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Sliding zone characteristics of alpine rockslides

D.A. Engl (1,2), T. Strauhal (3), W. Fellin (2), P. Tropper (3) & C. Zangerl (1)

(1) alpS - Centre for Natural Hazard Management, Innsbruck, Austria, (2) Institute of Infrastructure – Unit of Geotechnical and Tunnelling Engineering, University of Innsbruck, Austria, (3) Institute of Mineralogy and Petrography, University of Innsbruck, Austria (Daniela.Engl@uibk.ac.at, engl@alps-gmbh.com)

Rockslides featuring displacement rates in the order of millimetres to metres per year are widespread in alpine regions. Whereas rapidly moving rockslides are mostly restricted to competent rock types (e.g. igneous and carbonatic rock), slow to extremely slow rockslides preferentially occur in "low strength" crystalline rocks such as schists and phyllites. Although most of these deep-seated mass movements did not accelerate to extremely rapid velocities so far, the displacement rates can vary enormously in time. In many cases slope deformation is characterized by translational to rotational sliding mechanisms. Subsurface investigations typically exhibit pronounced strain localization at the base of the moving rock masses, forming a basal sliding zone. Drilling cores taken from this shear zones usually show a heterogeneous composition of highly disintegrated and crushed breccias and gouges. Slope stability and deformation behaviour of rockslides are thus controlled by the low strength in this narrow disintegrated shear zone rather than by the strength of the bulk rock volume.

In order to gain more insight in the time and state dependent properties of these sliding zones, an interdisciplinary study including structural geology, mineralogy and geotechnical engineering has been initiated. For that purpose, samples of shear zone material originating from rockslides in crystalline rock have been analysed with respect to grain-size characteristics, mineralogical composition and mechanical properties. Most of the samples were obtained from drilling cores whilst few of them were attained superficially from outcrops in well exposed rockslide areas. A complication is given regarding the shear zones related to presently inactive rockslides, since they cannot be detected by inclinometer measurements and hence are not a priori distinguishable from tectonic faults. On this account, samples from brittle tectonic faults i.e. tectonic fault breccia and gouge, have been collected from outcrops in the same rock type in order to establish possible distinction criteria. The mineralogical compositions of both the tectonic and the rockslide related breccias and gouges are analysed by means of thin sections and X-ray diffractometry. Special attention is paid to the occurrence of sheet minerals such as mica and clays, since they may affect the strength development during progressive shear. In addition, chemical alteration processes due to increasing disintegration and elevated fluid percolation within the shear zone are studied, based on a comparison of the unaffected rock adjacent to the shear zone and the material from the shear zones itself. Ring shear experiments are performed to determine the shear strength properties of the samples. Particular focus is given to the post peak behaviour of the sliding zone material by investigating the strength evolution at large shear displacements.

Information about the short and long term strength properties in shear zones of rockslides are crucial if stability analysis and slope velocity forecasts have to be performed. The data provided by this study could serve as key input parameters for various modelling strategies.