RV Franklin Cruise Fr 7/93 (09FA0793)

Itinerary

Depart Hobart 0900 Saturday 11th September, 1993
Arrive Nelson (NZ) 1600 Sunday 19th September, 1993
Depart Nelson (NZ) 2030 Tuesday 21st September, 1993
Arrive Townsville 0700 Tuesday 5th October, 1993

Scientific programs

1. Ocean transport in the Tasman and Coral Seas

Principal Investigator

Dr John Church, CSIRO Division of Oceanography

Other Investigators

Dr Gary Meyers and Mr Fred Boland, CSIRO Division of Oceanography

Professor Matt Tomczak, Flinders University of South Australia

Cruise narrative

The ship sailed on time at 0900 on Saturday the 11th of September. This cruise was the first with the new computer system. While there had been some frantic preparation in the weeks leading up to the cruise some of the systems had not been fully tested. This was partly because of the near-impossibility of testing some of systems in port. However, basic navigation and the CTD system were working at this stage. The first CTD station was reached at 3pm on the Saturday.

CTD work continued smoothly for the first part of the 43S section. Some problems were experienced with the ADCP software but this was going in an effective manner after about a day and a half. By this stage the ADCP, CTD, Trimble GPS, Navtrak GPS, thermosalinograph and sounder acquisition systems were all operational. The main problem with the computer system for the next week or so was an annoying problem with the winch monitor software (which provided the CTD pressure readout for the winch driver) hanging. This was exacerbated by the fact that the stand-alone PC version (which only provided wire out) could not be used safely because some of the magnets on the pulley had become ineffective leading to incorrect readings.

At about 1900 on Friday the 17th September a problem with the pitch control gear for the main propeller was discovered. One of the castings in the hydraulic control system had developed a crack and squirted hydraulic oil up to 5 feet when the propeller pitch was changed. It would squirt oil a lesser distance at other times. As it was not possible to repair at sea and there was no guarantee that it would not become worse (possibly rendering the main drive inoperative) the only option was to head for port. Bluff was considered but was decided against because going into the head sea to Bluff would have put extra strain on the cracked casting. Unfortunately this also made it virtually impossible to complete the 43S section.

We arrived in Nelson, New Zealand at 1600 (NZ time) on Sunday the 19th. Howard Smiths (the ship's operators) had already started chasing a replacement part and the only spare to be found was at the LIPS factory in Holland. Arrangements were made for the part to be flown out. A repair was also attempted on the existing part. Eventually the repair was passed by the Lloyds surveyor, Max Cameron (Chief Engineer) and Bruce Maroc (Howard Smith). The spare part was still shipped out from Holland and was insttalled during the following port period.

We left the ship repair dock at 1530 on Tuesday the 21st as we would have been blocked in if we hadn't. We moved to a vacant wharf while installation of the repair was completed and finally left Nelson at about 2030 on the 21st.

We did a test cast with the new small diameter bottles on the way north to Cape Reinga. One bottle was lost completely and the analyses showed that most of the bottles had performed much better than on the previous cruise. There were still a couple of obvious leakers though.

We began the 173E section in marginal conditions and behind time. We thinned out the CTD stations as much as we reasonably could and would still have been able to reach Townsville on the 4th if we had had a few days of reasonable weather after leaving Nelson. This was not to be - head seas and high winds led to very slow progress even though some stations were missed. XBTs were dropped at these locations.

The stop in Nelson had, in effect, used up all our bad weather allowance so there was no option at this stage but to ask for an extra day to get enough of the scientific program completed for the cruise to be worthwhile. This day was granted and the arrival data in Townsville changed to the 5th of October. Eventually the weather improved and the slightly cut down CTD program was completed without further incident. The last CTD station was completed at about 0400 on the 2nd of October. This was followed by a gyro test to compare the ship's heading received through the Navtrak GPS navigator and through the new synchro-digital converter in the ADCP deck unit. This showed heading-dependant difference with an amplitude of about 2 degrees. This will be pursued later.

The new computer system worked well and the new ops room layout is a big improvement.

CTD Measurements During RV Franklin Cruise Fr7/93

The CTD used throughout this RV Franklin cruise Fr7/93 was CSIRO CTD No. 2 (A Neil Brown Instrument Systems MkIII B profiler, Serial Number: 01-1013). The Sensors on the profiler where :

Sensor	Manufacturer	Resolution	Accuracy
Temperature:	Rosemount PRT	0.0005C	0.003C
Conductivity:	EG&G NBIS	0.001mmho	0.005mmho
Pressure	Paine Instruments	0.1 dbar	6.5 dbar
Dissolved Oxygen	Beckman Polarographic		

The fast response thermistor had been removed prior to this cruise, in fact the thermistor had not been used on this instrument in the field.

CTD Temperatures are calibrated against water (0.010C) and phenoxybenzene (~27C) using platinum resistance thermometers as transfer standards. The lab which carries out this calibration (The CSIRO Division of Oceanography Calibration Facility) is accredited by NATA, Australia's National Association of Testing Authorities, to calibrate CTDs to 0.003C at the water triple point and 0.004C at the phenoxybenzene point. Both of these uncertainties are at the 99% level. Calibration is carried out as often as practicable given the Franklin's itinerary.

The CTD was calibrated in May 1993 and February 1994. There was no significant difference between these two calibrations. The constants from the first of these calibrations were used.

