Geophysical Research Abstracts
Vol. 21, EGU2019-15440, 2019
EGU General Assembly 2019

How to tell the story of progressive rock failure?

Anne Voigtländer (1,2), Michael Krautblatter (3), and Kerry Leith (2)

(1) GFZ German Reseach Center for Geosciences, Potsdam, Geomorphology, Potsdam, Germany (avoigt@gfz-potsdam.de), (2) TUM Technical University Munich, Landslide Research, Munich, Germany, (3) ETH Eidgenössische Technische Hochschule Zurich, Earth Sciences, Zurich, Switzerland

The tales of landscape evolution and geomorphology build upon the principle of antagonism. It draws its excitement by confronting exogenic and endogenic processes and features. Yet, on the local, observable scale the story of progressive rock failure is commonly told from the perspective of exogenic protagonists. Endogenic processes, rock properties, and inherited geological features simply set the stage. Rock failure is then simply defined as a critical state when exogenic drivers overcome the resisting force.
In order to constrain key mechanical damage controls resulting in rock mass weakening and failure, we set up a case study experiment where we assess both exogenic and endogenic processes and features. We present neutron diffraction data on progressive damage in Carrara marble samples and quantify the internal elastic strain state of i) an intact rock sample with inherited geological strains, ii) mechanically and chemo-mechanically altered samples by external subcritical loads and water as an environmental agent. Our results show an initial overall contractional strain state and an induced extensional strain state by mechanical and chemo-mechanical processes. While the contractional strain state can retard crack propagation, the extensional state ease opening mode fractures. Moreover, water both promotes crack growth, e.g. by chemical enhanced stress corrosion, as well as retarding it by relaxing stress concentrations through enhanced plastic deformation. An assumed dominance of exogenic over endogenic processes and features is not observed, they rather exhibited positive and negative feedbacks, where the interaction is the key control of progressive rock damage. The story of progressive rock failure thus might be better told by a concept of interactors, rather than antagonists.