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Sulfur isotopic composition of garnet pyroxenite-hosted sulfides from Salt Lake Crater, O‘ahu: Insights into the source of rejuvenated melts

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Many Hawaiian volcanoes include a phase of rejuvenated volcanism that follows 0.5–2.5 Myr of quiescence after the shield stage. Rejuvenated-stage lavas are geochemically distinct, being enriched in incompatible elements yet characterized by depleted radiogenic isotope signatures[1]. This dichotomy leaves the process(es) responsible for generating these melts, and, indeed, the nature of the melted component(s) enigmatic[1]. As part of the rejuvenated volcanic stage, the Salt Lake Crater (SLC) vent on O‘ahu has erupted garnet pyroxenite xenoliths interpreted as high-pressure crystal fractionates from alkalic melts[1]. These deeply sourced xenoliths may provide critical physical and chemical constraints on the origin and nature of rejuvenated volcanism at Hawai‘i.

Sulfur (S) has four stable isotopes that enable fingerprinting of magmatic volatile processes and distinct melt-source components that may incompletely mix prior to eruption and crystallization[2]. Sulfides from SLC xenoliths occur both as inclusions and as an interstitial phase, potentially representing two distinct sulfide generations. We determined the major element composition of SLC sulfides by electron probe microanalysis, and measured the corresponding $^{33}S/^{32}S$ and $^{34}S/^{32}S$ ratios by secondary ion mass spectrometry. SLC sulfides have variable Ni (2.2–12.4 wt.%) and Cu (0.05–3.7 wt.%) content. No resolvable $\Delta^{33}S$ anomalies were observed (mean = 0.21 ± 0.71‰, 2SD, n=18), while, excluding an outlier (−6.3‰), $\delta^{34}S$ values ranged from −2.2‰ to +2.1‰. A possible compositional difference in $\delta^{34}S$ is observed between inclusion-hosted (median +0.36‰) and interstitial (median −0.75‰) sulfides; however, the difference between the medians approaches our 2σ analytical uncertainty (~1‰). Nevertheless, the $\delta^{34}S$ values of SLC sulfides overlap with those characteristic of mid-ocean ridge basalts[3,4] (−0.79 ± 0.87‰, 2SD) and ocean island basalts, such as Samoa[2,5–6] (1.6 ± 2.4‰, 2SD). This $\delta^{34}S$ distribution is consistent with mixing between a plume-derived mantle component and a depleted mantle reservoir, which may have contributed to the source of rejuvenated volcanism at O‘ahu.

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