PARAMETERIZATION OF PYROXENE/LIQUID REE PARTITION COEFFICIENTS.

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Introduction: Rare earth elements (lanthanides; REE) have been of great importance in unraveling the petrogenesis of basaltic igneous rocks. Because of this, it is useful to have quick estimates of REE partition coefficients. Here I give a generalized method for estimating REE partition coefficients that is applicable over a wide range of pyroxene compositions — from orthopyroxenes to augites.

Rationale: McKay et al. [1] showed that REE partition coefficients were sensitive to the CaO content of the pyroxene. Because REE substitute for Ca in the pyroxene M1 site, the more Ca sites that exist, the better the chance that a REE will partition into that site. Specifically McKay et al. showed that

$$\ln D(i) = [A(i) * Wo] - B(i) \quad (1)$$

and presented two matrices of A and B values for 8 REE — one matrix for pigeonite and one for augite. LREE changed the most with increasing Wo content, whereas HREE changed the least. However, this result was believed to only be applicable for bulk compositions near that of the Shergotty parent magma.

Further Work: Building on this theme, Jones [2] took literature and unpublished data [much of which came from McKay] and plotted logD(REE) vs. logD(Ca). Linear trends were found that appeared to be applicable to a wide variety of bulk compositions that crystallized orthopyroxene, pigeonite, and augite [2]. Standard errors for these regressions were ~±30%. As in the McKay study, LREE changed the most with D(Ca) and HREE changed the least. Slopes and intercepts of these regressions changed in a very regular way with REE atomic number. Both high-pressure and low-pressure D's fell on the same regression. Apparently, factors such as T and P that affect D(REE) change D(Ca) similarly.

Implications and Applications: The combined work of McKay and Jones emphasizes the importance of crystal chemistry for the partitioning of REE into pyroxene. Because the regressions of Jones are insensitive to pressure [up to 30 kbar] and temperature, it is only necessary to know the compositions of melts and pyroxenes to calculate approximate D(REE). Calculated D's will be compared to recently measured D(REE) for pyroxenes grown from a Y980459 composition [3].

References: [1] McKay G.A., et al. (1986) GCA **50**, 927-937. [2] Jones J.H. (1995) A Handbook of Physical Constants. AGU Reference Shelf. Vol. 3, 73-104. [3] Blinova A. and Herd C. D. K (2008) Goldschmidt Abstracts 2008.