All Current Meters Recovered from the Hunter Channel Array: FS Meteor Finishes Third DBE Cruise

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In Walfish Bay, Namibia, I took over the Meteor from my colleague Thomas J. Müller, who just had completed WHP section A8 along 11°20'S with his team. Initiated by a press release issued by the Coordinator's office in Kiel and the German Embassy in Windhoek, the arrival of the Meteor was well received in Namibia. The town and harbour of Walfish Bay had been peacefully incorporated by the Republic of Namibia only 74 days earlier. Surprisingly many German speaking Namibians from the nearby towns of Swakopmund and Walfish Bay, as well as from the capital Windhoek had come to visit the Meteor. Among them were a few elderly guests who enthusiastically reported their unforgotten impressions of the old Meteor they had visited as school kids some 68 years ago. At that time Kapitän Fritz Spiess was the chief scientist of the legendary Deutsche Atlantische Expedition 1925–27. Our port call at Walfish Bay exceeded everybody's expectation.

The Meteor left Namibia early on 15 May 1994 and sailed directly towards point "A" at 21°S, 10°W, situated on the eastern flank of the Mid Atlantic Ridge. Until early February 1994 we had planned to reach "A" coming from Pointe Noire, Republic of Congo, passing the island of St Helena. However, due to official travel warnings from the US Secretary of State and the German Auswärtiges Amt we were forced to reorganize the cruise track at short notice. The cruise track is shown in Figure 1a.

On 21 May, the Meteor crossed the Mid Atlantic Ridge and occupied her first stations in the eastern Brazil Basin. By then, all continuously recording systems, *i.e.* GEK (Geomagnetic Electro-Kinetograph), ADCP (Acoustic Doppler Current Profiler), radiation and environmental chemistry loggers, had become fully operational and remained so for most of the expedition. The first surface drifters and RAFOS floats were launched at the corner Sta. 295. All drifters were equipped with drogues at a depth of 100 metres. The course then changed southwestward to 223 degrees.

Further CTD stations partly in combination with minicorer deployments, more float and drifter deployments and zodiac based chemical sampling followed until we reached mooring "R", at Sta. 305 on the eastern flank of the Rio Grande Rise on 25 May. This and other moorings had been deployed by the Meteor in mid December 1992 as the German component of the Deep Basin Experiment.

On 27 May we reached the western side of the 200 km-wide zonal cross-Hunter Channel array at moorings "H1-6" (Figure 1b). Favoured by excellent weather conditions all moorings were recovered (Sta. 309–319, 27–30 May) after a 17 month deployment. We used the remaining time in the region for HYDROSWEEP surveys (swath echo sounder) and GEK tracks at night. The systematic survey of the bottom topography of the Hunter Channel is a long-term project of the Alfred-Wegener-Institut, Bremerhaven, the Universität Bremen and the Institut für Meereskunde in Kiel.

