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Reactions and microstructures in chloritoid-bearing phyllites during low-grade metamorphism: potential for phase equilibrium modeling and in-situ U-Th-Pb dating (Eastern Alps, Austria)

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Low-grade metapelitic rocks are widespread in tectonic units both structurally below and above the Eo-Alpine High-Pressure Belt (EHB, Eastern Alps, Austria). For a coherent understanding of the Late Cretaceous exhumation of the EHB, precise P-T-t-D data from these units are crucial, but only limited information is available so far and their geodynamic significance during the collision is yet to be clarified.

The 'Innsbruck Quartzphyllite Zone' is a part of the Upper Austroalpine Unit situated north of the Tauern Window that consists of low-grade metasediments, dominated by a quartzitic phyllite lithology. Owning to the scarcity of minerals useful for P-T determination (e.g. garnet), almost no petrological data exists in this unit. Recent structural mapping and new petrological and geochronological data revealed that the zone consists of several tectonic units corresponding to different nappe systems of the Austroalpine unit. In this contribution we present preliminary results of petrological and microstructural investigations of two different tectonic units within the 'Innsbruck Quartzphyllite Zone': the Windau Nappe (Tirolic-Noric Nappe System) and a nappe of unknown tectonic affiliation, herein termed the 'Königsleiten Nappe'.

In the Windau Nappe, rare chloritoid-bearing phyllites were found with synmetamorphic veins that contain Fe-Mg-carbonate, quartz and coarse-grained white mica. A polyphase deformation history is indicated by veins concordant to the main foliation that contain intrafoliate relict fold hinges. Occasionally, kyanite is preserved in the veins, commonly partially replaced by white mica and kaolinite. Layers at the host-rock-vein contact are typically enriched in accessory minerals that comprise rutile and monazite with subordinate apatite, xenotime and zircon. Samples from the Königsleiten Nappe comprise layered, chloritoid- and chlorite-bearing phyllites. The layering which is mostly reflected by a variety of accessory minerals in different layers (ilmenite, magnetite, apatite, allanite) is interpreted as a sedimentary inherited compositional heterogeneity, arguing for a simple deformation history. Carbonate phases are absent in the matrix but occasionally preserved as inclusions in chloritoid.

From petrographical observations using SEM imaging combined with EDX for phase identification, the extent of equilibration between layers of different local bulk composition is estimated. Reactions that are responsible for vein formation together with microstructures and minerals resulting from fluid-rock interactions observed at the vein-host-rock boundary are identified. We highlight the influence of X(CO_2) in the fluid, indicated by the presence of carbonates in veins or as inclusions.

Finally, we assess potential of these rocks for thermodynamic forward modelling which requires a precise understanding of (dis)equilibrium conditions between minerals. A special emphasis is put on phase relations between major and accessory minerals, the latter being potential geochronological targets. The aim is to understand reactions involving both major minerals (e.g. chloritoid, chlorite, albite) and U-Th-Pb bearing accessory minerals (e.g. rutile, allanite, monazite, apatite) available for in-situ dating in order to provide a link between quantitative P-T data and age information.