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Fluid Inclusions linked to quartz vein formation during decompression and recrystallization in the Venediger Duplex and Eclogite Zone of the southern Tauern Window (Eastern Alps)

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The Variscian Basement of the Venediger Duplex and the Eclogite Zone are part of the Subpenninic Nappes of the Tauern Window in the Eastern Alps. The investigated area, located in the southern Tauern Window along the Frosnitz Valley (Eastern Tyrol) shows asymmetric domino boudin structures with quartz-filled necks within the Venediger duplex. The amphibolite host rocks are surrounded by a layered penetrative foliation consisting of leucocratic gneisses (leucosomes) which can be linked with the Permian to Carboniferous intrusion of the Zentralgneis. Quartz samples are taken from the leucosomes and from the boudin neck structures.

Three fluid inclusion assemblages are distinguished. On the basis of the textural occurrence and rheological characteristics, the chemistry of the metamorphic fluid during recrystallization of the leucosomes and an earlier quartz precipitation in the necks is reconstructed. It can be shown that the grade of salinity increases from about 6 to 15 mass% accompanied with a small change in the aqueous system H_2O-NaCl-$MgCl_2$±$CaCl_2$. This change occurred during recrystallization and decompression at estimated maximum P conditions around 8,5 kbar and temperatures of 500-550°C (FIA V1). Subsequent healing of micro-cracks postdates recrystallization in the range between 600 and 350 MPa (FIA V2). Restricted to the boudin necks a late fluid generation of primary character consisting of CO_2-H_2O-NaCl chemistry indicates entrapment conditions between 250-300 MPa which is linked with a late stage precipitation of quartz in the necks (FIA V3). This late stage shows no recrystallization and cracking textures which can be clearly distinguished to a stage of earlier crack healing in recrystallized aggregates (intragranular versus conjugated, transgranular planes). In this late quartz vein generation fluid inclusion decrepitation features indicate isobaric cooling at the latest stage of the PT-evolution of the Venediger duplex.

In the Eclogite Zone concordant quartz and calcite layers affected by at least two fold generations (F1 and F2) occur beside carbonate-bearing micaschists and a penetrative foliation consisting of omphacite + garnet + epidote/zoisite + glaucophane. Samples of quartz mobilisates are taken out of these layers to recieve metamorphic conditions postdating the folding events. Additionally discordant quartz veins, which cut through both fold generations, are sampled to obtain conditions predating F1 and F2.

Texturally primary fluid inclusions from the concordant folded quartz and calcite layers in the Eclogite Zone (FIA E1, E2 and E3) are, similar to the Venediger Duplex, dominated by the H_2O-NaCl-$MgCl_2$±$CaCl_2$ system, whereat calcite entraps no $MgCl_2$–bearing fluid. Beside these, pure H_2O is additionally entrapped as primary inclusions in quartz. Secondary fluid inclusions (FIA E4 and E5) are, compared to the fluids in the Venediger duplex, significantly different in their chemistry and densities. They are dominated by the N_2-CH_4-H_2O system and texturally arranged along intragranular planes within totally recrystallized quartz grains. The fluid chemistry of ca. 90 mol% N_2 can be related to the breakdown of K-bearing minerals like phengite during retrogression of the eclogitic host rock. Calculated densities of the secondary inclusions indicate fluid reequilibration while leakage due to decompression and recrystallization. Fluid inclusions arranged along intra- and transgranular trails out of discordant quartz cutting through F1 and F2 are composed of the same aqueous saline system and constrain, together with results from concordant layers, the metamorphic conditions for both folding events between 2.5 and 4.8 kbar and 450-550°C.

Primary fluid inclusions of the H_2O-NaCl-$MgCl_2$±$CaCl_2$–system in quartz form N-S striking discordant veins of Venediger Duplex, Eclogite Zone and Glockner Nappe deliver information of metamorphic conditions during

and after the Barrovian-type metamorphic reheating event, which predates the formation of the current known nappe-stack of the Tauern Window and affected all units of the tectonic window together. Calculated isochores and densities of the inclusions show a formation and subsequent filling of these veins at pressures between 1.5 and 4.5 kbar and temperatures of 300-400°C.