Geothermobarometry of inclusions from Raman spectroscopy: advantages and limitations

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Raman spectroscopy provides information on the residual strain state of mineral inclusions trapped in other minerals. This information, coupled with elastic geobarometry theory [1], can be used to constrain the P-T conditions of entrapment for UHPM rocks. Finite Element (FE) numerical simulations [2] showed that the geometry of the host-inclusion system affects the residual strain which can lead to incorrect estimates of the entrapment pressure (P_{trap}).

We evaluated these geometrical effects with Raman measurements on selected inclusions in garnets. Our measurements show that faceted elongated crystals exhibit inhomegenous Raman shifts because of the presence of corners and edges that act as stress concentrators. The Raman shift depends on the shape of the inclusion and the point within the inclusion chosen for measurement. Step-by-step polishing of the host, followed by Raman measurements on the inclusion, demonstrated experimentally that the strain in the inclusion is gradually released upon approaching the free surface of the host. The magnitude and the rate of the strain release depends on the elastic properties of the inclusion and its crystallographic orientation with respect to the host.

The good agreement between our experimental results and FE models confirms that both the shape of the inclusion and its position within the host affect the residual strain. These effects must be taken into account in order to retrieve the correct P_{trap} through the elastic geobarometric approach.

[1]Angel *et al.* (2015) *J. Met. Geol.* **33**, 801-813.
[2]Mazzucchelli *et al.* (2018) *Geology* **46**, 231-234.

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