northern Irminger Basin. These were deployed by John Lazier from the Meteor this November. While it is too early to report results from these deployments, this may be a useful pilot experiment for WOCE attempts to monitor the Atlantic Subarctic gyre using floats.

### References


Davis, R.E., P.D. Killworth, and J.R. Blundell, 1994: Comparison of ALACE and FRAM results in the South Atlantic. J. Geophys. Res. (submitted).

Davis, R.E., D.C. Webb, L.A. Regier, and J. Dufour, 1991: The Autonomous Lagrangian Circulation Explorer (ALACE). J. Atmosph. Oceanic Techn., 9, 264–285.

Firing, E., 1987: Deep zonal jets in the central equatorial Pacific. J. Mar. Res., 45, 791–812.

Riser, S.C., 1995: New Lagrangian measurements of the flow filed at mid-depth in the western North Pacific. Abstract of talk to be given to IAPSO, August 1995.

Semtner, A.J., and R.M. Chervin, 1992: Ocean general circulation from a global eddy-resolving model. J. Geophys. Res., 97, 5493–5550.


# RAFOS Floats in the Antarctic Intermediate Water of the South Atlantic


*Olaf Boebel and Claudia Schmid, Institut für Meereskunde, Universität Kiel, 24103 Kiel, Germany*


## The Antarctic Intermediate Water

The Antarctic Intermediate Water (AAIW) extends from the subtropical South Atlantic into the North Atlantic reaching as far north as 20°N. It is found at latitude dependent core depths ranging from 700 m to 900 m and may be distinguished from the Central Water above and the North Atlantic Deep Water below by its distinctive salinity minimum and oxygen maximum. The site of formation is supposedly close to the Polar Front, but the import of AAIW through the Drake Passage from the Southeastern Pacific is also a possibility (McCartney, 1977). The possible pathways of the AAIW to the North at intermediate latitudes in the South Atlantic have been studied to a great extent. Reid (1989) discussed both the idea of a continuous flow of AAIW along the western boundary, as suggested by Wüst (1935), and the possibility of an anticyclonic flow underneath the subtropical anticyclonic gyre. According to Taft (1963) and Buscaglia (1971) AAIW would then depart eastward from the western boundary around 40°S and return to the western continental shelf at 25°S. However, no direct observations proving such a subtropical recirculation cell existed to date.

The description of the advection of the AAIW is the major research objective of the IfM Kiel 'RAFOS float' project in the South Atlantic. The project is incorporated in the Deep Basin Experiment (Hogg, 1994) in the framework of the WOCE Core Project 3.

## RAFOS floats

RAFOS floats are well suited to explore the drift of this water mass. These Lagrangian drifters float freely at a predetermined depth. They house a microcomputer that determines the float's position by acoustic tracking and measures pressure (p) and temperature (T) once a day. The acoustic tracking is achieved by measuring the times of arrivals (TOA) of coded sound signals transmitted by moored sound sources. The data quintuplet (p,T,3xTOA) is stored and subsequently transmitted to Kiel through the ARGOS satellite system, once the float has returned to the sea surface. The underwater mission may last for up to two years. Trajectories obtained so far from 17 floats (Fig. 1) launched during Meteor cruise 22 (M22) show a mean flow

