Whole-Rock Fe Isotope Compositions as a Tool for Exploring the Origin and Alteration of Hawaiian Shield-Stage Lavas

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We report the most geographically extensive Hawaiian Fe isotope dataset to date with two primary goals: 1) to test the use of stable Fe isotopes as a tool to elucidate mantle processes (e.g., mixing of mantle plume components [1]); 2) to investigate whole-rock Fe isotope ratios as a record of primary igneous and secondary processes throughout the Hawaiian Islands. Hawai‘i is an excellent geological laboratory for assessing new isotopic methods as it is well-studied and geochemically characterized. Although there have been Fe isotope studies done on individual systems within Hawai‘i (e.g., the differentiation of Kīlauea Iki [2]) or focusing on mineral records of small-scale geochemical processes (e.g., diffusion recorded in olivine [3]), whole-rock Fe isotope compositions throughout the chain have not previously been measured and examined.

We analyzed 33 carefully selected samples of shield-stage tholeiitic basalt from 14 subaerial and submarine volcanoes already fully characterized geochemically (major and trace elements, Pb, Nd, Hf, Sr, and recently Tl isotopes) with both Kea and Loa trend compositions, spanning the past ~5 Ma. This allows us to assess whether δ^{56}Fe can potentially trace mineralogical differences in the source. Iron isotope results, reported to IRMM-14, range widely from a δ^{56}Fe (±2SD) of 0.07 ±0.10‰ to 0.54 ±0.01‰. Excluding five isotopically heavy samples from Mauna Kea, West Maui, Ko’olau Makapu’u, Wai‘anae, and West Ka‘ena, the range (0.07‰ to 0.23‰) is tighter and consistently higher than average MORB (~0.10‰). By considering the variations of the measured δ^{56}Fe across the islands and relationships between these new data and pre-existing geochemistry, we have established what the bulk Fe isotope ratios of oceanic island basalts can reliably elucidate about mantle, magmatic, and secondary geologic processes.

[1] Nebel et al. 2019 *EPSL* **521** p. 60-67. [2] Teng et al. 2009 *Science* **320** p. 1620-1622. [3] Teng et al. 2011 *EPSL* **308** p. 317-324.