Inhomogeneity of crystal distribution patterns: towards an automated fractal-geometry based quantification

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INTRODUCTION

Fractal geometry offers useful tools for rock fabric quantification and new methods are currently under development to investigate the inhomogeneity of fabrics on different scale, such as crystal distribution and, grain- and phase-boundary patterns (Kruhl et al., 2004). These methods are now adapted for automated processing and suitable to quantify the inhomogeneity of rock fabrics from macro to microscale. Applications for quantifying inhomogeneity are mainly based on the box-counting and map-counting (Peternell 2002) methods and provide fractal dimensions and variation of fractal-dimension across a pattern.

MEASURMENTS

A fine-grained granite from central China (plates from a Do-it-yourself Market, Munich) have been investigated. Based on digital photographs of flat non-polished, polished and stained surfaces, the distribution patterns of biotite, quartz, plagioclase and K-feldspar have been quantified by the box-counting method. All patterns are self-similar, except biotite, and their fractal box-dimensions range from 1.71 to 1.80. Investigation of the rock microstructures reveals that the feldspars controlled the biotite distribution in such a way that crystals were either attached to the feldspars or clustered in remaining spaces. This affected the distribution and resulted in the non-self-similarity of the biotite pattern.
A comparison of manually (highest precision) and automatically digitized crystal distribution does not result in significant differences in fractal-dimension values. This opens up the possibility of fully automated data processing with sufficient precision.

RESULTS

The application of box-counting, a classical fractal geometry method for analyzing inhomogeneity leads to results as follows. Stained, polished and even non-polished granite surfaces yield the same information about the rock pattern even if the precision for digitalizing the outlines of the different phases is not the same on different surfaces. Consequently, information is gained about the pattern-forming processes of different phases. Even in case of non-similarity useful information is provided about interaction or disturbance of different processes. Such records form the basis of automated fractal geometry procedures and consequently of detailed pattern analysis of larger areas. Combining fractal and non-fractal data, i.e., chemical and/or mineralogical properties of rock, may provide even more useful data sets.

REFERENCES

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