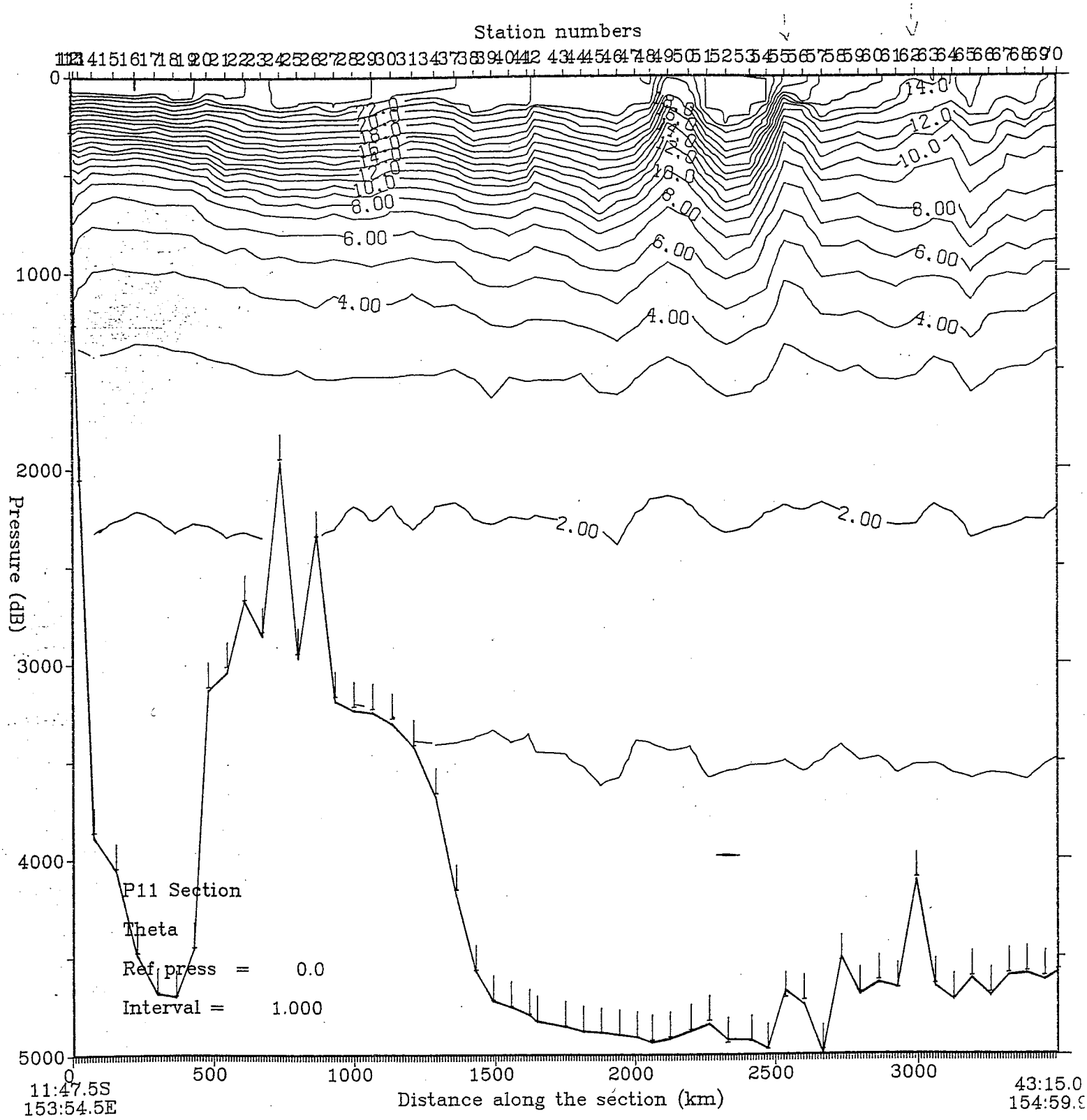
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Pressure (dB)
Distance along the section (km)
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Theta
Ref press = 0.0
Interval = 1.000
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153:54.5E
43:15.0
154:59.9