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Fast resetting of zircon in garnet inclusion pressures: implications for elastic geothermobarometry.

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The contrast in the thermoelastic properties between one inclusion and its surrounding host is commonly exploited to back-calculate the pressure (P) and temperature (T) conditions of inclusion entrapment. This is elastic thermobarometry and it is based on the elastic properties of minerals rather than chemical equilibrium. The effect of inclusion confinement is the inclusion residual pressure (P-inc), which can be determined via Raman spectroscopy. For a given host-inclusion system, a specific P-inc corresponds a P-T line along which the confinement effects between the two crystals disappear: the isomeke. By definition, this line potentially represents the P-T conditions of inclusion entrapment. Away from the isomeke, the inclusion exhibits *over-* or *under-pressure* with respect to the external pressure. The position and slope of the isomeke can be calculated using the equations of state of both the host and the inclusion [1].

In this contribution, we show how zircon-in-garnet isomekes can be partially investigated via in-situ Raman spectroscopy at high T and ambient P by comparing the evolution of the Raman peak position of the inclusion with respect to a free zircon crystal at the same temperature. Several zircon inclusions in pyrope-rich garnets from the Dora-Maira whiteschists (Western Alps) were heated up and brought from the *over-* to the *under-pressure domain* across their corresponding isomeke. At temperatures above the isomeke, we found that zircon inclusions in garnet can be reset on the timescale of laboratory experiments: after cooling down the P-inc was different from the original. We interpret this reset as the result of viscous relaxation at the host-inclusion boundary [2] and annealing of submicron dislocations of the garnet host at high temperature. Importantly, for similar heating rate and T range, viscous relaxation occurs more easily when the inclusions are in the *under-pressure domain*. This suggest that original confinement effects of zircon in a garnet host whose exhumation path mostly occurs within the inclusion *under-pressure domain* can be easily reset to record P-T conditions on the retrograde path, while those from a garnet host whose exhumation path mostly occurs within the inclusion *over-pressure domain* can be better preserved. Therefore, since the isomekes of zircon with garnet are steep in P-T, this system may be more reliable for high T and low P terranes for which the exhumation path passes directly or quickly into the *over-pressure domain* [3]. On the other hand, for UHP domains

such as Dora-Maira resetting occurs [4] due to the exhumation path being steep and thus in the *under-pressure domain* until low pressures.

[1] Angel et al. 2015 *Journal of Metamorphic Geology*, *33*(8), 801-813. [2] Zhong et al. 2020 *Solid Earth*, *11*(1), 223-240. [3] Gilio et al. 2021 *Journal of Metamorphic Geology* 10.1111/jmg.12625 [4] Campomenosi et al. 2021 *Contributions to Mineralogy and Petrology*, *176*(5), 1-17

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