

P10.16 HYDROGRAPHIC STRUCTURE OF THE UPPER OCEAN FROM DRONNING MAUD LAND
COAST, ANTARCTICA TO 30°S DURING AUSTRAL SUMMER, 1988

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1. INTRODUCTION

The Southern Ocean assumes greater importance recently in connection with the planning of World Ocean Circulation Experiment (WOCE) due to its role in the formation of Bottom Waters near the Antarctica coast contributing to the abyssal circulation of the world ocean and large scale export of heat to the atmosphere (WCP/ ICSU/ WMO Report, 1985). The presence of meanders and eddies near the frontal zones of the Southern Ocean further affects the meridional heat flux. The coverage of regional studies is not uniform in the Indian Ocean sector of the Southern Ocean. Studies on frontal morphology in this sector are concentrated in the area between South Africa and Antarctica, west of 30°E (Lutjeharms, 1985; Lutjeharms and Mc Quaid, 1986). Hydrographic observations taken as a part of Indian expeditions to Dronning Maud Land coast of Antarctica, east of 30°E, during few austral summer seasons, have helped to some extent in understanding the physical characteristics of the region (Ramaraju and Somayajulu, 1983; Nagvi, 1986). However, these surveys have not indicated mesoscale eddy nature in the hydrographic structure. In this paper, we show that not only Agulhas plateau but similar ones east of it like those of Crozet and Kerguelen in the southwestern Indian Ocean also have potential to generate instability in the Antarctic Circumpolar Current (ACC) and eddies based on the hydrographic data collected on board MV THULELAND during seventh Indian Antarctica expedition (February-March, 1988).

2. DATA AND METHODS OF ANALYSIS

Data on temperature and salinity were obtained through standard hydrocast operations carried out in the upper 1000m water column at 17 stations. Fig.1 shows the locations of these hydrographic stations. Salinity of water samples was estimated with the help of an on board salinometer (Autosal, Model: 8400; accuracy: ± 0.003 ppt). Normal dynamic computations were performed to derive the dynamic topography field and geostrophic circulation across the transect.

3. RESULTS AND DISCUSSION

The thermal structure in the upper 1000 m water column (Fig.2) suggests mainly the occurrence of two frontal zones - Antarctic Polar Front (APF) and Sub-Tropical Convergence (STC) - at 47°S and 42°S respectively, separated by an

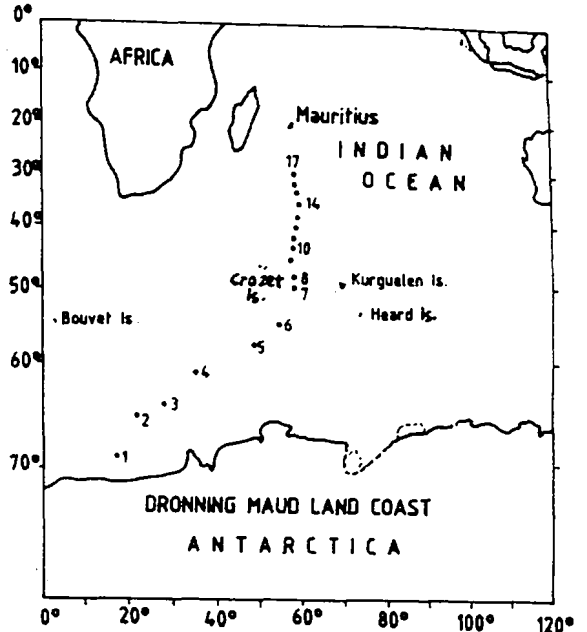


Fig.1 Locations of Hydrographic Stations

anomalous warm region (> 16°C). The subsurface temperature minimum seen prominently around 100 m depth near the Antarctica coast could be well traced up to 2000 km offshore. This coastal water sinks slowly northward to about 200 m depth and the orientation of 4°C isotherm seems to be the northern limit of the Antarctic Watermass. Earlier, Sievers and Emery (1978) have followed the most vertically oriented isotherm of 4°C as Sub-Antarctic Front (SAF) characterised with a sub-surface thermal gradient. However, it is not possible with the present resolution of stations to distinguish APF and SAF separately. The zone of first strong horizontal thermal gradient in surface waters encountered around station 8 while proceeding northward is considered as APF. The second zone of stronger thermal gradient near 42°S is taken as a representative of STC around which sea surface temperature increases from 12°C to 16°C.

