

Effect of melt composition on REE partitioning in anorthite

LOUISE SCHONEVELD*, HUGH O'NEILL AND
JÖRG HERMANN

Research School of Earth Sciences, the Australian National
University, Canberra, Australia, 2600

*correspondence: Louise.Schoneveld@anu.edu.au

Partitioning of trace elements into crystals has largely focussed on the crystal compositions and thermodynamic variables such as pressure and temperature. However, the composition of the melt must figure especially prominently when the trace element has a different valence state to the major element for which it substitutes, because of the “stoichiometric control”. As an example of this phenomenon, we investigated the partitioning of the rare earth elements (REEs), between anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$) and melt in the simple system $\text{CaO-Al}_2\text{O}_3\text{-SiO}_2$, varying only the melt composition.

The REEs substitute into the anorthite as the component $\text{REEAl}_3\text{SiO}_8$, in which the substitution of REE^{3+} for Ca^{2+} on the large cation site is charge-balanced by an additional Al^{3+} per formula unit replacing Si^{4+} on the tetrahedral network. This means that the REE crystal/melt partition coefficients depend on the activity of both SiO_2 and Al_2O_3 in the system.

The partitioning of all 14 REEs was investigated experimentally at 1400°C with three different melt compositions. REEs were added to the starting mixes in various concentrations to test the limits of Henry's Law.

The REE partition coefficients fall precisely on Onuma parabolas, but with an order of magnitude change over the melt compositions investigated. The SiO_2 -rich composition produced non-stoichiometric anorthite, which shifts the maximum of the parabola to lower ionic radius. Henry's law was followed from a few ppm to several weight percent.