



Novel erosion rate estimations from a steep alpine headwall through cosmogenic ^{36}Cl depth profiles

David Mair (1), Alessandro Lechmann (1), Serdar Yesilyurt (1), Dmitry Tikhomirov (1,2), Romain Delunel (1), Christof Vockenhuber (3), Naki Akçar (1), and Fritz Schlunegger (1)

(1) University of Bern, Institute of Geological Sciences, Bern, Switzerland (david.mair@geo.unibe.ch), (2) University of Zurich, Department of Geography, Zurich, Switzerland, (3) ETH Zurich, Laboratory of Ion Beam Physics, Zurich, Switzerland

Exposure age and erosion rate of various landforms are routinely determined by measuring concentrations of in-situ terrestrial cosmogenic nuclides (TCN). Analyzing TCN concentration distributions along depth profiles is particularly useful for studying settings with a complex erosional history, e.g., from having been subject to high erosion rates or from having experienced several exposures resulting in inherited TCN concentrations (e.g., Anderson et al., 1996). By modeling profiles with Monte Carlo methods, a unique solution for exposure age, erosion rate and inheritance can be obtained (Braucher et al., 2009; Hidy et al., 2010). We applied this method for the first time to steep headwalls of a mountain in the European Alps by measuring concentrations of the TCN ^{36}Cl within the local limestone. Sampling benefited from the unique railway tunnel, drilled through the mountain with several connections to the surface. This allowed us to sample depth-profiles at two sites within the north face and three sites in the southern flank. All samples yield low ^{36}Cl concentrations at the surface, while samples at depth feature high concentrations relative to their depth. This translates into young apparent surface exposure ages for surface samples and hints at a high erosion rate. The Monte Carlo profile modeling yields minimum ages, while no mean or maximum ages can be obtained, due to the lack of initial constraints on erosion. However, the simulations produce estimates on erosion rate and inheritance, independent of the initial erosion constraints. These estimations reveal average local erosion rates of 0.5 to 3 mm/yr for at least the last millennia, which is high, compared to Alpine catchment-wide denudation rates.

References

Anderson, R. S., Repka, J. L. and Dick, G. S.: Explicit treatment of inheritance in dating depositional surfaces using in situ ^{10}Be and ^{26}Al , *Geology*, 24, 47-51, 1996.

Braucher, R., Del Castillo, P., Siame, L., Hidy, A. J. and Bourlés, D. L.: Determination of both exposure time and denudation rate from an in situ-produced ^{10}Be depth profile: A mathematical proof of uniqueness. Model sensitivity and applications to natural cases, *Quat. Geochronol.*, 4, 56–67, 2009.

Hidy, A. J., Gosse, J. C., Pederson, J. L., Mattern, J. P. and Finkel, R. C.: A geologically constrained Monte Carlo approach to modeling exposure ages from profiles of cosmogenic nuclides: An example from Lees Ferry, Arizona, *Geochem. Geophys. Geosyst.*, 11, Q0AA10, 2010.