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Tracing Archean sulfur across stitched lithospheric blocks

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Craton margins are loci for volatile exchange among lithospheric geochemical reservoirs during crust formation processes. Here, we seek to revolutionise the current understanding of the planetary flux and lithospheric transfer of volatiles during supercontinent formation by tracing sulfur from the atmosphere-hydrosphere through to the lithosphere during crust formation. To do so, we trace the transfer of sulfur by following mass independently fractionated sulfur at ancient tectonic boundaries has the potential to. Mass independent fractionation of sulfur (MIF-S) is a signature (quantified as $\Delta^{33}S$ and $\Delta^{36}S$) that is unique to the Archean sedimentary rock record and imparted to sulfur reservoirs that interacted with the oxygen-poor atmosphere before the Great Oxidation Event (GOE) at ca. 2.4 Ga. Here we present multiple sulfur isotopes from across a Proterozoic post-GOE orogenic belt, formed when Archean cratons were stitched together during supercontinent amalgamation. For the first time, multiple sulfur isotope data are presented spatially to elucidate volatile pathways across lithospheric blocks. Across the orogenic belt, the Proterozoic granitoid and hydrothermal rock records proximal to Archean cratons preserve values of $\Delta^{33}S$ up to +0.8‰ and a $\Delta^{33}S$-$\Delta^{36}S$ array of $^{-1}$.2, whereas magmatic and hydrothermal systems located more distally from the margin do not display any evidence of MIF-S. This is the first study to identify MIF-S in a Proterozoic orogen indicates that tectonic processes controlling lithospheric evolution and crust formation at tectonic boundaries are able to transfer sulfur from Archean supracrustal rock reservoirs to newly formed Proterozoic granitoid crust. The observation of MIF-S in the Proterozoic granitoid rock record has the potential to revolutionise our understanding of secular changes in the evolution of crust formation mechanisms through time.