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Influence of the Southern Ocean frontal system on surface temperature and salinity in the Atlantic sector during the middle Miocene

H. Kuhnert and T. Bickert

MARUM, Universität Bremen, Bremen, Germany (hkuhnert@uni-bremen.de)

The middle Miocene climate approximately 14 Ma ago was characterized by the glaciation of Antarctica, deep-ocean cooling and variations in the global carbon cycle. Although the Southern Ocean underwent significant oceanographic changes as well there is limited information on the past surface hydrography in the Antarctic Circumpolar Current (ACC) region north of the Polar Front. The formation of intermediate water masses in this region is sensitive to changes in surface temperature and salinity, adding to the ACC's significance in the global ocean circulation and ventilation. We have reconstructed surface temperatures and seawater δ^{18}O at ODP Site 1092 in the Polar Frontal Zone of the Atlantic sector of the Southern Ocean from foraminiferal (*Globigerina bulloides*) δ^{18}O and Mg/Ca. Our record covers the time period from 13.2 to 14.4 Ma. Sea surface cooling by $\sim$3 $^{\circ}$C and freshening indicated by the $\sim$1 ‰ reduction of seawater δ^{18}O ($\delta^{18}O_{sw}$) at 14.2 Ma precede the major step in Antarctic ice sheet growth at $\sim$13.9 Ma. This pattern qualitatively mirrors previous findings from the Pacific sector, and we interpret the surface hydrographic changes to reflect the circum-Antarctic northward shift of the Southern Ocean fronts and specifically at Site 1092 the passage of the Subantarctic Front (SAF). Provided that the sea surface density gradient across the SAF (higher density to the south) was already established during the Miocene it is possible to estimate salinity gradients and hence the lower boundary for the $\delta^{18}O_{sw}$: salinity relationship. The magnitude of change in reconstructed $\delta^{18}O_{sw}$ requires a $\delta^{18}O_{sw}$: salinity slope significantly higher than the modern value ($\sim$0.52 ‰ per salinity unit) and it probably exceeded 1.1 ‰ per salinity unit. This implies the Polar Frontal Zone was influenced by freshwater ultimately derived from precipitation on Antarctica.

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