Geophysical Research Abstracts
Vol. 19, EGU2017-5699, 2017
EGU General Assembly 2017

Quantitatively linking garnet and zircon REE chemistry to metamorphic P-T paths

Matthew Kohn (1) and Nigel Kelly (2)

(1) Department of Geosciences, Boise State University, Boise, ID, USA, (2) Department of Geological Sciences, University of Colorado, Boulder, CO, USA

The rare-earth element (REE) chemistries of zircon and garnet are directly linked because, unlike nearly all other minerals, both prefer heavy REE (HREE). Thus, to maintain mass balance, growth of one mineral must diminish the HREE content of the other. Such a relationship has long underlain qualitative characterization of REE patterns to distinguish whether metamorphic zircon grows in the garnet stability field. But – can we move beyond qualitative interpretations to more quantitative models? Here we propose a model based on Lu that links garnet growth and different generations of zircon to an overall P-T path and reaction history. We choose Lu because it is most sensitive to garnet modes and HREE mass balance, and because it closely defines the slope of HREE. We make several assumptions: (1) Lu concentrations of garnet follow a Rayleigh distillation model, with a garnet:whole-rock partition coefficient for Lu of 13 taken from published data. (2) A P-T path is derivable either from garnet chemical zoning or from inclusion assemblages. (3) Garnet mass can be estimated along the P-T path based on whole-rock phase equilibrium calculations (mineral assemblage diagrams). For these assumptions, Lu concentration decreases by an order of magnitude when garnet mode reaches 18%. Published data from Dora Maira UHP whiteschists (Gauthiez-Putallaz et al., 2016; Contributions to Mineralogy and Petrology, 171:15) provide an opportunity to compare predicted zircon formation to whole-rock mineral reactions along a prograde P-T path. Zircon Lu contents correspond with modeled garnet modes that cluster at ∼30% and ∼36%. These modes, in turn, are predicted to occur close to the phlogopite-out and talc-out reactions along the prograde P-T path, suggesting that whole-rock reactions catalyze zircon dissolution-reprecipitation. Such models permit closer scrutiny of the links between zircon chemistry and reactions, and potentially allow finer-scale chronologic resolution of tectonic processes.