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New insights into structure and evolution of alpine sediment bodies from GPR measurements

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Talus slopes and valley fills are important sedimentary environments in the context of the alpine sediment cascade, as they represent an important link between weathering and removal rates on the one side and the sediment budget of entire catchment areas on the other. The inner structure of alpine sediment bodies provides information on the processes involved in their formation, while accumulated sediment volumes allow a quantification of sediment fluxes. However, our knowledge of the formation history of alpine sediment basins is still fragmentary.

We applied ground-penetrating radar (GPR) to gain insight into the internal sediment structures of numerous talus slopes and sediment basins in the Eastern Alps. The GPR measurements provide exciting new insights into sediment formation. The results show that almost all of the talus deposits investigated are characterised by pronounced stratification. Several different types of layering were identified, which were assigned to redistribution of material by dry grain flows or debris-flows of different magnitudes. Several talus slopes investigated show surface-parallel, persistent layers of different grain sizes which cannot be explained by any known models. We suggest a novel model of talus development which is driven by climatic fluctuations, leading to enhanced weathering and delivery of coarse clasts in cold phases and enhanced redistribution, dissection and depletion of intermediate storage in warmer phases.

This model is in concordance with the temporal course of infill at an adjacent alluvial basin. GPR profiling enabled a detailed calculation of sediment volumes which were assigned to certain time slices derived from historical maps. The results reveal phases of high sediment delivery in warmer periods of enhanced rainstorm frequency, which is probably due to dissection and sediment mobilization at the nearby talus slopes.