Contribution ID: **8** Type: **Keynote**

Elastic vs. Visco-plastic Rheology of Stressed Host-Inclusion Mineral Systems at non-Ambient Conditions: Insights from in situ Raman Spectroscopy

Tuesday, 13 September 2022 15:00 (29 minutes)

Mineral inclusions at ambient conditions often show residual pressures (P_{inc}) significantly different from the external one. This is the result of the contrast in the thermo-elastic properties between the inclusion and its surrounding host, which can be used to back calculate the pressure (P) and temperature (T) conditions of inclusion entrapment during metamorphic processes. This is the underlying concept of elastic thermobarometry, a method exclusively relying on the elastic behaviour of the system [1].
We have studied zircon-in-garnet (ZiG) systems by in-situ Raman spectroscopy at high temperature and ambient pressure to explore the elastic and non-elastic rheology of the system when the inclusion passes from the compression to tensile stress with respect to a free crystal at the same external conditions.
Upon heating non-elastic relaxation takes place immediately after the zircon inclusion experiences a given tensile residual stress with respect to a free crystal at the same external conditions. However, the inclusion develops a new compressive elastic stress on subsequent cooling without relaxation within the same T range it occurred upon heating. Consequently, Pinc at room T is significantly different from the original one. We conclude that ZiG resetting within the time scale of laboratory experiments occurs because, under tensile stress conditions, the resistance to plastic (rate-independent) deformation decreases significantly with respect to compression.
An important geological implication is that elastic thermobarometry using ZiG systems is only reliable when applied to low-P high-T rocks where the cooling path after inclusion entrapment passes quickly into the compression domain of the inclusion [2]. On the other hand, high-pressure rocks exhumed along quasi-isothermal paths take zircon inclusions into the tensile domain where they are reset until significant cooling starts at low pressures. ZiG systems in UHP rocks therefore often indicate pressures on clockwise exhumation paths instead of the conditions of original entrapment [3].
Finally, we emphasize how these results open the avenue for new and promising experimental approaches to study host-inclusion rheology beyond elasticity.

[1] R. J. Angel, P. Nimis, M. L. Mazzucchelli, M. Alvaro, F. Nestola *Journal of Metamorphic Geology.* 2015, v. 33(8), p. 801-813
[2] M. Gilio, M. Scambelluri, R. J. Angel, M. Alvaro *Journal of Metamorphic Geology.* 2022, v. 40 p. 229–242.
[3] N. Campomenosi, M. Scambelluri, R. J. Angel, J. Hermann, M. L. Mazzucchelli, B. Mihailova, F. Piccoli, M. Alvaro *Contributions to Mineralogy and Petrology.* 2021, v. 176(5), p. 1-17.

Primary author: Dr CAMPOMENOSI, Nicola (University of Hamburg)

Co-authors: Dr ANGEL, Ross J. (CNR - Istituto di Geoscienze e Georisorse); Dr ALVARO, Matteo (University of Pavia); Dr MIHAILOVA, Boriana (University of Hamburg)

Presenter: Dr CAMPOMENOSI, Nicola (University of Hamburg)

Session Classification: MS

Track Classification: Frontiers in Mineralogy and Inorganic Geochemistry