

WSEX91:

RV Polar Duke

Weddell Sea

Oceanography

February 1991 - March 1991

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WSEX91 CRUISE REPORT 10 February - 15 March

Introduction

WSEX91 was a scientific cruise on the R/V Polar Duke as part of a continuing program to look at Weddell Sea Bottom Water formation and production rates. It was coordinated by Professor Ted Foster of the University of California at Santa Cruz (UCSC) and funded by the National Science Foundation as part of the United States Antarctic Research Program (USARP).

BAS interests in the palaeoceanography and sediment transport of this region meant that collaboration was possible between the two centres. We have current meters and CTD transects to the North and East of the WSEX91 study area while Ted has current meters on the transect shown in Fig. 1 and repeated CTD stations over many years in this area of the Weddell Sea and adjoining regions.

The oceanography of the Weddell Sea has not been comprehensively studied, and particularly current meters are difficult to deploy and retrieve because of hazardous ice and weather conditions and lack of local knowledge about the bathymetry, so it was advantageous for all parties to be able to share information and expertise and collaborate in this way.

Narrative

The Polar Duke departed Marsh Base (King George Island) on 10 February with the scientific group on board; 5 scientists from UCSC, 2 technicians from Scripps, 1 person from the Argentine Antarctic Institute and myself from BAS. Ted Foster was the chief scientist and the only other physical oceanographer.

The first transect started on 11 February, just past Joinville Island and ran in a line roughly SE into the Weddell Sea, see cruise track, Fig. 1.

Current Meters

Seven current meters were laid on this line in water depths from about 400m to over 4,000m, but moorings not retrieved in previous years because of release failures and ice cover were abandoned altogether as part attempts to drag for them had been unsuccessful and wasted a lot of ship time.

The Oceano deck unit used for the releases on the deeper moorings was not functioning properly so their operation could not be checked when the meters were down, hopefully this is purely a problem in the deck unit and not the releases.

CTD casts

Initial casts were fraught with equipment problems. The pressure sensor was sticking, in part due to its storage in Punta Arenas for 2/2 years. It improved with

time but was never totally satisfactory. The oxygen sensor never worked and the conductivity, sensor needed some 'tweaking'. X-Y plots of temperature, but not conductivity versus pressure were obtained eventually in some form. This was useful in choosing points at which to fire water bottles and observe in real time the structure of the water column.

A pinger was attached to the CTD frame so an altimeter reading at 100 m from the bottom could be used by the operator to have the CTD positioned within the lowest 10m although in a shelving area this height was never decreased in case the ship drifted to shallower water.

In a typical CTD cast the frame was lowered by the winch man, in constant communication with the CTD operator, to 10m below surface before logging was started on analog and digital tapes. Using the PES recorded depth it was then taken to the bottom at a maximum rate of 60m/min and using the altimeter, guided to the safest depth closest to the bottom unless it was a shallow biological cast.

Logging was then stopped and the CTD brought back to the surface; water bottles fired at the appropriate depths through the water column, conductivity, temperature, pressure and altimeter readings where possible were recorded at each firing from the CTD deck unit.

If reversing thermometers were used for calibrations the bottles were held stationary for 5 minutes to let them 'soak' or equilibrate and then the bottle fired. Generally bottles were fired for calibrations in a part of the profile where T was reasonably constant with depth.

By convention the water depth of the cast was taken to be the value recorded on the PES when at the bottom of the cast along with the GPS/magnavox position recorded at that time. Salinity samples were usually taken every 4 or 5 casts for calibrating the data and then analysed with the Autosal within the next few days. The Autosal was positioned in a container lab. in the hold with very little other electrical or radio disturbance and gave good stable readings.

Once a routine was established samples of water, approx 100ml, were taken for oxygen concentrations in a profile from surface to bottom at every other station and these also analysed within a couple of days by Winkler titration.

Water samples from the fired bottles were taken as required for chlorophyll, zooplankton, heavy metals and sediment filtrations.

Suspended particles were filtered out at selected points in the water column particularly in the nepheloid layer and at closely spaced intervals above. Between 1-21 were filtered for each depth, through a nucleopore membrane filter using a vacuum pump and a plastic container to catch the water and build up the vacuum, which was not strong enough to resist a good build up of pressure and would collapse if the pumping rate was high.

Sediment filters are detailed in Table 1.

Coring

Another objective on the cruise was the collection of gravity cores opportunistically on the shelf slope, rise and bottom and/or at mooring sites where possible. This would give BAS scientists on the next geophysics cruise a better idea of local sediments for their own more comprehensive coring program in subsequent years.

