

RECRYSTALLIZATION OF QUARTZ AFTER HIGH-STRESS CRYSTAL PLASTICITY IN NATURAL SHEAR ZONES

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This study presents quartz microfabrics developed by recrystallization at relaxing stresses after high-stress crystal plasticity in natural shear zones at the base of the seismogenic zone. Quartz-rich fault rocks from the Deferegggen-Antholz-Vals (DAV) shear zone in the Eastern Alps and the basal thrust of the Silvretta nappe, Switzerland/Austria, are analysed by polarized light microscopy, scanning electron microscopy and transmission electron microscopy (TEM). Quartz microfabrics from the Silvretta basal thrust show branching zones of small recrystallized grains (average diameter 6 μm) cutting through coarse deformed original host grains. New grains show an almost random crystallographic orientation with large scatter around the original host orientation. In TEM, a high amount of low angle grain boundaries (LAGBs) are observed. Grains are partly bound by high angle grain boundaries (HAGBs) and LAGBs. In samples from the DAV shear zone, strings of recrystallized quartz grains in conjugate orientations cut through host grains. The new grains have a marked shape and crystallographically preferred orientation (SPO and CPO, respectively). The CPO is characterized by low misorientation angles to the host crystal and by high Schmid factors for basal $\langle a \rangle$ glide. In TEM, smoothly curved to straight HAGBs decorated by fluid inclusions bound recrystallized grains.

Both microfabrics record a switch from high-stress crystal plasticity to recrystallization at relaxing stresses. The development of new grains is dominantly by subgrain rotation and migration of LAGBs in areas of high strain developed during high-stress crystal plasticity and subsequent strain-induced grain boundary migration. We propose that new grains develop at almost random crystallographic orientations during nucleation and growth at high rates of stress relaxation (i.e. at low stress), as indicated by the quartz shear zones of the Silvretta basal thrust associated with pseudotachylytes. In contrast, at lower rates of stress relaxation (i.e. nucleation and growth at still high stress levels), new grains develop with CPO characterized by high Schmid factors for the favourable glide system, as observed for the DAV shear zone. The microfabrics give important information on the deformation and stress histories of natural shear zones.