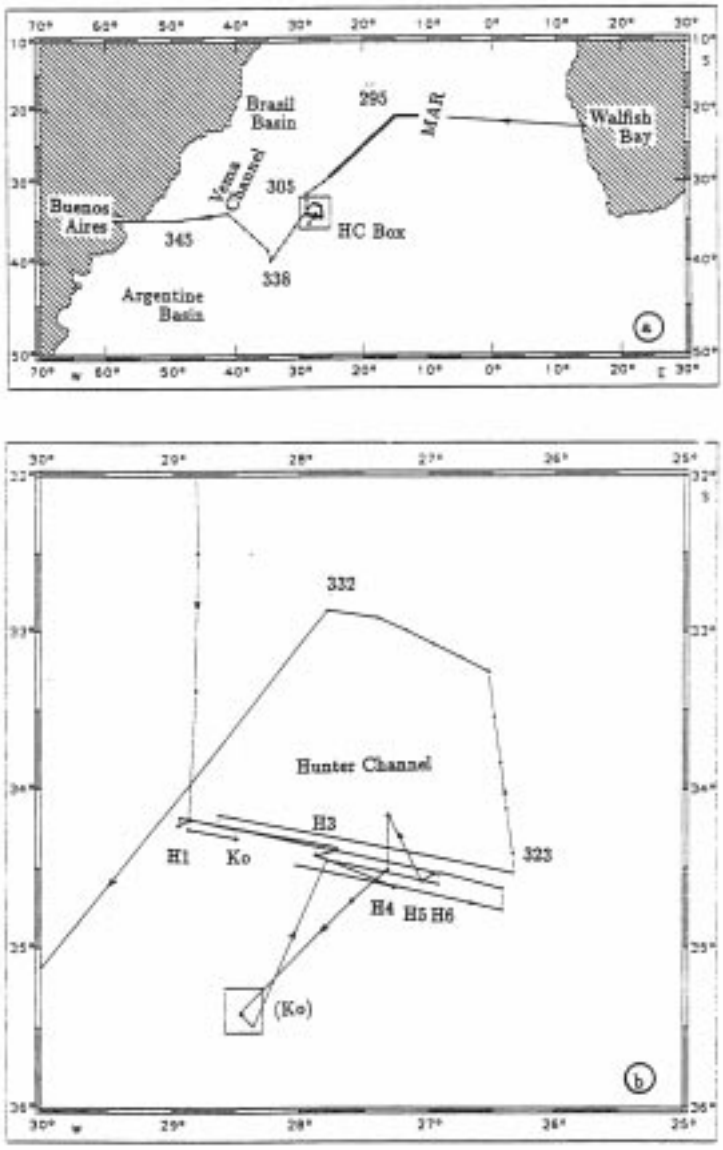

Figure 1. (a) Track of the Meteor cruise No. 28, leg 2. (b) Intensive CTD and mooring work together with nightly bathymetric surveys supplemented the efforts in the Hunter Channel (HC) area where the Meteor spent almost one week.

Analysis of selected CTD stations in conjunction with minicorer deployments will allow more precise hydrographic and sedimentological descriptions of this important passage for Antarctic Bottom Water on its equatorward drift. Figure 2a shows daily averaged vectors of a 17 month-long time series of near bottom flow at mooring "H6". Figure 2b shows a preliminary progressive vector diagram from the near bottom current (15 m bottom clearance) demonstrating the quasi-permanent nature of the overflow through the eastern side of Hunter Channel (34°32.6'S, 26°58.5'W, depth 4303 m). These new results compare well with earlier observations in the Vema Channel.

