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Deformation behaviour of feldspar in greenschist facies granitoide shear zones from the Austroalpine basement to the south of the western Tauern window, Eastern Alps

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Objective of this study is to elucidate the feldspar deformation behaviour at greenschist facies conditions relevant for the long-term rheological properties of continental crust. Uncertainties in models for the rheological properties are partly due to a poor knowledge of the deformation mechanisms taking place in granitoid rocks at inaccessible depth. The deformation behaviour of feldspar, the most abundant mineral in the continental crust, is characterized by an interaction of brittle, dissolution-precipitation and crystal-plastic processes, which is difficult to evaluate in experiments given the problematic extrapolation of experimental conditions to reasonable natural conditions. However, microfabrics of metamorphic granitoid rocks record the grain-scale deformation mechanisms and involved chemical reactions proceeding during their geological history. This usually includes deformation and modification through several stages in space (depth, i.e. P, T conditions) and/or time. For deciphering the rock's record this implies both, challenge and chance to resolve these different stages. Here, we use the deformation record of mylonitic pegmatites from the Austroalpine basement south to the western Tauern window. The structural, crystallographic and chemical characteristics of the feldspar microfabrics are determined via micro-analytical techniques (polarized light microscopy, scanning electron microscopy, SEM, electron back scatter diffraction, EBSD) to identify the relevant deformation mechanisms and deformation conditions. The pegmatites represent a relatively simple Ca-poor granitoid system, mineralogically dominated by albite-rich plagioclase, K-feldspar and quartz. The matrix of the mylonitic pegmatites is composed of alternating monomineralic albite and quartz ribbons defining the foliation. Fragmented tourmaline and K-feldspar porphyroclasts occur isolated within the matrix. At sites of dilation along the stretching lineation K-feldspar porphyroclasts show serrated boundaries to matrix albite grains. In intragranular zones within K-feldspar porphyroclasts, small albite but also K-feldspar grains and "subgrains" (K-feldspar domains with a small misorientation angle to the host K-feldspar porphyroclast) occur. Strain shadows around porphyroclasts are composed of polymineralic aggregates of albite, K-feldspar and quartz. The albite grains in ribbons show a shape preferred orientation (SPO) with a long axis of about 50-100 μm in the foliation plane and EBSD data reveal an absent to very weak crystallographic orientation (CPO). These microfabrics show indication of a sequence of brittle behaviour, localized dislocation glide-controlled deformation and dissolution-precipitation creep of feldspar. Monomineralic quartz ribbons and shear bands show evidence of dislocation glide by a pronounced CPO, implying dislocation creep. The microfabric is interpreted to have evolved during different stages of episodic deformation at transient high stresses with subsequent viscous flow at decreasing stresses.