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What happened after the Last Glacial Maximum in the Sölk Valleys (Styria, Austria)?

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The north-south oriented Sölk Valleys are located in the Niedere Tauern mountain range in Styria (Austria). During the Last Glacial Maximum (LGM) they served as catchment area for the Enns glacier, which flowed towards the east. The Sölk Valleys are dominated by cirques (mostly east or west facing), where several latero-frontal moraine ridges are preserved in different altitudes. These can be assigned to two different stadials, the Gschnitz stadial (Heinrich 1 Event; ~17-16 ka) and the Egesen stadial (~13-12 ka) based on their occurrence (altitude, exposure) and their degree of weathering. Commonly, the latero-frontal moraines of the Gschnitz stadial are scarce and where they exist they have smooth crests. Estimated equilibrium line altitudes (ELAs) are in the range of 1850-2000 m a.s.l. Latero-frontal moraines of the Egesen stadial characteristically show a multiphase glacier retreat. Estimated ELAs are in the range of 2100-2200 m a.s.l. ELAs vary greatly due to exposure and debris cover of the ancient glaciers. After the LGM and the late-glacial stadials significant sedimentation occurred in the Sölk Valleys.

In spite of the precision with which latero-frontal moraines and associated diamictons can be used to pinpoint former ice margin locations and reconstruct palaeogeography, open questions remain regarding the precise origin and significance of gravelly deposits. Therefore, this study aims to integrate geomorphological and sedimentological mapping approaches with study of the texture of gravels to provide a sharper palaeogeographic reconstruction than previously possible. Gravels were investigated for clast roundness, clast shape, and grain size charts were produced. For example, whilst some outcrops might be immediately recognized as alluvial fan or fluvial deposits, there are cases where either interpretation would be plausible. Thus, a deeper investigation into sediment composition using a statistical approach, is a useful semi-quantitative approach to improve interpretative confidence. The degree of roundness is categorized by six groups (very angular, angular, subangular, subrounded, rounded and well-rounded) and the shape by four groups (cuboidal, bladed, prolate and discoidal). The roundness data was also subjected to a cluster analysis. Based on this approach, sediments in the Sölk Valleys can be grouped into three categories (glacigenic features were not analysed): fluvial sediment, alluvial sediment and ice margin sediment. In general, fluvial sediments are characterised by an abundance of rounded pebbles and the grain size charts typically show an exponential increase in the coarse fraction. Ice margin sediments are mostly deltaic, as indicated by field evidence (clear bottomset-foreset-topset transitions). They are distinguishable from fluvial sediments by their bimodal grain size charts and the degree of roundness is less pronounced. Alluvial sediments show the most angular clast shape and in terms of grain size, more fine material is abundant in the sediment. In summary, sediment texture analysis proves to be a powerful means of elucidating and differentiating the processes responsible for different sediment packages in the Sölk Valleys, and provides an essential complement to the traditional mapping approach.

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