Multiple S isotopes record environmental changes in the 2 Ga Zaonega Fm

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Earth's initial oxygenation at ~2.3 Ga triggered a chain of events that ultimately led to redox changes in the atmosphere-ocean system. These changes increased continental weathering and the delivery of phosphate and sulphate into the oceans, thereby opening new niches for complex microbial communities. As proof of increasing seawater sulphate (SWS) concentraitons the first extensive evaporite deposits appear in the ~2 Ga Tulomozero Formation (TF) in the Onega basin, Russia. The TF carbonate associated sulphates (CAS) have relatively uniform $\delta^{34}S$ values of ~+10‰ (1), whereas the sedimentary pyrites of the overlying organic-rich Zaonega Fm (ZF) record a trend from negative $\delta^{34}S$ ~-10‰ to very positive $\delta^{34}S$ up to ~+40‰. This stratigraphic trend in S isotopes has been used to argue for an abrupt contraction of the SWS reservoir following its initial expansion (2). Though, importantly the ZF rocks were deposited in a magmatically active setting where basinal and/or post-depositional processes can significantly influence the geochemical nutrient and element cycling recorded in these rocks.

We have undertaken a high resolution multiple S isotope study, combined with major element geochemistry, mineralogy and detailed lithological descriptions to characterise the relationships between Paleoproterozoic sulphur cycling against the backdrop of global and/or local environmental changes by using recently drilled core material throughout the ZF. We further explore the application of minor S isotope ($\Delta^{33}S$ and $\Delta^{36}S$) relationships to assess the presence of different metabolic pathways, closed/open-system isotope behaviour and possible isolation of the basin.

[1]Reuschel, M. et al., 2012, Precambrian Research
[2]Scott, C. et al., 2014, EPSL