Quartz under stress: Raman calibration and applications to geobarometry of metamorphic inclusions

Bruno Reynard*[1] and Xin Zhong[2]

[1]Laboratoire de Géologie de Lyon - Terre, Planètes, Environnement [Lyon] – Université Claude Bernard Lyon 1, École Normale Supérieure - Lyon, CNRS : UMR5276 – France
[2]Freie Universität Berlin – Allemagne

Résumé

Since the discovery of coesite and diamond inclusions in metamorphic garnets of ultrahigh pressure rocks, the preservation of residual high pressures was demonstrated in included minerals in garnets and diamonds using Raman spectroscopy. Preservation of measurable stress and elastic deformations in metamorphic inclusions opened a new possibility for determining metamorphic conditions at which they were entrapped, independent of thermodynamic modeling of phase equilibria. Several calibrations have been proposed based on experiments and theoretical calibrations. Here we present an experimental calibration of the shifts of three major Raman peaks of quartz with hydrostatic pressure and uniaxial differential stress, and implications for their use in geobarometry based on Raman spectroscopy of quartz inclusions are discussed. The present calibration provides direct relationships between Raman shifts and stress, with a simple formulation of residual pressure and differential stress assuming uniaxial stress along the *c*-axis of quartz inclusions. It is tested on data from experimental and natural inclusions. Residual differential stresses are very sensitive to the precision of Raman measurements. Experimental inclusions yield residual pressures consistent with synthesis pressure. Differential stresses obtained on some experimental inclusions are sometimes incompatible, providing a criterion for identifying inclusions under complex stress conditions that are not appropriate for geobarometry. Recent data on natural inclusions show self-consistent differential stress, consistent with the assumption of major stress along the symmetry axis of the inclusion crystals. Conditions are defined for selecting data and avoid potential bias in the residual pressure and differential stress determination in inclusions. Applications of the present results to natural inclusion data suggest that combined determination of residual pressure and differential stress may be used both for barometry and thermometry pending further calibration. Reynard B & Zhong X (2023) Quartz under stress: Raman calibration and applications to geobarometry of metamorphic inclusions. *EGUsphere* 2023:1-19.

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*Intervenant