National Facility Research Vessel

RV FRANKLIN

VOYAGE DOCUMENTS

RV SOUTHERN SURVEYOR

CSIRO AUSTRALIA

CSIRO MARINE AND ATMOSPHERIC RESEARCH

Voyage Plans and Summaries

[back to voyage document index]

Franklin Voyage Summary No. FR09/2000

Title

Monitoring Ocean Climate Change around Australia: the Deep Ocean Time-series Sections.

Itinerary

Leg 1

Departed Dampier, 1000 hrs Tuesday 26 September, 2000.
Arrived Cocos Islands 0900 Saturday, 14 October 2000.

Leg 2

Departed Cocos Islands, 1600 hrs Saturday, 14 October 2000.
Arrived Fremantle, 0030 Tuesday, 31 October 2000.
Departed Fremantle, 1300 Tuesday, 31 October 2000.
Arrived Fremantle, 1330 Sunday, 12 November 2000.

Principal Investigators

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CSIRO Marine Research

Nathan Bindoff
Antarctic Co-operative Research Center

University of Tasmania

Scientific Objectives

- to establish a time series of full-depth repeat ocean measurements capable of resolving decadal and longer time-scale changes in the structure of the oceans around Australia, and their storage of important climate quantities such as heat, freshwater, oxygen and carbon. The proposed surveys will build upon the high-quality sections made in the mid-1990's as part of the World Ocean Circulation Experiment (WOCE).

- to use these data through comparisons with climate model runs to test climate model predictions, and to determine whether and how fast climate is changing due to the Greenhouse Effect and/or natural decadal variability.

- to improve our understanding of basic ocean processes and fluxes through collection of full depth direct velocity measurements while conducting the repeat surveys.

Cruise Objectives

To reoccupy portions of several WOCE hydrographic lines between Australia and 95° E in the southeast Indian Ocean as part of establishing a deep-ocean time-series section grid around Australia. Full-depth 24 bottle 5L Niskin/CTD casts will be taken at WOCE spatial resolution. Sampling and chemical analyses will be completed for salinity, oxygen, nutrients, dissolved carbon and alkalinity. At-sea quality control will occur with all CTD and sample data collected and scrutinised as soon as it is available and compared with the WOCE data.

Cruise Track

Two legs were undertaken (as indicated on Figure 1) — Dampier to Cocos Island and Cocos Island to Fremantle. One test and 62 CTD stations to the bottom were undertaken during leg one, and 80 CTD stations on leg two.

Results

The voyage achieved the cruise objectives. (Scientific Objective 3 was not addressed as no lowered Acoustic Doppler Profiler for attaching to the CTD/ Rosette package was available). Of the 143 stations in the original station plan, only one station was missed due to poor weather. Overall, the quality of the data is very high, with some exceptions as described in the Cruise Narrative below.

Exceptions to the otherwise high quality observations included some poor

salinity data due to problems with the salinometers early in the cruise and trouble with the nitrate channel of the autoanalyser throughout the cruise. The first problem we believe can be overcome given the stability of the Seabird CTD conductivity sensor; the nitrate data can be recovered by running the second (frozen) nutrient sample taken from each bottle. The new oxygen system gave excellent results.

Preliminary comparison of the WOCE and DOTSS sections shows some significant changes. Most dramatic is a shift of an upper ocean front along the 95° E section. The front was located several degrees of latitude further south during DOTSS than in the WOCE section taken five years before. The frontal shift resulted in temperature anomalies below the depth of the winter mixed layer of more than 3° C and salinity anomalies greater than 0.4 psu. The front (hence the anomalies) extends throughout the upper 500 m of the water column. More subtle but still significant changes occurred at the depth of the Antarctic Intermediate Water.

Cruise Narrative

Leg 1

We departed Dampier on time in good weather, proceeding to the start of the CTD section commencing at about 24° S off the west Australian coast. En-route we completed a trial CTD station to test for leaking bottles. We then commenced the CTD section late on Wednesday 27 September. Winds were light but there was a swell coming from the south.

