# Torrent deposits in Quaternary „alluvial talus“ (Northern Calcareous Alps, Austria): recognition and significance

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## Introduction:

In the Quaternary of the Northern Calcareous Alps, Austria, lithified successions of “alluvial talus” previously assigned to prevalent debris flow activity consist mainly of rudites deposited from torrent systems. On talus slopes, both recent torrent systems and fossil, lithified counterparts allow to establish criteria for recognition of torrential activity. In Quaternary lithified talus successions of the Northern Calcareous Alps, „alluvial talus“ including torrent deposits is common, and indicates that ephemeral surface runoff played an important to, locally, overriding role.


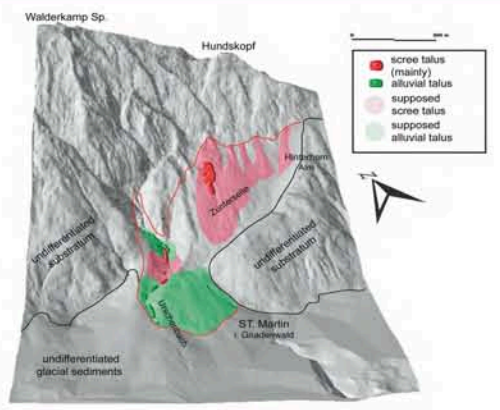


Fig. 1: (above)
Overview of the working area
Fig. 2: (right)
3D-model of the Urschenbach talus system near St. Martin (Gnadenwald) as an example for the complex composition of some of these systems. The torrent deposits occur in the alluvial talus (green).

Architectural elements of talus torrent systems include armoured channel (Fig. 3), riffle, braid plain, terrace (Fig. 4) and sieve lobe (Fig. 5). Channels include cascade, step-pool (Fig. 6) and, rarely, pool-riffle types. Due to ephemeral runoff, in the medial to distal reaches, channel types may be poorly developed. Modern, single flood events are recorded by channel deposits and, in the medial to distal part, by paired terraces formed during high-stage and waning-stage and, below the intersection point, a braid plain-sieve lobe assemblage.

Fig. 3:
Detail of the Guggenalm fan delta on the western bank of Achensee showing an inactive armoured channel overlain by sheet-flow deposits building a terrace. Notice the steep downstream imbrication. (Length of hammer is 33 cm)

Fig. 4:
Detail of upper part of Guggenalm fan delta on the western bank of the Achensee. The terrace is mainly composed by coarse sand to fine gravel, consists of sheet flow deposits and sieve lobes. The sediments dip with about 20°. (Length of Scale bar is 1m)

Fig. 5:
Detail from the distal part of Guggenalm fan delta on the western bank of Achensee. The foreground shows a complex of sieve lobes.

Fig. 6:
Detail from Schäferhütte alluvial talus below Walderkamp Spitz. The photo shows a small, dry plunge pool which is typical for a step-pool channel. Characteristics of plunge pools are: winnowed matrix, moderate sorting, composition of gravel to cobbles. The plunge pool is surrounded by a rampart of finer material with a muddy to sandy matrix. The axes of clasts in the punge pool are steep to vertical.

In fossil alluvial talus (e. g. the fill of dry mountain gorges detached from the present drainage system), cascade channels are recorded by clast-supported fabrics of cobbles to boulders. Step-pool channels are characterized by deposits of channel armour, plunge steps, plunge pools and by bedded, medium to coarse gravel that accumulated from small riffles.
In rudites that were deposited within channels, or from riffles or braid plains, “lunate pores” (Fig. 9 and Fig. 10) below larger clasts are widespread. These pores form by hyporheic interstitial flow, and are partly to completely filled by geopetal layers of winnowed, carnonate-lithic sand that fines upward into carbonate mud.
Both in Holocene and Pleistocene alluvial talus, amalgamated channel-fills and braid plain deposits may look similar to debris flow layers. Lunate pores on clast undersides, however, form only in poorly sorted sediment below highly turbulent fluidal flows. Riffle deposits consist of poorly sorted, faintly bedded gravels locally arranged in steeply dipping, downstream-imbricated fabrics. Terraces consist of stacked gravel-sand couplets deposited from sheet flow. Sieve lobes are of comparatively low preservation potential, and are recorded by lenses up to more than a meter thick and a few meters in length of well-sorted openwork gravel.

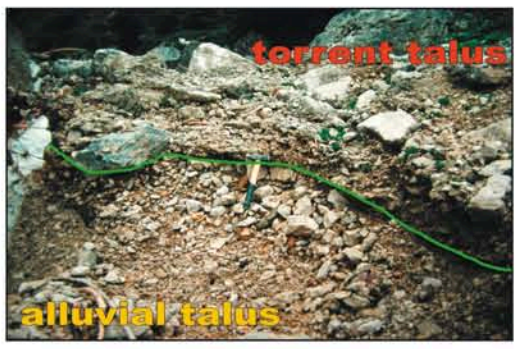


Fig. 7:
Detail from Urschenbach talus system near St. Martin (Gnadenwald) cf.: Fig. 2
The green line marks the border between fossil alluvial talus below and lithified channel deposits above.

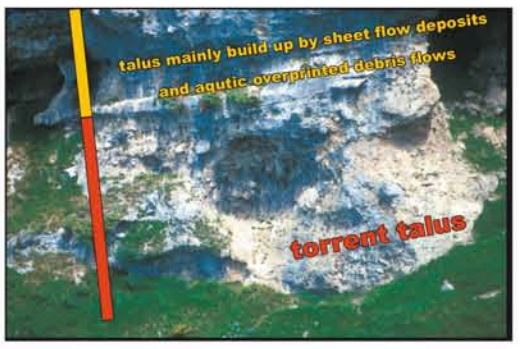


Fig. 8:
Hötting breccia at location Rossfall (Höttinger Alm). The lower part consists of fossil torrent deposits ( mainly channel and sheet flow deposits) whereas the upper part consists of sediments which were deposited from sheet flows and from cohesive debris flows overprinted by surface runoff. Outcrop size is about 30-35 m.

Fig. 9:
Detail of the Guggenalm fan delta on the western bank of Achensee showing channel deposits Typical are very poor sorting, locally steep clast imbrication, ponded lenses of stratified coarse sand to gravel between and abutting large clasts and „lunate pores“ below larger clasts. (Length of scale bar is 1 m)

Fig. 10:
Detail of the Guggenalm fan delta on the western bank of Achensee. „Lunate pores“ below larger clasts are partly to completely filled by geopetal layers of winnowed, carnonate-lithic sand. (Length of clast is about 5 cm)

The fossil, lithified Quaternary talus successions of the Northern Calcareous Alps have been traditionally interpreted as „interglacial sen. lat.“. Comparison with Holocene talus slopes suggests that by far most of the talus accumulated during cool climatic conditions, shortly after deglaciation. In fossil talus successions, the common presence of „alluvial talus“, i. e. of facies associations that formed under deciding influence of surface runoff, however, seems to preclude that the talus accumulated during cold phases. This is supported by the absence, or marked scarcity at least, of facies diagnostic of cold climates, such as successions of „grèze litée” deposited from stone-banked solifluction lobes (see also corresponding poster by Ostermann & Sanders, this session).

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