MS-13-P-2275 Combining EBSD and TEM to infer the crystallographic and shape orientation relation of acicular TiO$_2$-inclusions with the garnet host lattice

Habler G.\textsuperscript{1}, Proyer A.\textsuperscript{2}, Wirth R.\textsuperscript{3}, Abart R.\textsuperscript{1}

\textsuperscript{1}Department of Lithospheric Research, University of Vienna, Althanstrasse 14, 1090 Vienna, Austria, \textsuperscript{2}Department of Earth Sciences, University of Graz, Universitaetsplazt 2/II, 8010 Graz, Austria, \textsuperscript{3}GFZ German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany

Email of the presenting author: gerlinde.habler@univie.ac.at

Acicular TiO$_2$ inclusions with preferred shape orientation in natural garnet from a metapelite rock were investigated by EBSD, TEM and light microscopy (U-stage) in order to correlate the shape and crystallographic orientation of inclusions with the garnet host lattice and to characterize the interfaces between inclusions and host. Focused ion beam preparation was applied to selected rutile grains, which had been investigated by EBSD before, in order to obtain exact longitudinal and cross sections of rutile needles of 1-2 micrometer thickness. The data therefore allow the direct comparison and combination of results from EBSD and TEM investigations.

The majority of the rutile grains are acicular, having the needle long axes oriented parallel to Grt <111> or Grt <100> directions. For the majority of Rt-grains the needle long axis does not correspond to the Rt c-axis. TEM data confirmed the notion inferred from EBSD data, that the phase boundary of acicular rutile grains mainly follows Grt \{110\} and subordinately Grt \{100\} planes. Isometric rutile grains also have phase boundary segments parallel to Grt \{112\} planes.

Single point EBSD analyses of 213 rutile grains and the hosting garnet yielded a complex, but strict crystallographic orientation relation between inclusions and the garnet lattice (Proyer et al, 2013). Although there is no unique crystallographic orientation of rutile with respect to garnet, and there are no coincidences of low-indexed garnet and rutile planes, the comprehensive dataset allows inferring systematic orientation relations of rutile and garnet. The majority of Rt-grains are oriented with their c-axes at 12 positions along a cone around Grt <111> directions. In this orientation the Rt lattice is fixed relative to the corresponding Grt <111> direction. Rutile <110> directions corresponding to three different c-axes cones around symmetrically equivalent Grt <111> directions cluster subparallel to the fourth Grt <111> direction. Furthermore, rutile a-axes and Rt <110> directions of this Rt-population seem to avoid Grt <110> directions. Contrastingly, a second subordinate population of Rt needles has c-axes parallel to Grt <111> and one of the a-axes parallel to one of the Grt <110> directions.

TEM data support the interpretations inferred from EBSD analyses, cannot determine the complex orientation relations, which require a larger dataset for detection. Although no coherency of the rutile and garnet lattices was found, the shape and lattice orientation of rutile as well as its boundary geometry are strictly controlled by the garnet lattice.


Acknowledgement: Contributions by G. Habler and R. Abart were funded by the Austrian Science Fund (FWF): I471-N19 as part of the international DMG-FWF funded Research Network FOR741 D-A-CH. Additional funding was provided by the Austrian Science Fund (FWF): P16194-N06, P22749-N21.