The salinity structure (Fig.3) shows a strong saline gradient across STC where salinity increases from 34.1 to 35.6 ppt within a two degree latitudinal distance. A region of warm saline surface waters at station 9, south of STC, seems to be the result of the penetration of a warm core eddy into the area. Lutjeharms and Valentine (1988) in their studies on morphology of mesoscale eddies in the southwestern Indian Ocean have demonstra-

ted the occurrence of warm saline eddies south of STC due to the interaction of bottom topography of Agulhas plateau on ACC. The association of the present eddy

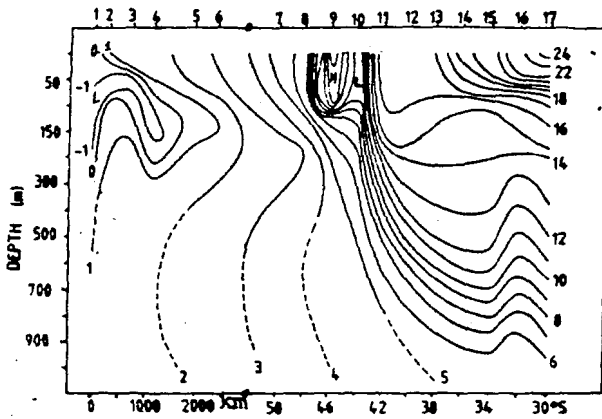


Fig.2 Thermal structure ($^{\circ}\text{C}$) along the transect

near Crozet Island further emphasises the role of topography of the eastern plateaus like those of Crozet and Kergulen to generate meanders in ACC and eddies then might be possible to be shed out of the meanders. The geostrophic current across the northern part of the transect between stations 7 and 17 (Fig.4) indicates a strong core of ACC ($> 8\text{ cm/s}$) in upper 200 m well away from the northern side of Crozet Island while at station: 7 nearer to the island, the ACC has been reduced nearly by half in its strength indicating the effect of the Crozet plateau on the zonal circulation. Recent

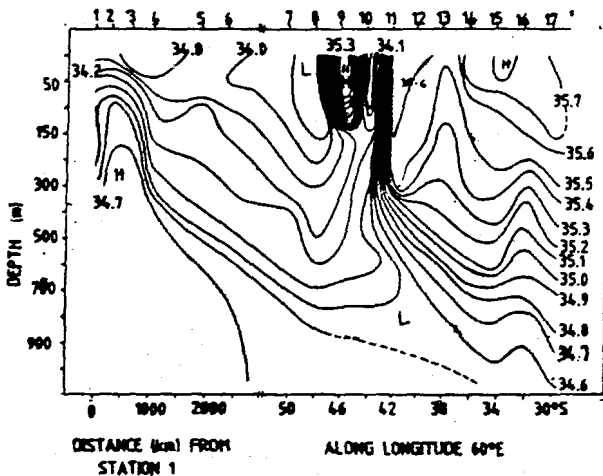


Fig. 3 Salinity structure (ppt) along the transect

studies of Park et al (1989) also indicate that the main path of ACC is encountered as a narrow vein, north of Kergulen plateau paving a way for the possible occurrence of meanders or eddies in the regional circulation. The presence of warm saline eddy at sea surface with a

north-south dimension of about 4°lat. further affects the sensible heat flux as seen from figure 5.

