Geophysical Research Abstracts
Vol. 15, EGU2013-3298, 2013
EGU General Assembly 2013

Multi-methodological investigation of a mass movement in the cuesta landscape of the northeastern Franconian Alb, Germany

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Slopes in cuesta landscapes are, due to their typical internal and external structure, strongly affected by mass movements. In the northeastern Franconian Alb, especially within the escarpment of the so called Rhätolias (Rhaethian (Upper Triassic)/Hettangian (Lower Jurassic)), high activity as well as a distinct diversity of landslide types can be observed. Slide masses are wide-spread and frequent, however, investigations on mass-movements are in general sparse in the study area.
Decisive factors for the intense sliding activity at the Rhätolias escarpment are (i) the complex geological situation with interbedded layers of sandstone and clay in varying thickness and spatial heterogeneity, (ii) the intense fracturing of the sandstones, due to the nearby fault zone of the Franconian line, and (iii) the high availability of water that percolates through the sandstone layers with velocities equal to those of karst layers. Furthermore, slide failure planes can evolve in different argillaceous layers making the processes even more complex.
In the course of area-wide high resolution mapping, one exemplary landslide at the Rhätolias escarpment was selected for a multi-methodological approach. The investigated landslide is located in a circular deep valley, on a north exposed, forested spur. Nearly all slopes in the valley are affected by mass movements of different age and type, including topples, slides, lateral spreads and flows, either as single or combined processes.
The study aims to delineate involved processes and resulting forms. Focus was set on the identification of the surface of rupture and its depth on the one hand, and the involved material and its distribution on the other hand. Based on results, conclusions can be drawn to deduce the potential landslide activity within other slopes of the Rhätolias.
The methodological approach includes a detailed geomorphological mapping as well as a morphometric analysis for the GIS-based reconstruction of the former surface and the mass balance. In order to analyze the internal structure of the slide mass and to detect the depth of the rupture surface, geophysical methods (electrical resistivity tomography (ERT) and seismic refraction tomography (SRT), as well as georadar were applied. To enhance the interpretability of results from geophysical measurements, probe drilling, soil analysis and substrate mapping were carried out.
First results suggest that the slide mass can be delineated from bedrock and debris of uncertain origin by geophysical methods in combination with geomorphological mapping. Furthermore, geomorphological mapping together with soil analysis allows an estimation of relative process ages. The applied combination of methods has proven to be a promising approach for a detailed understanding of the process system.