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The potential of high arctic colluvial fan development and process regeneration as palaeoclimate proxies; Colluvial source area and sediment mapping within the CRYOSLOPE Svalbard framework.

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Within the CRYOSLOPE Svalbard project we have conducted detailed geomorphological mapping and analysis of colluvial deposits in some valleys in central Spitsbergen. The scope of the project is to provide links between arctic slope processes and climate through the work with 1) meteorological monitoring 2) geomorphological mapping and present process monitoring and 3) future projections of slope activity. The lack of vegetation on arctic Svalbard together with intensive frost weathering and resulting high colluvial activity creates a potential for achieving palaeoclimate information by analysing slope deposit development through time and comparing this to present day process observations.

We present results from a genetic classification of colluvium and colluvial fan development and process regeneration in the Todalen Valley, east of Longyearbyen. The north-south running U-shaped valley is eroded by repeated glaciations, and today modern glaciers occupy two of its tributary valleys. The fractured sedimentary bedrock in the region is exposed to intensive frost weathering and both valley sides are covered by different types of colluvium. The presently active slope processes are primarily rock falls, dry- and wet snow avalanches, debris flows and slush flows. 2008 field observations compared with 1990 aerial photographs show that highly erosive debris-flow activity has had a significant morphological imprint on the landscape in the last decades.

Multi-genetic colluvial fan areas are widespread in both east- and west facing valley sides. Most fans have a main body of snow-avalanche and rock fall material with a younger imprint of wetter processes, such as debris-flows, superimposed on the surface. The debris-flows have remobilized the fan deposits and brought them further out on the valley floor, resulting in a lower surface angle than in the convex snow-avalanche fans.

Two fans, however, show a more regenerative succession of development which can be separated into four developing phases according to the dominating process: i) old snow avalanche fan body, ii) old debris-flow imprint, iii) renewed overprinting of snow avalanche and rock fall deposition with a slightly different source area and finally, iv) renewed debris-flow activity post-1990, partly overprinting the second avalanche fan (iii). The two oldest fan systems (i and ii) show significant rock surface weathering with extensive lichen cover, and the old debris flow system (ii, containing more fines on the soil surface) show significant periglacial redistribution of material through up-freezing processes.

These two examples of temporal shifts of dominating process in a colluvial fan system are different from the other multi-genetic fans, and shows how changes in the source area may be reflected in fan development: Backwards erosion of the source area of a wet debris-flow fan (ii) reached a more easily weathered bedrock unit. The sediment supply increased, and resulted in supra-imposed avalanche/rock fall deposits (iii) on top of a pre-existing "mature" debris-flow fan. This shows that it requires a thorough analysis and distinction between colluvial fan development controlled by climate change and changes induced by source area geology.