All CTD temperatures are ITS-90.

The CTD pressure was calibrated against a deadweight tester in the "down cast" direction only. In addition, the pressure at the first "in water" sample were used to derive an offset for each station.

Salinity calibration are based on in situ bottle data. Laboratory checks are only maintained to ensure the sensor is operating correctly. Using 1227 sample bottles out of a total of 1336, the difference between the CTD salinities and the water samples showed a standard deviation of 0.0020psu for the whole water column.

The calibration technique follows that used by Bob Millard's group at WHOI closely. The stations groups used were 1-18, 19-29, 30-40, 41-49, 50-60, 61-64 and 65-74.

Dissolved oxygen calibration is carried out using a method very similar to that described in Owens and Millard Jr (1985). This method is to fit the downcast profile of dissolved oxygen to the sample bottles collected during

the upcast.

The difference between the CTD downcast oxygens and the sample bottle oxygens show a standard deviation of 3.10 umol/L (equivalent to 0.069 mL/L) for the whole water column.

CTD Data Collection and Processing

Three Sun Sparcstations are now used for all logging and analysis tasks on RV Franklin. One is dedicated to data logging, another to user analysis and the third is a spare. The data that is logged (raw CTD data including flags at bottle firings) is very similar to that which was logged on the old system and the user interface is similar.

All new data files are copied to the other machines on the network within an hour and daily backups are made to exabyte on two of the three machines.

Uncalibrated 2 decibar averages are provided for user analysis.

Post-cruise processing follows the following scheme:

- there is an initial 'clean up' stage were station data is checked, unwanted casts are removed, etc.

- a set of uncalibrated 2dB average files are produced, as well as summaries of the data for each sample burst. At this stage temperature and pressure calibrations are put in.

- bad data (e.g. where something has got stuck in the conductivity cell) is removed.

- the sample data is merged with the hydrology data, and some samples are flagged as being 'unsuitable for calibration (e.g. due to large gradients). An iterative process then follows, where outliers are progressively removed and a calibration constant (a conductivity ratio) is determined for each station.

- once this has been done, calibrated 2dB average files are produced. A simple recursive filter is used to 'slow down' the faster sensors (pressure and conductivity) to the slowest sensor (temperature - the response time of the platinum resistance thermometer is ~.175 seconds). Values are checked for implausible gradients, and any ascending parts of the trace are ignored (i.e. any values for which the pressure is less than the maximum pressure for this cast so far are ignored). At the same time 2dB averages of oxygen current and oxygen temperature are calculated.

- the calibrated 2db averages are plotted, and the plots examined. In addition, T/S curves of groups are plotted and checked for agreement of the deep T/S values. The traces are also examined for density inversions, and sections removed if this seems appropriate.

Salinity and Dissolved Oxygen Measurements made during RV Franklin Cruise Fr7/93 (09FA0793).

Salinity. The water samples salinities where measured with a YeoKal Model 601MkIII Inductive Salinometer that was standardised daily with IAPSO Standard Sea Water (SSW) Batch P122 (Cond Ratio: 0.99991).
The accuracy of the salinnometer claimed by the manufacturer is 0.003 psu.
(Yeo-Kal Electronics Pty Ltd, Brookvale, NSW, 2100, Australia)

Oxygen. The method used is a modified Winkler titration. All oxygen values (Bottle and CTD were converted from umol/l to umol/kg using the salinity of the sample and the nominal temperature (25C) of the lab in which the analyses were done.

Nutrient Analyses

Samples are collected in 15ml polypropylene tubes and frozen for up to one week before analysis using a Technicon AA2 system. They are thawed at room temperature.

Nitrate determination is based on the reduction of nitrate in the sample

to nitrite using a granulated cadmium reductor column and imidazole buffer. Nitrite then reacts with sulphanilimide to form a diazonium ion which reacts with napthylethylene dihydrochloride to form a coloured azo dye which is measured at 550nm. Nitrite is also determined using the same chemistry without the use of a reductor column.

Dissolved phosphate is determined by reaction with acid molybdate in the presence of antimony ion. Phosphomolybdate is then reduced by ascorbic acid at 37C and the blue complex measured at 880nm.

Reactive silicate is combined with acid molybdate and the complex reduced by methylaminophenol. Interference by phosphate is eliminated by the addition of oxalic acid which reacts with excess molybdate and the blue colour is measured at 820nm.

Nutrients are converted from umol/l to umol/kg using the nominal temperature of the chemistry lab on RV Franklin (25C)

Table: Cruise Participants
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Fr7/93 Townsville - Brisbane 11 Sep - 5 Oct 1993

Name	Responsibility	Affiliation
Neil White	Chief Scientist	CSIRO DO
Steve Rintoul	CTD watch	CSIRO DO
Tony Woods	CTD watch	CSIRO DO
Andrew Fiedler	CTD watch	Flinders University
Rob Radcliffe	CTD watch	Flinders University
Bernadette Heaney	CTD watch	CSIRO DO
Bob Beattie	Computer support	CSIRO DO
Val Latham	Nutrients/Salts/DOs	CSIRO DO
Ruth Eriksen	Nutrients/Salts/DOs	Antarctic CRC
Erik Madsen	Electronics	CSIRO DO

References
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Owens, W. Brechner and Robert C. Millard Jr. " A new Algorithm for CTD Oxygen Calibration." Journal Of Physical Oceanography, 15, 621-631. 1985