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Deep-seated slowly moving rock slides in foliated metamorphic rock masses: New findings about kinematical and hydro-mechanical processes

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Deep-seated slowly moving rock slides are characterised by deformation along one or several shear zones where most of the measured total slope displacement localizes. Many of these rock slides move downwards at mean annual rates of some centimetres or even less and do not show any evidence for non-reversible acceleration in the past or in the future. Whereas some of these rock slides are currently inactive (dormant) or have even reached a stabilised final state others show a temporally variable deformation behaviour characterized by low base activities superimposed by acceleration phases. The trigger for these phases can be manifold and include heavy rainfall, snow melt, water level fluctuations of reservoirs, changes in the slope's equilibrium state due to antecedent slow creeping processes, variations in the material behaviour within the shear/sliding zone, erosion along the foot of the slope, etc.

In order to improve the understanding of the activity behaviour and trigger factors, to increase the quality of slope stability analyses and to assess the hazard potential detailed information about the rock slide geometry and kinematics are essential. Given that subsurface investigations such as boreholes and investigation adits on large-scale rock slides are costly, most published studies are related to investigations in the surroundings of infrastructures and human settlements. Within this study new field mapping, deformation monitoring, geophysical exploration and in-situ subsurface investigation data are presented which are obtained on case studies in paragneissic rock masses of the Austroalpine Ötztal-Stubai complex (Tyrol, Austria). The new investigations contribute to develop geometrical rock slide models, to study the internal deformation characteristics of the rock slide mass and to develop kinematical deformation models.

In addition, results show that all case studies are characterised by slope deformation mechanisms due to shear/slide processes along dm to m thick shear zones. Structurally, the shear zones are fairly heterogeneous and are composed of uncemented fault breccias and gouges (kakirites). The material is newly formed through cataclasis and fragmentation of the rock during shearing processes and possesses soil-like mechanical and hydraulical properties. Consequently, stability and temporal deformation behaviour of rock slides are dominated by hydro-mechanical properties of these zones. Extensive laboratory testing focussing on shear strength, rheological (creep) and hydro-mechanical/hydraulical properties are performed. Herein an overview focussing on the main findings obtained from mineralogical analyses, triaxial creep, triaxial compression, ring-shear, shear box, oedometer and permeability tests are presented.

The new findings increase the process understanding of slow to extremely slow moving rockslides in highly foliated metamorphic rock masses and provide new fundamentals for comprehensive slope stability analyses and hazard assessment.