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The microstructural and mineral chemical basis for constraining the effect of deformation on the Rb-Sr system in white mica and feldspar

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The Rb-Sr system in micas has widely been applied to date tectonothermal processes, fluid-induced recrystallization and mineral growth. In order to successfully interpret geochronological data of deformed rocks, a comprehensive understanding of deformation mechanisms and deformation-related mineral reactions is required. This study aims to constrain the influence of relative finite strain magnitude (discriminated in "high-" and "low-strain" domains) and deformation mechanisms on isotopic resetting of the Rb-Sr system in relict white mica and feldspar clasts in metapegmatites and metapelites.

Sample material stems from the Austroalpine Matsch crystalline unit in the European Eastern Alps. Three tectonometamorphic events were recognized there, covering Variscan amphibolite-facies regional metamorphism, a Permian low-Pressure event related to the emplacement of pegmatites and Cretaceous metamorphism at the greenschist-amphibolite facies transition. Cretaceous deformation was restricted to localized shear zones of various thickness, which allows sampling metapegmatites and metapelites from Cretaceous high- and low-strain domains.

As a first step we concentrated on the characterization and comparison of deformation and reaction microstructures in high- and low-strain domains of Cretaceous deformation affecting Permian metapegmatites and their metapelitic host rocks. Applied techniques include optical microscopy, scanning electron microscopy and electron microprobe analyses. White mica, feldspar and quartz microstructures and –textures in the Permian metapegmatites were investigated in order to identify interrelated deformation and re-equilibration mechanisms.

In Cretaceous high-strain domains coarse relict white mica and albite clasts in metapegmatites are often kinked and show undulous extinction. A fine-grained white mica generation crystallized in the foliation planes of the mylonitic matrix, within C´planes and in instantaneous shortening quadrants of white mica and feldspar clasts. Combined microstructural and mineral chemical data allowed to distinguish three types of white mica. Cores of coarse clasts (WM I) have almost pure muscovite end-member composition, but display major element chemical alteration (WM II) at grain boundaries, along cleavage planes and kink planes. These alteration domains and the fine-grained white mica (WM III) have phengitic composition (Si_{IV} =3.12–3.25). However, WM II and WM III were not distinguishable by major element composition. The fine-grained WM III generation often occurs in association with very fine-grained Cl-rich biotite and also K-feldspar. The latter crystallized preferably in deformation shadows of white mica and albite clasts and along microfractures in albite. Albite clasts have numerous micrometer-sized inclusions, but show inclusion-poor domains at the rim and along linear features tracing microfractures. These have various spatial orientations parallel and perpendicular to C-planes and parallel to C´planes of the mylonitic foliation in the matrix. EBSD (Electron backscatter diffraction) analyses of such domains showed the presence of small new grains (10 μm) with a strong angular lattice misorientation with respect to the host grain. The lack of an orientation relation between host and new grains points to a brittle behaviour of feldspar followed by growth of small grain fragments.

The obtained microstructural and mineral chemical data represent the basis for mechanical (grain size, grain shape) and magnetic separation of mineral fractions for TIMS (Thermal Ionization Mass Spectrometry) analysis of bulk samples. The resulting data are expected to yield information on the strain dependence of Rb-Sr isotopic resetting in pre-tectonic clasts.