



Institut für Meereskunde an der Universität Kiel

Forschungsbereich Ozeanzirkulation und Klima

Physikalische Ozeanographie II

Dr W Zenk

21 December 2003

Cruise Summary Report

Ship: **RRS DISCOVERY**

Dates: **8 – 21 December 2003**

Port Calls: **Fortaleza / Brazil and Rio de Janeiro / Brazil**

Institute: *Institut für Meereskunde an der Universität Kiel* (IfM)
also supported by the Southampton Oceanography Centre (SOC)

Number of Scientists: 9

Chief Scientist Officer: Walter Zenk

Principal Project: Contribution to the national German CLIVAR programme
Subproject B6: CLIVAR / marin

Support: *Bundesministerium für Bildung und Forschung, Berlin*

Research area: South Atlantic
– Brazil Basin – Vema Channel (Rio Grande Gap)

Scientific Team:

| IfM | SOC |
|----------------------|--------------------|
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1 Research Program

The equatorward abyssal flow of Antarctic Bottom Water represents an important branch of the global thermo-haline circulation. On the western side of the South Atlantic it compensates for the southward directed North Atlantic Deep Water. Fluctuations in the bottom water are therefore expected to interact with other limbs of the world-wide oceanic circulation. On its northbound flow Antarctic Bottom Water faces topographical constraints in form of submarine ridges. One of these is given by the Rio Grande Rise separating the Argentine Basin in the south from the Brazilian Basin in the north. Its zonal alignment is disrupted by a 600 meter deep gap called the Vema Channel. This south-north channel provides a natural choke point for property fluctuations and transports of bottom waters entering the Brazilian Basin.

Over thirty year-long bottom records from the Vema Channel depict a clear temperature increase from the beginning in the 1990. This trend has been repeatedly documented in observations from local CTD stations and moored thermometers. The prime objective of cruise DISCOVERY 276 was to install two near-bottom moorings on the sill of the Vema Channel as a continuation of this long-term time series. The expected new data set is planned to be recovered in 2005 by the German polar vessel POLARSTERN. Moored data in conjunction with on-side CTD casts, will be utilised to improve ocean circulation simulations.

In addition the long meridional cruise track between North Brazil and the Vema Channel was used as a pilot study for the collection of hydrographic data with quasi-online transmission to the European MERSEA consortium. Surface and in-situ data were implemented on land as parameters for real-time simulations of the state of the ocean.

2 Narrative of the Cruise

As planned months ahead of time, the Royal Research Ship DISCOVERY left Fortaleza, Ceará, Brazil on 8 December 2003 at 0900L. The previous day an IfM owned container with mooring equipment had been loaded and fixed on the stern of the ship. Major difficulties were encountered when further instrumentation, that had been air-shipped from Durban, South Africa to Fortaleza, was unavailable to us. In view of a local holiday it was impossible to predict when the transit freight would be delivered to the ship. The Principle Scientist decided to abandon plans to use an acoustic Doppler profiler for operation in the Vema Channel.

Under favourable weather conditions DISCOVERY sailed eastward around *Cabo Branco*, the eastern most corner of Brazil. For the next 4½ days we cruised on an almost southerly course to the northern end of a CTD section (DISCOVERY Sta. No. 15234). A cruise track is depicted in Figure 1.

After we had left the Exclusive Economic Zone (EEZ) of Brazil on the morning of 11 December, we started our data transmission to the CORIOLIS centre in Brest, France. From then on we delivered surface and selected in-situ data sets on a daily schedule. The information was made available in near-real time after transmission via in the GTS (Global Telemetry System) of the World Meteorological Organisation (WMO). The southward track was interrupted once for a test station (No. 12533) after leaving the EEZ off Brazil. The station inventory is given in Table 1.

On 13 December 2100L DISCOVERY started the CTD section across the southern end of the Brazilian Basin. This is the location where the equatorward spreading Antarctic Bottom Water, once through the Vema Channel, reaches the deepest part (depth > 5000 m)

of the Brazilian Basin. The CTD section consisted of eight stations and was finished two days later on the southern bank of the Vema Extension. During the World Ocean Circulation Experiment (WOCE) a current meter mooring had been deployed here for a year.

After following a direct course to the Vema Channel (called the Rio Grande Passage on international sea charts) we reached the sill area early on the morning of 17 December. An initial CTD station in the Vema Sill had to be cancelled due to strong winds of over 50 knots. After the wind had dropped two sub-surface moorings were deployed at the gateway to the Vema Channel. They will record currents and temperature and salinity fluctuations in the Antarctic Bottom Water for at least the next 18 months. We plan to recover the moored instruments with the German research vessel POLARSTERN. The canceled CTD station in the coldest core of the Vema Channel was shifted to the afternoon before we left the site (No. 15244).

