The South African SIBEX I Cruise to the Prydz Bay region, 1984: IV. Silica, dissolved oxygen, and trace metals

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Preliminary results on the distribution of silicate and oxygen concentrations in the SIBEX I area are given and discussed.

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Results and Conclusions

A preliminary analysis of some of the SIBEX chemical data shows the following findings:–

Silica

An area of decreased silicate and increased oxygen near the bottom at depths of about 5000 m was found and tentatively identified as newly-formed Antarctic Bottom Water. The temperature and salinity data do not clearly indicate the presence of this water, but the chemical tracers show a distinct pattern. (Figs 1 and 2).

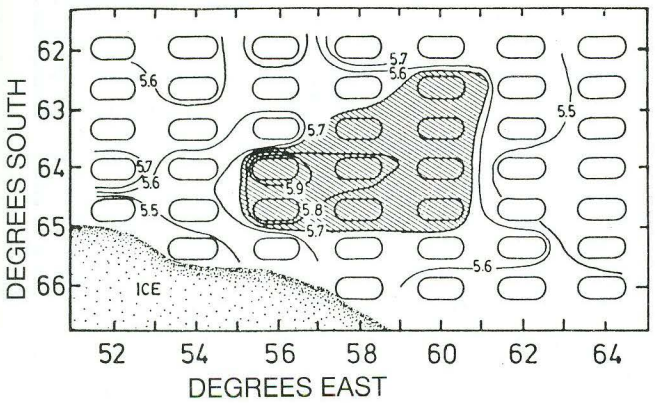

Fig. 1. Near-bottom dissolved oxygen (ml. ℓ^{-1}) (Area greater than 5.7 ml. ℓ^{-1} shaded)

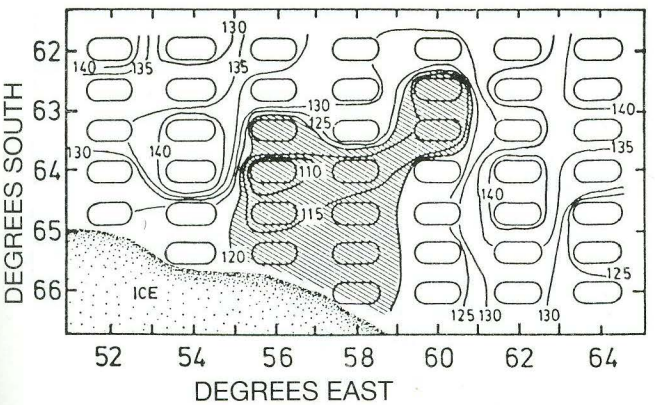

Fig. 2. Near-bottom silicate (μmol kg^{-1}) (Area with Si less than 120 μmol kg^{-1} shaded)

In the north, silicate in the upper mixer layer is always below 50 μmol kg^{-1} and the water is very well mixed, silicate showing little change with depth. This suggests that little uptake or regeneration is taking place. Below the mixed layer, silicate increases rapidly to exceed 82 μmol kg^{-1} at 350 m and below this increases more gradually with depth. Mixed layer silicates generally increase from north to south. The 50 μmol kg^{-1} silicate isoline appears useful for tracing water movements and, in the north, consistently delineates the lower limit of the mixed layer. From stations 2 to 8, the 50 μmol kg^{-1} isoline reaches the surface at 64°30′S and, to the south of this, an upward movement of silicate-rich Deep Water increases concentration in the upper mixed layer. In the south, silicate increased steadily with depth with no marked vertical gradients. There is evidence of downward penetration of silicate-poor water to at least 300 m at 65°S between stations 2 and 8 and stations 36 to 41, and also, to a lesser extent, between stations 23 and 29. In all cases, this downward movement was immediately south of the apparent upwelling of Deep Water.

Between stations 9 and 15, an area of higher silicate water at 64° – 65°S may indicate northward movement of the silicate-rich waters to the south.

Dissolved oxygen

Dissolved oxygen distribution was rather consistent over the grid with a few important exceptions. Oxygen values in the upper mixed layer were very constant (7,5 to 8,1 ml ℓ^{-1}) again indicating that very little photosynthesis or regeneration was taking place. Oxygen solubility tables do not extend below 0 °C, but suggest that the SIBEX oxygen values are near saturation. Below this, oxygen decreased sharply to 4,0 – 4,3 ml ℓ^{-1} and this delineates the bottom of the mixed layer over most of the area.

South of 64°30′S on the 64°E line (stations 2 to 8), oxygen-rich water penetrates to at least 300 m, and at 65°S, 300 m oxygen exceed 5,0 ml ℓ^{-1}, reaching 5,6 ml ℓ^{-1}, strongly suggesting that sinking occurs here. In the region where silicate indicates upwelling, the vertical gradient of oxygen is large. This indicates that the rising Deep Water has been ventilated, probably by storm action.

It is noteworthy that large chemical (oxygen and silicate) gradients occur in the Winter Water. However, a more detailed interpretation must await comparison with the physical oceanographic data.

Trace metals

Samples of sea water collected during SIBEX are now being analysed for trace metals. In addition, 176 biological samples were collected for the "scientific sea water" pump and from zooplankton hauls and are now being analysed for trace elements. These studies should assist in the interpretation of water mass movements.