Geophysical Research Abstracts
Vol. 14, EGU2012-10308, 2012
EGU General Assembly 2012

Geological and structural characterisation of deformation zones of deep seated rockslides in metamorphic rocks

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Generally, deep-seated slowly moving rockslides, characterised by average slope velocities in the range of some mm to dm per year, are frequently observed in foliated metamorphic rock masses such as gneisses, schists and phyllites. Many case studies show that this activity behaviour results from deformation, i.e. sliding/creeping along one or several discrete deformation zones which originate from initial rockslide formation processes. From a geological and structural point of view such deformation zones are extremely heterogeneous and are composed of uncemented fault breccias and gouges. The material that is newly formed through cataclasis and fragmentation of the rock during shearing processes possesses soil-like mechanical as well as hydraulical properties. Consequently, slope stability and temporal deformation behaviour of rockslides is dominated by hydro-mechanical deformation zone characteristics rather than by the properties of the overall mass movement.

In this study preliminary investigation results about the geological structure and mechanical behaviour of deformation zones of deep-seated rock slides are presented. The case studies herein are located in paragneissic rock masses of the polymetamorphic Austroalpine Ötztal-Stubai complex (Tyrol, Austria). In order to focus on the characterisation of the structure of deformation zones the degree of fragmentation, the spatial distribution of clay-gouges and breccias, moisture content and porosity, the distribution of shear planes, the mineralogical composition and grain shapes as well as grain alignment are investigated. Furthermore the shear strength properties (residual friction angles) are determined by ring shear tests. The results obtained are analysed in combination with geological, structural and geometrical observations of the rockslides from detailed field mapping, borehole and investigation adit data as well as slope deformation measurements.

Preliminary results show a complex geological and structural architecture at the basal contact between the rockslide mass and the stable bedrock below. There a several decimetre thick layer of clayey-silty fault gouge zone with variable orientated small-scale slickenslide surfaces were found. Residual friction angle results from shear tests and mineralogical analyses indicate the occurrence of high amounts of sheet silicates but without any swellable minerals. Below and above the gouge layer cohesionless fault breccias (gravelly-sandy) are located with lateral variations in thickness and degree of fragmentation (i.e. block in matrix structures).

The new findings increase the process understanding of the deformation behaviour of slow to extremely slow rockslides in metamorphic rocks and provide new fundamentals for comprehensive slope stability analysis.