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Holocene hillslope development in paraglacial tributary valleys in Nordfjord, Western Norway

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Within sediment transfers from sources to sinks in drainage basins, hillslopes function as a key element concerning sediment storage, both for short term and longer term periods. The rates of hillslope processes are exceptionally varied and affected by many influences of varying intensity. Research on current complex slope processes, sediment storage volumes and contemporary sediment transfer rates contributes to a better understanding of postglacial landscape evolution as well as the prediction of possibly future trends of landform development.

This PhD project is part of the NFR funded SedyMONT-Norway Project within the ESF EUROCORES TOPO-EUROPE SedyMONT (Timescales of sediment dynamics, climate and topographic change in mountain landscapes) Programme. Research is carried out within the Erdalen and Bødalen catchments of the Nordfjord valley-fjord system (inner Nordfjord, Western Norway). Both valleys can be described as steep U-shaped and glacier-fed tributary valleys. Denudative processes in both valley systems include rock and boulder falls, avalanches, slush flows, debris flows, creep processes, wash- and chemical denudation and fluvial transport of solutes, suspended sediments and bedload.

The main aims of this PhD project which are approached in a Holocene timeframe are: (i) to analyse morphometric influences and geomorphic consequences of the Little Ice Age (LIA) glacial advance on selected hillslope systems within defined headwater areas in both valleys, (ii) to investigate Holocene variations of sediment delivery and their impact on slope systems, (iii) to study morphometric and meteorological controls of contemporary denudative slope processes as well as (iv) to quantify the importance of sediment delivery from headwater areas and its changes over time.

A process-based approach is applied using a variety of different methods and techniques. Focus is on different temporal (Holocene to contemporary) and spatial (selected hillslope systems, headwater areas and entire valley system) scales. The applied methods range from standard methods like orthophoto- and topographical map interpretation, geomorphological mapping, hillslope profile surveying to advanced methods for fluvial bedload monitoring (including impact sensors) and different dating techniques (lichenometry and dendrochronology). Geophysical methods (georadar, seismic refraction surveys), high resolution digital elevation model (DEM) data and GIS techniques are applied in order to quantify different sediment storage volumes within the catchments. For monitoring contemporary rates of slope processes a designed monitoring programme is applied at selected hillslope test sites within the two study sites. The designed monitoring programme includes a wide spectrum of instrumentation; e.g. installed nets for collecting freshly accumulated rockfall debris, remote site cameras for monitoring rapid mass movement events (avalanches, slush- and debris flows) as well as installed temperature loggers both in rock walls and talus slopes for analysing rock temperatures and mechanical weathering.

First results show a recognizable more complex hillslope morphometry (steepening of lower hillslope segments) as well as a more complex composition (inherited by a combination of debris from gravitational processes and lateral moraine ridges) of loose material within the hillslope systems located inside of the LIA glacial advance limit as compared to hillslopes situated outside of this limit. Steepened lower hillslope segments and the more complex composition of slope deposits generate a higher intensity of currently acting slope processes with the consequence of higher sediment delivery rates from hillslopes located inside of the LIA glacial advance limit as compared to hillslopes situated outside of this limit.