

Reconstruction of Southern Ocean paleo-temperatures based on hydroxylated GDGTs along with changes in dust deposition and export productivity

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A robust understanding of past oceanographic variability in the Southern Ocean is important because of its role in modulating global climate change. Here we reconstructed past sea surface temperature based on indices derived from isoprenoid glycerol dialkyl glycerol tetraethers (GDGTs), both non-hydroxylated and the more recently discovered hydroxylated ones, in a 500 kyr sediment record (core PS2489-2) from the Atlantic sector of the Southern Ocean. The GDGTs are cell membrane lipids synthesized by Archaea and some Bacteria. The glacial-interglacial oscillations in paleo-temperatures derived from non-hydroxylated and hydroxylated GDGTs throughout the past 500 kyr mirrored phytoplankton export productivity and varied in time with dust and IRD input. However, despite a good correspondence between the reconstructed temperatures and known glacial-interglacial features, the amplitude of glacial-interglacial change in our reconstructed temperatures was much larger than that derived from alkenone and foraminifera assemblage records. Especially the reconstructed glacial temperatures were lower compared to their alkenone and foraminifera derived counterparts. We discuss the possible contribution of an eolian or ice edge related provenance of the hydroxylated GDGTs, difference in the recording season between respective source organisms, differences in archaeal depth habitat in glacial and interglacial periods, and a shift in the recording and export depth between glacial and interglacials.