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Younger Dryas glacial landsystems in the Swiss Alps – processes of moraine formation and modification

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Younger Dryas moraines are prominent features in the lateglacial landform record of the European Alps, which have partly been constrained by numerical dating. Contrasting to this, however, our understanding of mechanisms of moraine formation, glacier dynamics and the impact of postdepositional landform alteration is very incomplete, thus limiting our ability to reconstruct palaeoenvironmental conditions. We use a landsystems approach (cf. Benn & Lukas, 2006) to compare modern and Younger Dryas glacial processes and sediment-landform-associations in the Swiss Alps to those observed in the high arctic in order to (a) close these apparent gaps and (b) to provide a framework for palaeoclimatic inferences.

In the Swiss Alps, high latero-frontal moraines commonly mark the Younger Dryas maximum position. Detailed sedimentological logging and process observations at some modern Alpine glaciers show that such moraines have been formed by a combination of submarginal stacking of subglacial till (forming the core/base of the moraine) and supraglacial gravitational sedimentation in contact with the ice margin (forming the upper part of the moraine). Sedimentological observations in Younger Dryas moraines reveal very similar processes suggesting a distinct Alpine glacial landsystem in which high latero-frontal moraines are formed by active, temperate to partly polythermal, valley or corrie glaciers. Field observations also indicate that modern lateral moraines are partly modified by dead-ice meltout, especially along their lower slopes. Comparison with contemporary high-arctic environments such as Svalbard suggests that the processes of alteration have a large impact on the resulting landform assemblage and that preservation potential of ice-marginal moraines is limited under continuous permafrost conditions (e.g. Lukas *et al.*, 2005). On the contrary, the degree of modification of Alpine lateral moraines is much less severe, possibly due to the

discontinuous nature of mountain permafrost, the lower amount of dead ice contained within them and higher melt rates of dead-ice bodies. More data is needed on the interaction of permafrost and glaciers, in particular the effect on de-icing dynamics and ultimately the potential impact on glacial landform modification. Such information is crucial to correctly interpret Alpine glacial landscapes such as those left by Younger Dryas glaciation and periglaciation.

References

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