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Heterogeneous metasomatism in cumulate xenoliths from the Spanish Central System: implications on percolative fractional crystallization of lamprophyric melts

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The Spanish Central System granitic and metamorphic terrane is crosscut by various types (calc alkaline and alkaline) of post-Hercynian (Permian) dykes (Villaseca et al., 2004). The alkaline suite includes basic to ultrabasic lamprophyres and diabases which carry a varied suite of xenoliths.

Most of these xenoliths are felsic granulites, which represent fragments from the lower crust (Villaseca et al., 1999). However, these dykes also transport a significant proportion of mafic and ultramafic pyroxenitic xenoliths. These ultramafic xenoliths have been classified into four types (Orejana et al., 2006): i) highly altered ultramafic xenoliths, ii) Sp-pyroxenites, iii) hydrated clinopyroxenites and iv) hornblenditic xenoliths. The Sp-pyroxenites and hornblendites (types ii and iv) have been interpreted by Orejana et al. (2006) as segregates or cumulates formed within the crust - mantle boundary region.

The type i and iii xenoliths have not been studied in detail as yet. They are highly altered (with modal chlorite and serpentine group minerals in the range 20-95%), and show equigranular granoblastic textures, indicating solid-state recrystallization. They only retain fresh diopsidic clinopyroxene, brown spinel, kersutitic-pargasitic amphibole $\pm$ Ti-phlogopite. The absence of olivine and the predominance of modal cpx or normative *Hy* and *Di*, suggests that they are not typical mantle lherzolites, but represent cumulate pyroxenites derived by underplating events at the base of the crust.

The presence, within these xenoliths, of hydrated phases (amphibole and phlogopite) indicates a modal metasomatism, although the presence of some anhydrous xenoliths with LREE-enriched clinopyroxenes also indicates a cryptic metasomatic event. This metasomatic process seems to be heterogeneous, as the hydrated ultramafic xenoliths show three different signatures: I) clinopyroxenes and amphiboles with high incompatible trace element contents (LILE, HFSE and REE), II) LREE-enriched clinopyroxenes with low HFSE concentrations and III) relatively REE and HFSE-poor clinopyroxenes and amphiboles. Respectively, types I, II and III metasomatic characteristics, support crystallization from silicate, carbonate and hydrous melt/fluids.

We favour the presence of a unique metasomatic event related to the ascent of the Permian alkaline basic magmas. The isotopic ratios (Sr, Nd) of the ultramafic xenoliths suggest that the different geochemical fingerprints shown by the metasomatic minerals could be derived by interaction of calc alkaline-like pyroxenites with fractionated alkaline melts percolating through these cumulates. These magmas would evolve to either CO_2-rich, or H_2O-rich, residual melts/fluids, which would explain the observed metasomatic signatures.

References

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