Sulfur isotopic evidence on the age of recycled surface material in the Tristan-Gough plume source

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The recycling hypothesis argues that mantle plumes contain recycled surface material of oceanic crust / sediments. To further our understanding of the geodynamic evolution of Earth's interior constraints are required on the time spent by such recycled material before it re-surfaces in mantle plume volcanism. Most geochemical tools fail because compositional variability masks age information. A new promising tool are multiple-sulfur isotopes. At present-day, processes modifying sulfur produce isotopic fractionations that depend on the relative mass differences between its different isotopes. In contrast, Archean/earliest Proterozoic sediments exhibit mass-independently fractionated sulfur isotopes (MIF-S) acquired through photochemical reactions in the oxygen-poor atmosphere. The persistence of recycled MIF-S through subduction and eventual rise in a mantle plume has been demonstrated for two South Pacific plumes [1,2]. Is such old surface material a common or rare component in plume sources?

Here we present sulfur isotopes of mineral-hosted sulfide inclusions from rocks related to the major 130 Ma-long-lived Tristan-Gough plume system with a root at the core-mantle boundary related to the African LLSVP. Preliminary data on 12 sulfide inclusions from 3 samples show negative $\delta^{34}S$ values from -6 ± 0.6 to slightly positive values of 0.7 ± 0.4 ‰ (2σ error) and $\Delta^{33}S$ of -0.18 to 0.17 (± 0.12). These data fall in the range of overlapping values between Archean and Proterozoic sediments and do not allow an unequivolcal assignment to an age group prior or post 2.45 Ga ago. Tristan sulfides overlap in $\delta^{34}S$ with Pitcairn whereas Gough is indistiguishable from MORB. We will present the full data set on eight additional samples with multiple sulfide inclusions. Constraints on the age of recycled surface sulfur in the Tristan-Gough plume source as well as the origin of the sulfur isotopic variability will be discussed and integrated with other geochemical tracers.

[1] Cabral *et al*. (2013) *Nature* **496**, 490-494. [2] Delavault *et al*. (2016) *PNAS* **113**, 12,952-12,956.