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*Original Citation:*

*Availability:*

This version is available <http://hdl.handle.net/2318/144719> since

*Publisher:*

CRC Press - Taylor & Francis Group

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(Article begins on next page)

# Geophysical Characterization of an Instable Rock Mass

C. Colombero & C. Comina

Earth Science Department, University of Torino, Torino, Italy

## ABSTRACT

Focusing on gravitative processes that affect rock masses, an important pre-requisite for the stability analysis is the knowledge of the fracturing state. Among the available geophysical methods, seismic surveys are often suitable to infer the internal structure of a sloping body (Heincke et al., 2006; Maurer et al., 2010). We present the first results of the application of cross-hole seismic tomography as a characterization tool for the site of Madonna del Sasso (Verbania, NW Italy). The site is constituted by a high massive granite outcrop affected by a rock instability phenomenon with episodes of slow deformation recorded by standard monitoring devices. The site was also chosen for the installation of a microseismic monitoring network based on the recording of acoustic emissions related to micro-cracking processes. A detailed geophysical and geomechanical characterization of the test site was required in order to define the overall geometry and the fracturing state of the instable rock mass and to establish the best nodes position for the monitoring network.

A cross-hole seismic tomography was performed in the site, between the two available inclinometric boreholes. In cross-hole seismic tomography, sources are located both in well and on the ground surface as well as the receivers, that are placed in a nearby well or on the same surface. The travel times of the first arrivals are then used to produce a velocity cross-section of the subsurface between the two boreholes (Bregman et al., 1989). Cross-hole tomography is expected to provide better resolution than surface-based methods and is not depth-limited. To perform the tests a Borehole Impacter Source was used as in-hole source, while a hammer, impinging both vertically and horizontally, was employed as surface source. A prototype borehole string equipped with 8 three-component geophones (10 Hz) was progressively lowered in one of the two boreholes and 4 three-component geophones (2 Hz) were placed on the surface. First break picking was per-

formed on the acquired seismic traces to allow for both P- and S-wave velocities imaging. Data were inverted to obtain a tomographic image with the use of GeoTomCG software. The geophysical results (Figure 1) agree with the outcomes of previous geomechanical analysis and with the evidences from borehole logs. Two main areas with lower P and S velocity are highlighted and seem to be well correlated with the fracture traces visible on the yard in front of the sanctuary and on the high cliff bordering the site.

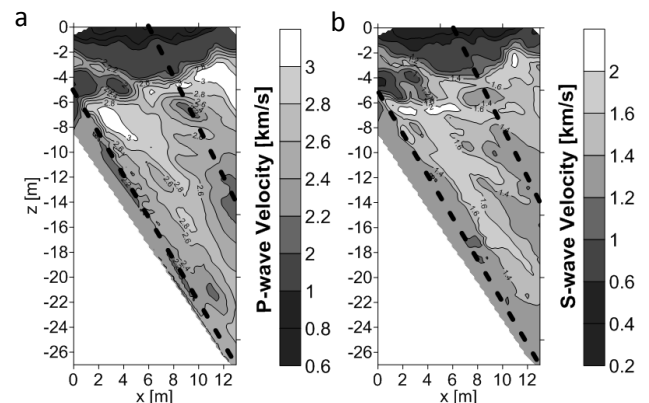


Figure 1. Seismic velocity sections in the investigated granite mass for P (a) and S (b) waves.

The seismic survey allowed investigating in depth the fracturing state of the granite mass, in order to better understand the instability mechanism and to design the monitoring system that will be placed in the next future.

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