Fault characterization: rock mass characterization versus IR thermal transient analysis

Giuseppe Mandrone[1], Andrea Filipello[1], Jessica Chicco[1], Damiano Vacha[1]
[1] Department of Earth Sciences, University of Turin, Via Valperga Caluso 35, Turin, Italy

Abstract

Knowledge of the structural features is of great relevance from geothermal systems to slope stability to hydrogeological assessment. In this framework, according to structural and geological setting, groundwater flow exercises a fundamental role both on the mechanical behavior and on thermo-physical properties of rock masses. Aiming to investigate this role, a test site in a limestone quarry in the Argentera Massif (Western Alps) was studied, since the evidence of a well-developed cataclastic normal fault in a calcareous fractured rock mass. Studies were focused on the thermal infrared (IR) imaging, comparing the obtained data with a geomechanical survey.

In particular, the thermal behaviour of the rock mass around the fault has been carried out by acquiring a time-lapse sequence of thermal image, at least once per hour. In situ and lab thermal conductivity analysis, using a needle probe device (K2Dpro, Decagon Devices®) to better define conductive heat transfer, were conducted as well. A geomechanical survey along two scanline using standard ISRM procedure, was realized. Since the high fracture density, customized elaborations were also fulfilled. Moreover, a photogrammetric survey aiming at the 3D reconstruction of the rock mass was carried out.

First results highlight the cataclastic zone seems to react faster to solar radiation showing greater temperature differentials, with respect to the remaining rock mass sectors. These data are in agreement to the thermal conductivity and can be compared through empirical relationships. According to Hoek & Brown approach, all the obtained results are in good agreement with rock mass characterization. An innovative 4D elaboration showing temperature differentials, is also made assigning values at every point of the dense-cloud obtained by photogrammetric surveys using the most suitable colour ramp.

Thermal IR imaging, temperature differentials and geomechanical surveys, can be then considered useful tools to evaluate fractured rock mass features underlining the groundwater role.