The new load sensor to measure the tension on the CTD end of the cable worked well but the altimeter on the rosette package was not working for the first few stations. With the swell and the roll of the ship, the tension was momentarily going to zero on the more severe rolls. On station 11 (the first deep station - to 4400 m) there was a kink in the *new* CTD wire on recovery. On station 12 (to 5000 m), the descent speed was reduced to 50 m/minute as the wire tension was going to zero on severe rolls. At about 500 m on the upcast, all contact with the CTD was lost. On recovery the lower 20 m of the wire was severely kinked. After consultation with Ian Helmond (in Hobart), 6500 m of CTD wire was streamed with a weight attached in an attempt to remove any residual twist in the wire. No further problems were encountered with CTD operations; a total of 63 CTD stations were completed on leg one. After the completion of CTD 63 at 1600 on October 13, we steamed to Cocos Island. In total, about 40 m was cut off the end of the CTD cable.

During most of leg 1 we experienced steady south east trade winds at between 15 and 25 knots. This made for easy working conditions except for the steaming between the last few CTD stations and the steam to Cocos Island.

All Niskin bottles were sampled for salinity, oxygen and nutrients. Every second station, samples were also taken for alkalinity. Throughout the cruise,

under-way meteorological, surface temperature, salinity fluorescence and upper layer currents were measured.

During the first leg of cruise FR09/00, we intended to test 2 XBT systems - the new Bureau of meteorology (BOM) hardware and the Sippican WindowsNT Software. The BOM system consists of a slower computer with a new IEEE interface. The Sippican software has been designed to work under WindowsNT and has never been tested against a CTD before. The BOM system worked well but the Sippican system could not be made to work on the first leg. A detailed report is attached as Appendix A.

Cetacean and marine wildlife sighting summary (Debbie Thiele)

Cetacean sighting survey effort was conducted during daylight hours on transit legs between CTD stations. A total of eight cetacean sightings (82 animals) were made on the survey. Cetaceans recorded were humpback whales, sperm whales, beaked whales and a range of tropical dolphin species. The frequency of cetaceans observed was low, however sea state conditions for surveying were generally poor to moderate, and rarely good due to the effect of SE winds. When sighting conditions were good, sightings were still rare. There are many factors that determine the distribution and movements of cetaceans. One reason which may explain the low number of sightings is that odontocete (toothed cetacean) prey may be more abundant in surface waters with a lower average temperature than is prevalent in this area at this time of year. Turtles were observed only in near shore waters during the first day of the cruise. Seabirds were present during most days, but not in large numbers. Surface feeding flocks were only occasionally observed after the first day in nearshore waters. Flying fish (very small to large) were also observed each day, but again in low numbers. Marine debris became more common as the ship neared the high seas fishing areas off the Indonesian EEZ.

Leg 2

Weather conditions on Leg 2 were often uncomfortable, with winds rarely below 20 knots and often higher.

As a result of the hard work during Leg 1, the gear on Leg 2 generally worked well. Exceptions included the salinometers and the ADCP. The range of the ADCP steadily decreased through the first part of Leg 2, and eventually no good data was received at all. The problem was eventually traced to a broken bulkhead connector which could not be fixed at sea (a new connector was installed prior to the following voyage). We encountered very few problems with the CTD and rosette system. Near the end of the cruise we encountered some difficulties with firing bottles on several casts. The problem was eventually traced to a combination of a small leak in the termination, a leak in the connector between the load cell and the CTD cable and a poor connection at the junction box on the winch drum.

Deep bottle salinities on the first part of Leg 2 were generally higher than those found on the previous WOCE occupations of these lines. When a new salinometer was used during the latter half of Leg 2, the agreement between the deep WOCE and DOTSS data was very good.

We found the load cell on the CTD end of the wire to be useful when operating in rough conditions. The fact that different load cells and their displays appear to be in different units is confusing and they should be made consistent in future. In rough seas (i.e. when the ship is either pitching or rolling) it is not possible to eliminate occasional transient loads close to zero throughout the cast, at any practical lowering speed. However, we encountered no problems with kinking of the wire associated with low loads on the end of the wire.

We completed several casts to depths greater than 6000 m. The tension at the block was near the limiting value of 1.1 tonnes, but casts to this depth could be done without exceeding this limit by decreasing the winch speed below 4000 m depth (at least in the relatively good weather we experienced at that time of the cruise).

