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Elastic geothermobarometry on multiple inclusions in a single host

Matteo Alvaro (1), Mattia Gilio (1), Ross Angel (1), and Marco Scambelluri (2)

(1) Department of Earth and Environmental Sciences, University of Pavia, Pavia, Italy (matteo.alvaro@unipv.it, mattia.gilio@unipv.it, ross.angel@unipv.it), (2) Department of Earth Science, Environment and Lifescience, University of Genova, Genova, Italy (marco.scambelluri@dipteris.unige.it)

The precise characterization of the pressure and temperature (P-T) histories of subducted rocks is of key importance for unravelling geological processes from the micro- to the macro- scale. Accurate PT provide key constraints on tectonic and geochemical processes affecting subduction dynamics and for interpreting the geophysical images of present-day converging plates. Conventional geothermobarometers are based on element-exchange and thermodynamic modelling. These methods are challenged in ultra high-pressure metamorphic (UHPM) terraines as the temperatures of deep subduction often exceed the closure temperature of geothermobarometers and minerals may undergo discontinuous reactions or re-equilibration during both prograde and retrograde paths.
An alternative and complementary method to determine P and T conditions of metamorphism that does not rely upon chemical equilibrium is elastic geobarometry applied to host-inclusion systems. This method is based on the analysis of the elastic response of a mineral inclusion trapped inside a crystalline host. Recent development of elastic geobarometry (Angel et al. 2018; Campomenosi et al. 2018; Mazzucchelli et al. 2018; Murri et al. 2018) allows us to retrieve encapsulation pressures for a variety of host-inclusion pairs starting from the determination of the residual strains acting on the inclusion as by X-ray diffraction or Raman spectroscopy. A great challenge with current elastic geobarometry is that the entrapment pressure conditions along an isomeke can only be determined if the temperature of entrapment is known.
In this study we performed a series of micro-Raman measurements on 10 quartz and zircon inclusions trapped inside two single crystal garnets from garnet-kyanite gneiss and a quartz-garnet vein from the Fjørtoft UHP terrane, Norway. From the micro-Raman data, using the program stRAinMAN (Angel et al. 2018), we calculated the strains at room conditions adopting the method developed by Murri et al. (2018). From the strains on the inclusion we calculated the entrapment conditions after correcting for the geometry of the system and the inclusion relaxation following the approach by Mazzucchelli et al. (2018). The intersection between the two sets of isomeke calculated on multiple quartz and zircon inclusions demonstrates that measuring different inclusion phases trapped inside a single host allows unique P - T conditions for the host rock to be determined.

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