Geophysical Research Abstracts
Vol. 16, EGU2014-3244, 2014
EGU General Assembly 2014

The use of the thermomechanical sensitivity of prone-to-fall columns for monitoring purposes

Pierre Bottelin, Denis Jongmans, Laurent Baillet, and Eric Larose
Grenoble University (UJF), ISterre, CNRS - UMR5275 Grenoble, France (denis.jongmans@ujf-grenoble.fr)

Ambient vibration studies have been increasingly applied on potentially unstable rock slopes. It was shown that seismic noise records on prone-to-fall columns allow the column resonance frequencies to be derived and it was found that the lowest resonance frequency f1 exhibits a decrease with the progressive decoupling of the column to the rock mass. These results suggest that the damaging process at work can be tracked by irreversible diminutions in resonance frequency and that f1 could be used as a parameter precursor to gravitational instability. Indeed, such frequency drop was observed on the Chamousset limestone column just before its collapse in 2007. On the other hand, the study of several columns has shown that thermal oscillations also create variations in resonance frequency, the characteristics of which depend on the site structure and on the cycle period. These reversible variations can mask small structural changes caused by damaging, making f1 difficult to use as a precursor. A detailed analysis of the thermomechanical behavior of a specific unstable column at the daily scale has shown that the f1 and air temperature curves are in phase, with a delay of a few hours. The interpretation is that an increase in f1 with temperature results from the stiffening of the interface between the column and the rock mass due to thermal expansion. A closer examination of the data at the collapsed Chamousset site revealed a greater sensitivity of f1 to temperature before the rupture than a few months before. We then propose to use the relative sensitivity of f1 to a variation in temperature (SfT) as a new parameter to track damaging. The idea is to benefit from daily thermal solicitations for computing a parameter characterizing the response of the column, which could be independent of temperature. First tests made on several sites reveal that SfT is site-dependent, with the larger values observed at the site exhibiting an open rear fracture, and that it shows no detectable variation with temperature. Numerical simulations are now performed to verify that SfT increases with damaging, as suggested by the observations at the Chamousset site before the collapse.