Small scale Pb isotopic heterogeneity in the oceanic upper mantle observed in sulfides in abyssal peridotites.

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Recently, the isotopic analysis of peridotite sulfides, a trace phase in the mantle, has been demonstrated to provide a record of mantle Pb isotopic evolution [1,2,3].

1. Mantle sulfides in abyssal peridotites consist mainly of pentlandite, pyrrhotite and chalcopyrite with very low modal abundances of <0.03% [4] and highly variable Pb concentrations, 0.1-10 ppm [2]. We examine the Pb isotopic composition of the oceanic mantle by *in situ* analysis of Pb isotopes by the ion probe in peridotite sulfide grains from the Southwest Indian Ridge (SWIR), particularly the Oblique Segment and the Atlantis II Fracture Zone, and from the Gakkel Ridge in the Arctic Ocean. Samples from the SWIR and Gakkel Ridge contain sulfides with a range of compositions, corresponding to both residual mantle sulfides and those crystallized from melts percolating through the peridotite. Sulfides from the SWIR confirm the presence of ancient refractory material in the oceanic upper mantle. Gakkel Ridge sulfides show a large range of isotopic variability reflecting both pre-existing heterogeneity and the complicated nature of the melt- rock reaction process.

The Pb isotopic composition of sulfides confirms that the oceanic upper mantle is heterogeneous with both unradiogenic and radiogenic materials present. Sulfides show that peridotites generally cover a larger isotopic range than basalts from the same area. The occurrence of individual samples with a range of sulfide isotopic compositions suggests that melt-rock reaction can produce significant compositional heterogeneity in the upper mantle at relatively small length-scales. The large range in isotopic compositions among individual melts and the signature of refractory mantle components are averaged out when melts coalesce to produce basalts.

[1] Burton *et al* (2012) *Nature Geosciences* **5**, 570-573 [2] Warren & Shirey. (2012) *EPSL* **359-360**, 279-29 [3] Blusztajn *et al* (2014) *Geology* **42**, 159-162 [4] Luguet, *et al* (2003) *GCA* **67**, 1553-1570