

DEBRIS FLOWS AND DENUDATION RATES

Perturbation of cosmogenic ^{10}Be catchment wide denudation rates

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Catchment-wide denudation rates derived from cosmogenic ^{10}Be have been widely used in the last years to understand the coupling of climate, tectonics and erosion in alpine mountain settings. A requirement in these studies is that a geomorphic and isotopic steady state has been achieved. We tested this assumption by sampling in a debris flow-prone area in Central Switzerland (Fig. 1). Debris flows are episodic processes and can perturb a steady sediment flux signal in an alpine catchment significantly.

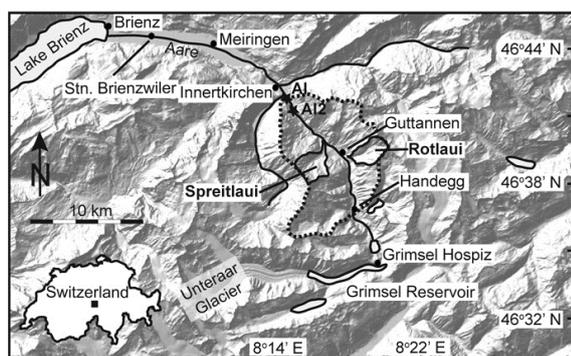


Fig. 1: Aare catchment, Central Switzerland. Active debris flow catchments are the Spreitloui and Rotloui torrents. Samples have been taken at AI and AI2 southeast of Innertkirchen.

Ten samples were taken between fall 2008 and fall 2010 capturing years which were debris flow-free (2008) and those with small and moderate debris flow events (2009) and with heavy debris flow events that caused severe damage of existing infrastructure (2010). The debris flow events in 2009 and 2010 occurred in the Spreitloui torrent (Figs. 1 & 2) with annual total volumes of up to 280,000 m³. Samples taken from 2008 yielded denudation rates of about 0.9 mm/a that are in a similar range with denudation ranges from other Alpine catchments [1]. Samples from 2009, taken following smaller to moderate debris flow events, yielded denudation rates on the order of 1.5 mm/a,

while following the major debris flow events in 2010 only a slight further increase to 1.8 mm/a was observed. This indicates that 1) debris flows can perturb denudation rates obtained with cosmogenic nuclides quite significantly and 2) that after the small to moderate debris flows from 2009 already a threshold of perturbation of denudation rates was approached. That might be a result of the remobilization of material from 2009 deposited along the debris flow fan and the junction with the Aare trunk stream during the 2010 events. Furthermore, preliminary cosmogenic *in situ* ^{14}C measurements in the same aliquots suggest (in combination with the ^{10}Be data) that the material released by the debris flows is material derived from the headwaters that might have been stored there for at most a few thousand years.

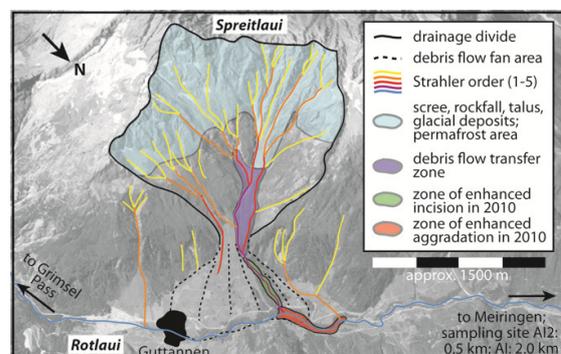


Fig. 2: Spreitloui torrent, active in 2009 and 2010. Substantial erosion and incision occurred in the debris flow fan area (green), while up to 15 m aggradation occurred past the confluence with the Aare (red).

- [1] H. Wittmann et al., J. Geophys. Res. 112 (2007) F04010, doi:10.1029/2006JF000729

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