Can we derive chemical erosion flux from river sediment?

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The chemical composition of river sediment results from the chemical composition of the source rock modified by weathering reactions occurring during erosion. It is therefore possible to derive from continental detrital sediments, the characteristics and intensity of weathering of a basin provided the source rock is known (e.g. Gaillardet et al. [1]). In practice, river sediment composition is also controlled by transport processes, which induce mineral sorting effects. These effects tend to concentrate secondary phases such as clay in the upper suspended sediments whereas deeper suspended sediments and bedload are enriched in primary (unweathered) minerals. Weathering budget must then take into account this variability. A second aspect is that erosion is not necessarily at steady state at a given time. Therefore, sediments and dissolved load may not satisfy geochemical mass balance between the source rock and the erosion flux. This is certainly the case when considering single day sampling, as seasonal variation indeed imbalance chemical and physical erosion fluxes. This can also be the case for annual compositions as climatic variations or anthropic impact can induce changes in the erosion distribution in a given basin.

In this study we present geochemical data for river sediments of the Ganga and Brahmaputra sampled at different positions in the basin from the Himalayan sources to the delta. Sampling includes depth profile in the river, which allows to determine the variability generated by transport processes. The data show that there are systematic variations that considerably affect the geochemical signature of the sediments. Integrating depth profile data allows to compare weathering characteristics in the different positions of the basin. For the Ganga, there is a clear increase of the weathering downstream marked in particular by depletion in Na and K. This is consistent with significant processing of the sediments in the floodplain. Such variation is not observed in the case of the Brahmaputra. This is likely linked to a faster transit in the narrower floodplain of the Brahmaputra. Suspended sediments from the delta are also clearly enriched in Al and Fe relative to the average Himalayan sources implying considerable bedload transport and floodplain sequestration. Integrating these river sediment data allows to compare Na and K loss with dissolved riverine flux.

[1] Gaillardet et al. (1997) *Chem. Geol* **142**, 141-173.