

FS Meteor Completes A8

Thomas Müller (Chief Scientist), Institut für Meereskunde an der Universität Kiel, 24105 Kiel, Germany

A8 was the last of three zonal WHP sections in the South Atlantic as part of the German WOCE contribution: Sections A9 (19°S) and A10 (30°S) were completed on Meteor cruises 15/3 in 1991 and 22/5 in 1993, respectively. On A8, 110 full depth stations with CTD and up to 40 bottle samples per station were obtained. Water samples were analysed onboard for salinity, oxygen, nutrients, anthropogenic tracers CFC-11, CFC-12, CFC-113, CCL4 and carbon dioxide. In addition, underway measurements of currents and meteorological data as well as near surface temperature and salinity were made.

During the cruise the nominal station spacing was decreased to 10 nm and 5 nm over the shelf and continental breaks, to 24 nm over the mid Atlantic Ridge, and increased to 38 nm over the deep Pernambuco and Angola basins. Bottle samples to analyse for oxygen, nutrients and salinity were taken on each station, samples for anthropogenic tracers and CO₂ on each second station.

In addition, four test stations and a survey with ADCP were performed off the Brazilian shelf before the WHP section began, and a box around the eastern end of the section was occupied.

Underway measurements of currents were made with a shipborne Acoustic Doppler Current Profiler (ADCP) down to 200 m and with a Geomagnetic Electro-Kinetograph (GEK), eight satellite-tracked drifting buoys and expendable current profilers (XCPs) as well as near surface temperature and salinity and meteorological parameters supplemented the station work.

The cruise also presented the opportunity for non-WOCE measurements. As part of a long-term Atlantic-wide survey of the distribution and ecology of fish larvae, 69 plankton hauls were performed at 6 levels between the surface to 200 m.

Aerosols determine the formation of clouds. Over the South Atlantic several sources may be expected; aerosols of sea salt and remainders of continental aerosols of mostly desert origin as well as particles which result from decomposition of dimethyl sulphide (DMS) formed by chlorophyll in the sea. Aerosol samples were filtered from air and are to be correlated with DMS concentrations in sea water and air.

Meteor sailed from Recife,

Brazil, 29 March. Heading eastwards (Figure 1), outside the 12 nm zone at 8°17'S, 34°30'W the continuously recording systems were switched on; the integrated system DVS to acquire navigational and meteorological data as well as near surface temperature and salinity, the shipborne 150 KHz ADCP, and the towed GEK. (DVS is a German acronym for a data distributing system on-board FS Meteor.) The first two days of the cruise were used to test the two CTD systems, each equipped with a 24 x 10 l rosette sampler, on four deep water stations (165–168). Also, the analysis systems for oxygen, nutrients, CFCs and CO₂ were set up.

At 11°20'S, 34°W we began a section along A8 shorewards with XBT and XCP drops thereby achieving a box with ADCP and GEK in the divergence zone of the western branch of the South Equatorial Current.

On 1 April, (Station 169) section A8 started at 10°3'S, 35°46'W on the 200 m depth contour outside the 12 nm zone of Brazil normal to the continental shelf break. On each of the following stations, together with the first CTD rosette, a 150 kHz self-containing ADCP was lowered (LADCP) to 1000 m. The bottles were used to increase the number of water samples up to 40, the bulk of them came from the main CTD lowering which always went down to 10 m above the bottom. At 34°W (Station 181) the nominal latitude 11°20'S was reached, 13 stations at 5 nm to 20 nm spacing were obtained. Station spacing was then increased to 30 nm until 32°W (Station 185).

