Accelerated Displacements and Progressive Rock Slope Failure

1) Creation date of the summary: 19.09.2014

2) Record ID: 33320

3) Last update: 29.08.2014

4) Project status: Planned

5) Organizational unit: Departement Erdwissenschaften, Geologisches Institut, Löw, Simon, simon.loew@erdw.ethz.ch, LZ=03465

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7) ETH researcher(s): no entry

8) External researcher(s): no entry

9) Funding source(s):
   - Own resources of the professorship

10) Partner organizations: no entry

11) Short Summary: In this project we study the physical processes behind precursory signals of catastrophic rock slope failures in crystalline rocks. The most important precursory signal studied in this project is accelerated slip recorded over 10 years at high spatial resolution at the Preonzo (Switzerland) rockslid

12) Keywords: Earth Sciences, Engineering Geology, Engineering Geophysics, Environmental
13) Project description:
Large rock slope instabilities show precursory signals prior to catastrophic failure which remain difficult to fully understand from a rigorous physical perspective. The most important precursory signals are accelerated slip over timescales of weeks to years, which are used as indicators for progressive failure and time-to-failure estimations, critical for rockslide early warning and hazard mitigation programs. Most fundamental studies of the underlying mechanisms are small scale creep or stress relaxation experiments (e.g. Hao et al. 2014) which can not be directly extrapolated to sites scales. The major difficulty in predicting future displacements and accelerations leading to catastrophic failure is related to the complexity of fracture patterns and properties in rockslope instabilities, and the mechanisms driving subcritical crack growth at site scale. Existing numerical studies of progressive rockslope failures strongly simplify the rockslide structure, kinematics and driving mechanisms.

This study is based on an exceptionally well documented rock slope failure (Preonzo 2012, Switzerland), where detailed investigations of 3D rockslide structure, kinematics, and environmental loading conditions will be performed. A ten year accelerated creep stage leading to failure is documented at high spatial and temporal resolution from ground based radar interferometry, TPS and extensometer monitoring data. Additional information on stress conditions and fracture propagation mechanisms in rock bridges will be gained from fractographic analyses. Different model approaches will be used to investigate the deformations during the accelerated creep stage of this and other well-documented sites, such as discrete fracture network models (Scholtes and Donze 2012), slider block models (Helmstetter et al. 2004), or static fatigue and damage models (Amitrano and Helmstetter 2006).

14) Popular description:
Unstable rock slopes can be reliably detected from field observations and modern remote sensing methods. However, predicting the future behavior and estimating reliably time-to-failure remains a very uncertain, yet highly important task. This study is based on a detailed analysis of an exceptionally well documented rock slope failure which happened close to the village of Preonzo (Switzerland) in May 2012. This failure involved about 200’000 m3 of crystalline rocks and was monitored at high spatial and temporal resolution since 2010. At this site detailed investigations of 3D rockslide structure, kinematics, displacements and environmental loading conditions will be performed. Additional information on stress conditions and fracture propagation mechanisms in rock bridges will be gained from new field investigations. Different model approaches will be used to investigate the deformations during the accelerated creep stage of this and other well-documented sites, such as discrete fracture network models (Scholtes and Donze 2012), slider block models (Helmstetter et al. 2004), or static fatigue and damage models (Amitrano and Helmstetter 2006).

15) Graphics: no entry
16) Publications:

17) Links to important web pages: no entry