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Evolution of $d^{13}C$ of Surface Water Masses in the Southeastern Indian Ocean Over the Last 50,000 Years

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The Southern Ocean (SO) is an important area for ocean-atmosphere CO_2 equilibration, being the principal location where wind driven overturning brings deep water to the surface as part of thermohaline circulation, and its accumulated load of "excess" respired CO_2 is released. The stable isotopic composition ($d^{13}C$) of this dissolved inorganic carbon (DIC) in the surface ocean reflects the balance between fractionation during dissolution from the atmosphere and the preferential uptake of the lighter isotope of carbon, ^{12}C, during photosynthetic fixation. The addition of respired DIC to the surface in polar reaches of the SO and its subsequent loss through atmospheric exchange results in a gradient of increasing $d^{13}C$ northward in SO surface water today that traces air-sea exchange and photosynthetic uptake. We have obtained a latitudinal transect (32° to 42° S) of 5 sediment cores from the Southeast Indian and Southern Ocean spanning the last 50 ka. We have determined the $d^{13}C$ for 3 species of planktonic foraminifera that live at differing depths (*Globigerina bulloides, Globoratalia inflata,* and *Globoratalia truncatulinoides*) to examine the $d^{13}C$ evolution of both surface and shallow subsurface waters across the last half glacial cycle. Holocene isotopic difference in the surface-dwelling *G. bulloides* between our northernmost and southernmost sites is ~1‰ with the southern core more enriched. This trend is opposite to that of DIC $d^{13}C$ in the modern SO, indicating that *G. bulloides* $d^{13}C$ in the southern sites are influenced by photosynthetic uptake. In the glaciation, the *G. bulloides* $d^{13}C$ difference between our northern and southern sites increased to 1.5‰, with the values in our southern cores about 0.5‰ and our northern cores of around -1.0‰. A carbon isotope minimum (CIM) during the deglaciation is present in all species, which we suggest reflects the upwelling of a ^{12}C-rich respired DIC pool from the deep ocean at the beginning of the deglaciation. The different timing of this CIM between the surface-dwelling *G. bulloides* and the two deeper dwelling species in our southern sites suggests partial re-entrainment of this DIC and a somewhat complicated pathway of release for respired- DIC that was trapped in the glacial deep SO.