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The influence of antecrysts on the whole-rock composition of lava flows and dykes from Corvo Island (Azores)

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The Corvo volcanic island is one of the Azorean islands located to the west of the Mid-Atlantic Ridge. The volcanostratigraphy of Corvo has been established based on the caldera-formation event, defining three main units: Pre-caldera, Syn-caldera and Post-caldera Units.

We have deeply studied the petrology and geochemistry of representative samples of the whole volcanostratigraphical sequence, including lava flows and dykes. They range in composition from picrobasalts to trachytes. Regardless of their age, they can be divided in two groups according to their texture and composition: microlitic rocks and porphyritic rocks. The former are more evolved in composition.

The microlitic rocks are holocrystalline to hypocrystalline, with compositions that range from hawaites to trachytes. They are mainly composed of Pl, Ol, Cpx and Opq phenocrysts and microcrysts and occasional glass.

The porphyritic rocks are holocrystalline alkaline picrobasalts to alkaline basalts. They are characterized by the presence of variable proportions of large crystals. These are subhedral to anhedral Ol, Cpx, Pl and scarce Opq crystals; they are up to centimetric in size and some of them are corroded and present overgrowth rims. These mineral phases have very primitive compositions (Fo90-81, An88–70 and Cpx with 0.91-0.76 mg*). They have been described as antecryst, as they crystallized from progenitor magmas and have been reincorporated to their host lava during eruption.

The porphyritic rocks have a volume fraction of antecryst from 10 to 80%. The major element compositional trend defined by these porphyritic rocks does not agree with a single fractionation process. However, their behavior appears to be directly related to the amount and composition of antecrysts. The composition of the rocks with smaller amounts of antecrysts is more evolved and appears to be controlled by the composition of the groundmass.

To elucidate the influence of the antecrysts on the whole-rock compositions, we have added the major element composition of each antecrystic mineral (Ol, Cpx and Pl) to that of the most primitive antecryst-free sample (MgO: 5.55 wt. %). Ol antecrysts produce the greatest changes in all major element contents (adding 20 % of Ol modifies the whole-rock composition more than adding 100 % of any other antecrystic phase). On the other hand, the accumulation of Pl antecrysts produces the smallest effect. The compositional trend defined by the porphyritic samples can be best approached as a combination of the effects of Ol and Cpx antecrysts, with a minor influence of the Pl crystals. This means that these rocks mainly accumulate Ol and Cpx antecrysts, coherently with the petrographical observations.

In consequence, the compositional trend defined by the porphyritic samples is due to the presence of varying proportions of antecrysts in the samples. Therefore, the composition of antecryst-bearing volcanic rocks must not be considered representative of natural melt compositions and only antecryst-free samples must be considered as original melts. This is especially important when using whole-rock compositions to draw information on magmatic processes, where the most primitive compositions are commonly selected.