Geophysical Research Abstracts
Vol. 19, EGU2017-7523, 2017
EGU General Assembly 2017

Crystallographic Orientation Relationships (CORs) between rutile inclusions and garnet hosts: towards using COR frequencies as a petrogenetic indicator

Thomas Griffiths (1,2), Gerlinde Habler (1), Philip Schantl (3), and Rainer Abart (1)

(1) University of Vienna, Faculty of Earth Sciences, Geography and Astronomy, Department for Lithospheric Research, Vienna, Austria (th.griffiths@univie.ac.at), (2) Max Planck Institute for Iron Research, Department of Microstructure Physics and Alloy Design, Düsseldorf, Germany, (3) Karl Franzens University Graz, Department for Petrology and Geochemistry, Graz, Austria

Crystallographic orientation relationships (CORs) between crystalline inclusions and their hosts are commonly used to support particular inclusion origins, but often interpretations are based on a small fraction of all inclusions in a system. The electron backscatter diffraction (EBSD) method allows collection of large COR datasets more quickly than other methods while maintaining high spatial resolution. Large datasets allow analysis of the relative frequencies of different CORs, and identification of 'statistical CORs', where certain limited degrees of freedom exist in the orientation relationship between two neighbour crystals (Griffiths et al. 2016). Statistical CORs exist in addition to completely fixed 'specific' CORs (previously the only type of COR considered).

We present a comparison of three EBSD single point datasets (all N > 200 inclusions) of rutile inclusions in garnet hosts, covering three rock systems, each with a different geological history: 1) magmatic garnet in pegmatite from the Koralpe complex, Eastern Alps, formed at temperatures > 600°C and low pressures; 2) granulite facies garnet rims on ultra-high-pressure garnets from the Kimi complex, Rhodope Massif; and 3) a Moldanubian granulite from the southeastern Bohemian Massif, equilibrated at peak conditions of 1050°C and 1.6 GPa. The present study is unique because all datasets have been analysed using the same catalogue of potential CORs, therefore relative frequencies and other COR properties can be meaningfully compared.

In every dataset > 94% of the inclusions analysed exhibit one of the CORs tested for. Certain CORs are consistently among the most common in all datasets. However, the relative abundances of these common CORs show large variations between datasets (varying from 8 to 42 % relative abundance in one case). Other CORs are consistently uncommon but nonetheless present in every dataset. Lastly, there are some CORs that are common in one of the datasets and rare in the remainder.

These patterns suggest competing influences on relative COR frequencies. Certain CORs seem consistently favourable, perhaps pointing to very stable low energy configurations, whereas some CORs are favoured in only one system, perhaps due to particulars of the formation mechanism, kinetics or conditions.

Variations in COR frequencies between datasets seem to correlate with the conditions of host-inclusion system evolution. The two datasets from granulite-facies metamorphic samples show more similarities to each other than to the pegmatite dataset, and the sample inferred to have experienced the highest temperatures (Moldanubian granulite) shows the lowest diversity of CORs, low frequencies of statistical CORs and the highest frequency of specific CORs. These results provide evidence that petrological information is being encoded in COR distributions. They make a strong case for further studies of the factors influencing COR development and for measurements of COR distributions in other systems and between different phases.

Griffiths, T.A., Habler, G., Abart, R. (2016): Crystallographic orientation relationships in host–inclusion systems: New insights from large EBSD data sets. Amer. Miner., 101, 690–705.