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Sulfur isotope compositions as a tracer of marine biogenic and terrestrial sulfate in the Skytrain Ice Core from 0 - 125 ka BP

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Analysis of the sulfur (S) isotope composition of ice cores represents a novel method to trace the variable sources of sulfate transported to Antarctica. Non-sea-salt (nss) sulfate is thought to be dominated by marine biogenic inputs, and relatively stable fluxes in the EPICA Dome C core have been interpreted to show that marine productivity around Antarctica remained constant between glacial and interglacial periods. However, recent work from Dome Fuji highlighted the possibility of a substantial terrestrial sulfate component during glacial periods. Building on this research, we present the first S isotope dataset covering an entire glacial cycle (0-125 ka BP) from the Skytrain Ice Rise in West Antarctica. We find that S isotope compositions are significantly depleted in the heavier isotope and show more variability during the Last Glacial compared to the Holocene or Last Interglacial period. The S isotope values also display linear relationships with water isotope ratios and nss-magnesium concentrations in the ice, suggesting a climate-driven increase in the flux of isotopically-light terrestrial sulfate during the Last Glacial. Given the relatively stable nss-sulfate concentrations in the Skytrain Ice Core, this increase in terrestrial sulfate potentially implies a significant reduction in the flux of marine biogenic sulfate, especially during the Last Glacial Maximum and Marine Isotope Stage 4. These findings provide new insights into the key controls on the sources of sulfate delivered to the West Antarctic Ice Sheet and a better understanding of how the S cycle interacts with the climate system over glacial-interglacial timescales.

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