A heterogeneous rejuvenated magma source in Kauai and Niihau, Hawaii

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We present new Hf and Pb isotope data on 72 previously characterized [1] lavas from the full eruptive history of Niihau, Kauai and North Arch Volcanic Field, which with Kaula form a transect across the Hawaiian island chain.

Early, shield-building (tholeiitic) lavas from Kauai and Niihau overlap in Nd-Hf-Sr-Pb isotopes, contrasting with the across-plume gradient seen in younger shield lavas elsewhere in the chain (LOA-KEA trends [2]). Their isotopes require the presence of a LOA-like component in the source, but are less isotopically extreme than other LOA volcanoes.

In contrast, late Kauai and Niihau rejuvenated lavas do not overlap in isotope spaces, and share common isotope characteristics with coeval lavas from nearby North Arch and Kaula, respectively. Both groups are distinct from shield lavas, with steep slopes in ε_{Nd} - ε_{Hf} (> 1.7). The high ε_{Hf} for a given ε_{Nd}, high $^{87}Sr/^{86}Sr$, and trace element systematics in the Niihau and Kaula lavas require contributions from both recycled, aged (> 1 Ga) lithosphere and a carbonatitic component with LOA characteristics. In contrast, Kauai and North Arch require mixing between a DMM-like component and an endmember below the ε_{Nd} - ε_{Hf} mantle array with $^{206}Pb/^{204}Pb > 18.6$ that is absent from shield lavas.

These data reveal significant isotope heterogeneity in rejuvenated magmas that requires multiple, distinct source components. In particular, the presence of isotopically enriched LOA-type components can be extended to the source of rejuvenated lavas. The LOA-like component in the shield stage persists in the western rejuvenated lavas (over 5 Ma longevity in Niihau), but not in the eastern. The change from a homogeneous shield stage across Kauai-Niihau, to the bilateral heterogeneity in the later LOA and KEA volcanoes over similar distances is consistent with variable sampling of plume material due to changes in Pacific plate motion [3].

[1] Cousens & Clague (2015) *Journal of Petrology, egv045.*
[2] Weis et al. (2011) *Nature Geoscience 4(12), 831.*
[3] Jones et al. (2017) *Nature 545, 472-477.*