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# Covariance of radiogenic isotopes (Sr, Nd, and Pb) and trace elements in 2021 Cumbre Vieja lavas

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The Canary Islands are an intraplate volcanic island chain off the coast of northern Africa. The western islands have been volcanically active for 1–4 Ma [1], with the most recent eruption taking place on the island of La Palma from 19 September to 13 December, 2021. Active geochemical monitoring of prolonged eruptions can improve volcanic hazard forecasts if lava chemistry can be linked to eruption dynamics. Here we report whole-rock radiogenic isotope and trace element analyses of 11 lavas spanning days 4 to 84 of the eruption. Average $^{143}$Nd/$^{144}$Nd (0.512899 ± 4), $^{87}$Sr/$^{86}$Sr (0.703088 ± 10), $^{206}$Pb/$^{204}$Pb (19.514 ± 6), $^{207}$Pb/$^{204}$Pb (15.604 ± 3), and $^{208}$Pb/$^{204}$Pb (39.418 ± 8) are intermediate compared to older La Palma lavas [2]. Lava erupted on day 4 has higher $^{87}$Sr/$^{86}$Sr and $^{206}$Pb/$^{204}$Pb compared with subsequent lavas and $^{87}$Sr/$^{86}$Sr increases slightly over the latter half of the eruption. This trend mirrors trace element systematics (e.g. La/Yb, and ∑REE), which decline early and then increase towards the end of the eruption. Combined trace element and radiogenic isotope data indicate that La Palma magmas are mixtures of at least two components: (1) enriched material with high La/Yb, $^{87}$Sr/$^{86}$Sr, and $^{206}$Pb/$^{204}$Pb, and (2) depleted material with lower ratios. The enriched component constitutes a greater fraction of the lavas in the first and last weeks of the eruption. The differences between the components cannot be explained solely by fractional crystallization, so some combination of mantle source heterogeneity, long-lived crystal mush dynamics, or crustal assimilation (e.g., Jurassic oceanic crust, Sahara dust, or sediments [3]) must contribute to changes in lava chemistry over time. Regardless, processes affecting lava trace element abundances and radiogenic isotope ratios do not appear to detectably control invariant $^{3}$He/$^{4}$He measurements in clinopyroxene, olivine, and amphibole [4].

References:

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