Geophysical Research Abstracts
Vol. 19, EGU2017-6966, 2017
EGU General Assembly 2017

Texture transition in experimentally deformed quartzite

Rüdiger Kilian (1) and Renée Heilbronner (1,2)

(1) Department of Geosciences, University Basel, Basel, Switzerland, (2) Department of Geology, Tromsø University, Tromsø, Norway

Quartz crystallographic preferred orientations (textures), most commonly presented in the form of pole figures, are often used to infer deformation processes or conditions - despite the fact that we still do not understand fully how the different types of texture are generated.

Here, we re-analyse experimentally deformed Black Hills Quartzite using EBSD maps. Samples were deformed in general shear in the dislocation creep regimes 1 to 3 at temperatures ranging from 875 to 915°C, constant shear strain rates of $\sim$1e-5/s (Heilbronner & Tullis, 2006), and resulting flow stresses of (600 MPa $\geq$ Tau $\geq$ 100 MPa).

Already at low strain, a strong alignment of <11-20> in the shear plane and of {10-11} with the maximum principal stress direction is observed. [0001] pole figures of recrystallized grains in regime 1 exhibit a peripheral maximum, roughly perpendicular to the shear plane while in regime 3 two elongated maxima are formed very close to the kinematic y-direction. Regime 2 shows a mixture of these two texture types. In regime 1, dynamic recrystallization is dominated by bulging recrystallization (nucleation of new grains), and in regime 3 by subgrain rotation recrystallization. In regime 2, again a mixture of regime 1 and 3 can be observed.

Texture strength increases with the amount of crystal plastic deformation and is generally the lowest for the texture type with peripheral [0001]. During crystal plastic deformation [0001] rotate towards the kinematic y-direction. The coexistence and transition from one to the other texture type is suggested to result from two different texture-forming processes.

The first process is thought to be crystal plasticity by glide on various <11-20> slip systems and associated rotation of the crystal lattice, with the attractor of [0001] close to - but not exactly parallel to - the kinematic y-direction. The second process is suggested to be the growth of oriented grains during bulging recrystallization and associated (fracturing and) grain boundary sliding. The contribution of both processes results in the final texture type.

The most distinctive difference of the three suites of experiments is the flow stress, decreasing from regime 1 to regime 3. Since the temperature and strain rate differences in these experiments are very small indeed, it is argued that the two end-member texture types do not indicate a temperature dependence of a slip system. Rather, they seem to depend on the flow stress and hence on the recrystallization mechanism. It remains to be tested whether this relation also holds in natural quartz mylonites where those texture types are frequently observed.