



Contemporary erosion rates above and below the Alpine LGM ELA

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Post-glacial geomorphic processes in the Alps appear to operate differently in the glacially oversteepened basins of the high Alps, as compared to the lower-slope, lower-elevation basins of the pre-Alps and Foreland. In the glacially steepened parts of the Alps denudation rates inferred from cosmogenic nuclides appear to be uncorrelated with most common basin metrics (e.g. relief, slope), with the possible exception of mean elevation, where denudation rates are positively correlated with mean elevation (Wittmann et al., 2007; Delunel et al., 2010). In foreland areas where basins have not been oversteepened by glacial erosion, denudation rates increase with mean relief and slope. We present here a study in which we demonstrate distinct, but different, relationships between drainage density (m per m^2) and denudation rates. We find a significant inverse relationship between drainage density and erosion rates in glacially oversteepened basins, but a significant positive correlation for basins in foreland areas. We find that the transition between these zones of opposing correlation corresponds roughly with the last glacial maximum equilibrium line altitude (LGM ELA). Above the former ELA, mass wasting processes dominate the hillslope processes, and lead to a decrease in drainage density with increasing erosion rate. Mass wasting intensifies with elevation and this leads to the observed correlations with both drainage density and mean elevation (Delunel et al. 2010). Rock strength also plays a role, but affects both drainage density and erosion rate, and so does not strongly affect the correlation. Below the ELA, hillslope processes are less important and erosion rates and drainage density are both dominated by fluvial incision processes and rock type. Regions with higher drainage density tend to be more efficient at removing rock thereby having higher erosion rates.

Delunel, R., Van der Beek, P., Carcaillet, J., Bourlès, D., Valla, P. (2010): Frost-cracking control on catchment denudation rates: Insights from in situ produced ^{10}Be concentrations in stream sediments (Ecrins–Pelvoux massif, French Western Alps). *Earth and Planetary Science Letters* 293, 1-2, 72-83.

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.