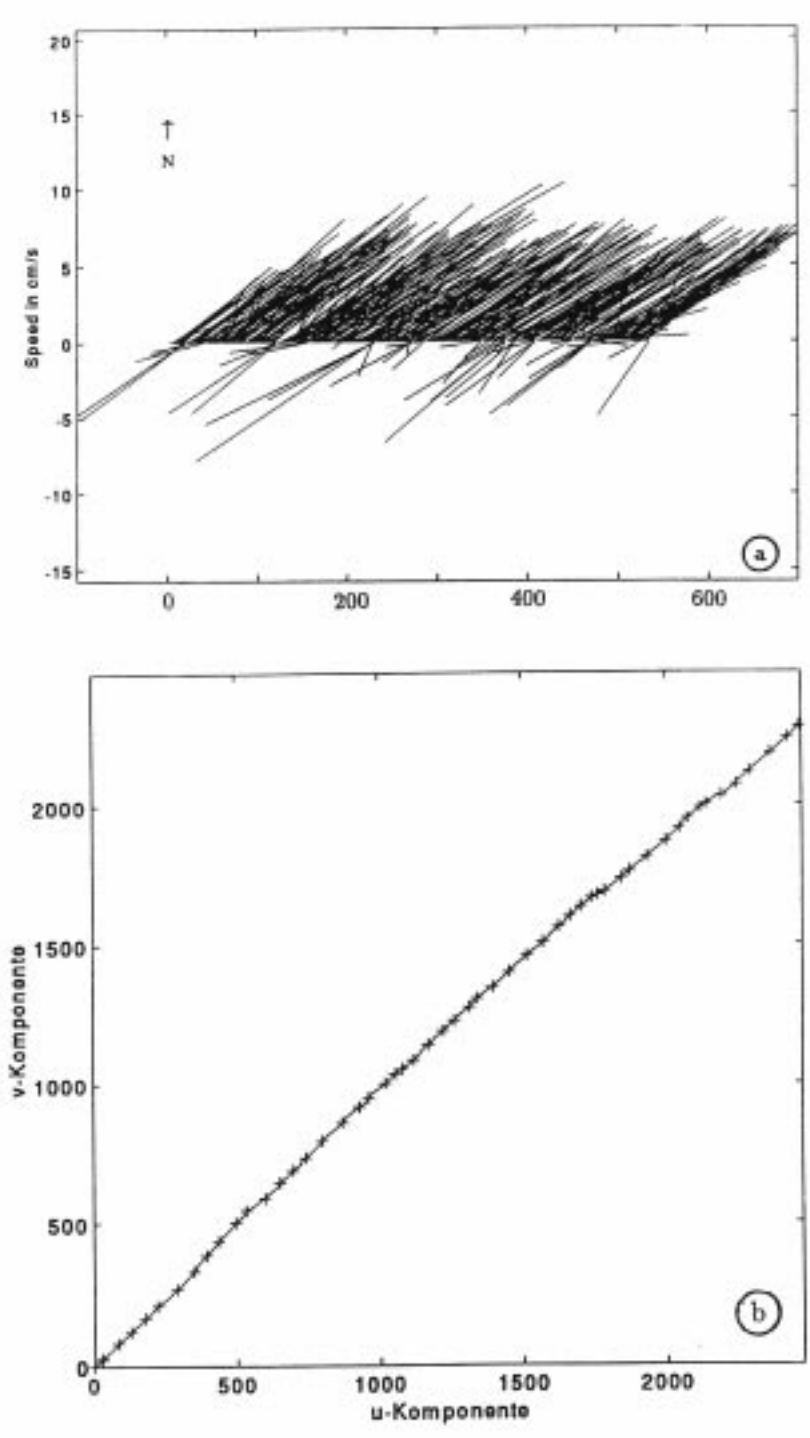

Figure 2. Direct current observations from the eastern sill of the Hunter Channel (Mooring"H6", 15 m bottom clearance). (a) Daily averaged vectors (2 h sampling interval) of the 17 month long record (December 1992–June 1994). (b) Progressive vector diagram of time series in (a). Similar currents were observed at the western sill ("H1").

We expected serious problems with mooring "K0". This sound source rig had broken loose in mid February 1994 when signals from our "watch dog" top buoy were reported by Service ARGOS. Upon several release commands no remainders showed up at the mooring site of "K0" in the Hunter Channel. However, to our greatest surprise we were able to locate the sound source's shifted position at approximately 35°22'S, 28°28'W by listening with two separate MAFOS monitors on the hydrographic wire. The listening procedure was repeated five nights from different locations resulting in a search radius of less than 8 nm. However, despite of a 36 hour intensive search the Meteor was unable to find the lost mooring on the sea surface. Instead, we spotted two fisherman's balls, one styrofoam plate and a plastic bottle at this location.

On 1 June the search was discontinued. The ship returned to the Hunter Channel and set the replacement sound source mooring "K0 2" (Sta. 322). After a final HYDROSWEEP leg across the Hunter Channel a narrowly spaced deep CTD section was carried out at the eastern and northern exits of the channel area (Sta. 323–332). Because of rough weather conditions we had to skip further minicorer deployments, which were otherwise performed regularly under the CTD probe on deep stations. Chemical samples from the surface (Universität Ulm) were taken regularly from the zodiac during CTD operations whenever the weather conditions allowed.

On 4 June the Meteor left the well measured Hunter region and headed for its southernmost position at 40°S, 35°W. Here sound source mooring "K4" was launched at Sta. 338. Sound sources are an integral component of the RAFOS system. Their signals are sensed by drifting floats. Arrival times of the coded transmissions are recorded in the floats. After the floats surface, typically after 10–15 months, the stored information is transmitted by a satellite link and converted in Kiel into a series of float positions.

