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The behaviour of solid microinclusions during host mineral deformation: meta-pegmatite garnets from the Koralpe, Austria

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Permian pegmatitic almandine-spessartine garnets from the Saualpe-Koralpe crystalline basement complex (Eastern Alps, locality Wirtbartl, Austria) possess extremely high abundances of micro- to nano- inclusions. Garnets are both concentrically and sector zoned with respect to the microinclusion density, but show a continuous decrease of Mn/Fe+Mn from core to rim. Inclusion phases are corundum, xenotime, zircon, rutile, and Na-Mg-Al-rich $(AB)_5(PO_4)_3$ phosphates (alluaudite-wyllieite group), with several phases bearing significant amounts of trace elements such as Sn, Nb, Ta and U. Rutile needles indicate an epitactic relationship with the host garnet. Taken together with the concentric and sector zoning of inclusion density this suggests an exsolution mechanism is likely to explain the formation of the microinclusions.

The Saualpe-Koralpe complex experienced eclogite facies metamorphism during the Cretaceous tectono-metamorphic event at ca. 90 Ma (Thöni 2006). Microstructural, optical and EBSD analyses have shown that pegmatite garnet deformed plastically at this metamorphic stage. Plastic deformation was accomplished by subgrain rotation recrystallization in localised deformation zones (Bestmann et al. 2008) and by lattice distortion in less well developed zones observable only by electron optical methods (orientation contrast imaging, EBSD analysis).

Trails of coarser inclusions ca. 10μm in diameter are found within discrete straight or curved planes in the host mineral whereas original $\leq$1μm sized inclusions are absent in a $\sim$20μm broad zone adjacent to the inclusion trails. This lack of submicron sized inclusions defines characteristic bleaching zones. In areas of well-developed garnet recrystallization the bleaching zones are wider and the inclusions further increase in size to 30 - 100μm. Trails of coarsened inclusions are sometimes but not always related to garnet lattice distortion or subgrain formation. There are numerous occurrences of recrystallized zones and/or brittle cracks which appear to continue laterally as inclusion trails, however the order in which these features formed and their relationship to one another is not yet clear. Where brittle features are observed alone, no bleaching zone is present. All inclusion phases listed above have been found uniformly distributed in the fine grained areas as well as in the coarser inclusion trails, whereas apatite appears to occur only in the trails and not in the garnet matrix.

Further investigation of the composition and orientation of the inclusions with respect to the local deformation of the host garnet lattice will provide new information on the chemical-mechanical feedback operating in host mineral-inclusion systems during metamorphic overprinting. The presence of visible and easily quantifiable bleaching zones within a homogeneously deforming host mineral matrix suggests the possibility of extracting quantitative information on material transport across and within deformation zones, as well as the interrelation of strain and chemical equilibration.

References

Thöni, M. (2006) Mineralogy and Petrology 88: 123-148

Bestmann M., Habler G., Heidelbach F., Thöni M. (2008) Journal of Structural Geology 30: 777-790