



K-Ar data quantify re- and neocrystallization in low grade metamorphic slates

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The understanding of the Ar system in low to very-low grade metamorphic slates is difficult due to complex microstructures and the individual chemical evolution of the K-bearing phases. A well-known problem is the role of inherited detrital versus newly crystallized sheet silicates. Processes which form newly formed K-bearing phases can be grouped as follows: (1) early diagenetic formation; (2) formation during deformation related to background strain (homogeneously distributed) at elevated temperatures; (3) highly localized deformation along faults and shear zones. The main aim of this study is to obtain an improved understanding of the effects of metamorphic processes during the evolution of pervasive schistosity while exposed to background strain. The Flysch units of the Glarus Alps, as inverted former accretionary wedge, are the key lithologies for such studies, because of an exhumed peak metamorphic N-S temperature gradient ranging from 200 to 320 °C. By combining microstructural and geochemical changes (mineralogy, K-Ar analyses), the effects of chemo-mechanical processes will be unravelled for the K-Ar system. In a microstructural point of view, dehydration and recrystallization take place along this metamorphic gradient resulting in changes of the sheet-silicate composition and formation of a spaced cleavage. The cleavage is defined by SPO (shape preferred orientation) and spatial accumulation of sheet silicates as well as shape changes of large minerals (mainly calcite and quartz) towards increasing axial ratios owing to pressure solution or viscous deformation processes (dissolution-precipitation creep). The processes included in dissolution-precipitation creep affect not only quartz and calcite, but also the sheet silicates. This led to a local change in the chemical and isotopic composition of these minerals. We measured K-Ar isotopic compositions of different grain size fractions along the temperature/deformation gradients. In each sample, the apparent K-Ar age is decreasing with decreasing grain size, but did not reach time of maximum temperature in the area. This shows the relationship between dissolution-precipitation creep and the resetting of the K-Ar system. Knowing the volume proportion of white mica allows a quantification of reset proportion of this mineral group in each sample. These isotope systematics are supported by the mineral chemistry. The newly developed micas are typically low-grade micas with a significant pyrophyllite exchange. This chemical characteristic differs from the detrital composition, which is defined by a certain Na-component and the Tschermak exchange. This change towards the new composition is increasing with decreasing grain sizes and increasing strain. Isotope and mineral chemistry data indicate, that resetting mechanisms are highly controlled by dissolution-precipitation creep. Therefore, apparent ages in such slates depend on grain size and strain. High strain requires larger amounts of mass transfer, which includes resetting of the minerals. The small grains include more newly formed grains in comparison to the large grains, which results in different apparent ages. Such isotope data have large potential to quantify the amount of re- and neocrystallisation in these deformation regimes.