Iron isotope constraints on the lower mantle structure of the Samoan mantle plume

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Seismological studies have revealed large thermochemical structures (LLSVPs) in the lowermost mantle, variably inferred as piles of recycled material, the remnants of early Earth differentiation, or both. However, we lack the direct geochemical observations needed to constrain the role of mineralogical heterogeneity in the generation of these seismic anomalies.

The chemical distinction between the Vai and Malu volcanic chains in Samoa has been suggested to correspond to mantle plume zoning arising from plume source heterogeneity within the Pacific LLSVP. This model implies that magmas erupted along either chain are derived from mantle of contrasting mineralogy. However, the existing geochemical datasets indirectly constrain source history and do not trace mantle mineralogy. Since iron isotopes show mineral-specific fractionation effects, they offer an exciting opportunity to link radiogenic isotopic tracers of mantle source history (Pb, Nd etc.) with source mineralogy [1,2].

Here we utilise a suite of new Fe isotope data from the Vai and Malu chains to constrain the structure and mineralogical heterogeneity of the lower mantle and the entrainment of this material into mantle plumes. Samples have been selected from a range of subaerial and submarine volcanic centres with well-characterised radiogenic isotopic compositions that cover a range of Pb and Nd isotopic space. Despite well resolved Pb and Nd variability and the expectation of contrasting mantle mineralogy, preliminary data suggest little Fe isotope variability is observed in these Samoan basalts. With novel application of phase equilibria modelling, we quantify the constraints this places on the mineralogy in the source region of the Samoan plume.

[1] Williams & Bizimis (2014), *EPSL* 404, 396-407; [2] Konter et al., (2016), *EPSL* 450, 221-232.