Thermally-induced shape maturation of quartz in garnet

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Sheltered inside crystals, mineral inclusions preserve crucial information on the geological history of our planet. Inclusions allow estimation of the pressure and temperature trajectories of metamorphic rocks, but also can tell about rock mineralogy and provenance, and geodynamic and petrogenetic processes. This information is recovered under the axiom that the inclusions have remained immutable objects that do not deform.

We have analysed the shape and orientation of quartz inclusions within garnet, a common metamorphic mineral, and show that they undergo a change from irregularly-shaped forms in rocks formed at T<550 °C, to combined dodecahedron and icositetrahedron geometries in granulites equilibrated at T>750 °C. Microstructural evidence of *necking down* is widespread. Coincidence of garnet crystallographic axes with morphological symmetry axes of quartz polyhedral inclusions demonstrates that the shape of the negative crystals is imposed by the host garnet. Lack of fluid at the quartz-garnet boundary indicates that inclusion shape change occurs by thermally-induced grain boundary diffusion, driven by the minimization of the surface energy of the host-inclusion system. This behaviour is similar to what is long known for fluid and melt inclusions.

Since inclusions acquire a negative crystal shape *after* entrapment, our discovery redefines the conceptual framework for the application of elastic thermobarometry, and motivates a reevaluation of the criteria for mineral inclusion syngenesis in metamorphic rocks.