Detecting Slow Deformation Signals Preceding Dynamic Failure: A New Strategy For The Mitigation Of Natural Hazards (SAFER)

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Abstract

Rock slope monitoring is a major aim in territorial risk assessment and mitigation. The use of "site specific" microseismic monitoring systems can allow to detect pre-failure signals in unstable sectors within the rock mass and to predict the possible acceleration to the failure. To this aim multi-scale geophysical methods can provide a unique tool for an high-resolution imaging of the internal structure of the rock mass and constraints on the physical state of the medium. We present here a cross-hole seismic tomography survey coupled with laboratory ultrasonic velocity measurements and determination of physical properties on rock samples to characterize the damaged and potentially unstable granitic cliff of Madonna del Sasso (NW, Italy). Results allowed to achieve two main advances, in terms of obtaining: i) a lithological interpretation of the velocity field obtained at the site, ii) a systematic correlation of the measured velocities with physical properties (density and porosity) and macroscopic features of the granite (weathering and anisotropy) of the cliff. A microseismic monitoring system developed by the University of Turin/Compagnia San Paolo, consisting of a network of 4 triaxial geophones (4.5 Hz) connected to a 12-channel data logger, has been deployed on the unstable granitic cliff. More than 2000 events with different waveforms, duration and frequency content were recorded between November 2013 and July 2014. By inspecting the acquired events we identified the key parameters for a reliable distinction among the nature of each signal, i.e. the signal shape (in terms of amplitude, duration, kurtosis) and the frequency content (maximum frequency content and frequency distribution). Four main classes of recorded signals can be recognised: microseismic events, regional earthquakes, electrical noises and calibration signals, and unclassified events (probably grouping rockfalls, quarry blasts, other anthropic and natural sources of seismic noise).

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