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Reconstruction of a pre-historic past rock avalanche in the Hohen Tauern region: The Auernig sturzstrom

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Keywords

Mass movement, rock avalanche, dynamic fragmentation, sedimentology, Hohe Tauern

Introduction

Gravitational processes i.e. mass movements are constantly re-shaping mountain morphology and thus altering a landscape which was formed mainly by the interplay of tectonics and climatically-controlled processes (glacial and fluvial erosion and sedimentation).

Amongst the mass movements, a rock avalanche, also called sturzstrom (HEIM 1932; HSÜ 1975) is the most impressive phenomenon, not only because of its dimension (> 1 Mio m^3) and its high velocity (in the range of 100 m/s). In addition the onset of such a sudden events has been barely recognized in due time by human societies, thus leading to major catastrophies in historical time (e.g. Dobratsch rock avalanches near Villach in 1348 A.D.; EISBACHER & CLAGUE 1984) as well as to myths and sagas. In many cases the sheer size of such rock avalanches leads to a blocking of rivers and the rapid formation of lakes affecting villages as well.

The long run-out increasing with the size (volume) of the sturzstrom mass indicates a completly different dynamics than much smaller rock falls with quite short and rather predictable transport paths. The responsible mechanism leading to kilometer long transport paths accompanied by a strong rock fragmentation is in the focus of modern research. How is a previously intact wedge of rock transformed into a fast flowing mass acting like a fluid? In order to understand this process of "fluidization" studies of former rock avalanche events including geological condition, morphology, structures and sedimentology complement considerations based on rock mechanical tests and models.

Further emphasizes is put on principal reasons for such kind slope failure. Are the big but rare rock avalanches triggered by earthquakes shaking and weakening the rock or by a wetter climate with higher precipitation leading to increased hydraulic pressure in open joints promoting slope instability (PRAGER et al. 2008). As most of the rock avalanches occurred in pre-historic time any correlation with other e.g. climatic archives has to be based on reliable physical dating (exposure age, ^{14}C etc.)

The research project Auernig sturztrom is supported by the "Nationalpark Hohe Tauern" and has been carried out in the course of regular Austrian geological mapping program for map sheet UTM Obervellach. The final report including dating results from Susan Ivy-Ochs and Christian Wirsig (ETH Zürich) will be published soon.

Figure 1: Location of the study area

Field evidence

The Auernig sturzstrom which was first described by HAMMER (1926) represents one of the rare pre-historic rock avalanches in the Eastern Alps which occurred in crystalline rocks, here in prasinite (amphibolite). A synform in the detachment zone with an axis in direction of the slope enabled most probably a first, short sliding phase. After around two kilometers of travel distance the rock mass shows already a strong disintegration due to dynamic fragmentation, as exhibited during excavations for a railway tunnel. The maximum thickness in the range of 100 m is found in the area where the sturzstrom was deflected by the opposing valley flank. From this location on, longitudinal ridges occur in marginal position partly high above the valley floor indicating a "swashing" flowpath. A 25 m high outcrop in around 5.5 km travel distance exhibits the internal structure of a ridge. The angularity of clasts increases towards the top from subangular to very angular. This is accompanied by a decrease in matrix content, which in lower part consists predominantly of silt and gets more sandy towards the upper part. Thus in the lower part, the appearance of the sturzstrom deposit, a massive matrix-supported diamicton, shows a striking similarity with basal traction till, especially in the lowest part, where "erratic" fluvial clasts got entrained. In contrast, the sediment in the upper part of the sequence, just beyond the huge angular boulders on top of the ridge, is clast-supported. Data on grain-size distribution and clast shape complete the picture of a "coarsening-upward" sequence indicating an increase in comminution towards the base. In total, the Auernig sturzstrom provides a nice example for studying dynamic fragmentation (McSaveney & Davies 2006) and the effect of fluidization.

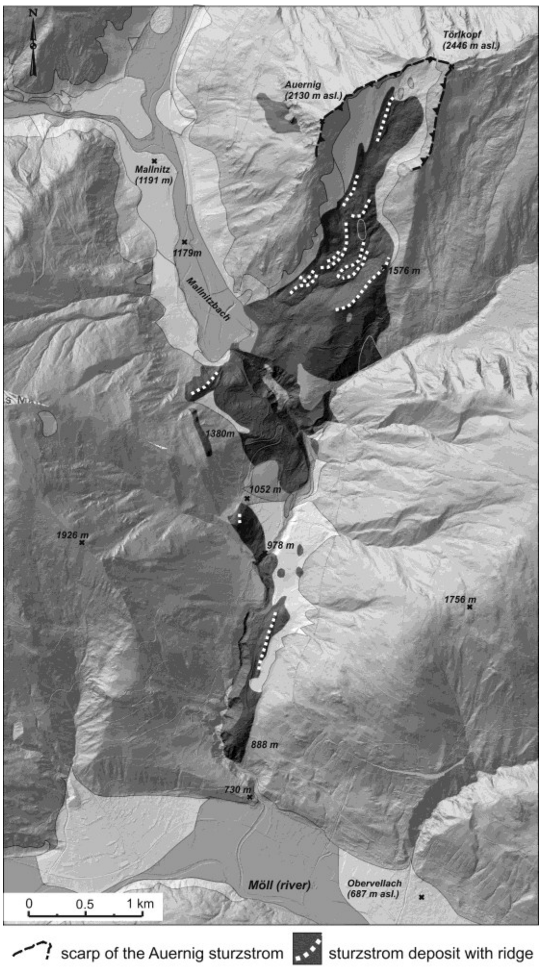

Figure 2: Simplified geological map of the Auernig sturzstrom scarp and deposits.

References

Eisbacher, G.H., Clague, J.J. 1984. Destructive mass movements in high mountains. Geol. Surv. Can. Pap.: 84–16. 228 pp.

Hammer, W. 1926. Geologische Beobachtungen beim Bau des Wasserkraftwerkes bei Mallnitz (Kärnten). Jahrbuch der Geologischen Bundesanstalt ; 77:29-62.

Heim, A. 1932. Bergsturz und Menschenleben. In: Beiblatt zur Vierteljahresschrift der Naturforschenden Gesellschaft in Zürich. No. 20, Jrg. 77, 218pp. Zürich.

Hsü, K.J. 1975. Catastrophic debris streams (sturzstroms) generated by rock falls. Geol. Soc. Amer. Bull. 86: 129–140.

McSaveney, M.J. & T.R.H. Davies 2006. Rapid Rock Mass Flow with Dynamic Fragmentation: Inferences from the Morphology and Internal Structure of Rockslides and Rock Avalanches. In: Evans, S.G., Scarascia-Mugnozza, G., Strom, A. & R.L. Hermans (Ed.), Landslides from Massive Rock Slope Failure. (285-304). New York

Prager, C., Zangerl, C. Patzelt, G., Brandner, R. 2008. Age distribution of fossil landslides in the Tyrol (Austria) and its surrounding areas. Authors. Natural Hazards and Earth System Sciences, Vol. 8, Issue 2: 377-407.

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