THE UPPER MANTLE BENEATH THE CANARY ISLANDS: FROM PASSIVE MARGIN TO INTRA-PLATE MAGMATISM

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Abstract

Trace element patterns in mantle xenoliths from the Canary Islands document an evolution from strongly depleted oceanic mantle lithosphere, to mantle lithosphere variably metasomatized during the Canary Islands intra-plate magmatic event. The original oceanic composition is best preserved in the REE concentrations in olivine and orthopyroxene which are strongly depleted in MREE relative to HREE. The least enriched Cr-diopsides have concave upwards trace element patterns with weak negative anomalies in Zr and Ti. LAM-MC-ICPMS Sr isotope analyses of such clinopyroxenes show $^{87}Sr/^{86}Sr$=0.70270.7028, which is within the range of N-MORB and well below the range of Canarian magmatic rocks. Modeling suggests that the oceanic lithospheric mantle beneath the Canary Islands originally was more refractory than average DMM (depleted MORB Mantle). We have found no variations in mantle composition that may be related to distance from the African continent. The metasomatic processes associated with the formation of the Canary Islands include cryptic metasomatism, formation of phlogopite, fluid-wall rock reactions, and resetting of the Sr isotope system. Cr-diopsides in the most highly metasomatized xenoliths are strongly enriched in LREE relative to HREE, depleted in Zr-Hf and Ti, and give $^{87}Sr/^{86}Sr$ ratios (0.7029-0.7033) within the range of Canary Islands basalts. Estimates based on the trace element contents in enriched Cr-diopside, together with fluid inclusion studies, imply that the metasomatism was caused by siliceous carbonatite (or carbonaceous silicate) melts. The degree of metasomatism has been moderate in the lithospheric mantle beneath Hierro and Lanzarote, and extensive beneath Tenerife and La Palma. Our data suggest that metasomatism by siliceous carbonatite melts represents an early stage of the Canarian intraplate magmatic event, preceding the basalt magmatism that has given rise to the exposed rock complexes. Widespread evidence of carbonate metasomatism in the upper mantle beneath ocean islands suggests that carbonate-rich magmas may be important during the early stages of the formation of many oceanic islands. The oldest part of the volcanic structures may thus be significantly different from the exposed parts.