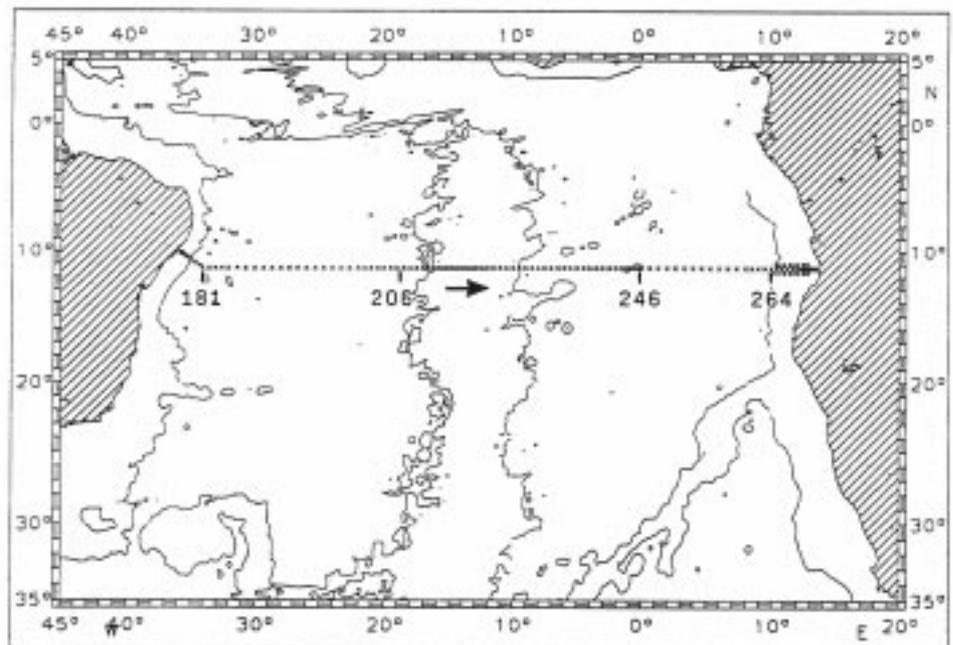


Figure 1. CTD stations during M28/1.

**Investigators responsible for
WHP underway measurements**

CTD, XBT, XCP, ADCP, underway	Thomas Müller, IfM Kiel
Oxygen, Nutrients	David Hydes, IOSDL, UK
Tracers	Alfred Putzka, University of Bremen
CO ₂	Kenneth Johnson, BNL Brookhaven

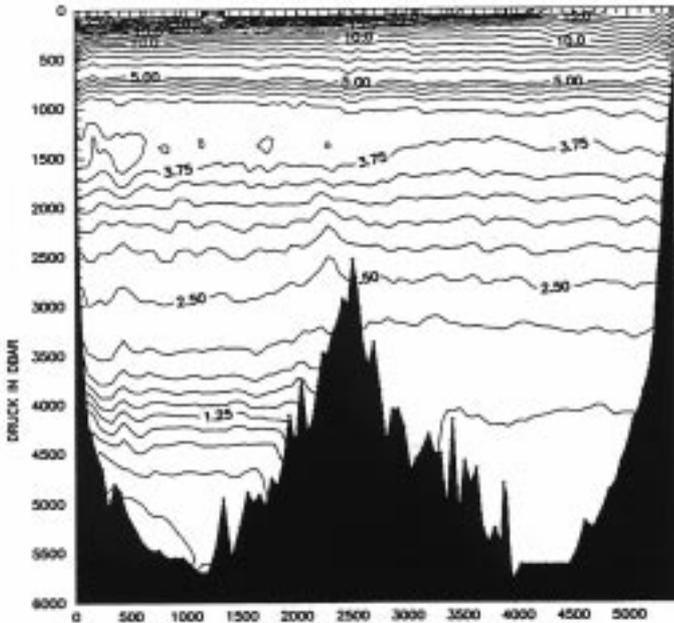


Figure 2. Distribution of potential temperature along 11°20'S from Brazil (left) to Angola (right). Contour intervals are 1°C and 0.25°C for temperatures higher and less 5°C, respectively.