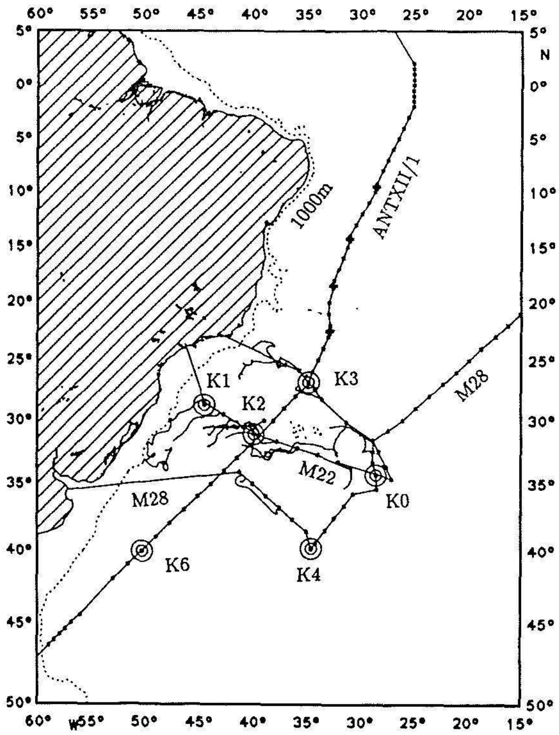


*Figure 1. Western South Atlantic with 1000 m isobath (dashed line). Solid curves: float trajectories launched during M22. Open circles: sound source positions. Asterisks: launch positions of floats. M22 (12/1992), M28 (5/1994), ANT XII/1 (11/1994).*

of 5 cm/s in predominantly western directions between 25°S and 32°S. Data obtained by R. Davis farther south using Autonomous Lagrangian Current Explorer (ALACE floats), however, depict a strong eastward flow at 40°S. Thus, for a working hypothesis, the assumption of the centre of a recirculation cell of AAIW at 36°S is reasonable and was used for the determination of the sound source position and float deployment pattern during the Meteor cruise 28 (M28) and the Polarstern cruise ANT XII/1.

## The Polarstern cruise ANT XII/1

During the Polarstern cruise ANT XII/1 from Bremerhaven to Punta Arenas in November 1994 the last of three RAFOS float seedings in the area was performed by IfM Kiel. During the previous expeditions M22 (December 1992) and M28 (May 1994), 23 and 29 floats were seeded, respectively (Fig. 1). During ANT XII/1 a total of 42 RAFOS floats were deployed, one at every degree of latitude, covering the western South Atlantic from the equator to 39°S. The floats were programmed to mission lengths ranging from 361 days (1 year) to 721 days (2 years). This results in a total of 52 float years or an average under-water mission length of 14.8 month per float. A total of 43 CTD casts were taken during ANT XII/1 to determine the depth of the AAIW core. This information was used to individually ballast each float to reach neutral buoyancy at the depth of the salinity minimum of the AAIW (Fig. 2).

The CTD was used in conjunction with a 24-bottle (10l each) rosette sampler to draw water from different water masses in order to provide the organic (G. Kattner, AWI, Bremerhaven) and inorganic chemists (J. Butler, NOAA, Boulder) on board with samples. At 7 stations, deep hydrocasts were taken to at least 3000 m. The majority of the casts however, were terminated at 1500 m, after covering the AAIW layer. Fig. 2 shows the salinity section obtained from raw data. One can clearly observe the salinity minimum of the AAIW ranging from 40°S to 20°N. The AAIW tongue ceases at 20°N where it faces high salinity water from the North. At 40°S a possible formation area of AAIW is indicated by an outcrop of isohalines. Here, the lowest salinities during the whole cruise were observed. The salinity minimum of the AAIW rises slowly from approximately 950 dbar at 37°S to 700 dbar at the equator.

In addition to the Kiel RAFOS floats, 8 ALACE floats were launched for R. Davis, R. Peterson and W. White (Scripps Institution of Oceanography) south of 40°S. These instruments operate independently of sound coverage by cycling between surface and drifting depth on a 10 day schedule. Thus, the area observed by drifters is extended southward into the Falkland Current. Furthermore, 29 MARVOR floats seeded during this cruise by M. Ollitrault and his group (IFREMER, Brest) will improve the knowledge of diffusivity and advection in the area. These floats were seeded between 2°N to 2°S crossing the equator at 25°W and in four batches of five floats, arranged in a cross pattern of about 40 km side length to study diffusivity. These instruments actively ballast themselves to approximately 800 dbar. To observe the motion of the thermocline water, surface drifters drogued at 100 m were provided by W. Krauss (IfM, Kiel). On a number of previous expeditions a total of 150 drifters were deployed in the South Atlantic. During this cruise, additional 35 drifters were seeded between 2°S and 46°S at positions uncovered so far by surface drifter trajectories.

