FLUID-INCLUSIONS FROM PERMIAN PEGMATITES OF THE EASTERN ALPS

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Fluid inclusions (FIs) in garnet, spodumene and tourmaline from Permian pegmatites were investigated. Samples, taken from the area at St. Radegund (Rappold Complex: RC), the Koralpe Complex (KC), the Millstatt Complex (MC) and the Polinik Complex (PC), represent pegmatites from the Koralpe-Wölz high-pressure nappe system. They consist of K-feldspar, quartz, plagioclase, muscovite, garnet, tourmaline ± spodumene and in rare cases also beryl.

Garnets were characterized using BSE imaging, semiquantitative X-ray elemental maps as well as quantitative EPMA measurements and represent almandine-spessartine solid solutions, dominated by low Ca-contents in the core areas. A "jump" to increased Ca-contents at the rim areas is interpreted as effect of Eo-Alpine Cretaceous overprint.

FIs in garnets from cores with low Ca-contents reflect variations in chemistry. In the RC, CO_2+H_2O FIs dominate whereas CO_2±N_2 fluids predominate in the KC. The MC an PC are dominated by CO_2±CH_4±N_2 fluids accompanied by the rare presence of H_2O±CO_2+N_2 FIs. The occurrence of daughter crystals (i.e. calcite, rutile, muscovite and apatite), especially in the RC and KC, indicate post-entrapment in-situ mineral reactions between the fluid and the garnet host, thus enable the reconstruction of the chemistry of an early H_2O+CO_2 dominated Permian fluid.

FIs in spodumene hosts from the RC, KC and MC characterize a CO_2+H_2O- and, in rare cases, an aqueous system. Daughter crystals are frequent (calcite, cassiterite, smithsonite, sinhalite? and unidentified minerals). Graphite solid inclusions in the host occur in the KC as well as in FIs from the MC. FIs are entrapped parallel to the c-axis of the spodumene crystals and exhibit extensive necking, leading to differences in their phase proportions. As suggested for garnets, established daughter phases indicate in-situ reactions between the spodumene host and an early Permian CO_2+H_2O fluid.

FIs in tourmaline from the RC and MC consist of H_2O+CO_2+N_2 chemistry and differ to FIs from the KC where pure CO_2 or CO_2+N_2 dominate. Separate H_2O+CO_2+CH_4±N_2 FIs and aqueous FIs are entrapped in tourmaline of the PC. FIs are free of daughter crystals, presumably representing the Permian entrapped H_2O+CO_2-dominated fluid. Reducing conditions after entrapment are indicated by the presence of graphite in the FIs.

To conclude, FIs in the magmatic minerals of the Permian pegmatites underwent intense post-entrapment modifications due to cooling and melt fractionation processes including the presence of Permian minerals like mica as additional nitrogen source along with the H_2O-CO_2 dominated Permian magmatic fluid. The investigated fluids from pegmatite minerals, which crystallized from different stages during pegmatite formation, enable this reconstruction even though pegmatites were affected by Cretaceous high-pressure overprint.