Geophysical Research Abstracts
Vol. 18, EGU2016-15142, 2016
EGU General Assembly 2016

Semi-automatic mapping of fault rocks on a Digital Outcrop Model, Gole Larghe Fault Zone (Southern Alps, Italy)

Silvia Mittempergher, Alice Vho, and Andrea Bistacchi

Università degli Studi di Milano Bicocca, Department of Earth and Environmental Sciences, Milano, Italy (andrea.bistacchi@unimib.it)

A quantitative analysis of fault-rock distribution in outcrops of exhumed fault zones is of fundamental importance for studies of fault zone architecture, fault and earthquake mechanics, and fluid circulation. We present a semi-automatic workflow for fault-rock mapping on a Digital Outcrop Model (DOM), developed on the Gole Larghe Fault Zone (GLFZ), a well exposed strike-slip fault in the Adamello batholith (Italian Southern Alps). The GLFZ has been exhumed from ca. 8-10 km depth, and consists of hundreds of individual seismogenic slip surfaces lined by green cataclasites (crushed wall rocks cemented by the hydrothermal epidote and K-feldspar) and black pseudotachylytes (solidified frictional melts, considered as a marker for seismic slip).

A digital model of selected outcrop exposures was reconstructed with photogrammetric techniques, using a large number of high resolution digital photographs processed with VisualSFM software. The resulting DOM has a resolution up to 0.2 mm/pixel. Most of the outcrop was imaged using images each one covering a 1 x 1 m2 area, while selected structural features, such as sidewall ripouts or stepovers, were covered with higher-resolution images covering 30 x 40 cm2 areas.Image processing algorithms were preliminarily tested using the ImageJ-Fiji package, then a workflow in Matlab was developed to process a large collection of images sequentially.

Particularly in detailed 30 x 40 cm images, cataclasites and hydrothermal veins were successfully identified using spectral analysis in RGB and HSV color spaces. This allows mapping the network of cataclasites and veins which provided the pathway for hydrothermal fluid circulation, and also the volume of mineralization, since we are able to measure the thickness of cataclasites and veins on the outcrop surface.

The spectral signature of pseudotachylyte veins is indistinguishable from that of biotite grains in the wall rock (tonalite), so we tested morphological analysis tools to discriminate them with respect to biotite. In higher resolution images this could be performed using circularity and size thresholds, however this could not be easily implemented in an automated procedure since the thresholds must be varied by the interpreter almost for each image.

In 1 x 1 m images the resolution is generally too low to distinguish cataclasite and pseudotachylyte, so most of the time fault rocks were treated together. For this analysis we developed a fully automated workflow that, after applying noise correction, classification and skeletonization algorithms, returns labeled edge images of fault segments together with vector polylines associated to edge properties. Vector and edge properties represent a useful format to perform further quantitative analysis, for instance for classifying fault segments based on structural criteria, detect continuous fault traces, and detect the kind of termination of faults/fractures. This approach allows to collect statistically relevant datasets useful for further quantitative structural analysis.