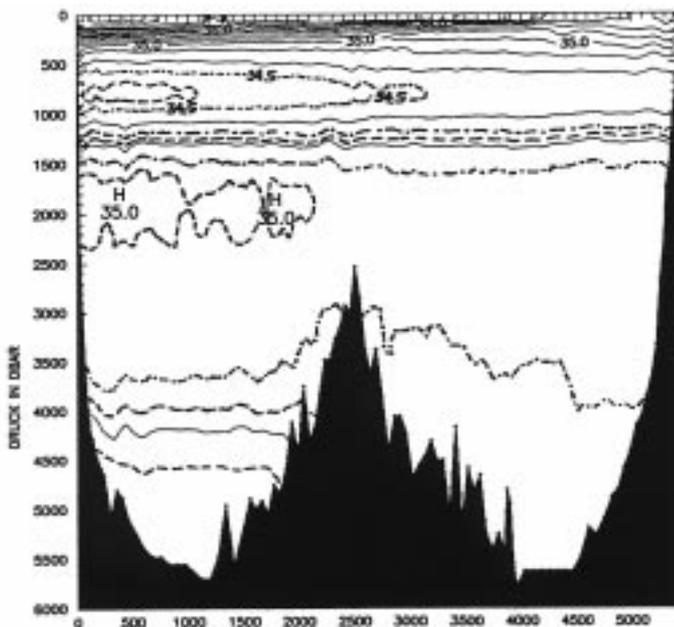


Figure 3. As Figure 2 for salinity. Contour intervals are 0.2 psu between drawn lines. Dash-dot lines denote a contour increment of 0.1 psu, while long dashes resolve the distribution of an additional interval of 0.05 psu.

Here, outside the 200 nm economic zone of Brazil, measurements with the multibeam echosounding system HYDROSWEEP and sampling of aerosols began. Across the Pernambuco Basin, station spacing was increased to 38 nm with T5 (1800 m) XBTs halfway in between. Up to Station 190 at 25°20'W, all stations had biological sampling. From then on spacing for biological hauls was 70 to 90 nm. Four satellite-tracked drifters were launched between 20°W and 15°45'W.

Approaching the mid Atlantic Ridge, from 22°W (Station 200) spacing was decreased to 30 nm to 17°W (Station 210) and down to 24 nm over the ridge to 12°W (Station 222). At 19°S (Station 206) over the western flank of the ridge, we crossed section A15 which was worked at almost the same time by the US RV Knorr. CTD and bottle data from this station were exchanged by e-mail while still at sea.

Spacing was increased again towards the Angola Basin to 28 nm until 1°W where the section ran close to the Dampier Seamount. Expecting higher hydrographic variability and different species of fish larvae, two extra CTD stations (245 and 247, no bottles) and plankton hauls were obtained.

From 0°E onwards station spacing increased to 38 nm across the Angola Basin until we reached the African continental break at 8°E (Station 260). T5 XBT probes were launched halfway between stations. Four more satellite-tracked drifting buoys were launched between 1°20'E and 5°20'E.

With 28 nm station spacing we reached 10°E (Station 264) where we entered the 200 nm economic zone of Angola. Since no clearance had been applied for plankton hauls and GEK, we continued with CTD measurements only. Station spacing was reduced successively to 25 nm and 10 nm until we reached the 50 nm zone at 12°57'E (Station 274). While waiting for an extension of the clearance to 12 nm to be arranged by the German Embassy in Luanda, Angola, we surveyed the northern part of a box around the eastern end of A8 using the CTD/LADCP system down to 1000 m depth (Stations 275–281 along 11°S). We completed this box with stations 282–286 along 11°40'S with plankton hauls as well after the extension of the clearance had been granted. After two days interruption we rejoined A8 at 13°5'E (Station 287) and completed it on the 200 m depth contour at 13°33'E with Station 290 on 7 May 1994.

All deep casts were taken with the same Mk IIIB CTD which already served on A9 and A10. The shallow CTD casts served for calibration purposes and provided CTD values at bottle depths. Figures 2 and 3 display the distribution of potential temperature and salinity using the pre-cruise calibration along A8. Note that salinity is high or low by 0.01 psu and will be adjusted during the final *in-situ* calibration procedure.

Nutrients and dissolved oxygen were measured from each bottle for each station, tracer, pCO₂ and TCO₂ concentrations were determined for each bottle over the continental break and for each bottle taken at alternative stations.