

Recommended trace element partitioning data for melting of hydrous pyroxenites and glimmerites

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Many mantle-derived melts may be derived partly or wholly from mantle source rocks other than peridotite. Especially for alkali-rich melts, hydrous pyroxenites form important source assemblages. Clinopyroxene and phlogopite dominate most of these assemblages, but they contain several minor phases that are rare or absent (unstable) in peridotites. These may include ilmenite, rutile, apatite, perovskite, titanite, carbonate and amphibole. In cratonic areas with lithosphere thicker than about 120km, the amphibole will be K-richterite, whereas calcic amphiboles occur in areas with thinner lithosphere.

The determination of partition coefficients for mineral/melt pairs has concentrated on peridotite minerals, whereas many hydrous pyroxenites minerals have been neglected. We present a set of mineral/melt partition coefficients for application to melting of hydrous pyroxenites. We synthesise information from new high-pressure experiments on melting of hydrous pyroxenites and on the crystallisation of lamproite, basanite and andesite melts, supplementing these with existing experiments on well-studied minerals (Ca-amphibole, clinopyroxene, garnet). Estimated partition coefficients are presented for minerals such as ilmenite, titanite, rutile and perovskite for which experimental values are lacking. These are based on inter-mineral partitioning data from natural mantle rocks in combination with experimental values for other minerals.

Cs, Rb and Ba are extremely incompatible in all but phlogopite, and so are dominated by phlogopite despite $D_{\text{Ph/Lq}} < 5$ for these elements. Apatite D-values vary enormously and are not well studied in silicate melt compositions: values for lamproite melts for D_{REE} are 2-8 (peaking at Nd-Sm). Apatite therefore dominates REE behaviour during melting of hydrous pyroxenites, requiring it to be present in the sources of many alkaline melts. Similarly, Ti-oxides are required to supply HFSE, and ratios between D_{HFSE} and the first row transition elements (FRTE) can be used to distinguish between Ti-rich minerals.

Many FRTE are compatible in hydrous minerals, often more so than in olivine (e.g. D_{Ni} 12-20 for amphiboles, 9 for phlogopite), resulting in bulk partition coefficients for most hydrous pyroxenites higher than peridotite for Ni, Cr, Sc, Ti and Cu, and comparable for Co. Copper is compatible in amphiboles, rutile and ilmenite and will be controlled by these minerals in the absence of sulfides.