Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20261

Experimental Evaluation of Stress Relaxation of Quartz Inclusions in Garnet

BENJAMIN A PUMMELL AND JAY B. THOMAS

Syracuse University

Presenting Author: bapummel@syr.edu

Host-inclusion elastic thermobarometers are widely used to determine the pressure and temperature (*P–T*) conditions of formation and deformation, and histories of metamorphic rocks. Metamorphic *P–T* paths may be complex, and this complexity can affect the stress state of mineral inclusions. Most previous experimental studies for host-inclusion thermobarometry have included only static *P–T* conditions. Further refinement and experimentation are necessary to better understand how host-inclusion systems behave during progressive metamorphism and exhumation. This study is the first to apply dynamic experimental pressure-temperature-time (*P–T–t*) conditions for host-inclusion thermobarometers. Quartz inclusions in garnet hosts were grown hydrothermally from powdered oxide materials in a piston-cylinder device in two-stage isothermal or isobaric experiments. Isothermal experiments were conducted as both pressurization and depressurization experiments ranging from 1.0–3.2 GPa. Isobaric experiments were conducted as both heating and cooling experiments from 300–800°C. First-stage conditions were held constant for 48 hours. Second-stage experimental conditions were held constant for 0–912 hours. Changes in experimental pressures ranged from 0.5–1.2 GPa. Changes in temperature ranged from 100–500°C. Individual quartz inclusions were measured for changes to the 128, 206, and 464 cm^{-1} Raman bands to determine the entrapment pressures (P_{trap}). Over 200 individual inclusion measurements on each experiment indicate that the majority of inclusions reequilibrated towards the new experimental *P–T* conditions. Average P_{trap} values for all experiments are between the two pressure stages. There is no evidence suggesting that significant numbers of inclusions were entrapped after adjusting *P–T* conditions to the second-stage condition. This study demonstrates that the stress state of quartz inclusions in garnet have an immediate elastic response to changes in *P–T* conditions followed by a protracted viscoelastic response. Experimental results indicate that changes to *P–T* conditions during metamorphism will modify the stress state of quartz inclusions, and the final stress state of quartz inclusions provides information on the final metamorphic conditions.