Mantle Depleted Components Through Time and Space: Single or Multiple Compositions?

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Oceanic island basalts provide a direct window into mantle composition and the timescales associated with our dynamic Earth. Previous studies mainly focused on the shield volcanic stage and the enriched mantle components that are easily distinguished in those basalts. Mantle isotopically depleted compositions are typically more difficult to resolve unless large amounts of this material participated in mantle melting or unique processes allow for their compositions to be erupted undiluted, such as very small degrees of melting of a source with minimal fusible enriched components (e.g., rejuvenated basalts). Hawaiian basalts show depleted compositions for ~76 Myr that are not constant over time (e.g. the oldest Emperor Seamounts have lower $^{87}Sr/^{86}Sr$ and LILE concentrations than younger rejuvenated lavas). This suggests there are multiple Hawaiian depleted components that manifest during different periods of plume activity and that the composition of depleted components evolves during the lifetime of the plume, as has been observed for enriched components[1,2,3]. A comparison of Hawaiian with compiled data of rejuvenated basalts from Samoa, Society, Marquesas, Canary Islands, and Mauritius shows that their composition differs between oceanic basins, suggesting either that depleted components in the mantle vary in composition and with time (as enriched components do), or that the depleted composition is overprinted by the enriched components associated with each mantle plume. The lavas erupted at Marquesas, Society, and Mauritius present average isotopic compositions similar to those of prevalent mantle (PREMA) whereas Hawai‘i, Samoa, and the Canary Islands show much greater variation. Hawai‘i and Samoa are also the plumes with the highest buoyancy flux and seismic anomaly at depth[4]. We hypothesize that the plume strength may affect the amount of entrained depleted compositions of different time-integrated histories and that hotter, stronger plumes may supply the excess heat necessary to melt more refractory depleted components, controlling rejuvenated lava composition. [1] Harrison *et al* (2020) *Chem. Geol.* **532**, 119324 [2] Harrison *et al* (2017) *EPSL* **463**, 298-309 [3] Tanaka *et al* (2008) *EPSL* **265**, 450-465 [4] Jackson *et al* (2017) *Nature* **542**, 340-343.