Past changes in nutrient supply and utilization in the Southern Ocean from assemblage-specific Si isotopes in diatom opal

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We investigate variations of nutrient supply and consumption by diatoms in the Polar Frontal Zone of the Indian sector of the Southern Ocean since the last glaciation. Diatom stable silicon isotopes ($\delta^{30}Si$) are indicators of nutrient utilization in surface waters. However, reconstructions of past variations in utilization are often hampered by changes in diatom assemblages over time that can cause mixed (total) diatom $\delta^{30}Si$ changes due to species-specific fractionation effects that are unrelated to variations in consumption. To address this problem, we measured the $\delta^{30}Si$ of two distinct diatom assemblages separated from each sample: a pennate assemblage dominated by *Fragilariopsis kerguelensis*, and a centric assemblage dominated by *Thalassiosira lentiginosa*.

The $\delta^{30}Si$ records of both assemblages show distinct variations during the past ~30 kyr. The total diatom assemblage shows similar values around 1.7‰ during the Last Glacial Maximum (LGM) and Holocene and lowest values around 1.4‰ during the Deglacial. The pennate diatom assemblage $\delta^{30}Si$ remains stable around 1.8‰ over the entire time. In contrast, the centric diatom assemblage $\delta^{30}Si$ is always lower than the pennate assemblage and varies strongly between 0.7‰ during the Deglacial, 1.3‰ during the LGM and 1.5‰ during the Holocene.

Based on modern diatom seasonality, we suggest that the two assemblages represent two different phases of a seasonal diatom succession, whereby the pennate assemblage represents spring/summer conditions with maximum nutrient (Si) utilization and the centric assemblage represents a later summer/fall assemblage which feeds on a pre-utilized nutrient pool and which is more affected by processes in the deep mixed layer. The strong Si isotopic variations during the Deglacial indicate potentially large changes in the seasonal cycle of nutrient availability and consumption.