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Variably depleted mantle in the source of Azores lavas

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The Azores Plateau in the North Atlantic is a classic example of near-ridge oceanic plateau (600 km) associated with the upwelling of the Azores mantle plume. The radiogenic isotope signatures of Azores lavas show systematic inter-island variations, which are often interpreted in terms of sampling several distinct, chemically enriched reservoirs from the Azores plume [1].

Here we discuss new radiogenic cerium isotope data on Azores lavas in the context of recent isotope data on olivine-hosted melt inclusions [2]. Olivine-hosted melt inclusions have very high neodymium isotope ratios (up to $\epsilon_{Nd} = 18.1$), suggesting that variably depleted mantle is the dominant component of the Azores mantle source [2]. Radiogenic Ce isotopes reflect the time-integrated La/Ce ratio of the mantle source. La/Ce approaches zero values in incompatible element depleted mantle, while the Sm/Nd and Lu/Hf ratios retain higher, more variable values. Melts from variably depleted mantle therefore develop distinct signatures in Ce–Nd–Hf space [3].

The new Ce isotope values for 36 whole-rock lava samples covering the whole Azores Plateau reveal a number of parallel, vertically stacked trends in Ce–Nd and Ce–Hf isotope space, pointing to variably incompatible depleted end-members, that are not discernible in Sr–Nd–Pb–Hf isotope space. The observed isotope trends in Ce–Nd–Hf space are readily explained by variable contribution of melts from volumetrically dominant, but variably depleted mantle and similar, but inherently heterogeneous enriched local plume components. Hence, although not directly reflected in the erupted basalts on a whole-rock scale [1, 2], variable contribution of melts from a variably, in part highly depleted mantle control the isotope composition of Azores lavas.

These results indicate the North Atlantic mantle below the Azores is variably depleted and contains highly depleted domains. The lavas closest to the proposed plume center [4] do not correspond to either extreme in terms of mantle depletion, suggesting mantle depletion in Azores is inherently complex and not a simple mixing product between plume and ridge mantle.

[1] Béguelin et al. (2017) *Geochimica et Cosmochimica Acta*, 218, 132-152.

[2] Stracke et al. (2019) *Nature Geoscience*, 12(10), 851-855.

[3] Willig et al. (2020) *Geochimica et Cosmochimica Acta*, 272, 36-53.

[4] Bourdon et al. (2005) *Earth and Planetary Science Letters*, 239, 42-56.