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BHQ revisited (2): Texture development

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Analysis of crystallographic preferred orientations (CPO) is mostly used to derive the kinematics of flow or conditions and processes of deformation. Observations from naturally and experimentally deformed rocks indicate that specific texture types might relate to deformation conditions or flow laws - with a number of variables being based on assumptions that are not fully tested. For example, the activity of certain slip systems is interpreted from pole figure geometries assuming that grains are oriented such that the shear stress is minimized, thus enforcing specific c-axis and a-xis directions, so-called "easy glide" orientations.

Black Hills Quartzite (BHQ) deformed experimentally in the dislocation creep regime reveals a CPO development that depends on finite strain (Heilbronner & Tullis, 2006). In that study the CPO development was tracked through the analysis of optically derived C-axis pole figures and corresponding orientation maps indicating a transition from a girdle distribution to a single maximum around the kinematic y-axis with increasing strain.

In this contribution, we re-measure the same samples using EBSD. The availability of the full crystal orientations in combination with novel techniques of orientation and misorientation mapping and combinations of fabric and texture data allow us to analyze the texture development in more detail. Special emphasis is on (a) the ratio of glide to dynamic recrystallization, (b) the relation of grain scale strain to bulk strain and (c) the development of intragranular misorientations with increasing recrystallization and strain.

One interesting result of our analysis concerns the inference of “easy glide” grains based on their c-axis direction. As it turns out, the alignment of <a>-directions at the periphery of the pole figure is more rapidly attained than the clustering of the c-axis about the y-axis (classical interpretation for prism glide) or at the periphery (classical interpretation for basal glide). It appears that grains can be unfavourably oriented for glide despite their c-axis direction falling in those positions which were used in the “classical” interpretation. Additionally, it turns out that grain-scale dispersion axes can be used to describe the kinematic behaviour in a more consistent way compared to the rotations axes obtained from intragranular misorientations in the range of 2-10°.

The implications derived from the experimental data set will be compared to data obtained from natural quartz mylonites which formed in a comparable recrystallization regime. This is the companion poster to “BHQ revisited (I) looking at grain size” where the development of the dynamically recrystallized grain size is addressed.

Reference cited:

Heilbronner, R., and J. Tullis (2006), Evolution of c axis pole figures and grain size during dynamic recrystallization: Results from experimentally sheared quartzite, J. Geophys. Res., 111, B10202, doi:10.1029/2005JB004194.