Finally, the existing sound source array was extended to the South. During M22, four sound sources (K0-K3) were deployed around the Rio Grande Rise in addition to an American sound source array deployed farther north in the Brazilian Basin. During M28 K0 was replaced and IfM Kiel added another in the western Argentine Basin at 40°03.14S 50°08.54W (Fig. 1) and enlarges the area covered by sound signals to the

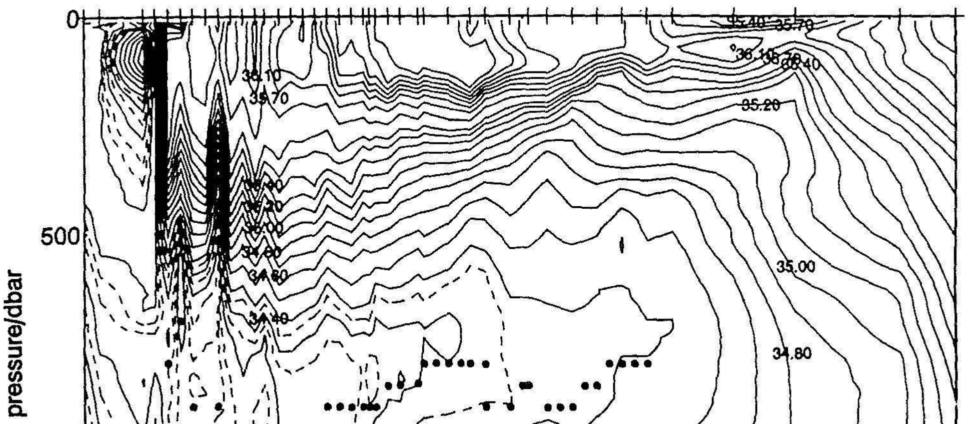


*Figure 2. Section of salinity based on preliminary data, obtained by CTD-casts taken during ANT XII/1. The bullets represent launch positions of RAFOS floats at their target depth.*

South in order to track floats caught in the recirculating branch of the AAIW.

## Acknowledgement

With pleasure we acknowledge the technical assistance of U. Huenninghaus and P. Meyer in the preparation of the floats. The officers and crews of FS Polarstern substantially contributed to the success of this project. We appreciate the support of Deutsche Forschungsgemeinschaft (DFG) and the Bundesministerium für Forschung und Technologie (BMFT).

## References

Buscaglia, J.L., 1971: On the circulation of the Intermediate Water in the southwestern Atlantic Ocean. J. Mar. Res. 29, 245–255.

Hogg, N., 1994: Status of the Deep Basin Experiment. Intern. WOCE Newsl. 17, 5-6.

McCartney, M.S., 1977: Subantarctic Mode Water. In: A voyage of Discovery, edited by M. Angel, 103–119.

Reid, J.L., 1989: On the total geostrophic circulation of the South Atlantic Ocean: Flow patterns, tracers and transports. Progr. Oceanogr., 23, 149–244.

Taft, B.A., 1963: Distribution of salinity and dissolved oxygen on surfaces of uniform potential specific volume in the South Atlantic, South Pacific, and Indian Oceans. J. Mar. Res., 21(2), 129–146.

Wüst, G., 1935: Schichtung und Zirkulation des Atlantischen Ozeans, Die Stratosphäre. In: Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition auf dem Forschungs- und Vermessungsschiff "Meteor" 1925-1927, 6. Lieferung 1. Teil, 2, 180pp. (The stratosphere of the Atlantic Ocean, W.J. Emery, editor, Amerind Publishing, New Delhi, 112pp, 1980).

