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Physical-chemical conditions during crystallization of Fogo Holocene lavas (Cape Verde): implications for the morphological evolution of oceanic islands

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CapeVerde Archipelago is a hotspot resulting from a mantle plume well resolved down to the lower mantle. It has been volcanically active at least since the Oligocene, the last eruption having occurred in 1995 at Fogo Island. Volumetrically, the emerged part of the Fogo Island is dominated by very recent volcanics ($\leq$ 105 ka), which are implanted over a Pliocenic "basement" shared with the neighboring Brava Island and Rombos Islet.

Post-basement Holocenic lavas are highly silica-undersaturated ranging in composition from melanephelinites ($a_{SiO_2} \approx$ 0.23 to 0.27) to tephriphonolites ($a_{SiO_2} \approx$ 0.23). Mg-in and clinopyroxene-liquid thermometry on (mela)-nephelinites produced similar results, T $\sim$ 1100 – 1200 ºC, (ΔT $\pm$ 20ºC), supporting textural observations that indicate co-precipitation of olivine + clinopyroxene at the liquidus during the crystallization of these lavas. Both V/Sc $>$10 and conventional oxygen barometry on primitive magmas (Mg# = 0.68) indicate highly oxidized conditions (ΔQFM $\sim$ +2), but early precipitation of iron-oxides induced rapidly decreasing f_{O_2} during fractionation, giving ΔQFM $\sim$ 0 at Mg# = 0.46. Clinopyroxene-liquid barometry applied to (mela)-nephelinites Ti-augite phenocrysts indicates pressures of 1–11 kb, but with a strong cluster at 5-8 kb. This data suggests a multi-stage magma ascent beneath the Fogo Island: main fractionation occurred at multiple levels within the mantle (15 - 30 km depth) and was followed by transient/rapid stagnation within the crust before eruption. In contrast, the averaged clinopyroxene data from the most evolved magmas

(phonotephrites and tephriphonolites) indicates crystallization at lower T ($\sim$ 1030 ºC) and much shallower depths ($\sim$ 5 km; P $\sim$1.5 kb), suggesting a more important role of crustal magma chambers on their genesis. These shallow level magma chambers may have induced gravitic/mechanical instability, triggering caldera collapsing and associated giant landslide(s), which predated the recent (post-caldera) volcanism in the island. Owing to their undersaturated and non primitive character, Holocenic Fogo lavas are highly enriched in incompatible elements (e.g., Rb 42 to 154 ppm; Nb = 66 to 201 ppm; La = 45 to 126 ppm), contrasting with depleted time-integrated $^{87}Sr/^{86}Sr$ (0.703440 – 0.703902) and $^{143}Nd/^{144}Nd$ (0.512718 – 0.512888). Nb-Ta enrichment over the LREE, Sr-Nd isotopic values below the mantle array, and somewhat high Ba/Nb ($\geq$ 7.8) and Rb/Nb ($\geq$ 0.44) suggest contributions from HIMU and EM-I mantle components, as well as precluding significant crustal assimilation to their genesis.

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