Geophysical Research Abstracts
Vol. 18, EGU2016-8335, 2016
EGU General Assembly 2016

Development of discrete aggregates of recrystallization along micro-shear zones in quartz ribbons during multistage ductile evolution of a quartz vein

Alberto Ceccato (1), Giorgio Pennacchioni (1), and Michel Bestmann (2)

(1) University of Padua, Department of Geosciences, Italy (alberto.ceccato.2@studenti.unipd.it), (2) GeoZentrum Nordbayern, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

The post-magmatic ductile deformation of the Rieserferner pluton (Eastern Alps) includes localized ductile shear zones exploiting a set of joint-filling quartz veins. These deformed veins show different stages of evolution, from coarse grained vein quartz to the fine grained recrystallized aggregates of ultramylonites, locally recorded in different domains of heterogeneously sheared veins. The microstructural evolution includes, with increasing strain: (i) Development of ribbon mylonites consisting of elongated grains, oblique to the shear zone boundary, derived from different quartz veins crystals. The individual ribbons have different crystallographic orientations and aspect ratios. (ii) Dismantling of ribbons along a fracture-like network of fine grained recrystallized quartz aggregates, that commonly represent micro-shear zones (μSZ). These discrete recrystallization zones are preferentially developed in ribbons whose crystallographic <c> axis is oriented either parallel or normal to ribbon elongation. (iii) Extensive dynamic recrystallization to fine-grained (10-20 μm) aggregates leading to quartz ultramylonites. Typically ultramylonites show a layered texture with bands having different crystallographic preferred orientation (CPO) that probably reflect the original heterogeneity in crystallographic orientations of the vein.
Electron backscattered diffraction analysis indicates that the μSZ within quartz ribbons are mainly parallel to {r} or {z} planes of the host grain, and the new grain inside μSZ show a weak CPO with their basal plane parallel to the μSZ boundary. There is no systematic relationships between the Dauphiné twinning and the μSZ. Misorientation analysis suggests that in the host grain dislocation creep is dominant on {m}<a> slip system, whereas it is probably a minor mechanism within μSZ. Subgrains and low-angle boundaries (LAB) are heterogeneously developed at the border of the μSZ, and more commonly occur around the tips of μSZ. LABs are common also inside new recrystallized grains. Recrystallized grains have a strong shape- and grain-boundary-preferred orientation, given their sub-rectangular/polygonal shape. Therefore, some boundaries are aligned and continuous over more than one-grain diameter, and four-grain-junction are common. Even though a clear correlation between μSZ thickness and accommodated slip have been identified, the microstructure of μSZ appears to be strain-insensitive.
Panchromatic SEM-Cathodoluminescence (CL) images show complex heterogeneous patterns with the "bright" grey shade of the host quartz ribbons largely turned to darker grey along μSZ. In the recrystallized aggregates the new grains commonly show a bright core surrounded by a darker rim forming a grain boundary network. Part of the resetting in CL is likely related to fluid-rock interaction and Ti resetting (Bestmann and Pennacchioni, 2015) and this process may have occurred by fluid infiltration along the recrystallized aggregate and the substructured host grain, or along micro-fractures precursory of the μSZ.

The collected dataset is not sufficient yet to define neither the origin of the μSZ nor the deformation mechanism occurring during shearing along these discrete microstructures. However, we speculate that there was (i) a contribution of micro-fracturing in the nucleation stages of the μSZ; and (ii) a component of grain boundary sliding during progressive deformation of the fine grained aggregates.

References

Bestmann, M., & Pennacchioni, G. (2015). Ti distribution in quartz across a heterogeneous shear zone within a granodiorite: The effect of deformation mechanism and strain on Ti resetting. Lithos, 227, 37-56.