Geophysical Research Abstracts,
Vol. 11, EGU2009-12891-1, 2009
EGU General Assembly 2009

Texture measurements in fine grained polyphase aggregates

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When analyzing natural and experimental microstructures, we routinely use the two methods for orientation imaging and texture measurements: (a) the computer-integrated polarization microscopy (CIP, Panozzo Heilbronner & Pauli, 1993) and (b) the electron back scatter diffractometry (EBSD, e.g. Kunze et al., 1994). The CIP method yields orientation maps and pole figures of c-axes (of uni-axial materials), while the EBSD method yields complete textural data for all crystallographic orientations. In order to compare the orientation images the Euler maps (obtained from EBSD) are recalculated and presented with the more intuitive colour look-up tables (CLUTs) of the CIP method.

In this contribution we compare and contrast the results achieved by these two methods using two different samples taken from a metagranodiorite (Kilian et al., 2009): (1) a coarse grained mylonitic rock with polycrystalline quartz aggregates and (2) a very fine grained ultramylonitic rock with single quartz grains dispersed in a polymineralic matrix.

For the coarse grained sample (1) both methods yield the same (strong) c-axis pole figure: the geometry of the c-axis polefigure as well as the texture intensity (maximum of polefigure) are identical. The texture of sample (2) - where small quartz grains are dispersed in the polymineralic matrix - is very weak to random. The CIP and EBSD c-axis pole figures are different and - as noted previously - these differences arise from a machine specific bias of the EBSD (Schmocker 2002).

In addition to texture analysis, both methods are capable of image segmentation (identification and separation of individual grains in the orientation image) as well as shape and grain size analysis. However due to the entirely different approach taken, the results may differ significantly. For example, when deriving the grain size distribution for sample (2) EBSD (combined with with the OIM® analysis software) yields a positively skewed histogram (with the mode occurring in the smallest grain size interval) while the CIP method (combined with Image SXM software) yields a quasi-Gaussian monomodal distribution with the mode being very close to the mean. There are a number of reasons for this discrepancy: artefacts are introduced by the pixel resolution of the smallest grains; different results are obtained by supervised versus automatic segmentation; the criterion by which grains are accepted or rejected are different: in CIP it is based on visual inspection - in EBSD it is based on pattern quality. In the CIP approach, the segmentation is interactive and therefore supervised: grains with a cross sectional area of less than a few pixels are rejected as artefacts. In the EBSD approach, on the other hand, grains of 1 pixel diameter can be accepted if the pattern quality (index) is above a given threshold value. As a consequence CIP tends to under-estimate the smallest size fraction while EBSD tends to overestimate it. For the larger grain sizes (large w/r to pixel size) the number fractions derived with both techniques are consistent.

On our poster we will demonstrate how to best combine CIP and EBSD for texture and microstructure analysis. As a general rule we prefer CIP for monomineralic coarse grained material, EBSD for polyphase finer grained material. At low magnifications, sample preparation and measurements are usually faster for CIP, and samples are easier to prepare. At the same time, EBSD is very useful when analyzing polyphase material because of the possibility to create phase masks obtained from element maps.

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