Himalayan erosion rates and ^{10}Be systematics in the Ganga basin

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A key parameter to understand the evolution of the Himalayan orogen and its impact on Earth surface processes is the mass of material removed from the system through physical erosion and sediment export. Himalayan erosion rates have been widely derived from thermochronological exhumation studies, river incision rates and sediment budgets covering both long-term exhumation rates and short-term events. Cosmogenic nucleids provide the opportunity to study large-scale basin average erosion rates at intermediate time scale [1, 2]. However, the use of ^{10}Be has yet remained limited for the major Himalayan basins [3].

Here we report ^{10}Be measurements from river sediments covering the Ganga basin that drains the central part of the Himalayan range. Sediments were collected between 2004 and 2010 at the Himalayan front in the main trans-Himalayan rivers, in the floodplain southern cratonic tributaries, and finally in the Ganga (Bangladesh) which integrates the whole basin. ^{10}Be concentrations measured at the Himalayan front range from (8 to 55)·10^3 at. g^{-1} and vary (up to a factor 2) interannually for most of the rivers. In Bangladesh, four different samples yield in contrast similar concentrations (~20·10^3 at. g^{-1}), close to the average of the upstream mountain-outlets values. Those results suggest several preliminary conclusions: (1) The sediment contribution of the southern tributaries of the Ganga is limited to <1%, consistently with their much higher ^{10}Be concentrations and erosion rates of ~0.008 mm. yr^{-1} for the Indian craton. (2) No systematic evolution of the average ^{10}Be concentrations is observed during floodplain transfer as it would be expected from long time transfer in the Ganga plain [4]. (3) Mixing and diffusion during transfer are, however, sufficiently efficient to smooth the lateral and temporal variations and to provide, in Bangladesh, a well constrained mean erosion rate of 1.3 ±0.3 mm. yr^{-1} for the central Himalayas.

[1] Granger *et al.* (1996) *J. Geology*, **104**, 249-257. [2] Wittmann *et al.* (2009) *EPSL*, **288**, 463-474. [3] Vance *et al.* (2003) *EPSL*, **206**, 273-288. [4] Granet *et al.* (2010) *GCA*, **74**, 2851-2865.

Potential rates of denitrification linked to iron and sulfur oxidation in aquatic sediments

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Recent works have shown the existence and importance of chemoautotrophic denitrification via sulfur and iron. Relatively little is known, however regarding the environmental importance of these processes in anoxic sediments. Our goal was to investigate the potential of the two alternative nitrate-reducing processes and compare them to the classical, heterotrophic denitrification in freshwater (riverine) and coastal sediments.

Potential nitrate reduction rates in these sediments ranged from 200 to 700 nmol NO_3^- cm^{-3} h^{-1}. The addition of Fe (II) together with nitrate had little to no effect on total nitrate reduction rates. We observed however a significant effect on the rate of nitrite production in certain sediments; nitrite production was lower in the presence of Fe (II). We hypothesize that Fe (II) reacts, either biotically or abiotically, with nitrite that is produced during heterotrophic denitrification.

Sediments that were supplied under anoxic conditions with nitrate showed high nitrate reduction rates as well as sulfate release rates. No sulfate was supplied to these sediments and exceeded porewater flushing of sulfate indicating the coupling of nitrate reduction with sulfide oxidation resulting in the production of sulfate. The sulfate production rates reached values as high as 60 nmol SO_4^{2-} cm^{-3} h^{-1} and could make up for 15% of the nitrate reduction rates.

This study shows that nitrate reduction linked to iron oxidation in the investigated freshwater and coastal sediments, with ample carbon and high heterotrophic denitrification is of minor importance. The role of nitrite reduction by Fe (II) is under investigation. Sulfide oxidation by nitrate reduction appears to play a significant role in nitrogen cycling, potentially accounting for 1-15% of the nitrate reduction rates.