Geophysical Research Abstracts, Vol. 8, 10149, 2006
SRef-ID: 1607-7962/gra/EGU06-A-10149

Physical Simulation of Active Layer Shearing on Permafrost in steep alpine Scree Slopes

A. Rist (1,2), M. Phillips (1), W. Ammann (1) and W. Haeberli (2)

(1) WSL - Swiss Federal Institute for Snow and Avalanche Research SLF, Davos, Switzerland,
(2) Physical Geography Division, Department of Geography, University of Zurich, Switzerland

(rist@slf.ch / Phone: +41-81-4170276)

In mountain permafrost terrain, steep scree slopes could be destabilized in the next few decades with active layer deepening due to global warming, because the permafrost surface as a potential shear plane could grow into washed-out fine grained materials with a lower shearing resistance. Additionally, mass wasting processes related to permafrost degradation in mountain areas could increase in magnitude, because the active layer as a potentially moving mass will become thicker.

In previous studies, the geotechnical behaviour of homogeneous granular materials of which scree slopes consist, was tested with elaborate technical equipment in the laboratory. However, for plug-like movements of the active layer it is important to distinguish between an immobile frozen layer (permafrost) and a sheared off unfrozen layer (active layer) in laboratory experiments. In this study, a physical model considering these two layers has therefore been developed and active layer shearing on permafrost has been simulated under various conditions.

The experimental setup is basically a shear box with a flat frozen layer in the lower immobile frame simulating the permafrost, and a thick unfrozen layer in the upper movable frame simulating the active layer. To determine the inner friction angle, the lower frame is inclined until the upper frame slides downslope. This means that the shear stress is induced passively by the downhill-slope force of the active layer itself, as under natural conditions.

Thus the dependence of the inner friction angle on four factors (grain size and volumetric ice content of the simulated permafrost, grain size and volumetric water content

of the simulated active layer) has been investigated. Two values were chosen for each factor.

The results showed a positive correlation between each single factor and the inner friction angle. The stabilizing effect of a grain size increase was expected. However, it is remarkable that the effects of the water and ice content on the inner friction angle were even higher.

The developed inclinable 2-layer-shear box proved to be suitable to determine the effects of various factors on the inner friction angle. It can therefore help to improve estimation of the disposition of active layer instability in mountain permafrost regions.