Geophysical Research Abstracts
Vol. 14, EGU2012-12721, 2012
EGU General Assembly 2012

The geological significance of cosmogenic nuclides in sediment of large lowland basins

H. Wittmann and F. von Blanckenburg

Deutsches GeoForschungszentrum GFZ, Potsdam, Germany

Understanding the links between sediment production in the source area, its transport through large lowland basins, and the final delivery into the ocean is indispensable for assessing long-term sediment delivery ratios with the ultimate aim to determine global Earth surface mass fluxes. Challenges in predicting such sediment yields are 1) spatial- and temporal scale-dependent variability of erosion in the source area; and 2) the quantification of sediment incorporation into sinks such as floodplain deposits, and the timing of their release after intermittent storage.

In the large Amazon basin, we have tackled these challenges with a combination of using the *in-situ*-produced cosmogenic nuclides ^{10}Be and ^{26}Al and modern suspended sediment fluxes. Concentrations of cosmogenic nuclides in river sediment yield basin-wide denudation (weathering + erosion) rates. Sampled at some distance from the Andean front in the upper Amazon floodplain, we show that ^{10}Be-derived denudation rates provide a spatially-averaged rate that sums both sediment production and the release of dissolved weathering products of the Andes. With increasing distance from the high-relief sources, local variability in denudation rates is averaged out, providing a mean sediment production rate that also integrates over long time scales (a few kyr), such that effects of human disturbances are minimized[1]. In the fine sand-sized sediment fraction at the outlet of the Amazon basin, we find the same concentrations of ^{10}Be as in the source areas[2], showing that their erosion rate is dominating the sediment flux in the entire Amazon basin. The preservation of this Andean erosional signal is possible because ^{10}Be and ^{26}Al concentrations are not modified during sediment storage times if the duration of storage is <0.5 Myr. With a box model, we show that nuclide addition by irradiation within the floodplain is negligible because the irradiation depth is mostly too shallow, while decay of ^{10}Be and ^{26}Al is also insignificant as continuous exchange of Andean-sourced sediment with bank sediment of near-channel deposits ensures short storage times and homogenization of concentrations[3].

However, we also show that very old, distal deposits are sometimes tapped by the modern river during e.g. large avulsions[4]. Here ^{26}Al/^{10}Be ratios provide a chronometer of nuclide decay in deeply buried floodplain sediment, due to the different half-lives of the nuclides. The ratio starts to record changes once deposits have been isolated for longer periods (>0.5 Myr) from the modern river. The modern river can re-incorporate large amounts of these old deposits, and once corrected for decay, their concentrations show that this sediment is sourced in cratonic shield areas of low denudation rate[4].

Modern sediment fluxes, determined by river load gauging at the outlet of the Amazon basin, record the rate of sediment export of the basin over $\sim$10 yr time scales and agree with our ^{10}Be-derived rates within a factor of 2[2]. This agreement indicates that a sediment delivery ratio is, at first order, constant from the Andes to the Amazon outlet, and net sediment deposition is apparently not taking place. We can budget Andean sediment production as 620 Mt/yr over the last $\sim$5 kyr, and total export of sediment into the Atlantic today at $\sim$1000 Mt/yr.

[1] H. Wittmann, et al. (2009), *EPSL*, 288, 463-474.

[2] H. Wittmann, et al. (2011), *GSA Bull.*, 123, 934-950.

[3] H. Wittmann, F. von Blanckenburg (2009), *Geomorphology*, 109, 246-256.

[4] H. Wittmann, et al. (2011), *Geology*, 39, 467-470.