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Talus slope development: an integrated concept based on the Eastern Alps.

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Talus slopes are deposystems that accumulate in onlap onto the area of sediment provenance, that is, rock cliffs. 'Talus slope – rock cliff ensembles' are subject to strong internal feedback due to the direct interplay of slope accumulation with cliff degradation. Our field observations in numerous Quaternary talus-slope successions indicate an overall predictable relation between talus slope maturity, depositional geometry, and sedimentary facies:

After exposure of rock cliffs by deglaciation or rocksliding, a low-dipping immature talus (dominated by debris flows and/or by rockfalls) or a rock glacier initially accumulates. Upon progressive aggradation and steepening of the proximal slope segment, prevalent processes of deposition change to grain flows and 'sorted rockfalls' in the steep-dipping (30-35°) proximal slope segment, while deposits of debris flows, ephemeral fluid flows, and rare large rockfalls prevail on the distal, lower-dipping slope segment. In successions of mature talus slopes, the proximal slope package overlies the lower-dipping, distal slope deposits along a narrow 'downlap interval'. The downlap interval is characterized by a marked upslope steepening of bedding surfaces over a short vertical and lateral distance.

Immediately after cliff exposure by deglaciation or rocksliding, talus can aggrade at rates of up to a few tens of meters per 1000 years; initially high accumulation rates, however, decrease rapidly with buildup of slope and consequent burial of the rock cliff. On present carbonate-lithic talus slopes of the Eastern Alps the prevalent processes of sediment transport, final deposition, and deposit overprint in many cases change over lateral distances of a few tens to a few hundreds of meters; this gives rise to different types of talus slopes. Whereas glacial-interglacial cycles determine presence/absence of talus, as well as the altitude range of effective talus formation, minor climatic changes thus are hardly to read clearly from fossil talus successions. The highly non-steady character of accumulation, intercalated with phases of inactivity or erosion, further devaluates talus successions as faithful recorders of palaeoenvironmental change. In mountain ranges subject to glacial-interglacial cycles, most talus-slope successions correspond to the transgressive and highstand systems tract, respectively, of marine glacio-eustatic depositional sequences. Talus slope successions represent the altitudinally highest 'tip' of depositional sequences driven by glacial-interglacial cycles, and can comprise unconformity-bounded synthems.