Geophysical Research Abstracts,
Vol. 11, EGU2009-2183, 2009
EGU General Assembly 2009

Erosion-driven uplift of the modern Central Alps

J.-D. Champagnac (1), F. Schlunegger (2), K. Norton (1), F. von Blanckenburg (3), L.M. Abbühl (2), and M. Schwab (2)

(1) Universität Hannover, Institut für Mineralogie, Hannover, Germany (champagnac@gmail.com), (2) Institute of Geological Sciences, University of Bern, Baltzerstrasse 1-3, CH-3012 Bern., (3) Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences, Telegrafenberg 14473 Potsdam

We present a compilation of four sets of data of modern tectono-geomorphic processes in the Central Alps of Switzerland that appear to suggest that rock uplift is a response to climate-driven denudation in the absence of active convergence. These are (1) basin-averaged Late Holocene denudation rates determined from cosmogenic nuclides and from suspended river loads; these slightly exceed, but spatially mimic the pattern of rock uplift rates as determined by geodetic leveling; (2) the geodetic reference point is also the geomorphic base level with respect to erosion; we further present (3) a compilation of modern plate motion velocities shows that the rotation pole of the Adriatic plate is located within the area, hence the area is not under convergence; finally (4), we illustrate that the Central Alps have acted as a closed system for Holocene sediment redistribution up to the peri-Alpine lakes which have operated as a sink for the erosion products of the inner Alps.

While a variety of hypotheses have been put forward to explain the Central Alpine uplift (e.g. lithospheric forcing by convergence or mantle processes; ice melting) we show with a numerical isostatic model that the correlation between erosion and crustal uplift rates reflects a positive feedback between denudation and the associated isostatic response to unloading. Therefore erosion does not passively respond to advection of crustal material as might be the case in actively converging orogens. Other forces need to be considered to drive surface erosion. We suggest that the geomorphic response of the Alpine topography to glacial erosion and the resulting disequilibrium for modern channelized and associated hillslope processes explains much of the pattern of modern denudation and hence rock uplift. Therefore, in a non-convergent orogen such as the Central European Alps, the observed vertical rock uplift is primarily a consequence of passive unloading due to erosion.

REFERENCES:

Anderson, H. and Jackson, J., 1987. Active tectonics in the Adriatic region. Geophysical Journal Royal Astronomical Society 91, 937–983.

Battaglia, M., Murray, M.H., Serpelloni, E. and Burgmann, R., 2004. The Adriatic region: An independent microplate within the Africa-Eurasia collision zone. Geophysical Research Letter 31, L09605, doi:10.1029/2004GL019723.

Calais, E., Nocquet, J., Jouanne, F. and Tardy, M., 2002. Current strain regime in the Western Alps from continuous Global Positioning System measurements, 1996 – 2001. Geology 30, 651-654.

Norton, K.P., von Blanckenburg, F., Schlunegger, F., Schwab, M. and 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.

Wittmann, H., von Blanckenburg, F., Kruesmann, T., Norton, K.P., and Kubik, P., 2007. The 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.