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# Pressure estimates from fluid and solid inclusions in minerals from UHPM rocks

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Mineral inclusions entrapped in UHPM rocks can provide fundamental information about geological processes such as subduction. When a host-inclusion pair is exhumed from depth to the Earth's surface, a non-lithostatic pressure ($P_{inc}$) is developed in the inclusion because of the contrast in their elastic properties (Angel et al., 2015). If correctly interpreted, $P_{inc}$,allows the stress conditions at entrapment ($P_{trap}$) to be estimated.

For solid inclusions, the back-calculation of the $P_{trap}$ requires the change in the volume of the cavity upon changes of external P and T to be accounted for. Therefore, the calculation does not rely on isochors but on isomekes, that are lines in P-T space along which the relative change in volume for the host and the inclusion are equal, but not constant. The current solution incorporates isotropic non-linear elasticity (Angel et al., 2017), and has been extended to include non-simple geometries of the system (e.g. faceting of the inclusion or proximity to external surfaces of the host, Mazzucchelli et al., 2018).

This approach could in principle be extended to fluid inclusions in UHPM rocks, that have the advantage of being elastically isotropic. Classical thermobarometric analysis of fluid inclusions relies on the assumption that the cavity does not change its volume upon exhumation implying that the host is infinitely rigid, a situation that is never met in reality.

For a water-rich fluid inclusion entrapped at the metamorphic peak for Dora Maira Massif (4.3GPa and 730°C) that did not suffer stretching or decreptation, using an isochor for the fluid we would calculate a $P_{inc}$ of 1.49 GPa at room temperature. If the host mineral is a stiff pyrope garnet and the effect of volumetric expansion of the host ($\Delta$V/V=0.00702) is included, the final $P_{inc}$ decreases to 1.32 GPa. Further, if the host is softer quartz the volumetric expansion is much larger ($\Delta$V/V=0.06586) and it decreases the final $P_{inc}$ on the fluid to 0.84 GPa. However, the $P_{trap}$ for natural fluid inclusions can be estimated quantitatively only if the composition, and thus the exact equation of state of the fluid, is known at any P and T condition.

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