

Master subject:
Numerical modeling of progressive rock fracturing and crack propagation under cyclical environmental forcing using thermally activated damage laws.

Keywords: rock mechanics, statistical physics, fracture mechanics, environmental seismology, erosion process

Profile and skills required

Master's degree or engineering degree in mechanics, physics, or geophysics, with a strong interest in numerical models. Interest in geosciences/natural hazards would be appreciated.

Project description

The environment (meteorological and climatic conditions) is known to play a key role in rock erosion within the critical zone (the first few tens of meters of the subsurface). Cracking and fracturing in this critical zone are crucial in landform buildings but also in gravitational natural hazards (rockfalls, landslides).

The sources and dynamics of fracturing on natural rock outcrops and cliffs remain insufficiently documented, and a quantitative estimation of environmental forcing on crack production is missing. Field and laboratory observations demonstrate the role of daily thermal cycles, rain, and freeze-thaw cycles on progressive rock damage and, furthermore, rock erosion, but the physics behind it is insufficiently quantified.

During this project we will adapt a numerical model describing thermally activated damage development in solid materials to the case of cyclical loadings. We will, for instance, include explicitly the time in the numerical scheme, together with a free boundary surface and, if possible, a pre-existing crack. The goal of the project will be to evaluate how cyclical loadings will increase the size of the crack. Numerical results will be compared to field and laboratory observations.

Field experiments in the Alps will be part of the internship.

PhD funding will be open after the project.

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