The radiogenic nature of the lithospheric mantle beneath Lanzarote (Canary Islands)

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Keywords: Canary Islands, mantle xenoliths, stable isotopes.

In this study, the carbon (of CO_2) and noble gas isotope signatures of fluid inclusions hosted in Lanzarote mantle xenoliths were investigated. The analyzed samples come from Quaternary alkali basic lavas belonging to cycles III and IV of Fuster et al. (1968), which are recognized as the most recent volcanic deposits on the island. In this study, 7 mantle xenoliths were investigated: 6 spinel harzburgites and 1 dunite. We find 4He/20Ne and $^{40}Ar/^{36}Ar$ ratios comparable to those measured in xenoliths from El Hierro islands (Sandoval-Velasquez et al., 2021), suggesting the presence of an atmosphere-derived component (possibly inherited from paleo-subduction events) in the lithospheric mantle beneath Lanzarote. In most of the samples, the $^{4}He/^{40}Ar^{*}$ ratios decrease from olivine (Ol) to orthopyroxene (Opx) at increasing Mg# with values lower than in xenoliths from El Hierro. This behavior is compatible with variable degrees of partial melting, which supports the residual character of the spinel harzburgites and dunite studied here. Rc/Ra values ($^{3}He/^{4}He$ ratios corrected for atmospheric contamination) indicate a more radiogenic mantle signature (5.97±0.44 Ra; 2σ, n = 13) than in El Hierro (7.45±0.26 Ra; 2σ, n = 14) and other Canary Islands (Sandoval-Velasquez et al., 2021). This evidence reinforces earlier findings of a systematic west to east decrease in $^{3}He/^{4}He$ ratios along the Canary Islands (from La Palma-El Hierro to Lanzarote). Considering that fluid inclusions in mantle xenoliths better preserve (than surface gases or lavas) the isotopic composition of the local mantle, these results point to source heterogeneity, and identify the presence of an enriched mantle (EM) component beneath eastern islands coming from the African subcontinental lithospheric mantle (SCLM). Finally, the first $\delta^{13}C$ values reported for Lanzarote show a heavier isotopic signature ($-2.25‰ < \delta^{13}C < +0.8‰$) than classical MORB-like upper mantle ($-8‰ < \delta^{13}C < -4‰$), as recently found in El Hierro xenoliths. This supports that recycled crustal carbon is presumably a regional characteristic of the upper mantle located beneath the Canary Islands.

Fuster J.M., Cendrero A., Gastesi E., Ibanola E. & Lopez-Ruiz J. (1968) - Geology and Volcanology of the Canary Islands-Fuerteventura. Consejo Sup. Invest. Cient., Madrid.

Sandoval-Velasquez, A., Rizzo A.L., Aiuppa A., Remigi S., Padrón E., Pérez N.M. & Frezzotti M.L. (2021) - Recycled crustal carbon in the depleted mantle source of El Hierro volcano, Canary Islands. Lithos, 400-401, 106414. https://doi.org/10.1016/j.lithos.2021.106414.