While in the Vema Channel area we communicate repeatedly with LT C M Vladimir from the Brazilian Navy and other parties in Kiel, Southampton, Hamburg, and Rio. We made arrangements for the transportation of some mooring equipment from IfM Kiel that had been found some weeks earlier on a shore site south of Salvador. The Navy had move the stranded gear to Rio where DISCOVERY took the opportunity to return it in the empty IfM container back to Europe.

Before re-entering the Brazilian EEZ again, we made use of the remaining time including one reserve day. We took another CTD section at the northern outskirts of the Santos Plateau (No. 15245-51). This area is known as a secondary overflow region for bottom water from the Argentine Basin. After completion of the Santos section on the late afternoon of 19 December 2003 1700L DISCOVERY finished all scientific observations and made for Rio de Janeiro.

A festive and joyful multi-course christmas dinner on that evening was tempered by an unexpected message from England: We learned that ten crew members of the DISCOVERY who were supposed to relieve their colleagues on board, were deported from Brazil at the airport in Rio immediately after landing. While the reasons for this astonishing event remained obscure, the crew members concerned on board faced the fact that they would be unable to celebrate christmas with their folks at home.

DISCOVERY reached Rio on the morning of 21 December 2003. The scientific party disembarked the next day. The ship left port for Glasgow, Scotland, on 26 December.

3 Acknowledgements

The chief scientist and his team would like to thank cordially Kapitän Robin Plumley and his crew for the warm welcome and excellent co-operation on board. Financial support came from the *Ministerium für Bildung und Forschung* in Berlin. This cruise was a German contribution to the international climate variability and predictability (CLIVAR) programme of the World Meteorological Organisation (WMO). In Germany is coordinated by E Fahrbach from the *Alfred-Wegener-Institut* in Bremerhaven. Barter time on RRS DISCOVERY was arranged by agencies in the UK (NERC RSU) and in Germany.

Cruise Track DISCOVERY 276, Status: 18-Dec-2003 11:3

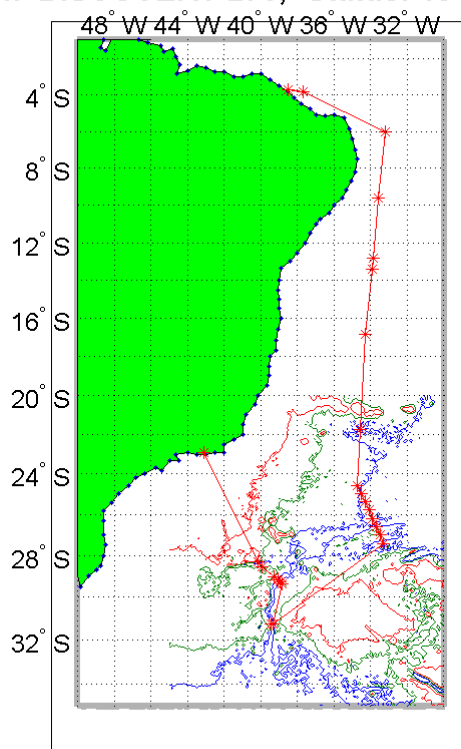


Figure 1: Track chart of DISCOVERY cruise 276 between Fortaleza and Rio de Janeiro, 8 – 21 December 2003. Selected contour interval in the wider Vema region denote isobaths 3000 (red), 4000 (green) and 4500 m (blue).

Table 1: Mooring Activities

| | Sta No. | IFM No. | Date 2003 | Latitude South | Longitude West | Depth (m) | Instr. Type | Remarks incl. planned instr. depth |
|------|--------------------|--------------------|----------------------|---------------------------|---------------------------|----------------------|------------------------|---|
| East | 15242 | V 438-01 | 17 Dec ↓ | 31° 15.28' | 39° 18.97' | 4535 | Argos | ID 2264 @3178m |
| | | | | | | | MC | S/N 2484 @3221m |
| | | | | | | | RCM 8 | S/N 9322 @3222m |
| | | | | | | | MC | S/N 2485 @3973m |
| | | | | | | | RCM 8 | S/N 10074 @3974m |
| | | | | | | | MC | S/N 1284 @4298m |
| | | | | | | | RCM 8 | S/N 10504 @4299m |
| | | | | | | | MC | S/N 1286 @4515m |
| | | | | | | | RCM 8 | S/N 9311 @4517m |
| West | 15243 | V 439-01 | 17 Dec ↓ | 31° 15.78' | 39° 26.87' | 4453 | Argos | ID 2262 @3217m |
| | | | | | | | MTD | S/N 36 @3217m |
| | | | | | | | RCM 8 | S/N 10658 @3259m |
| | | | | | | | MTD | S/N 40 @3475m |
| | | | | | | | RCM 8 | S/N 12004 @4012m |
| | | | | | | | RCM 8 | S/N 10500 @4336m |
| | | | | | | | MTD | S/N 37 @4362m |

