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Expedition 354 on the Bengal fan: Implications on Neogene erosion regime and climate

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In Himalaya, the monsoon precipitations exert a primary control on erosion. From its intensity depends the extension of the glacier cover, landslide activity, river incision, vegetation cover, and export of sediments towards the floodplain. The monsoon also exerts a primary control on the chemical erosion as weathering rates are clearly dependent upon river discharge.

In the floodplain, sediment export also is tightly controlled by climate. The seasonality and intensity of the monsoon allow to reach discharge high enough to ensure the efficiency of river transport to the delta (Lupker et al. 2011). This efficient transport also acts as a limiting factor for weathering as it reduces residence time in the floodplain. The comparison between the Ganga with a large floodplain and the Brahmaputra with a narrow floodplain and comparatively lower residence time confirms that Himalayan weathering is limited by transport.

Recent IODP Expedition 354 in the Bengal fan (France-Lanord et al. 2016) generated a comprehensive record of Himalayan erosion over the Neogene and Quaternary. It documents the interplay between Himalayan tectonic and climate. The Bengal fan is predominantly composed of detrital turbiditic sediments originating from Himalayan rivers, and transported through the delta and shelf canyon, supplying turbidity currents loaded with a wide spectrum of grain sizes. Turbiditic deposition makes that record at a given site is discontinuous which was the reason for an E-W transect approach. Expedition 354 drilled seven sites along a 320 km E-W transect at 8°N allowing the restitution of an almost complete record of Himalayan erosion at the scale of the Neogene.

Turbiditic sediments have clear Himalayan origin and close mineralogical and isotopic analogy with those of the modern Ganga-Brahmaputra river sediments. Major and trace element geochemistry show relatively stable compositions throughout the Neogene and Quaternary. They reveal a very weak regime of chemical weathering with no significant variation through time. Concentrations in mobile elements such as Na and K relative to Al are significantly higher than in modern sediments and suggest that weathering or soil erosion is amplified in the modern time. Low weathering of the sediments at 8°N indicates that erosion was dominated by physical processes and that transport was rapid enough to prevent evolution of particles in the floodplain. In the modern Himalaya, low weathering is achieved primarily by landslides and rapid transfer through the floodplain, i.e. limited recycling of sediment deposited in the floodplain. Both processes are favoured by the seasonality and the intensity of the monsoon. On the organic side, carbon isotopic analyses of organic matter in turbidites clearly reveal its continental origin. The hydrogen isotopic composition of leaf-wax compounds reveals low δD since Early Miocene, indicative of significant amount effect i.e. Monsoon. Overall, the low weathering intensity suggests that comparable erosion regime was established since at least Early Miocene.

References

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