Fe-Mg partitioning between mafic minerals and alkali silicate melts: an experimental study

POSTER

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Theme: Theme 04: Crust: Magmatism, Recycling, and Metamorphism

Abstract

The understanding of mineral-melt equilibrium is essential to separate crystal cargoes that recorded previous stages of emplacement or eruption during igneous differentiation. This study investigates the Fe-Mg exchange between olivine and pyroxene, and alkali magmas as an approach to equilibrium. Crystallization experiments have been performed on two ultrabasic alkali compositions (basanite and tephrite) from atmospheric to high pressure (0.5-2.0 GPa). The atmospheric pressure experiments were carried out over a range of $\mathit{f}O_2$ (from 2 log units below to 2 log units above the fayalite-magnetite-quartz buffer, QFM) using a high-temperature vertical furnace with CO/CO_2 mixing gases. The high-pressure experiments were realized in an end-loaded piston-cylinder using a Pt-graphite capsule and NaCl-pyrex-graphite-MgO assemblage. The experimental results show that in basanite, the Mg-rich olivine (Fo>80) is a liquidus phase, followed by titanian clinopyroxene (>3 wt.%), whereas in tephrite is titanian clinopyroxene, followed by plagioclase, and then by olivine (Fo<60) under reduced condition (QFM-2). Our data and previous studies in the literature show that $Kd\ ^{Ol\text{-}alkali\ melt}{}_{Fe\text{-}Mg}=0.27$ ($R^2=0.97$),

which is in contrast with 0.34 of $Kd^{Ol\text{-}tholeiitic\ melt}_{Fe\text{-}Mg}$ [e.g.,1 and 2]. Thus, the composition of the melt has an important role in Fe-Mg partitioning, which is in agreement with the thermodynamic model [3]. Our data also shows that $Kd^{Cpx\text{-}alkali\ melt}_{Fe\text{-}Mg}=0.23$ ($R^2=0.94$). These geochemical ratios coupled to textural behavior can be used as a first assessment to distinguish between xenocrysts, antecrysts, or phenocrysts in ultrabasic/basic alkali magmas (basanite, alkali basalt, and tephrite).

References: [1] Matzen *et al* (2011) *Journal of Petrology* 52, 1243–1263 [2] Roeder & Emslie (1970) *Contributions to Mineralogy and Petrology* 29, 275–289 [3] Toplis (2005) *Contributions to Mineralogy and Petrology* 149, 22–39

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