The major event of Leg 2 was the emergency medical evacuation of the Chief Steward, Ron Culliney. On Friday October 27 Ron suffered a suspected stroke. After consulting doctors on shore, we immediately headed for Fremantle as fast as possible. On Sunday evening October 29 we rendezvoused with the Australian Navy vessel HMAS Anzac and Ron was transferred by IRB in very heavy seas and strong winds (8-10 m seas, 40+ knot winds). The operation was completed in the dark. Ron was flown by helicopter from the Anzac to a Perth hospital early Monday morning.

The cruise was extended by 7 days to allow the work to be completed as in the original station plan. Following Ron's transfer to the Anzac, Franklin continued to Fremantle to load the fuel, food, and replacement crew required to complete the work. We tied up at the wharf at midnight Monday October 30, and sailed again as soon as bunkering was complete, at 1300 the following day.

We steamed west to resume the CTD stations where we left off. In total, the diversion to Fremantle and return added more than 2000 nm of extra steaming to the cruise. Steaming west into the strong and persistent westerly winds for four days tried the patience of all on board. The weather continued to be marginal for much of the remainder of the cruise. One station had to be skipped because there was no time to wait on station until the weather improved.

Summary

The most significant difficulty experienced during Leg 1 was kinking of the CTD wire on the first deep stations. However, after this problem was overcome no further difficulties were experienced. Whenever a new CTD cable is fitted there

is a need to stream it to remove residual torque and to tension the cable on the drum before it is used for CTD casts. Careful attention was paid to ensure high quality hydrology and CTD data was collected; overall, the data quality is good and should be a valuable contribution to the establishment of long-term time-series sections in the eastern Indian Ocean to measure both natural variability and anthropogenic climate change.

Personnel

Scientific participants on Leg 1

John Church, CMR, Cruise Leader/Manager
Ming Feng, CMR, Watchleader
Linsay Pender, ORV
Gary Carroll, CMR
Ann Gronell, CMR
Erik Madsen, ORV
Bronte Tilbrook, CMR
Alain Poisson, LPCM, Paris
Gary Critchley, ORV
Rebecca Cowley, ORV
Neale Johnston, ORV
Debbie Thiele, Deakin University

Scientific participants on Leg 2

Steve Rintoul, CMR, Cruise Leader/Manager
Neil White, CMR
Serguei Sokolov, CMR
Dan Conwell, ORV
Pamela Brodie, ORV
Mark Rosenberg, Antarctic Cooperative Research Centre,
Neale Johnston, ORV
Val Latham, ORV
Dave Terhell , ORV
Mark Pretty, CMR
Andrew Lenton, CMR
Juliette Dubois, LPCM, Paris

Franklin officers and crew members

Ian Taylor, Master
Arthur Staron, First Mate
John Boyes, Second Mate
Ian Murray, Chief Engineer
Robert Cave, First Engineer
Hugh McCormick, Electrical Engineer
Phil French, Greaser

Bill Hughes, Bosun
Terry Ganim, A/B
Tony Hearne, A/B
Norm Irvine, A/B
Gary Hall, Chief Cook
Wayne Hatton, Second Cook
Ron Culliney, Chief Steward

We received excellent support from the Ship's officers and crew and the scientific staff. We thank them and the shore based support staff for ensuring the success of the cruise. A number of people at CMR put in significant effort prior to the cruise to design, install and test new systems to meet the demanding needs of this cruise. In particular we thank Ron Plaschke for his logistics support and overseeing the upgrading/installation of the new systems and Ian Helmond and the Workshop for their design and assembly. We also thank Chari Pattiaratchi, Chief Scientist of the following cruise, for accommodating the need to extend the cruise following the medical evacuation.

