



## **Environmental controls, rates and sedimentary mass transfers of contemporary slope processes in the headwater areas of two mountain valleys in western Norway**

Katja Laute and Achim A. Beylich

Geological Survey of Norway (NGU), Geo-Environment Division, Trondheim, Norway (katja.laute@ngu.no)

The role of hillslopes, functioning as key elements for sediment production, storage and transfers, is particularly important within headwater systems in cold climate mountain landscapes which are considered to react sensitively to climate change and human impact. This study provides a first detailed and systematic quantification of denudational slope processes as well as a sediment budget for the headwater systems of two steep mountain valleys located in western Norway. The focus of this study is on (i) contemporary geomorphic process rates and sedimentary mass transfers within the headwater areas of the drainage basins Erdalen (79.5 km<sup>2</sup>) and Bødalen (60.1 km<sup>2</sup>), (ii) the absolute and relative importance of the identified relevant denudational slope processes, and (iii) the importance of sediment delivery from slope systems into headwater main stream channels within the sedimentary budgets of the headwater systems.

Identified relevant contemporary processes in both drainage basins include rock and boulder falls, snow avalanches, slush flows, debris flows, slow mass movements/creep processes, wash- and chemical denudation and fluvial transport of solutes, suspended sediments and bedload. These denudational processes were analyzed based on an extensive geomorphic monitoring program conducted over a period of four years (2009–2012) combined with detailed geomorphological mapping and in-depth studies of the most important slope processes. A range of different monitoring and field techniques was applied.

Results show that the intensity of contemporary denudational processes in Erdalen and Bødalen are rather low and appear to be in a comparable range of magnitude as in a number of other cold climate environments situated at higher latitudes of the northern hemisphere. The present-day spatio-temporal pattern of denudational slope processes occurring in the headwater systems is controlled by a complex combination of meteorological and morphometric factors. Comparing the different denudational slope processes according to their annual mass transfers, the highest relative importance is found for rockfalls, snow avalanches, slope wash and chemical slope denudation in Erdalen, and for rockfalls, chemical slope denudation, snow avalanches and debris flows in Bødalen. The revealed differences between the single headwater areas regarding the absolute and relative importance of denudational slope processes are seen as a consequence of the different glacially inherited valley morphometries. However, due to the generally rather low process intensities postglacial modification of the inherited glacial relief is altogether minor in both valleys.