Micro- to nanoscale features of rutile needles in metapegmatite garnet

Taisia Alifirova [1], Nina Daneu [2], Thomas Griffiths [1], Gerlinde Habler [1]

[1] University of Vienna, Dept. of Lithospheric Research, Josef-Holaubek-Platz 2 1090 VIENNA, Austria;
[2] Jožef Stefan Institute, Dept. for Nanostructured Materials, Jamova cesta 39 1000 LJUBLJANA, Slovenia

Rutile inclusions in garnet have been widely noticed in eclogites and related rocks (Aulbach, 2020 and references therein). In order to obtain petrogenetic information from host-inclusion systems, determination of the inclusions origin is crucial, even in case of developed shape preferred orientation and crystallographic orientation relationships (COR) between host and inclusion phases (Griffiths et al., 2020).

We report micro- and atomic scale mineralogical and crystallographic observations on rutile (Rt) inclusions in metapegmatite garnet (Grt) from the Wirtbartl locality, Austroalpine Saualpe-Koralpe complex (Austria). Garnet of interest has magmatic growth features, like concentric and sector zoning as reflected by colouring and presence of inclusions, and has undergone eclogite facies metamorphic overprint. The coloured Grt core is rich in equant submicrometer-sized inclusions. An optically less coloured Grt rim contains acicular Rt inclusions ~150-300 nm wide and up to 100 µm long which are the focus of this study.

Previous electron backscattered diffraction (EBSD) data of this sample material have shown that among 11 specific Rt-Grt CORs (Hwang *et al.*, 2015) those Rt needles predominantly pertain to COR-4, where Rt<001> || a Grt<111>, one Rt<100> || a Grt<110>, and the other Rt<100> || a Grt<112> (Griffiths *et al.*, 2020). The relative frequency of COR-4 in samples 04T26K6K (n = 14) and HS00704 (n = 132) amounts to 42.9 % and 72.0% of all Rt-needles in this Grt zone, respectively. These COR-characteristics drastically differ from other Grt domains, rock types and localities worldwide. The last point served as a ground to investigate Grt-Rt relationships and their interfaces at atomic scale, which is expected to yield information on factors that cause variability of Rt-Grt COR distributions.

Atomic resolution investigations have been applied to Rt-Grt interfaces of cross- and parallel sections of Rt-needles using scanning transmission electron microscopy (STEM). Grt preferably forms {110} facets in contact with Rt, while the Rt-inclusions form large interface segments parallel to Rt {100} and {110} planes. Short interface segments largely do not form physical planes of both Grt and Rt, though being parallel to higher index planes. In this case, Rt/Grt interfaces have stepped character. All studied interfaces show an amorphous layer between Grt and Rt, although locally the crystal lattices are attached to each other via atomic scale 'bridges'. Structure and arrangement of the atomic scale features are characteristic for particular Rt/Grt interfaces associated with a given COR, and are supposed to be associated with compositional and crystallographic properties of the host-inclusion system.

Funding by the Austrian Science Fund (FWF): I4285-N37 is acknowledged.

Aulbach, S., 2020. Temperature-dependent Rutile Solubility in Garnet and Clinopyroxene from Mantle Eclogite: Implications for Continental Crust Formation and V-based Oxybarometry. *Journal of Petrology* 61, egaa065.

Griffiths, T.A., Habler, G., Abart, R., 2020. Determining the origin of inclusions in garnet: Challenges and new diagnostic criteria. *American Journal of Science* 320, 753-789.

Hwang, S.-L., Shen, P., Chu, H.-T., Yui, T.-F., and Iizuka, Y., 2015, Origin of rutile needles in star garnet and implications for interpretation of inclusion textures in ultrahigh-pressure metamorphic rocks. *Journal of Metamorphic Geology* 33, 249-272.