A total of 6 x 2m core liners for a gravity core were available for use and 6 cores in total were collected with lengths varying from just under 2m to about 40cm length. See Table 2 for details.

More cores were attempted by piecing together unused liner segments but all failed to retain their contents in sandier areas.

It was hoped to have a 3.5 kHz echo sounder operational in the shelf and shelf break areas but shortly after the cruise started the sounder stopped working and could not be fixed.

The Cruise Track

Transect (1) was a repeat of CTD stations in past years on Ted's mooring line. At Station 50 a new transect (2) was started towards the SW attempting to get as close to the peninsula as possible, beyond the point where the original Endurance went down, to look at the very cold ice shelf water production but the track was curtailed by heavy ice cover which lodged the ship for 12 hours. An unsuccessful attempt was made to go North and another transect (3) was made headed East to finish the original line (1). On transect (3) a fixed position time series or 'yo-yo' cast was made over a period of 36 hours. Every 12 hour the CTD unit was deployed from 10m to 600m and brought back to 50m below surface until the start of the next 12 hour period.

This showed the evolution of the step-like structures observed in the temperature trace over a tidal period which remained quite stationary with internal tidal motions superimposed on it. Ted Foster is particularly interested in these fine structure phenomena in this region.

The line (1) transect was completed at its SE end and the ship headed North and along the ice edge zone to survey the presence of these step structures and to take biological samples.

The first part of transect (1) was repeated so cores could be taken near mooring sites and CTD stations from the chaotic start, repeated. Interleaving of fingers of cold shelf water and warm deep water was observed here in varying degrees on the shelf slope and rise. The last section of CTDs was as near to the line 14 sediment drift as there was time and another core taken.

CTD drops were continued through Antarctic Sound on the way to Deception Island. At Deception the cores were left to be collected in April by the RRS John Biscoe. Volcanic rock samples were taken here and a couple of CTD stations.

This ended our part of the science on the Polar Duke and from 7-10 March the science turned to Krill fishing in the Bransfield Strait/Anvers Island Gerlache Strait region headed by Maggie Amsler from Palmer station.

Much of the remaining part of the sea time was spent dismantling and packing equipment ready for storage in Punta Arenas for shipment back to the US and checking data. The labs, decks and working areas were given a thorough spring cleaning. For almost three days crossing the Drake Passage the sea was too rough to be able to do anything more than fighting seasickness.

C O R E 4

28 Feb '91

Position: 63° 30.323'S 63° 30'
51° 14.113'W 51° 14'

Uncorrected PES depth: 2200m
Wire out: 2188m

Labelled: 901 GC059

On site of mooring (c), CTD site 91086, at shelf slope.

C O R E 5

1 Mar '97

Position: 63° 22.167'S
51° 54.966'W

Uncorrected PES depth: 1135m
Wire out: 1027m

Labelled: 901 GC060

On, or near site of mooring (b), CTD station 91092.

C O R E 6

2 Mar '91

Position: 64° 25.621'S
54° 10.265'W

Uncorrected PES depth: 1158m

Labelled: 901 GC061

At or near top of shelf slope in region of Line 14 sediment drift.

Previous attempt at a sixth core (1/3) resulted in all contents dropping out of core tube, some residual sand was retained in a petri dish from position 63° 16.205'S, 52° 30.218'W PES depth 495m.

(4/3) Also core 7 attempted at 64° 18.324'S, 54° 17.990'W PES depth 705m but again emptied out of the bottom, did not clog together sufficiently to enable the core catcher to retain it.

Personnel List

Prof T D Foster: Principal Investigator - UC Santa Cruz Hydrography, CTD casts, current meters, cruise plan.

Jim Schmitt)
Doug Masters) Technicians from Scripps Inst of Oceanography. Responsible for CTD casts, oxygen and salinity analyses reversing thermometer calibrations.

Laura Linn Graham: Scientist/Technician - UC Santa Cruz, CTD watch and heavy metal sample collection.

Sergio Sañudo-Wilhelmy: PhD student - UC Santa Cruz. CTD watch, collection of water samples distanced from ship for lead tracing, aerosol collection and volcanic rocks.

Viviana Alder: PhD student, employed by Argentine Antarctic Institute working on nanoplankton and chlorophyll1 sampling for fish population distributions.

Marion Barber: British Antarctic Survey,. scientist. CTD watch, taking sediment cores and filtering for suspended particulates in water column, particularly bottom water.

Nathaniel Plant)
Clarence Low) UC Santa Cruz masters students employed in data collection, CTD watches and mooring deployments.

Kevin Wood)
Peter Kalajian)
Jamie Scott) Antarctic Support Associates, Technicians, computer and communications people. Responsible for ASA equipment on board.