Geophysical Research Abstracts
Vol. 12, EGU2010-5017-2, 2010
EGU General Assembly 2010

Pre-failure behaviour of an unstable limestone cliff from displacement, seismic and meteorological data

Jean-Luc GOT (1), Philippe MOUROT (2), and Jacques GRANGEON (1)

(1) LGIT, CNRS, Université de Savoie, Le Bourget-du-Lac, France (jlgot@univ-savoie.fr), (2) MYOTIS, Saint-Martin d'Hères, France (pmourot@myotis.fr)

We monitored the displacement and seismic activity of an unstable vertical rock slice in a natural limestone cliff of the southeast Vercors massif, southeast France, during the months preceding its collapse. Displacement measurements showed an average acceleration of the movement of its top, with clear increases in the displacement velocity and in the discrete seismic event production rate during periods where temperature falls, with more activity when rainfall or frost occurs. Crises of discrete seismic events produce high amplitudes in periodograms, but do not change the high frequency base noise level rate. These crises are constituted by large numbers of 20-50 Hz dominant frequency seismic events, which concatenate to form signals up to one-minute long. Their spectrum exhibits remarkable stationary features and a limited, but clear, frequency sliding with time. We infer that these crises express the critical crack growth induced by water weakening (from water vapor condensation or rain) of the rock strength rather than to a rapid change in applied stresses. Seismic noise analysis showed a steady increase in the high fequency base noise level and the emergence of spectral modes in the signal recorded by the sensor installed on the unstable rock slice during the weeks preceding the collapse. High frequency seismic noise base level seems to represent subcritical crack growth. It is a smooth and robust parameter whose variations are related to generalized changes in the rupture process. Drop of the seismic noise amplitude was concomitant with the emergence of spectral modes - that are compatible with high-order eigenmodes of the unstable rock slice - during the later stages of its unstability. Simultaneously the duration of the events, normalized by their amplitude, decreased. This pattern is coherent with the reduction of the contact surface (rock bridges) between the unstable rock slice and the rock massif. Seismic event detection and noise analysis, especially high frequency base noise level analysis may complete that of inverse displacement velocity in early-warning approaches when strong displacement fluctuations occur.