A tourmaline bearing eclogite in the eo-Alpine Polinik unit, Eastern Alps: The record of HP- metamorphic and metasomatic fluid activity

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An eclogite boudin from the Kreuzeck Mts. (Carinthia, Eastern Alps) was studied in terms of microthermometry, geothermobarometry, geochemistry and geochronology. This boudin is representative for a suite of a W-E striking eclogites that occur as lenses up to hundred meters in size enclosed in pelitic gneisses and schists. They contain the mineral assemblage grt + omp (jad_{33-48}) + qtz + zoi/czoi + calcic amphibole + phengite + rutile + titanite + apatite + zircon + allanite. One sample contains additionally large idiomorphic mm-sized grains of tourmaline with dravite – rich composition hosting inclusions of rutile, apatite and omphacite which are interpreted as a high pressure phase.

The calculation of a pseudo-section for this phengite-bearing eclogite sample yields P-T conditions of 1.6±0.1GPa and 650±30°C for the assemblage garnet + omphacite + phengite + zoisite + calcic amphibole + quartz + rutile.

Fluid inclusions were studied from the mineral assemblage tourmaline – quartz – apatite, which appear as texturally in equilibrium. Quartz occurs as pockets with granoblastic texture. Tourmaline contains texturally primary inclusions in the system H_2O-CH_4-N_2-NaCl-CO_2 with an estimated salinity of about 5 equiv. wt% NaCl. Higher salinities of 29 wt% were derived by the depression of the melting point of ice from additional high-saline aqueous inclusions (H_2O-NaCl-$CaCl_2$) along cracks. Saline aqueous inclusions in apatite and quartz in the system H_2O-NaCl-$CaCl_2$ contain salinities between 8 and 22 wt%. Salinity calculations for non-polar and aqueous inclusions were derived from salt solution by clathrates and from the melting point of hydrohalite (antarcticite), respectively. Additionally aqueous fluid inclusions in quartz show rarely calcite daughter minerals. Calculated isochores of primary fluid inclusions in all three studied minerals combined with additional thermobarometric estimates yield minimum conditions of about 10 – 12 kbar.

Two types of zircons with differing trace element content were observed: a very large (ca. 300x500 µm) irregularly shaped generation with very low U-, Th- and Li-values and a small (<50-100 µm) generation, intergrown with but not included in tourmaline, with significantly higher U-, Th- and Li-values indicative for a crustal source. Both zircons give an age range between 86±1 and 109±2 Ma which corresponds to the peak of eo-Alpine metamorphism in the Eastern Alps.

This study shows that two coeval fluid species of different origin were involved: The saline aqueous fluids in apatite and quartz are typical for eclogites and metamorphic fluids of crustal origin whereas the carbonic-methaneous fluids in tourmaline are strange in eclogites but typically recorded in granitic pegmatites and therefore probably indicative for an external source of magmatic origin. It is concluded that the subducting continental slab was infiltrated by external fluids at depths between 36 and 50 km when it was located close to the mantle wedge.