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Co-existing fenitizing fluids and carbonatite melts derived from ultramafic lamprophyres

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Fenites are enigmatic rocks formed by high-temperature metasomatism adjacent to carbonatite and alkaline igneous intrusions. The geological process of fenitization is thought to result from multiple pulses of alkali-rich aqueous fluids expelled from cooling carbonatitic and/or alkaline melts [1-3]. Fenitizing fluids may play an important and previously unrecognised role in upgrading the Rare Earth Element (REE) contents of carbonatites. However, fenites are poorly documented and their potential utility as exploration tools is limited, with insufficient experimental constraints on the compositions and processes of fluid expulsion from carbonatite and alkaline magmatic systems. Deciphering their varying minero-chemical composition may aid in the development of exploration tools in the search for REE deposits [3].

We have conducted high-pressure experiments on an ultramafic lamprophyre (aillikite) at conditions in which carbonatite melts are expected to occur, at depths between 25 – 90km (~0.5 – 2.5 GPa) and temperatures of 850 - 1100°C. Whereas alkali-poor carbonatite melts were generated in all experiments at temperatures above 900°C, they all co-existed with immiscible alkali-rich aqueous fluids. We determined compositions for the dissolved solutes and fluids, establishing that K is the major alkali element present in these fluids. We put forward the exciting hypothesis that the expulsion of K from carbonatite melts at depth may explain the lack of K-rich, and predominance of Na-rich, carbonatites in the geological record and the propensity for fenite aureoles to be dominated by K-rich phases including phlogopite and feldspar [4]. We find no evidence in our experiments of co-existing immiscible carbonatite and silicate melts.

References:

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