Experimental simulation of rare metal enrichments during the fractionation of alkaline magma

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Carbonatite and alkaline magma are key pieces of the deep carbon cycle and constitute one of the principal resources of rare metal (REE, Nb, Ti, Zr). Little is known on the processes responsible for rare metal enrichments since magmatic, metamorphic and hydrothermal events are often tangled. The aim of this study is to simulate, by experiments at pressure and temperature, the petrological processes such as crystal fractionation and immiscibility between carbonate and silicate liquids, in order to assess the petrological factors ruling enrichment in rare metal during the differentiation of alkaline magmas.

Several experimental studies have tackled the rare metals partitioning between immiscible carbonate and silicate liquids [1, 2, 3] and show negligible to massive enrichments in the carbonate liquid. These variations can be ruled by the experimental conditions (pressure, temperature, oxygen fugacity) or the chemical composition of the involved magma (water and alkali contents), or can reflect more technical issues such as unequilibrated experiments. So far no prevailing cause has been clearly isolated.

Twenty six experimental charges have been synthetized using piston-cylinder and internally heated pressure vessel, at crustal and mantle conditions. The partitioning of rare metals between carbonate and silicate liquids, and between crystals (pyroxene, calcite, nephelinite, perovskite, titanite) and liquids has been characterized. These results allow us to disentangle the relative importance of parameters such as pressure, temperature, chemical composition, oxygen fugacity on rare metals enrichments during the differentiation of alkaline magma.

[1] Martin *et al.* (2013) *Journ. of Pet.* **54**, 2301-2338. [2] Veskler *et al.* (1998) *Journ. of Pet.* **39**, 11-12. [3] Veskler *et al.* (2012) *Geoch. et Cosmoch. Acta* **79**, 20-40.