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Linking deformation and chemical re-equilibration: new results from the Cretaceous Vinschgau shear zone (Southern Tyrol, Italy)

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The Austroalpine Matsch Unit in the European Eastern Alps preserves evidence for at least three tectonometamorphic cycles, including a Variscan amphibolite-facies metamorphism, a Permian high-T/low-P event related to the intrusion of pegmatites and a Cretaceous metamorphism at the greenschist to amphibolite-facies transition. The southern tectonic boundary of the Matsch unit is formed by the about 2 km thick Vinschgau shear zone, which was active during the Cretaceous and involves metapelites, orthogneisses and metapegmatites (Schmid & Haas 1989). A characteristic mylonitic foliation with an E-W trending stretching lineation, S-C and S-C-C′ fabrics with general top W non-coaxial shear kinematics developed. Remarkable strain-gradients occur at the cm- to m-scale, partly associated with lithological heterogeneities.

In this contribution we focus on the relationship between deformation and microstructural- and chemical re-equilibration of white mica and feldspar in the Permian metapegmatites. Based on detailed structural characterization during field work, we used optical microscopy and scanning electron microscopy (SEM) as well as electron backscatter diffraction (EBSD) for microstructural and microtextural characterization. An electron microprobe (EPMA) was used for analyzing the major element compositions of microstructurally different phase generations.

In the Permian metapegmatites metamorphic white mica, plagioclase feldspar (ab87 - ab99) and K-feldspar replaced the primary pegmatite assemblages. Magmatic white mica with near-end member composition of muscovite is strongly deformed, showing kinks, undulose extinction and cracks. A new fine-grained white mica generation with elevated celadonite-component (SiIV = 3.05-3.25 cations/11O) not only predominates the mylonitic foliation and compressional quadrants of mm-sized albite and muscovite clasts but also compositionally altered zones within primary magmatic white mica along kink planes and cleavage planes. The major element composition of metamorphic white mica varies in different microstructural subdomains. Deformation of albite clasts is mainly reflected by book-shelf microstructures and specific fracture sets. Fine-grained plagioclase aggregates of two compositionally different feldspars formed in the strain shadows of pre-existing clasts. This is interpreted as the result of dissolution-precipitation creep of plagioclase. The formation of metamorphic K-feldspar in structurally-controlled subdomains (e.g. in extensional quadrants of pre-Cretaceous clasts) clearly demonstrates the timing of this reaction relative to the Cretaceous deformation. Similar to the dissolution-precipitation mechanism during Pl-deformation the Kfs forming reaction was most likely assisted by the presence of a fluid phase, as inferred from the related microstructures.

The combination of new microstructural, microtextural, mineral chemical, kinematic and P-T data from structurally well constrained sampling sites allows to correlate specific deformation structures of the metapegmatites with the Cretaceous tectonometamorphic event, to put constraints on the physical (P-T-X-) conditions during localized deformation and to relate different re-equilibration phenomena with variable finite strain intensities.

Schmid SM, Haas R (1989) Tectonics 8: 697-718