Geophysical Research Abstracts
Vol. 17, EGU2015-1729, 2015
EGU General Assembly 2015

Quantifying glacial erosion in the European Alps using apatite fission track dating

Cornelia Wangenheim and Christoph Glotzbach
Insitute of Geology, Leibniz University Hannover, Hannover, Germany (wangenheim@geowi.uni-hannover.de)

To investigate the impact of glacial erosion on landscape evolution during the Quaternary, problems may occur in choosing the best method, because many methods only reflect parts of the era. Erosion rate calculations based on cosmogenic nuclides only cover the Holocene and erosion rate calculations based on river load gauging reflect even shorter timescales (e.g. von Blanckenburg 2005). In this study we investigate the potential of thermochronological methods, especially apatite fission track dating (AFT) to quantify glacial erosion in the European Alps.
The topography of the European Alps is strongly influenced by Quaternary glaciations, as it formed characteristic features like overdeepened and hanging valleys. The study area is located in the Central Alps of Switzerland, which is a high mountain area. At ∼0.9 Ma glacial erosion has led to a considerable increase in valley incision rates in this area (Haeuselmann et al. 2007) and therefore it is ideally suited to study the glacial impact on landscape evolution.
The advantage of using AFT dating, while studying changes in erosional processes, is that possibly arising nonsteady-state erosion will be recorded within the spatial distribution of thermochronological ages. In this study we applied AFT dating on both bedrock and sediments. The bedrock samples derive from different elevations to figure out whether or not spatial differences and elevation dependencies exist. Combined with already published data we have a relatively high sample density distributed throughout the whole study area. The detrital samples originate from stream sediments and from glacial deposits in the form of late glacial moraines and cave sediments from the last ∼0.5 Ma in order to obtain possible lateral variations in erosion.
The AFT ages of the bedrocks vary between ∼4 Ma and ∼9 Ma, resulting in an average long-term exhumation rate of ∼0.5 km/Ma. Most of the ages range between 7 and 9 Ma, confirmed by prevailing ages of stream sediment samples. The bedrock age distribution of this area indicates that ages do not only increase with elevation, they also show a distinct local trend along major valleys. This trend may be at least partly caused by focused valley incision during glaciations (Shuster et al. 2011), as the youngest ages appear around the position of the equilibrium line altitude of the Last Glacial Maximum, where it is assumed that Quaternary glacial erosion reached an integrative maxima.

Haeuselmann, P. Granger, D. E. Jeannin, P.-Y. and Lauritzen, S.-E. (2007): Abrupt glacial valley incision at 0.8 Ma dated from cave deposits in Switzerland. - Geology 35, 143–146.
Shuster, D. L., Cuffey, K. M., Sanders, J. W. and Balco, G. (2011): Thermochronometry reveals headward propagation of erosion in alpine landscape. - Science 332, 84-88.
von Blanckenburg, F. (2005): The control mechanisms of erosion and weathering at basin scale from cosmogenic nuclides in river sediment. – Earth and Planetary Science Letters 237, 462 – 479.