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Rejuvenated lavas resolve enriched ponded melt at the lithosphere-asthenosphere boundary

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Rejuvenated volcanism occurs at ocean islands that would otherwise be considered extinct, outside of the spatial-temporal evolution of the parent hotspot track. Aitutaki of the Cook-Austral islands is a perplexing case of rejuvenated volcanism following an ~8 Myr eruptive hiatus. Current mechanisms for rejuvenated volcanism, such as flexural arch decompression due to nearby lithospheric loading (Hawai'i) or plate subduction (Samoa), do not explain the rejuvenated lavas on Aitutaki [1,2], being located ~1400 km from the nearest plate boundary and lacking a current plume heat source.

Here, we examine these lavas using a new comprehensive geochemical dataset combined with 2-dimensional geodynamic modelling. Our new radiogenic Sr-Nd-Hf-Pb isotopic data resemble the Cook-Austral EM1 lavas, and completely overlap Samoan rejuvenated lavas in Pb-isotope space. The Fe-isotope data of rejuvenated Aitutaki lavas boasts unusually heavy δ^{57}Fe (= 0.27 ± 0.02, 2 s.e.) for an oceanic island, comparable to those observed in Samoan rejuvenated lavas [3]. Previous modelling shows similar heavy δ^{57}Fe signatures in mantle-derived melts cannot be explained solely by fractionation during partial melting from any common mantle source [4,5]. Instead, these high values require a source enriched in heavy Fe isotopes prior to melt generation. Here we present a geodynamic model that is consistent with seismic imaging that indicates pooling of low-volume melts at the lithosphere-asthenosphere boundary (LAB) [6], which can serve as a pre-enrichment factory for heavy Fe isotopes. Secondary reactivation melting of this enriched pond at the LAB then leads to the observed decoupling of radiogenic EM1-style and stable Fe isotope signatures. Incorporation of such a component in active plume lavas may explain heavy Fe isotope signatures observed elsewhere in OIBs [5].

References

[1] Bianco, T. A., et al. (2005). G^3 **6**(8).

[2] Konter, J. G. and M. G. Jackson (2012). G^3 **13**(6).

[3] Konter, J. G., et al. (2016). EPSL **450**: 221-232.

[4] Sossi, P. A. and B. Debret (2021). Magma Redox Geochemistry: 303-330.

[5] Soderman, C. R., et al. (2021). Geochimica et Cosmochimica Acta **292**: 309-332.

[6] Hua, J., et al. (2023). Nature Geoscience **16**(2): 175-181.