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Detachment mechanism, runout and age of the Kandersteg landslide event, Switzerland

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In this study, new insights into the timing and process of the Kandersteg rock avalanche were gained through an integrated approach using field and remote mapping, cosmogenic nuclide dating, structural analysis and runout modelling using DAN3D.
The Kandersteg rock avalanche is one of the largest rock slope failures in the Alps. Its volume was estimated to about 750 - 900 million m3 and the landslide deposit stretches over about 10 km2. One can separate four main phases of rock avalanche emplacement. In a first phase, the rock mass detached along pre-existing discontinuities. Structural analysis of the source area shows that the basal sliding plane largely follows bedding of the upper fold limb of the regional-scale recumbent Doldenhorn fold. Bedding planes of Oehrlikalk (i.e. limestone) with interbedded marl layers must have acted as a weakness zone crucial for the detachment of the event. Today's prominent lateral scarp of the rock slope failure is marked by a steeply dipping fault oriented NW-SE. The head scarp is defined by both bedding planes and a steeply NW dipping discontinuity set. In a second phase, the sliding body fragmented and hit the valley floor and steep valley sides near Kandersteg causing intense crushing of the main landslide body but preserving a characteristic boulder carapace. In a next phase the dry fragmented rock avalanche propagated northward over a substrate of fluvial sediments. The source rock stratigraphy was preserved in the deposit. Internal tensile deformation of the landslide body led to the formation of hummocky terrain with transverse ridges. In a final phase the landslide became more fluid through entrainment of water and water-rich sediments. Landslide movement continued northwards where it stopped at a distance of around 10 km from the source approximately 8 minutes after initial failure. The event has previously been suggested to have occurred 9600 years ago based on dating lacustrine deposits underlying reworked rock avalanche material (Tinner et al. 2005). However, new ages derived from direct dating of the blocky landslide deposit can be presented in this study.
The results of this study hence provide fundamental information on emplacement processes of long-runout events that evolve into more fluid mass movements due to the entrainment of sediment substrate. Furthermore, the new understanding of the time of failure puts the Kandersteg rock avalanche in a completely new context.
REFERENCES
Tinner et al. (2005) Der nacheiszeitliche Bergsturz im Kandertal (Schweiz): Alter und Auswirkungen auf die damalige Umwelt, Swiss Journal of Geosciences, 98, pp. 83-95.