Visible and invisible complexities in rocks: mineralogical and petrological constraints on the Variscan metamorphic gradient in the Southalpine metamorphic basement (Brixen quartzphyllites)

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The basement of the Southern Alps is represented by the Brixner Quartzphyllite whose Variscan *P-T* conditions correspond to a greenschist-facies metamorphic overprint. This metamorphic basement shows a metamorphic gradient ranging from the lower greenschist-facies in the S to the amphibolite-facies in the N. This metamorphic gradient reached peak metamorphic conditions in the Brixen area and decreases in a southern direction. Due to the emplacement of Permian intrusions into this basement, locally a Permian contact metamorphic overprint can be observed. The aim of this study was to provide mineralogical and mineral-chemical constraints of major mineral phases as well as accessories such as apatite on this gradient and if possible obtain *P-T* conditions along a profile from north to south.

The quartzphyllite samples were collected along a traverse from Reccoaro (TKP054) in the S to Brixen (TKP022) in the N. Petrographic investigations revealed that the metapelites contain quite a complex polyphase mineral assemblage. The mineral assemblage in the S is represented by chlorite + muscovite + albite + quartz. Towards the center of the traverse, biotite occurs in the mineral assemblage, which has subsequently been replaced by chlorite. Samples in the vicinity of the Permian Cima d'Asta intrusion show petrographic evidence for contact metamorphism since K-feldspar, chloritoid and andalusite occur. In the N the mineral assemblage is chlorite + muscovite + plagioclase + quartz + garnet. Therefore, the metapelitic zones of chlorite, biotite and garnet could be observed along the traverse.

Mineral chemical investigations revealed further complexities. The chemical compositions of muscovite, chlorite and plagioclase vary continuously with increasing *P-T* conditions from S to N. Si in muscovite decreases (from 3.3 to 3.1 apfu) with increasing Al^6 (from 2.4 to 2.7 apfu). Muscovite also shows an increase in the paragonite component from 4% to 13%. Similarly chlorite changes its composition also showing a decrease in Si and an increase in Al^6. Plagioclase changes from pure albite to anorthite contents of 30%. The data also revealed that the southernmost sample (TKP054) shows evidence for a later *T*-accentuated overprint (Permian?) texturally not visible. Also, the second southern sample (TKP056) from the traverse shows two plagioclase generations, which are also likely due to a later overprint.

The chemical composition of apatite also changes continuously from S to N with slightly increasing F contents. F increases from 3.6 wt.% in the S to 3.8 wt.% in the N. A contemporaneous increase in FeO, Y_2O_3, and Cl has also been observed. Geothermobarometry yielded so far *P-T* conditions of 554 ± 11 °C and 6.49 ± 1.3 kbar in the northernmost sample TKP022. Currently it is planned to apply muscovite-chlorite-quartz geothermobarometry to the rest of the samples of the traverse to obtain more quantitative data on the *P-T* gradient from the southern samples. This study clearly shows that quartzphyllites indeed are able to record complex metamorphic histories hidden in petrographic and mineral chemical data.