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Quartz-in-garnet elastic barometry vs. conventional thermobarometers: a comparison across diverse tectonic settings

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In recent years, elastic thermobarometry has gained wider acceptance and utility within the petrologic community and beyond. In particular, quartz-in-garnet (qtz-in-grt) elastic barometry is widely used because of the ubiquity of garnet in metamorphic rocks. The technique is based on using Raman spectroscopy to quantify strains recorded by inclusions, and modeling the elastic evolution of the inclusion-host pair to constrain the initial conditions of inclusion entrapment. Recent studies have validated the technique experimentally by comparing pressures from the qtz-in-grt barometer with experimental conditions of garnet growth and entrapment of quartz, and have shown that the barometer can provide reliable pressure conditions of garnet growth. However, current experimental studies fail to capture the reliability of the technique under disparate pressure (P), temperature (T) and deformation conditions, and studies that systematically compare qtz-in-grt barometry and conventional thermobarometry are lacking.

In this work, we compare P conditions from qtz-in-grt barometry and conventional thermobarometry from the following locations: spatially and temporally variant high P/T subduction zone eclogite blocks from the Franciscan Complex in California, high P/T subduction zone rocks of varying compositions from Syros, Greece, high P/T and low P/T rocks of varying compositions from the Betics system in Spain, low P/T schists from the Jajarkot and Karnali klippen in the Himalaya, high-P rocks from the Alps, and low P/T metapelites from northeast Nevada. Qtz-in-grt barometry constraints from the Franciscan and Syros show good agreement with some reference P-T conditions, but disagree with some thermodynamic equilibria constraints and subsets of multi-mineral thermobarometry calibrations. Qtz-in-grt barometry constraints from the Himalaya are in excellent agreement with reference P constraints. Measurements of samples from other localities are currently in progress. This set of quartz inclusion analyses further allows us to evaluate the effects of inclusion geometry, anisotropy, P and T conditions of garnet growth, and P and T paths on the ultimate P conditions recorded by the qtz-in-grt barometer. The data-set also provides insights into the possible limitations of other techniques (e.g., conventional thermobarometry).