Susan Wijffels	John Church	Steve Rintoul
Chief Scientist	Cruise Leader Leg 1	Cruise Leader Leg 2

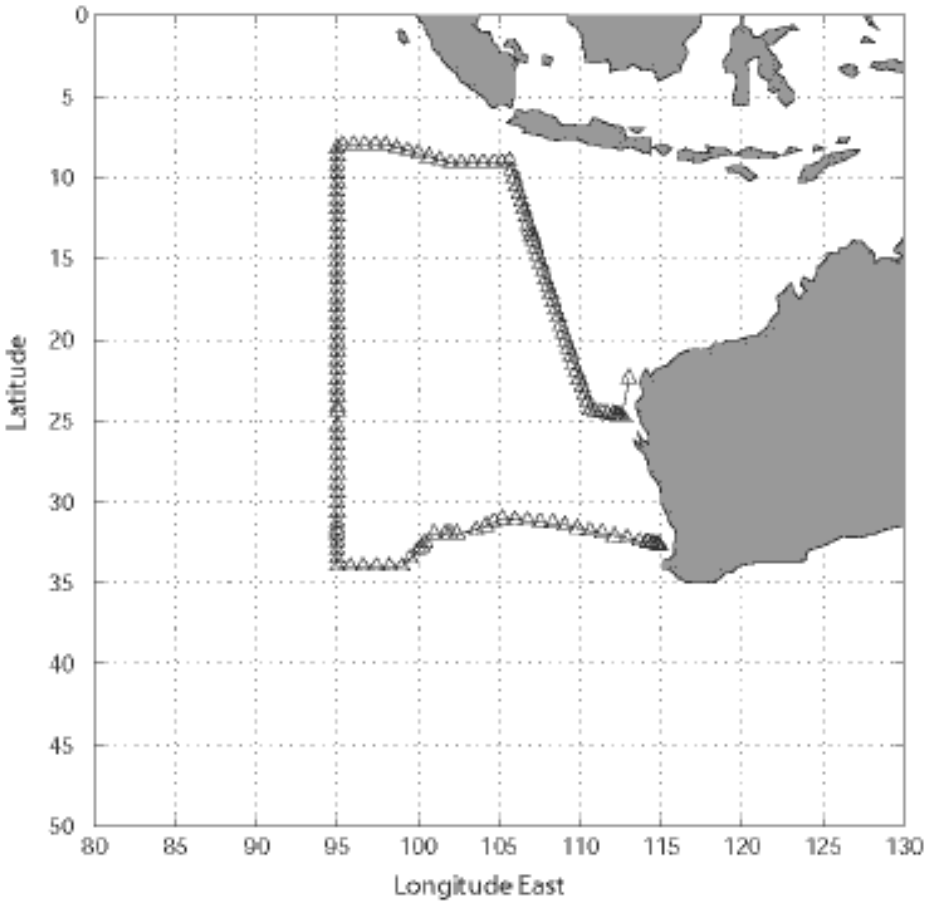

Figure 1: Hydrographic stations occupied during the cruise are indicated by triangles.

Appendices

Appendix A — Report on testing of XBT systems.

The BOM system was tested with 14 XBTs over 4 CTDs. The XBTs all matched each other well and matched the CTD's with varying depth offsets of less than 2 or 3m. There appears to be a slight temperature offset but this is within 0.2 degC which is within the specifications for t-7 probes. No detailed analysis has been done but the data looks good and the system appears to work well. The data will be given to BOM who will do the detailed comparison after the CTD corrected data is available.

The Sippican system had problems from the beginning. The Sippican software had not been loaded before the computer was sent from Hobart. We installed the software, which apparently cause the computer to malfunction and run V E R Y slowly. Several days were lost trying to figure this problem out. We tried to re-install windows but the Windows 2000 system disks that had been sent were corrupted. Finally, Erik managed to fix the computer's hard drive and, at Rick's suggestion, we reloaded the Sippican system with the mk12 card installed. When we tried to launch a probe, the system couldn't communicate with the mk12 card because the "MK12IO.SYS" file was either missing or not working properly. We found the file and tried putting it various places but no luck. Given that it was installed (presumably properly and in the right place) by the Sippican installation, we have no idea why it didn't work. In the end, we ran out of CTD's and gave up. Steve Rintoul will be bringing a BOM windows computer with the Sippican program and mk12 card already installed to test on the second leg.

All credit to Erik Madsen for putting a LOT of time and effort into getting both systems up and (almost) running.

Updated: 31/01/03