Geophysical Research Abstracts, Vol. 9, 03021, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03021

Fabric development in localized ductile shear zones in metagranites of the Gran Paradiso nappe

R. Kilian (1), R. Heilbronner (1), H. Stünitz (1), L. Menegon (2)

(1) Department of Geoscience, University Basel, Switzerland (Contact Email: ruediger.kilian@unibas.ch), (2) Department of Geosciences, University Padova, Italy

In the metagranites of the Gran Paradiso napppe (Western Alps) low strain domains are preserved which are relatively unaffected by the main ductile deformation. These domains exhibit cm-scale, planar shear zones formed under lower amphibolite facies conditions. We study the microstructural evolution of quartz aggregates which are deformed in a matrix of biotite and plagioclase-decomposition-derived aggregates together with K-feldspar porphyroclasts in relation to increasing shear strain.

Plagioclase-decomposition-derived aggregates (oligoclase, albit, biotite, white mica, epidote) with grain sizes of 5-20 microns accomodate most of the shear strain and always represent the mechanically weakest phase of the deformed rock. K-feldspar deforms by fracturation at low strains (healed by quartz precipitation), and increasing dynamic recrystallization at higher strains. In the ultramylonitic parts, K-feldspar is found in fine grained, recrystallized and compositionally layered mixtures together with oligoclase, albite and mica and in necks of boudinaged quartz layers. The deformation mechanism in the mechanically weaker matrix is inferred to be diffusion creep.

Pure quartz aggregates form the mechanically stronger phase of the shear zones. Quartz porphyroclasts show minor indication for subgrain rotation recystallization. The dominant process for dynamic recystallization is grain boundary migration in all quartz aggregates resulting in a fairly constant grain size (110-140 microns). Some minor annealing cannot be excluded although an SPO and a strong CPO are present in most domains with a competely recystallized grain population. C-axis orientations show asymmetrical (with respect to the shear zone boundary), peripheral single point maxima, inclined synthetically with the sense of shear, indicating basal <a> and potentially subordinate rhomb <a> slip. In higher strained domains maxima migrate towards the Y direction of the finite strain ellipsoid and a second, antithetical set of maxima persists throughout various strain intensites. The deformation mechanism is inferred to be dislocation creep. In the most highly strained parts of the shear zones (ultramylonites) the quartz aggregates have a width of only 1 to 2 grain diameters. In these aggregates the CPO is weakened. The grain size is smaller ($<$ 50 micron) where 2nd phase particles occcur and the quartz aggregates disintegrate at maximum shear strain.

This is an example where quartz constitutes one of the mechanically stronger phases during progressive deformation while the local strain rate is controlled by diffusion creep of the matrix. The microstructure and the deformation mechanism in quartz potentially changes to diffusion creep in the highest strain parts of the shear zones.