PROGRESSIVE CHANGES IN MELT COMPOSITION IN THE UPPER MANTLE BENEATH THE CANARY ISLANDS: EVIDENCE FROM TRACE ELEMENT COMPOSITIONS OF MINERALS IN MANTLE XENOLITHS

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Laser ablation microprobe data on minerals and glass inclusions in mantle xenoliths from the Canary Islands show a progressive change in the compositions of melts present in the lithospheric mantle beneath these islands. Cr-Mg series spinel peridotites from all the islands show evidence of strong depletion overprinted by metasomatism. Partial melting involved the reaction opx → ol ± cpx + highly silicic melt. Estimates imply that relative to the primordial mantle, the different parts of the Canarian upper mantle have suffered about 25% fractional melting; that represents the combination of (i) partial melting during the opening of the Atlantic Ocean, and (ii) an additional stage of partial melting at the onset of the Canarian intraplate magmatic event. Metasomatism involved recrystallization of exsolved, deformed opx to poikilitic, undeformed opx, formation of poikilitic cpx, formation of phlogopite, and significant addition of incompatible trace elements except Zr, Hf and Ti. Modeling based on cpx compositions identifies carbonatitic melt as the main metasomatic agent. The degree of metasomatism is weakest in Hierro (W) and Lanzarote (E), and strongest in Tenerife (middle). During the earliest stages of metasomatism, highly enriched carbonatitic melts mixed with relatively MREE-depleted, silicic (>60% SiO₂) melts formed by decomposition of opx. Mixed melts with a low carbonatitic/silicic melt ratio are preserved as glass inclusions in harzburgite xenoliths in La Palma, and reflected in cpx compositions in xenoliths from Hierro and Lanzarote. In the upper mantle beneath La Palma and Tenerife, the emplacement of carbonatitic melts increase with time, and
metasomatism by melts dominated by the carbonatitic mixing member is reflected in poikilitic opx and cpx and the presence of phlogopite. The strongest degree of metasomatism took place in the upper mantle beneath Tenerife. At a later stage Ti-Al-Fe-rich dunites, wehrlites and clinopyroxenites formed at mantle depths from mildly alkaline basaltic magmas similar to those that dominate the exposed parts of the islands. Ti-Al series rocks appear to be restricted to magma conduits and to have caused only minor metasomatism in the mantle wall-rocks. It is interesting that mantle metasomatism is dominated by carbonatitic melts, whereas such melts appear to be insignificant among the magmatic rocks exposed at the surface. However, carbonatitic melts may have been important during the early stages of the Canarian magmatism, forming the oldest and deepest parts of the islands.