Geophysical Research Abstracts
Vol. 21, EGU2019-17641, 2019
EGU General Assembly 2019

Grain boundary-based quantification of Shape Preferred Orientations using Scan lines

Johanna Heeb (1,2), Nicholas E. Timms (2), David Healy (1), Enrique Gomez-Rivas (1), and Chris Elders (2)

(1) School of Geosciences, Geology and Petroleum Geology, University of Aberdeen, Aberdeen, United Kingdom (r03jh17@abdn.ac.uk), (2) School of Earth and Planetary Sciences, Curtin University, Perth, Australia (19246301@student.curtin.edu.au)

Shape Preferred Orientation (SPO) is of major interest in various fields related to fabric analysis and coupled material characteristics, deformation behaviour and seismic velocity anisotropy. SPO is defined by the degree of alignment of elliptically shaped grains and forms an ellipse for 2-D and an ellipsoid for 3-D analysis. A quantitative understanding of the influences of SPO is an understudied field. It is necessary to reliably quantify the magnitude and geometry of SPO to analyse possible interactions and their impact on various rock properties.
Analysing grain fabrics directly from images can be problematic for automated software, as a distinct grain boundary identification is necessary. Various attempts include processing backscattered electron (BSE) images with image analysis software (Herwegh, 2010), or using electron backscatter diffraction (EBSD) data. Another approach is to manually trace grain boundaries with vector graphics software, combining reflected microscopy, SEM and EBSD data to obtain precise grain boundary maps. The resulting vector graphic grain boundary maps are processed by specialized image analysis software such as ImageJ. The common method to quantify the SPO is to define grains from which parameters such as grain areas, equivalent circular diameter and lengths, orientations, and ratios of long and short axes can be derived.
We present a new approach: SPO quantification via grain boundary property analysis from vector graphic maps, using the fracture pattern analysis tool FracPaQ (Healy et al., 2017). The vector segments that form the boundaries are analysed in terms of their length, orientation, abundance and distribution. Grain boundary-based SPOs are compared with grain-based SPOs, showing a broad equivalence. Further geometric relationships of SPOs are revealed by using scan line statistics of grain boundary intersections. Using scan line statistics, the directionally-dependent grain boundary density can be quantified and a maximum and minimum grain boundary density direction identified. The orientation of the minimum grain boundary density equals the orientation of the grain elongation, equivalent to the direction of the SPO. SPO strength can be assessed by analysing the difference in intensity between the maximum and the minimum grain boundary density. The scan line grain boundary analysis has potential in various fields: it is not only useful to assess the strength of SPO but might also provide data on grain boundary shape and thus on aggregate grain shape, accommodating deformation mechanisms and possibly grain growth dynamics.

Healy, D.; Rizzo, R. E.; Cornwell, D. G.; Farrell, N. J.C.; Watkins, H.; Timms, N. E. et al. (2017): FracPaQ. A MATLAB™ toolbox for the quantification of fracture patterns. In: Journal of Structural Geology 95, S. 1–16. DOI: 10.1016/j.jsg.2016.12.003.

Herwegh, M. (2000): A new technique to automatically quantify microstructures of fine grained carbonate mylonites. Two-step etching combined with SEM imaging and image analysis. In: Journal of Structural Geology 22 (4), S. 391–400. DOI: 10.1016/S0191-8141(99)00165-0.