Automated Thin Section Textural Analysis Using Image Processing

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ABSTRACT

In the field of geology, as in many other fields, a common problem is the analysis of thin sections. An example is the petrographic study of clastic rock samples, i.e., mineral composition, texture, etc. Conventionally, this analysis has been performed by point counting using a polarizing microscope. Although point counting is very time consuming, it is widely used in geology, biology, medicine, and material sciences, among others. Point counting for thin sections is normally conducted through mechanical or electromechanical devices attached to the microscope; usually such devices are very expensive and offer limited functionality. Point counting is very time consuming. The final results of the analysis are subjective and highly dependent on the geologist's experience. This work describes a novel workflow to maximize the amount of information that we can extract from thin sections by combining optical devices and image processing algorithms. The strength and originality of this workflow reside in its high level of automation ensuring that thin section analysis takes much less time than with traditional petrographic methods (a few minutes of computation vs. a couple of hours of human manipulations). The workflow that we are proposing is fully automated to process the entire thin section. The kernel of this workflow uses a region-growing algorithm for the individual grain shape identification (one grain at the time). An iterative process within the kernel allows for the complete and automated scan of the thin section. According to our experience, region growing is the most robust algorithm available for grain shape identification. Indeed, this algorithm shows low sensitivity to the noise on thin sections comprising grains that contain fluid inclusions, cracks, dust, partial dissolution, etc. We provide a comparison between our automated workflow and manual point counting, which shows improvements in both reduced time expenditure and increased accuracy. In addition, this workflow can be applied through a graphical user interface (GUI) allowing a straight-forward interaction between the geologist and the software (pre-processing and post-processing).