# Meridional Transport Estimates for the Northern North Atlantic

*Manfred Bersch and Jens Meincke, Institut für Meereskunde, Universität Hamburg, 22529 Hamburg, Germany*

On Meteor cruise 18 between 2 and 22 September 1991 two sections with hydrographic and current measurements were run from Reykjavik to Cape Farvel at the southern tip of Greenland and from Cape Farvel to the Porcupine Bank off the Irish coast (WOCE section A1E/AR7E). The continuous current measurements were performed with a ship-mounted Acoustic Doppler Current Profiler (ADCP) with a transducer frequency of 153.6 kHz, reaching a maximum depth of about 450 m. The ADCP data, sampled during intervals of 4 minutes, were corrected for the ship velocity, misalignment and scaling effects, and tidal motion. Temporal averaging between pairs of CTD stations increases the accuracy of the derived velocities from about 30 cm/s for a single profile to about 3.6 cm/s for a section segment.

Fig. 1 shows the horizontal structure of the derived flow field of the upper 500 m along both sections. West of the Reykjanes Ridge, in the Irminger Sea, the highest velocities of about 20 cm/s are associated with the East Greenland Current, following the isobaths of the continental

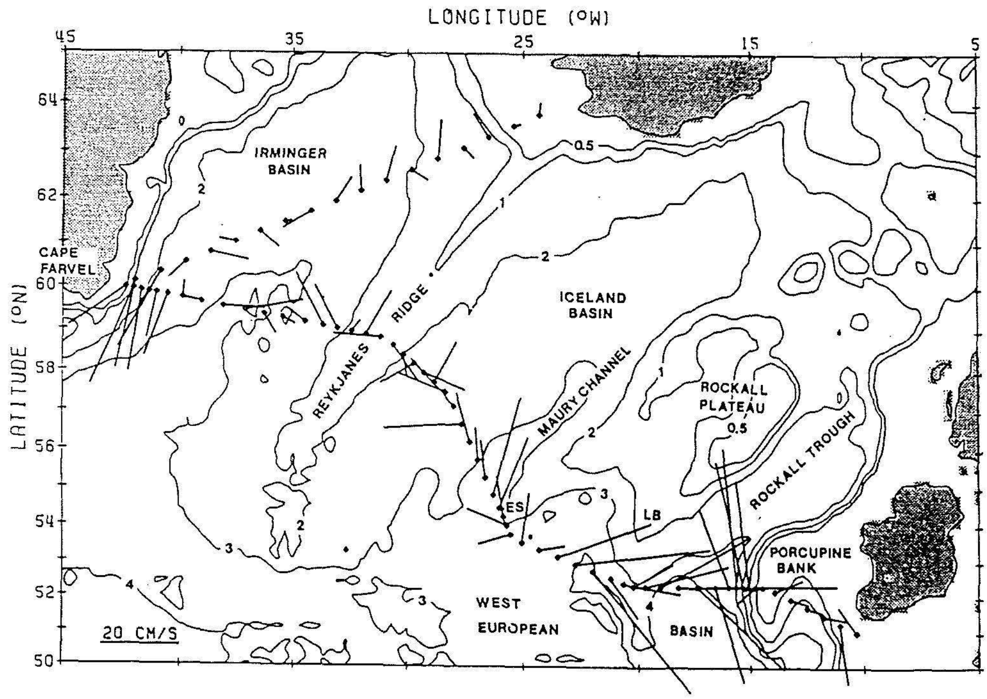


*Figure 1. Geographical distribution of the corrected water velocity from ADCP measurements along the Greenland-Iceland and Greenland-Ireland sections, averaged horizontally (between the CTD stations on the southern section) and between 70 and 350 m depth. The bases of the velocity vectors are marked by dots. Bottom topography is in km. ES: Eriador Seamount, LB: Lorien Bank.*