Abbreviations

| | |
|-------|------------------------------|
| RCM 8 | Aanderaa Current Meter RCM 8 |
| MC | MicroCat - moored CTD logger |
| MTD | Mini TD - moored T-p logger |
| Argos | Watch dog buoy |
| S/N | Serial number of instrument |
| ↓ | Deployment |

Appendix:

DISCOVERY 276

Station List and Sample Log

Status: 20-DEC-2003

| Date Year 2003 MM DD | Time GMT hhmm | Station | Cast | Latitude North DD MM.MM | Longitude East DD MM.MM | Water depth m | Instr. depth m | Instr. type | Samples/ remarks |
|----------------------------|---------------------|---------|------|-------------------------------|-------------------------------|---------------------|----------------------|----------------|--|
| 12 08 | 0900 | -9 | -9 | | | -9 | -9 | -9 | Sail from Fortaleza |
| 12 08 | 2200 | -9 | -9 | | | -9 | -9 | 3 | Start vmADCP |
| 12 11 | 1304 | -9 | -9 | -13 24 50 | -33 55.57 | 4677 | 1000 | -9 | Release test SN: 350, 107 |
| 12 11 | 1415 | -9 | -9 | -13 24 79 | -33 55.18 | 4663 | 1000 | -9 | Release test SN: 351, 095 |
| 12 11 | 1540 | 15233 | 00 | -13 24 88 | -33 54.77 | 4712 | 1016 | 2 | SBE, calibration MC (SN:1284,1286, 2484, 2485), MTD (36,37,40) |
| 12 14 | 0001 | 15234 | 01 | -24 33 78 | -34 43.13 | 4355 | 4361 | 2 | SBE |
| 12 14 | 0544 | 15235 | 02 | -24 58.02 | -34 30.13 | 4558 | 4553 | 2 | SBE |
| 12 14 | 1137 | 15236 | 03 | -25 23.03 | -34 17.92 | 4628 | 4630 | 2 | SBE |
| 12 14 | 1718 | 15237 | 04 | -25 45.93 | -34 05.99 | 4666 | 4670 | 2 | SBE |
| 12 14 | 2340 | 15238 | 05 | -26 11.84 | -33 54.11 | 4608 | 4608 | 2 | SBE |
| 12 15 | 0511 | 15239 | 06 | -26 36.20 | -33 41.99 | 4525 | 4550 | 2 | SBE |
| 12 15 | 1110 | 15240 | 07 | -27 00.84 | -33 29.60 | 4225 | 4230 | 2 | SBE |
| 12 15 | 1633 | 15241 | 08 | -27 24.98 | -33 17.03 | 4661 | 4693 | 2 | SBE |
| 12 17 | 1157 | 15242 | -9 | -31 11.6 | -39 16.7 | 4575 | 4579 | 1 | Deployment V438-1 |
| 12 17 | 1614 | 15243 | -9 | -31 13.3 | -39 25.9 | 4453 | 4399 | 1 | Deployment V439-1 |
| 12 17 | 2139 | 15244 | 09 | -31 11.91 | -39 19.91 | 4496 | 4515 | 2 | SBE |
| 12 18 | 1021 | 15245 | 10 | -29 22.44 | -38 50.73 | 4260 | 4259 | 2 | SBE |
| 12 18 | 1412 | 15246 | 11 | -29 15.38 | -38 58.69 | 4631 | 4675 | 2 | SBE |
| 12 18 | 1813 | 15247 | 12 | -29 11.39 | -39 03.91 | 4689 | 4741 | 2 | SBE |
| 12 18 | 2330 | 15248 | 13 | -29 00.30 | -39 17.30 | 4049 | 4053 | 2 | SBE |
| 12 19 | 0413 | 15249 | 14 | -28 47.15 | -39 34.70 | 3932 | 3955 | 2 | SBE |
| 12 19 | 0930 | 15250 | 15 | -28 31.55 | -39 54.83 | 4061 | 4083 | 2 | SBE |
| 12 19 | 1305 | 15251 | 16 | -28 26.14 | -40 01.89 | 4231 | 4263 | 2 | SBE |
| 12 19 | 1658 | 15252 | 17 | -28 19.33 | -40 10.88 | 4545 | 4527 | 2 | SBE |

List of abbreviations:

Mooring: 1
 CTD: 2 SBE 10x12 l bottle rosette sampler
 VmADCP: 3
 MC Microcat moorer CTD recorder
 MTD Mini TD moored temperature / pressure logger
 -9 dummy value