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Application of the image analysis method to the detection of transcrystalline microcracks observed in microscope images of rock structures

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Damage by microcracking is the main dissipation process associated with inelastic behaviour and failure in most brittle materials such as rocks, concrete and ceramic composites. Rocks are typically inhomogeneous, containing initial defects such as grain boundaries, intercrystalline microcracks and transcrystalline microcracks. Rocks fail through macrofracture preceded by the development of many microcracks. Thus, fast and correct detection of microcracks in rock structures is important from geosciences point of view.

The paper is concerned with the development and application of an automatic algorithm of image analysis for detection of transcrystalline microcracks in dolomite and granite structures.

Rock samples were subjected to the laboratory strength tests and then thin sections were duly prepared. For each measurement field on thin sections we considered a set of input colour images obtained using an optical polarizing microscope. By using polarization, we increase the amount of colour information. From the standpoint of image analysis, additional colour information is very useful in accurate segmentation of rock structure images.

Proposed image analysis method is based on: RGB to CIELab colour system transformation, two-dimensional Gauss matched filtration, TOP-HAT function with linear structuring element and transcrystalline microcracks segmentation for each colour image.

Automatic method was compared with non-automatic identification of microcracks.

The obtained results confirm the adequacy of the image analysis method applied to the segmentation of the microscope images of transcrystalline microcracks in analysed rocks. The proposed technique allows to detect an opened as well as closed microcracks without any dyeing substations and can be adapted to another rock structures such as quartzites and sandstones.

The research yields an algorithm that allows a fully automatic segmentation of transcrystalline microcracks and then geometrical and statistical analysis. The developed method may facilitate the petrographical and stereological studies of rock structures observed under the polarisation microscope.