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Melting mode and source lithology inferred from trace element systematic in historical olivine from Lanzarote, Canary Islands

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Trace element concentrations and ratios in olivine phenocrysts, such as fractionation-corrected Ni x (FeO/MgO) and Fe/Mn, have been shown useful as probes of pyroxenite derived component in mixtures of primary mantle melts (e.g. Sobolev et al., 2007). For instance, higher Ni and lower Mn and Ca contents are expected in partial melts of pyroxenite compared to those of lherzolite. We have measured trace element concentrations in olivine from 1730-1736 AD (Timanfaya) and 1824 AD eruptions in Lanzarote (Canary Islands), which erupted mafic and mantle nodule bearing magmas, ranging in composition from highly silica-undersaturated basanite through alkali basalt to tholeiite. The early basanite exhibit the largest olivine trace element variation covering the range of those from MORB and OIB worldwide, whereas later erupted tholeiite have values typical from pyroxenite derived melts. The Fo value decreased systematically with time during the 1730-36 eruption and the proportion of silica-saturated primary melt increased in the parental magma mixture with time. At the end of the eruption, tholeiite magmas crystallized olivine with, increasing concentrations of Mn and Ca and higher Ca/Al at relatively uniform Ni x (FeO/MgO) and Fe/Mn, all of which is readily explained by increased decompression melting at lower temperature. The basanite from the eruption that took place in 1824 AD has olivine with even higher Fo value and trace element variability similar those of the Timanfaya basanite. The fact that the Lanzarote basanite contain olivine with trace element systematic spanning that of MORB and pyroxenite melt can be explained by CO_2-flux melting of a lithologically heterogeneous source, generating the diverse compositions. Initial reactive porous flow through depleted oceanic lithosphere and equilibration with dunitic restite of percolating pyroxenite melt may have amplified the observed Ni depletion in olivine of the earliest basanite. The fact that olivine compositions and basanite magma were reproduced approximately a century later may reflect episodic carbonatic fluxing in the slowly uprising Canarian mantle plume.