4.5.41

Past and present fluxes from the Himalaya to the Bengal Fan

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Testing models of carbon cycle forcing requires reconstructing past fluxes of erosion. On a specific basin, organic carbon burial can be approximated using organic carbon content of eroded sediments. Weathering fluxes must be deduced from the difference of chemical composition between the source rocks and the eroded sediments. At the global scale, isotope compositions of the ocean ($^{87}Sr/^{86}Sr$ or $\delta^{13}C$) can be used as proxy of erosion. At both scale, the comparison with modern systems is essential to test the validity of our approaches. The Himalayan system offers the possibility to study both long-term sedimentary record and a modern river system that has been relatively stable over the Neogene. At the global scale, the effect of the Himalayan erosion has been largely debated. It is now clear that, during the Neogene, marine Sr cannot be used to trace directly past continental erosion. This is due to the exceptionally radiogenic composition of the Himalaya which makes that Himalayan rivers dominates the global riverine flux despite the fact that they supply only 2% of the dissolved Sr flux to the oceans. This configuration probably prevails during all the Neogene because Early Miocene sediments from the Himalaya are quite similar to modern ones. Earlier, the rise of oceanic Sr isotopic ratio could in fact trace the onset and intensity of the Himalayan erosion.

Himalayan fluxes of silicate weathering can be deduced from ratios of soluble element to insoluble elements in eroded sediment compared to the Himalayan source rocks. Such budget applied to the modern system sediments can be compared to measured fluxes of dissolved load in rivers. On the first order the comparison is correct and the proportion of the different cations released by silicate weathering are consistent. However river sediments must be considered with caution, as their chemical composition are controlled by transport processes. Bedload and suspended load at different depth in the river channel have marked chemical differences that affect geochemical budget. For instance sediments sampled at the same location on the Ganga have CIA varying between 75 at the surface and 62 in the bedload. Comparable mineralogical differentiation due to transport processes is also observed in the Bengal fan[1] and lead to important differences. Tacking into account this variability is complex but necessary in order to refine estimations of present and past erosion fluxes. Comparable problems occur for organic carbon whose concentration can be significantly controlled by mineralogical parameters.

Reference

[1] Galy V. et al. (2004) *This session.*

4.5.42

Geochemical differentiation induced by sediment transport in the Bengal fan: Implications for carbon uptake budget

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The DSDP Hole 218 (Leg 22) records a Mio-Pliocene sedimentary section in the middle part of the Bengal fan near 8°N. Sedimentologic, mineralogic, geochemical, and C, Sr, and Nd isotopic data allow 1) the determination of the origin of the detrital organic and inorganic material, and 2) the comparison with the sediments carried by modern rivers and cores recovered in the proximal and distal fan.

Sr and Nd isotopic data are characteristic of Himalayan sediments and are similar to those of the distal fan (ODP Leg 116). $\delta^{13}C$ data on total organic carbon are variable: stable around -25‰ in the lowest part and heavier and more variable (between -23 and -19‰) above 370 mbsf. Similar $\delta^{13}C$ shift was observed on distal fan records and corresponds to the expansion of C4 photosynthetic plants in the Gangetic basin 7 Ma ago. The increase is, however, less pronounced on Hole 218 than in the distal fan. Clay mineral assemblages are characterised by a dominance of illite and chlorite with minor proportion of smectite and kaolinite. We observe a minor increase in the proportion of smectite in the upper Miocene and Pliocene part of the Hole, which contrasts strongly with the distal fan where smectite becomes the dominant clay after 7 Ma. In Hole 218, sediments appear to have significantly lower grain size than in the distal fan suggesting that they are channel-levee type deposit whereas the distal fan could have accumulated coarser material transported downstream.

While the sources of sediments remain rather stable, significant differences are observed between the middle and distal fan records. These are linked to mineralogical contrast and likely derive from differentiation processes during transport overshadowing the weathering and organic carbon burial budget drawn from these sediments. For instance, compared to the distal fan, the upper Miocene and Pliocene sediments of Hole 218 led to a smaller silicate weathering rate and a lower organic carbon burial. The geochemistry of these sediments is partly controlled by transport processes and mineralogical sorting, which need to be taken into account in order to model past weathering fluxes.