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Insights from ultramafic nodules on the plumbing system of the Fogo Island 2014-2015 Eruption (Cape Verde)

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The last eruption on Fogo Island (Cape Verde Archipelago) occurred in 2014-2015, with mostly hawaiian and strombolian but sometimes vulcanian activity, with variable emission rates of lava flows, pyroclasts and gases (SO2 and CO2). Some lava flows, mainly from the first stage of the eruption enclosed small granular ultramafic nodules (1-3cm), with angular to rounded shapes. The host rocks are porphyritic tephrites, with Ti-augite and Ti-magnetite phenocrysts and, sometimes, amphibole xenocrysts in a brown glassy matrix including laths of plagioclase, clinopyroxene and Ti-mgnetite.

The nodules are composed of an early crystallization phase olivine, in subheuedral crystals devoid of kink-bands or in rounded crystals enclosed in clinopyroxene oikocrysts. Clinopyroxene occurs in subeuhedral to anhedral zoned crystals, sometimes partially patchy replaced by late igneous amphibole which also occurs as primary crystals as well as in some xenocrysts. In both cases they frequently show reaction rims with transformation in rhonite, most probably resulting from degassing. Oxide minerals are present as a minor component occurring in sub-euhedral to anhedral crystals as inclusions in olivine and clinopyroxene or interstitially between silicate minerals.

The typical cumulus textures, and the mineral chemistry already obtained for the ultramafic nodules from the 2014 eruption at Fogo strongly suggest that they have a cumulate origin and are cognate with the host magmas. Indeed, the similar composition of Ti- augites from the nodules and phenocrysts (Wo49-51 En42-36 Fs12-10), as well as the olivine Fo contents and high CaO contents in olivine are explained by crystal segregation from the same magma of the host rock.

Geothermobarometric calculations point to crystallization temperatures for the cumulates between 1150 and 1200 ºC and pressures around 7- 10 kbar, while phenocrysts in host rocks crystallized at around 1000 ºC, and pressures of 3-4. These data confirm the existence of a polybaric plumbing system feeding the 2014-15 Fogo eruption, with some of the reservoirs having developed at mantle depths (at least 22 km).

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