Maastrichtian-Rupelian paleoclimates in the southwest Pacific realm – a critical evaluation of biomarker paleothermometry and dinoflagellate cyst paleoecology at Ocean Drilling Program Site 1172

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Sea surface temperature (SST) reconstructions based on isoprenoid glycerol dialkyl glycerol tetraether (isoGDGT) distributions from the Eocene southwest (sw) Pacific Ocean are unequivocally warmer than can be reconciled with state-of-the-art fully coupled climate models. However, the SST signal preserved in sedimentary archives can be obscured by contributions of additional isoGDGT sources. We here use current proxy insights to assess the reliability of the isoGDGT-based SST signal in 69 newly analysed and 242 re-analysed samples covering the Maastrichtian to Oligocene from ODP Site 1172 (East Tasman Plateau, Australia) following state-of-the-art chromatographic techniques. We then reinterpret the record in context of paleo-environmental and paleoclimatologic reconstructions based on dinoflagellate cysts. Our ~130 kyr-resolution SST record reaffirms previous reconstructions of anomalous warmth in the early Eocene sw Pacific and remarkably cool conditions during the mid-Paleocene. Dinocyst diversity and temperature-sensitive taxa show a strong response to the local SST evolution, supporting the robustness of the marine biomarker record. In addition, the long-term isoGDGT and dinocyst records provide further support for an apparent temperature control on compositional changes of branched glycerol monoalkyl glycerol tetraethers (brGMGTs), recorded in the same samples.

Soil-derived branched GDGTs (brGDGTs) stored in the same sediments are used to reconstruct mean annual air temperature (MAAT) of the nearby land through the MBT5me proxy. General trends in SST and MAAT are similar, except for 1) an enigmatic absence of MAAT rise during the Paleocene-Eocene Thermal Maximum and Middle Eocene Climatic Optimum, and 2) a subdued middle–late Eocene MAAT cooling relative to SST. Both dinocyst assemblages and brGDGT indices (the isomerization index) suggest a mid-shelf depositional environment with strong river-runoff during the Paleocene-early Eocene, becoming more open marine thereafter. This trend reflects gradual drying and more seasonal precipitation regime in the northward drifting Australian hinterland. The overall correlation between dinocyst assemblages, biodiversity and SST changes suggests that temperature and associated environmental changes exert a strong influence on the surface-water ecosystem.