Chloritoid-bearing phyllites of the Upper Austroalpine nappes: Are these rocks that low grade?

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Chloritoid is a common mineral of the Upper Austroalpine nappes. There, it is mostly found in Al- and Fe-rich phyllites and fine grained micaschists that are dominated by fine grained phyllosilicates, stained by graphite and/or oxides and deformed in the dissolution-precipitation creep regime. Chloritoid frequently occurs oblique to the main schistosity and is hence interpreted as a post-tectonic phase. For these reasons, the chloritoid from the Upper Austroalpine nappes has long been considered as a lower greenschist facies mineral that cannot be used for determining P-T conditions precisely.

In this contribution we present examples of chloritoid-bearing phyllites from the Schöckel Nappe (Hirschkogel Lithodem) and Gschnaidt Nappe (Raasberg Formation), both belonging to the "Graz Paleozoic", from the Bundschuh Nappe ("Carboniferous of Oberhof", Gurktal Alps) and from the Salzachgeier Nappe ("Innsbruck Quartzphyllite Zone", Kitzbühl Alps). Microstructural observations indicate that even if chloritoid overgrows the main schistosity, it is either parallel to it and often boudinaged, or oblique to it and folded or used as the cross-cutting element of flanking structures. Therefore, it cannot be considered as post-tectonic.

SEM observations combined with EMP analyses allow us to characterize the mineral chemistries, the phase relations and the prograde metamorphic reactions between chloritoid, white mica, chlorite, rutile, ilmenite as well as staurolite, garnet and biotite. Thermodynamic modelling and RSCM thermobarometry is used for determining the conditions of the observed equilibrium assemblages, showing that the chloritoid-white mica-chlorite assemblage without garnet and/or staurolite can theoretically be stable up to 550 °C. Our study also highlights the role of detrital ilmenite as an important Fe-source for chloritoid growth and the relevance of the bulk-rock chemistry for the nature of the prograde reactions. Metamorphic regional isograde based on the occurrence of chloritoid, garnet and staurolite are therefore ambiguous even in the simple system of Al- and Fe-rich metapelites. We finally emphasize that chloritoid-bearing phyllites are good targets for determining P-T conditions with pseudosections in units lacking garnet.