Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20303

Zircon-in-garnet (ZiG) elastic thermobarometry: a first look at experimental calibration

MEGAN M. KOCH AND JAY B. THOMAS

Syracuse University

Presenting Author: mmkoch@syr.edu

Classical thermodynamic modelling to retrieve pressure-temperature (P-T) histories of metamorphic rocks relies heavily upon assumptions of periods of equilibrium in metamorphic systems. Recent studies have called into question the degree to which equilibrium is maintained, especially when considering the nucleation of a new mineral phase and the degree of "overstepping," or the increase in P-T conditions above a given isograd, required to do so. As such, alternative methods of determining P-T paths that do not require an assumption of equilibrium are needed. Elastic thermobarometry of host-inclusion systems allows for calculation of P-T conditions by measuring the elastic response of mineral inclusions to stress imposed by rigid, isotropic host minerals. Though the minerals zircon and garnet have similar bulk moduli, zircon-in-garnet (ZiG) elastic thermobarometry has been employed as a method of recovering P-T conditions of garnet growth. Continued interest in this host-inclusion pair has led to insightful ZiG studies in well-characterized natural samples that do not always result in geologically consistent determinations of P-T conditions [1]; for this reason, experimental calibration is needed. In order to investigate the utility of ZiG elastic thermobarometry, we performed piston-cylinder experiments entrapping synthetic, uranium-free zircon in almandine at temperatures between 700-900 C and pressures ranging from 15–30 kbar. We used Raman spectroscopy to measure the shift in the 356, 439, 975, and 1008 cm^{-1} phonon modes in zircon due to stress imposed by the isotropic almandine host. Using the Grüneisen tensor method, we obtained a range of entrapment pressures less than or equal to the experimental pressure. Preliminary results of this study suggest that ZiG host-inclusion systematics are complicated by factors such as crystallographic orientation, the presence of sub-micron polycrystalline inclusion clusters, and potentially post-entrapment relaxation.

[1] Campomenosi *et al.* (2021), *Contrib Mineral Petrol* 176, 36. https://doi.org/10.1007/s00410-021-01793-6