Geophysical Research Abstracts
Vol. 12, EGU2010-14015, 2010
EGU General Assembly 2010

Factors controlling the denudation rates of the Alps

Bernhard Salcher, Florian Kober, and Sean Willett
ETH Zürich, Geological Institute, Earth Surface Dynamics

Factors controlling the denudation rates of the Alps

We investigate the geomorphic process control on millennial timescale denudation rates of the Alps by comparing geomorphic characteristics of the landscape to denudation rates determined by cosmogenic nuclides (e.g., 10Be) (Wittmann et al., 2007; Norton et al., 2008). In particular, we investigate the degree of disequilibrium in the landscape due to the transition from glacial conditions at LGM to the modern, fluvially dominated state of today. We quantitatively evaluate basin geometry, drainage density, channel steepness index (ks), as well as lithology, vegetation, and rock uplift.
Catchments of the alpine foreland, lacking glacial erosion during the LGM, show equilibrium profiles, high drainage densities and have denudation rates that are positively correlated with the channel steepness index (ks). In contrast, catchments affected by glacial erosion during the LGM, show channels profiles largely out of equilibrium, a large spread of ks, low drainage density but variable and high denudation rates; rates are typically three to five times higher than those in the foreland.
Within the alpine, glaciated basins, we find that the catchment morphology plays a fundamental role on denudation rate. In particular, the number and size of tributary basins is related to the denudation rate. Drainage density reflects this trend; the more and larger tributary basins per catchment the longer the total length of streams per catchment and the lower the denudation rate.
We also observe a negative correlation between ks and denudation rate in places. Almost all tributary basins have convex parts between the trunk and the tributary basin's valley floor (bedrock knickzones) (Norton, 2010). These convex parts raise the ks. Catchments which lack subbasins have lower ks due to missing knickzones but show higher denudation rates. In addition to the previously identified correlation between rock uplift rate and denudation rate, it seems that the state of disequilibrium of catchments as characterized by size, drainage density and channel steepness index may play a role possibly because sub basins influence the sediment routing system. This is in contrast to catchments where sediments are more directly delivered to the trunk stream (where Be10 samples were commonly taken).

References:

Norton, K.P., von Blanckenburg, F., Schlunegger, F., Schwab, M., Kubik, P.W. (2008): Cosmogenic nuclide-based investigation of spatial erosion and hillslope channel coupling in the transient foreland of the Swiss Alps. Geomorphology 95, 474-486.
Norton, K.P., von Blanckenburg, F., Kubik P.W. (2010): Cosmogenic nuclide-derived rates of diffusive and episodic erosion in the glacially sculpted upper Rhone Valley, Swiss Alps. Earth Surface Processes and Landforms. doi: 10.1002/esp.1961
Wittmann, H., von Blanckenburg, F., Kruesmann, T., Norton, P., Kubik, P.W. (2007): Relation between rock uplift and denudation from cosmogenic nuclides in river sediment in the central Alps of Switzerland. Journal of Geophysical Research-Earth Surface 112, doi:10.1029/2006JF000729.