Geophysical Research Abstracts
Vol. 12, EGU2010-4163, 2010
EGU General Assembly 2010

The influence of fine-grained fracture infillings on destabilization processes in permafrost-affected rock walls in the Alps

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During a systematic survey of discontinuities in the permafrost-affected summit region of the Zugspitze (German/Austrian Alps), we found that a number of discontinuities that show signs of recent instability have a centimetre to decimetre thick infill of fine-grained materials. We hypothesize that fine-grained fracture infillings are a key control of instability at the study site.

We conducted a systematic mapping of discontinuities and performed a grain-size analysis of infill material. Direct Shear tests were made under defined conditions and temperature-paths to test the mechanical properties of 30 fine-grained cleft material samples in a frozen and unfrozen state. The frozen samples were sheared at a temperature of -3˚C and normal stresses simulating a rock overload of 8 meters. After a thawing period up to 5˚C, the shear tests were continued. We observed that the development of shear stress and the settlement- and uplift-processes in the samples depend on the grain sizes, in particular of clay and silt concentrations.

Generally, the shear tests showed a temperature-dependent decrease of shear strength up to 50% and more by thawing, whereas samples with a higher content of coarse components react less sensitive then samples dominated by fine components. In this context, silt seems to be the most affecting component for destabilization by thawing and should get more attention in following stabilization studies. Permanent extensometers were installed to monitor temporal and spatial behaviour of discontinuities with fine-grained infillings in under different thermal regimes and in different mechanical settings.