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Highly branched isoprenoid (HBI) biomarkers as an Antarctic sea-ice proxy in deep ocean glacial age sediments

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Antarctic sea-ice plays a primary role in the climate system, potentially modulating interhemispheric millennial-scale climate change and deglacial warming. Recently, microfossil proxy data have provided important insights into this potential forcing. However, additional proxies for glacial sea-ice reconstructions are required, to support the microfossil data and to control for potential preservation issues. We consider highly branched isoprenoids (HBIs) as a sea-ice proxy, building on earlier studies in the Arctic and Antarctic. This study focussed on measuring HBIs in glacial deposits in Southern Ocean deep ocean sediment cores. These deep-water sites provided a study location away from the local sea ice complexities associated with previously studied coastal and shallow water sites and, for the first time, allowed an evaluation of HBIs during several phases of glacial sea-ice variability inferred from microfossils. Down-core profiles of HBIs diene (II) and triene (III) were compared with diatom-based reconstructions of Antarctic sea-ice derived in three high-resolution sediment cores recovered from a transect across the Scotia Sea, Southwest Atlantic. High quality chronological control was achieved through a combination of abundance stratigraphy, relative geomagnetic palaeointensity data, and down-core magnetic susceptibility/ice core dust correlation. Positive correlations, observed between (II) and sea-ice presence, and a strong coupling between (III) and marginal ice zone conditions indicated that the two HBIs are both closely related to sea-ice edge dynamics. Strong down-core correlations between the HBIs indicate coeval sedimentation related to the summer breakdown of sea-ice melt-induced stratification. Combined, the two HBIs and diatoms demonstrated their potential as proxies for permanent sea-ice cover and sea-ice seasonality, two parameters poorly resolved in current climate models. The sea-ice reconstructions presented confirmed that HBIs are a viable proxy for glacial Antarctic sea-ice and sea ice dynamics back to at least 60 cal ka BP.