Geomorphic relation of Pleistocene talus relicts to their present-day setting: linked, offset, isolated

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Field investigations and Th-U age-dating of cements of lithified Pleistocene talus relicts of the Northern Calcareous Alps (Austria) shows that these relicts may be (a) „linked“ with, (b) „offset“, or (c) „isolated“ from their present-day geomorphic setting. The approach based on local base-level as well as on processes and trajectories of downslope transport provides a more rigid framework of description and communication of the geomorphic relation of fossil deposits to their actual geomorphic setting.

In the Pleistocene of the Northern Calcareous Alps, relicts of talus slopes are common, and since long had triggered speculations on their geomorphic significance. Because talus slopes accumulate only below rock cliffs, erosional remnants of lithified talus located off present cliffs record a former geomorphic constellation. In the past, the assessment of fossil talus slopes relative to their present-day geomorphic setting had suffered from incorrect or doubtful assumptions, from lack of absolute ages, and overgeneralization.

Doubtful assumptions were (1) that the talus slopes reached down to the valley floor, and (2) that talus profiles can be reconstructed as continuously steepened. In the present Northern Calcareous Alps, talus slopes from cliff base to valley floor represent just one of several types of geomorphic positions of talus. Holocene scree slopes are common that terminate high above the valley floor, and there is no necessity to postulate huge talus mantles. Talus profiles are quite different from each other, and are segmented. Depending on slope segmentation and the relative length of slope segments, the graphically reconstructed talus apex may be positioned very differently, as to render such an approach to reconstruction of little quantitative significance. Consideration of the geomorphic significance of talus relicts, or the degree of “geomorphic linkage” of a relict relative to its present setting, must found on the relation of the deposit to the base-level of erosion, and to processes and trajectories of downslope transport. The following definitions of geomorphic linkage are based on our field investigations combined with Th-U dating of cements of talus relicts (to deduce minimum ages).

Linked: A talus relict is „linked“ with its actual geomorphic setting if that deposit could still accumulate, in its whole extent, within that same setting, and at the same location and altitude (above sea-level) than the deposit is preserved. **Example**: A fossil talus slope that terminates at the same cliff toe-line and, downslope, pinches out at the same level than the actual talus slopes.

Offset: A deposit is „offset“ from its actual geomorphic setting if it could again accumulate within this setting (because processes of deposition and downslope transport trajectories would in principle allow for), but now is far set off the local base-level of erosion. **Example**: A fossil talus slope that terminates at the toe-line of a cliff but, downslope, terminates by erosional truncation hundreds of meters above the actual local base-level.
Isolated: A fossil deposit is „isolated“ from its actual geomorphic setting if that deposit could neither be produced by the present processes and/or pathways of downslope transport at site, and could not accumulate at its location within the recent setting, typically because it is far off the local base-level. **Example**: A fossil talus relict preserved along a crestline and remote of a cliff, or the fill of a bedrock-incised gorge preserved along the crestline of a mountain range.
Clear-cut distinction between the defined types of geomorphic linkage must be based on consideration of the entire depositional system (e. g. talus slope, alluvial fan) from which a fossil deposit accumulated. Th-U ages of cements of talus relicts, and consideration of additional undated talus relicts, together show that only a minority of the investigated talus relicts is preserved in geomorphic isolation. Most relicts are offset from or are still linked with their present-day geomorphic setting. Our age data do not imply a straightforward relation between the degree of geomorphic linkage of talus relicts and their age. The lack of a simple correlation between geomorphic linkage and age of talus relicts hints on more efficient action of linear-erosive processes relative to processes of denudation. Landscape dissection related mainly to ice streams, local (valley) glaciers and rock glaciers, and to linear incision by surface runoff in chutes, gorges and valleys, as well as to runoff-induced weathering gives rise to complicated relations between preservation of slope deposits, their age, and their geomorphic setting. The palaeogeomorphic significance of each talus relict must be assessed separately within its specific context.