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Impact of structural geology on the failure mechanisms of a rock fall site in a metamorphic rock mass (Hüttschlag, Austria)

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The case study presented herein is located in the alpine environment of Austria (Hüttschlag), in the geologic unit of the Rauris Nappe, belonging to the Glockner Nappe System. The study site is composed of intensively foliated and fractured calc-mica schists and greenschists. Together with several generations of pre-existing discontinuity-sets, they form a rock mass, which has hosted multiple rock fall events since 2019. The rock fall events show a cumulative volume of 41 000 m^3, with individual blocks of up to 200 m^3 reaching the valley bottom.

In order to gain insights into the interplay between structural geology and the rock fall failure mechanism, we present a combined approach of methods. They act on multiple observation scales: At the micro-scale, intact rock samples are studied by petrographic microscopy of orientated thin sections. This provides insights into the mineralogy of the intact rocks and their inherent brittle and ductile microstructures (e.g. micro-cracks, folding).

In the field, advanced remote sensing techniques were applied, to perform medium- to large-scale investigations. For this purpose, a ground-based radar interferometer (GB-InSAR) was installed for several months. By this, the actual deformation of the unstable rock face and of the rock fall deposit at the slope´s foot was measured at mm resolution. Additionally, several campaigns of terrestrial laser scanning (TLS) enable us to derive high-resolution recordings of the inaccessible rock face, backed by 3D point cloud processing (LIS Pro 3D) tools. For additional displacement measurements and graphic representation of the results, unmanned aerial system photogrammetry (UAS-P) delivers a 3D model of the rock face.

Geological field investigations complete this combined approach, comprising the recording of lithological, hydrogeological and structural geological features. They embed the rock fall site in its geological setting and allow the creation of a 3D discontinuity network, validating the measurements derived from the advanced remote sensing techniques listed above.

The preliminary results promise interesting insights into the interplay between distinctive structural features and the failure mechanisms of the rock fall site in Hüttschlag, working on variable scales: From micro-structures to well-defined discontinuities, that may be reactivated in

course of the rock fall process. This broad database serves as the basis for numerical modelling, intensifying the investigation of failure mechanisms. Furthermore, the high-resolution recordings of the instable rock face derived from UAS-P and TLS allow us to assess the potential failure volume of future rock fall events, contributing to the rock fall site´s hazard assessment subsequently.