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Mass wasting processes and their control on denudation rates, Matter-Valley, Switzerland

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The Valais Region and particularly the Matter Valley (SW-Switzerland) are subjected with frequent severe damages due to mass wasting processes as a result of oversteepend slopes, abundant unconsolidated slope material, heavy precipitation events and permafrost thawing. Numerous investigations have been employed to understand frequency-magnitude relationships of rock-fall and debris flow events in order to create hazard maps.
In completion to these efforts we have investigated cosmogenic nuclide derived catchment wide denudation rates (10Be, 14C) in the Matter and Saas Valleys. The study serves two purposes: 1.) We test the impact of temporally variable and episodic sediment supply from glacial forefields, rock falls and debris flows on cosmogenic nuclide derived catchment wide denudation rates by establishing a time series. 2.) By sampling additionally in a spatial manner we aim to understanding the downstream mixing of sediment and the potential incorporation of landslide and debris flow material from tributary catchments.
Preliminary corrected denudation rates (for elevation and shielding effects) remain constant downstream the Matter Valley for the year 2010, at around 1 mm/yr. A single rate of the Saas Valley yielded similar rates. Samples for 2011 are currently processed. In comparison, these 10Be denudation rates (integrating over the last ∼600yrs) are in good agreement with sediment yield denudation rates in the lower river course near Visp (∼0.8 mm/yr - integrating over a few decades; Schlunegger & Hinderer, 2003). Sediment yield data of glacial erosion or cosmogenic data from the headwater samples of 1.0 -1.4 mm/yr (Hallet et al. 1996; Wittmann et al., 2007). This suggests longer term steady denudation rates, at least for the last centuries. It is one of the rare cases where these two denudation rate measure techniques match.
Short term variations and storage effects are currently tested with cosmogenic 14C. Similar, in an independent effort to predict alpine scale denudation rates via drainage density measures, the Matter (and also Saas Valley) rates are predicted in the range of 1 – 1.4 mm/yr within uncertainties. These numbers are again in good agreement with the empirical data established.
However, for the sampling year of 2010 and 2011, no major debris flow or rock fall deposits delivered significant material to the modern stream thus are not detected in the nuclide inventory. However, if such events would have occurred they would readily perturb the cosmogenic signal as observed elsewhere (Aare, see Kober et al., this conference).

References:

Hallet et al. (1996). Glob. Planet. Change 12: 213-235.
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Wittmann et al. (2007). JGR-ES 112: doi:10.1029