Geophysical Research Abstracts
Vol. 18, EGU2016-622, 2016
EGU General Assembly 2016

Characterizing 3D grain size distributions from 2D sections in mylonites using a modified version of the Saltykov method

Marco Lopez-Sanchez and Sergio Llana-Fúnez
Dept. of Geology, University of Oviedo

The understanding of creep behaviour in rocks requires knowledge of 3D grain size distributions (GSD) that result from dynamic recrystallization processes during deformation. The methods to estimate directly the 3D grain size distribution –serial sectioning, synchrotron or X-ray-based tomography– are expensive, time-consuming and, in most cases and at best, challenging. This means that in practice grain size distributions are mostly derived from 2D sections. Although there are a number of methods in the literature to derive the actual 3D grain size distributions from 2D sections, the most popular in highly deformed rocks is the so-called Saltykov method. It has though two major drawbacks: the method assumes no interaction between grains, which is not true in the case of recrystallised mylonites; and uses histograms to describe distributions, which limits the quantification of the GSD.
The first aim of this contribution is to test whether the interaction between grains in mylonites, i.e. random grain packing, affects significantly the GSDs estimated by the Saltykov method. We test this using the random resampling technique in a large data set ($n = 12298$). The full data set is built from several parallel thin sections that cut a completely dynamically recrystallized quartz aggregate in a rock sample from a Variscan shear zone in NW Spain. The results proved that the Saltykov method is reliable as long as the number of grains is large ($n > 1000$).
Assuming that a lognormal distribution is an optimal approximation for the GSD in a completely dynamically recrystallized rock, we introduce an additional step to the Saltykov method, which allows estimating a continuous probability distribution function of the 3D grain size population. The additional step takes the midpoints of the classes obtained by the Saltykov method and fits a lognormal distribution with a trust region using a non-linear least squares algorithm. The new protocol is named the two-step method.
The conclusion of this work is that both the Saltykov and the two-step methods are accurate and simple enough to be useful in practice in rocks, alloys or ceramics with near-equant grains and expected lognormal distributions. The Saltykov method is particularly suitable to estimate the volumes of particular grain fractions, while the two-step method to quantify the full GSD (mean and standard deviation in log grain size). The two-step method is implemented in a free, open-source and easy-to-handle script (see http://marcoalopez.github.io/GrainSizeTools/).