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Plume-related stable isotope compositions in the seamount series of La Palma, Canary Islands, Spain

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The basaltic rocks of the submarine series and the first subaerial rocks of Fuerteventura, Canary Islands contain amphiboles and phlogopites whose stable and radiogenic isotope compositions were interpreted as reflecting recycled ocean crust (Demény et al., 2004). Shallow-level crustal assimilation as the cause of low δ^{18}O can be ruled out as H isotope analyses show no evidence of seawater influence (see Demény et al., 2004). Instead, the H isotope values (in ‰ relative to V-SMOW) are around –95 ‰ similar to other plume-related rocks of the region (Demény et al., 2004) and depleted in D relative to typical upper mantle with –70 $\pm$10 ‰. In order to corroborate these results we collected additional plume-related rocks from La Palma to determine whether the Fuerteventura data are typical for the pristine plume material, or simply characteristic of the mantle below Fuerteventura.

The rocks of the Basal Complex of La Palma was chosen for comparison as these rocks represent the initial stage of the plume-related magmatic activity, similarly to those studied in Fuerteventura. Gabbros of the Basal Complex representing different stages as well as basalt-hosted xenoliths and megacrysts were investigated by H-O-Sr isotopes and trace elements. Some of the gabbros show strong ^{18}O-depletion (as low as 1.0 ‰) at constant δD of $\sim$ –85 ‰. In addition there is another δD-δ^{18}O trend with positive slope ranging between normal upper mantle compositions (δ^{18}O $\sim$ 5.3 ‰, δD $\sim$ –70 ‰) and those data obtained for the Fuerteventura rocks. The strong

δ^{18}O shift at constant δD can be interpreted as resulting from interaction of meteoric water with rocks at high temperatures. The H and O isotope compositions indicate that the meteoric water infiltrated the edifice at high elevations $>$2000 m above sea level. The samples plotting on the positive δD-δ^{18}O trend have primary Sr isotope ratios (at Sr contents below 1000 ppm) that exclude the possibility of significant seawater interaction as a cause of the low δ^{18}O values. Thus, the stable isotope results results may be interpreted as a mixing of typical upper mantle and plume material. The new results support the notion that the Canary mantle plume is characterized by δD and δ^{18}O values lower than those for the average upper mantle.

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Reference:

Demény, A., Vennemann, T.W., Hegner, E., Ahijado, A., Casillas, R., Nagy, G., Homonnay, Z., Gutierrez, M., Szabó, Cs. (2004): H, O, Sr, Nd and Pb isotopic evidence for recycled oceanic crust in the Transitional Volcanic Group of Fuerteventura, Canary Islands, Spain. Chem. Geol., 205, 37-54.