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A re-evaluation of sediment and solute transfers in Karkevagge Swedish Lapland

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Karkevagge, Swedish Lapland, has been the site of detailed geomorphic investigations for over sixty years. The classic study by Rapp (1960) not only identified the dominant processes operating on slope evolution in the valley, but also their magnitudes. Since that landmark study, there has been on-going research focused on better understanding magnitudes and frequencies of the dominant processes, but there has been no comprehensive reassessment of the overall sediment and solute fluxes in the valley. This paper compiles data from numerous recent studies in an effort to obtain an understanding of contemporary sediment fluxes in the valley. .
Kärkevagge is a 5km long glacial valley located in northern Swedish Lapland at approximately 68o26' N latitude and 18o18'E longitude. The 30 year mean annual air temperature from the nearby Katterjakk climate station is -1.7oC and mean annual precipitation is 844mm. Some 50% of the precipitation comes in the form of snow. Mean total sediment output from the catchment is 0.2-11.2tkm-2d-1 (Rehn et al., 1982). There is however considerable spatial variability in sediment transfer within the valley.
Solifluction accounts for the greatest sediment mass transfer in the valley at 1176 t/km2/yr. Mean mass transfer is in the vicinity of 20,000t/yr. (Ridefelt et al., 2009). Annual movement is on average 4cm/ yr. but displays considerable spatial variability depending on moisture availability
Slush avalanches and slush torrents represent significant contributors to sediment transfer in the valley, with mean mass/area transfers of 128t/km2/yr. They display considerable variability in their magnitude, varying from as little as 0.5m3 to >300m3. Slush torrents may contribute between 10,000 and 20,000m3 of mass flow (Gude et al., 2000).
Solute transfer amounts to 46t/km2/yr. for the valley as a whole but there is considerable spatial variability. Total solute flux is greatest at the valley outlet, but within the valley solute flux is greatest at the base of the dam impounding Lake Rissajaure. Within-valley solute variability is strongly controlled by bedrock lithology variability.
Earth slides and debris flows account for approximately 43t/km2/yr. Rockfalls account for approximately 8.7 t/km2/yr. while small avalanches account for 1.4t/km2/yr. These mass movements display considerable spatial and temporal variability in magnitude and frequency within the valley. Valley side wash moves 0.59t/km2/yr. of fine sediment.
Fluvial transport is estimated to be between 40-50 t/km2/yr. flood and slush events contribute suspended sediment up to as much as 3.4t/km2/day. There is considerable variability in suspended sediment transport within the valley channel systems (Rhen et al. 1982).
Rapp's (1960) sediment transfer rates continue to provide a broadly reliable framework for understanding sediment fluxes in Kärkevagge. However subsequent calculations suggest some earlier magnitude determinations need minor revision. Process rates are highly variable spatially and temporally.