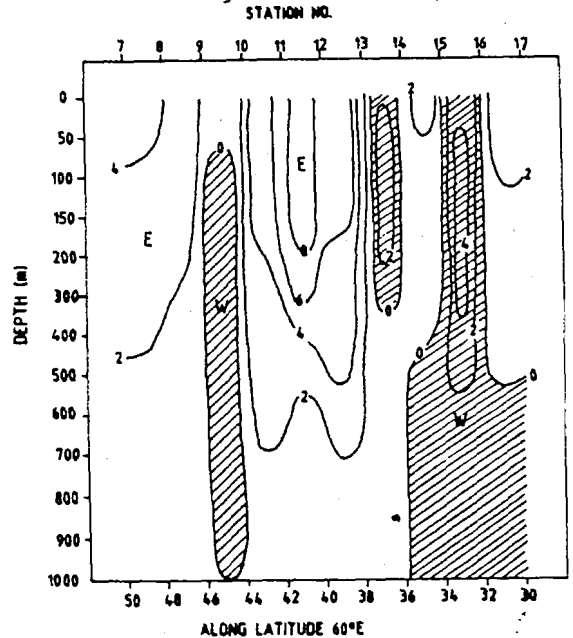


Fig.4 Geostrophic Current (cm/s) w.r.t. 1000 db surface.

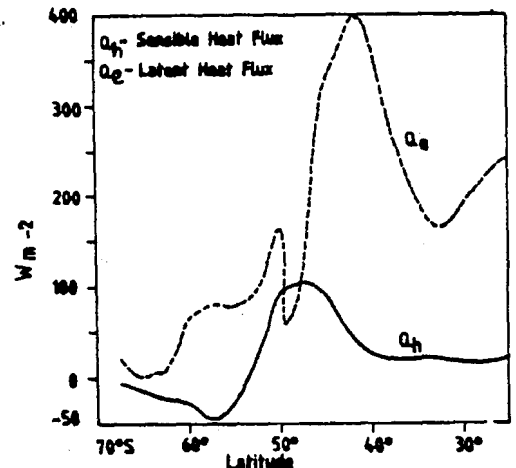


Fig.5 Sensible and latent heat fluxes (w/m^2) along the transect

It is necessary to ascertain the presence of eddy with satellite infrared imagery and the pictures are not available unfortunately in spite of our good efforts to procure them. From figures 2 and 3, we can identify in general three distinct watermasses along the transect as 1.) Cold and fresher surface waters (< 34.5 ppt) with sinking nature around 50°S 2.) Warm saline surface waters north of 40°S with greater vertical stability and 3.) Deeper warm saline (> 34.5 ppt) waters rising near 66°S . Intense vertical mixing has been inferred in the upper 300 m water column of the both Antarctic and subantarctic regimes from the super-

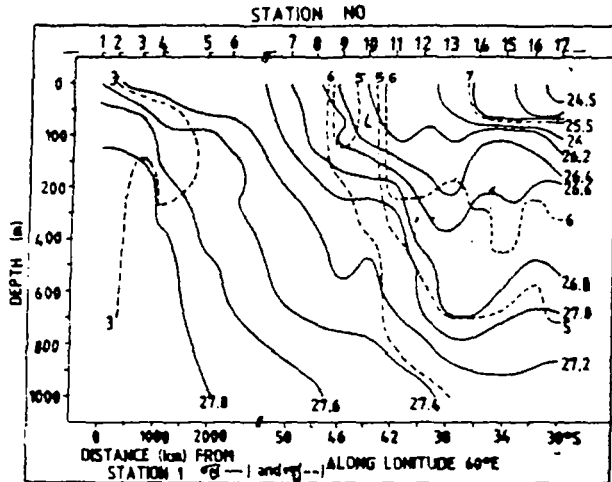


Fig.6 Structures of density flux function (---) and density (—) along the transect

imposition of density flux function lines (γ) over density field (σ_t) as seen from figure 6. North of STC, mixing across isopycnal surfaces is very much reduced.

4. ACKNOWLEDGEMENTS

We wish to thank Drs. B N Desai, J S Sastry and R Sengupta of the National Institute of Oceanography, India for their interest in this study. One of the authors (VRB) is grateful to the Department of Ocean Development, Government of India, New Delhi for giving an opportunity to take part in the seventh Indian Antarctica expedition.

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