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Widespread incorporation of surface-derived sulfur in Eoarchean rocks from Isua and Labrador

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The geodynamic mode during the Eoarchean is controversial. For instance, it is not clear yet, if and how volatiles cycled between crust and mantle. Multiple sulfur isotopes (^{32}S, ^{33}S, ^{34}S, ^{36}S) have been shown to be a powerful tool to trace the recycling of surface material into the mantle. In this study, we obtained bulk-rock multiple sulfur isotope data of >3.7 Ga rocks (serpentinites, magnesite, amphibolites, metasediments) from the Isua Supracrustal belt (ISB, SW Greenland), well characterized samples from the >3.7 Ga Nulliak assemblage (Labrador) [1], and from a pre-Uivak ultramafic body (Labrador) [1] to evaluate how widespread the mass independently fractionated sulfur (MIF-S) signature was incorporated. The metasedimentary rocks from the ISB yield Delta^{34}S of +1.1-+2.7 and large Cap delta^{33}S anomalies of up to +3.1, overlapping with previous studies. In combination with published data [2-3], the ultramafic and mafic samples from Isua have delta^{34}S spanning from -0.18 to +2.7 and Cap Delta^{33}S from -0.13 to +0.46. The d^{34}S, Cap Delta^{33}S and Cap Delta^{36}S data of the Nuliak suite and the pre-Uivak ultramafic body show incorporation of MIF-S. Overall, this indicates that both Eoarchean terrains show widespread incorporation of sulfur that has been processed at the surface. The magmatic rocks from Isua show a more pronounced D^{33}S signature than those from Labrador. These signatures indicate both hydrothermally processed sulfur as well as signatures derived from sedimentary pyrites. The occurrence of negative and positive delta^{33}S in different rock types sampled in close proximity indicates that the signature is primary and not redistributed from sedimentary units during metamorphism. Direct U-Pb dating of sulfides yielding non-zero Cap Delta^{33}S from >3.8 Ga peridotites south of the ISB reveals an Eoarchean origin [4], providing evidence that volatiles cycled within the crust-mantle system early, possibly during subduction-like processes.

[1] Ishikawa, A. et al. (2017) *GCA* 216, 286-211.
[2] Siedenberg, K. et al. (2016) *Precamb. Res.* 283, 1-12.
[3] Lewis, J. et al. (2023) *Chem. Geol.* 633, 121568.
[4] Lewis, J. et al. (2023) *Goldschmidt abstract, DOI: 10.7185/gold2023.17835.*