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Late-glacial to Holocene sediment dynamics in high Alpine regions – insights from multimethod approach on aeolian deposits (Sanetsch Pass, Switzerland)

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Widespread loess deposits accumulated during the last glaciations in low-elevation regions of Europe, and are often used as paleo-environmental archives (e.g. Muhs, 2013; Martignier et al., 2015). High-elevation aeolian deposits occur also in the European Alps where they have been interpreted as result of Late-glacial glacier retreat (Montandon, 1940; Spaltenstein, 1985). However, high Alpine regions are characterised by complex sediment dynamics with potential multiple reworking and deposition cycles given the various active geomorphic processes in these settings.

This study aims to deepen our understanding of high-altitude aeolian deposits as potential paleo-environmental archives, especially by explaining their depositional history and provenance. We focus on the Sanetsch Pass (Switzerland), where aeolian sediments were identified on both a high-elevation platform covered by patterned ground (2680 m a.s.l.) and within an alluvial fan located at lower altitude (2100 m a.s.l.). Our detailed multi-methodological approach reveals both the provenance of such sediments, the processes and timing of sediment deposition/reworking, and a possible connectivity between the two investigated deposits (i.e. sediment cascade).

Based on grain-size distributions, micromorphological study of sediment thin sections and X-ray diffraction analyses, we could infer that the deposit from the high-elevation platform is a primary aeolian deposit with allochthonous origin that was then partially reworked and sorted in a fluvial system before being incorporated in the nearby alluvial fan, periodically submerged in an ephemeral ice-dammed lake. According to conventional luminescence dating (quartz and feldspar OSL), primary loess deposition at high elevation occurred before or soon after the Younger Dryas (YD). After YD glacier retreat, aeolian deposits were partly transported away from the slopes and deposited in the fluvio-glacial plain, to be then rapidly buried by the build-up of the alluvial fan, as confirmed by the absence of paleo-soils (total organic carbon analyses and micromorphology). Both portable and conventional luminescence measurements evidence as well that the high-elevation aeolian deposits were significantly reworked by cryoturbation, making them therefore unsuitable as proxy for precise timing on paleo-environmental reconstruction.

Beyond broadening our knowledge about Alpine aeolian deposits, this study demonstrates the importance of a multimethod approach to reconstruct sediment dynamics and to not overlook the sediment connectivity which may link distinct geomorphic landforms in high Alpine regions.

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