Modeling garnet-fluid partitioning in H_2O-bearing systems: a primary statistical attempt to extend the crystal lattice-strain theory to hydrous systems

AMIT MELTZER [1], RONIT KESSEL [2]

[1] Institute of Earth Sciences, The Hebrew University of Jerusalem, Jerusalem 91904, Israel.(*correspondence: amit.meltzer@mail.huji.ac.il)

[2] Institute of Earth Sciences, The Hebrew University of Jerusalem, Jerusalem 91904, Israel. (Ronit.kessel@mail.huji.ac.il)

Describing different geochemical processes raises the need to understand the crystal-melt partitioning of rare earth elements (REE). Many of these major igneous processes at different tectonic environments in Earth occur in the presence of garnet as a residual phase in the mantle. Since the pioneer crystal lattice-strain model, there were several attempts to acquire knowledge and quantitative description of garnet-melt partition coefficients over a wide range of conditions. However, high pressure high temperature experimental data demonstrate distinct differences in partitioning analyzed under anhydrous conditions and those determined in the presence of H_2O. In this study, we present for the first time a constraint on the partitioning of REE, Y, and Sc between garnet and hydrous fluids as a function of the water content in the fluid. We analyzed published hydrous experimental partitioning data using different statistical methods and modeled key parameters in the lattice strain model (D_0, r_0 and E). We show the robust correlation between r_0, temperature and the partitioning of Mg between the fluid and the crystal phases, the ability to predict D_0 using the partitioning of Fe between these phases and the prediction of E using various parameters describing the fluid phase. We validate and illustrate the ability to predict partitioning of REE in H_2O-bearing systems using only major element analysis. Consequently, our statistical model allows to refine the descriptions of key trace elements transfer in a more realistic condition.