The passage towards "K4" was combined with more float and drifter launches and GEK observations, resulting in a quasi-continuous section from the centre (21°S) of the subtropical gyre to its southern perimeter north of the confluence region (35°S).

On station 338 an extended CTD cast was taken. Samples include, as in other selected cases, probes of helium, tritium, nutrients (Universität Bremen) and sulphur hexafluoride (Woods Hole Oceanographic Institution). After the Meteor had occupied this southern corner station she cruised northwestward towards the outer Vema Channel. Additional drifters and floats were launched between shallow (1500 m) CTD-Stations 338 and 344.

After the last drifter and float were deployed on Sta. 342 and 343, respectively, the ship cruised to the final position at the 200 nm-zone off the Brazilian coast line. Here, at Sta. 345 more water samples were taken in the western boundary current system before the Meteor called at Buenos Aires on 14 June 1994.

When approaching the South American shelf the Meteor had occupied 44 CTD stations, 23 of which included joint minicorer deployments. 89 XBT probes were dropped and seven moorings had been recovered and two deployed. 29 RAFOS floats, two MAFOS monitors and 20 satellite tracked surface drifters with drogues at 100 m depth had been launched. Quasi-continuous measurements of solar radiation and skin sea surface temperatures (University of Colorado) as well as nearly uninterrupted GEK records (Institut für Angewändte Physik, Universität Kiel) were collected.

Acknowledgements for Meteor Cruises

The cruises and the scientific analysis of the data were supported by the Deutsche Forschungsgemeinschaft (DFG) and the Bundesministerium für Forschung und Technologie (BMFT), Bonn, Germany. For the work on A8, the cruise participants wish to thank the ship's crew for their skilled work. Special thanks go to the Angolan authorities and the German Embassy in Luanda, Angola, who in a joint and extremely quick effort made the extension of the clearance possible.

Indian Ocean Plans Continue to Evolve

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The next two years will see the emphasis of the WOCE Global survey shift to the Indian Ocean. The planned programme is the culmination of three years work by US and other investigators, and will continue until 1996, as shown in Table 1. However it is not the first WOCE work in the Indian Ocean; Australian, British, French, and German researchers have all been and will continue to be active in the region. A list of known WOCE and WOCE-related programmes is given in Table 2 and shown in Figure 1.

The US will be responsible for most of the one-time hydrography, but considerable effort has been made to ensure that other nations' work is coordinated. Thus, the British and Australians will be sampling within the ACC at the same time as the US samples I8S and I9S. Section S4 between 20°E and 120°E does not form part of the US expedition, but has been proposed separately for the 1995/96 austral summer. Of the lines originally proposed for the Indian Ocean, only I5 remains uncommitted; the French intend proposing an occupation of the complete line in 1996, which will mean both end sections are occupied twice.

Repeat hydrography is not as well-covered as required by the international WOCE plan. German and Australian scientists have worked in the Arabian Sea and south of Sri Lanka. Three more cruises along portions of IRl and IR3 are planned for 1996 on the Meteor. The Australians will carry out repeat hydrography near Sri Lanka and in the North Australian Basin. Further work in the Perth Basin

Table 1. Latest cruise schedule for US WOCE work in the Indian Ocean (supplied by D. Moller, WHOI)

Legs	Ports	Dates (1994– 1995)	PI
Transit	Brindisi– Fremantle	29 September– 25 October 1994	
I8S, I9S	Fremantle– Fremantle	1 December– 19 January 1995	McCartney
19N	Fremantle– Colombo	24 January– 6 March	Gordon
I8N, I5E	Colombo– Fremantle	10 March– 16 April	Talley
I3	Fremantle– Port Louis	20 April– 7 June	Nowlin
I5W, I4	Port Louis– Port Louis	11 June– 11 July	Toole
I7N	Port Louis– Mattrah	15 July– 24 August	Olson
I1	Mattrah– Singapore	29 August– 18 October	Morrison
Service	Singapore	20 October– 4 November	
I10	Singapore– Singapore	6 November– 24 November	Bray
I2	Singapore– Mombasa	28 November– 19 January 1996	Johnson