

Sulfur recycling in subduction zones

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The $\delta^{34}\text{S}$ ratios in arc lavas range from ~ 0 to $+10$ ‰ (relative to Canyon Diablo Troilite) [1,2]. In contrast, mid-ocean ridge basalts (MORB) have $\delta^{34}\text{S}$ ratios plot in a more restricted range from -2 to 0 ‰ [3]. These differences between arc lavas and MORB may be the result of heavy sulfur derived from seawater in subducted sediments cycling through the mantle wedge and manifested into arc magmas. Equally possible is that the heavy sulfur in arc lavas may result from crustal or surface sulfate contamination.

To examine this issue, bulk rock (via GSMS) and individual sulfides (via SIMS) in subcontinental mantle peridotite xenoliths from Dish Hill California, Kilbourne Hole New Mexico, Simcoe Washington, and Ichinomegata Japan were analyzed for their sulfur isotope compositions. The Simcoe and Ichinomegata xenoliths have radiogenic $^{187}\text{Os}/^{188}\text{Os}$ isotopic compositions consistent with slab-derived Os that is presumably contained within their sulfides [4,5], whereas Dish Hill and Kilbourne Hole peridotites do not. The Dish Hill and Kilbourne Hole bulk rock acid volatile fractions and individual sulfides have $\delta^{34}\text{S}$ ranging -5 to $+1$ ‰ and -3 to $+1$ ‰, respectively, typical for subcontinental mantle peridotite elsewhere [6], and MORB. The $\delta^{34}\text{S}$ for Ichinomegata and Simcoe individual sulfides are on average systematically heavier ranging from -0.5 to $+3$ ‰. The bulk rock and bulk rock sulfate for all of the locales range from $\delta^{34}\text{S}$ of -2.3 to $+11$ ‰. The $\delta^{34}\text{S}$ individual sulfides from Ichinomegata and Simcoe are consistent with a scenario of metasomatism via slab derived components and confirm the mobility of sulfur during slab dehydration and melting. The bulk rock sulfate data have $\delta^{34}\text{S}$ typical of bulk rock data previously reported for peridotites and likely show a pervasive effect of surface alteration of the xenoliths.

[1] Alt *et al* (1993), *EPSL* **119**, 477-494 [2] deHoog *et al* (2001) *EPSL* **189**, 237-252 [3] Labidi *et al* (2012), *Chem. Geol.* **335**, 189-198 [4] Brandon *et al* (1996), *Science* **272**, 861-864 [5] Brandon *et al* (1999), *Chem. Geol.* **160**, 387-407 [6] Chaussidon and Lorand (1990), *GCA* **54**, 2835-2846