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U-Th-Sr isotope ratios in sediments from the Ganga-Brahmaputra system

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The nuclides of the radioactive series are recognized as relevant tracers and chronometers of weathering processes. Their analysis in the dissolved and suspended loads of rivers could be used for establishing weathering mass balance at the watershed scale and for constraining weathering time scale. However such a use imposes first to correctly understand the processes controlling the origin of U-Th fractionation in sediments and water relative to erosion and weathering processes.

We propose to address this question in the case of the Himalayan river system, one of the most erosive area in the world. This study involved the analysis of ^{238}U-^{234}U-^{230}Th disequilibria and of Sr isotope ratios in the Ganga-Brahmaputra stream sediments.

At the scale of the Ganga-Brahmaputra river system, the variability of the $^{87}Sr/^{86}Sr$ isotopic ratio is comparable with the one already observed by Singh and France-Lanord [1], and which mainly expresses the lithological diversity of the sediment sources. However, the data highlight that suspended materials have less radiogenic Sr isotope ratios than the sediments. This systematic shift could result from the mineralogical sorting of the particles during their transport, associated with the different origin of the transported materials according to their size.

U activity ratios in sediments and suspended materials have values in the range of those previously published by Sarin et al. [2]. However, TIMS data presented here demonstrate that sediment of the Ganga-Brahmaputra river system are in ($^{234}U/^{238}U$) disequilibrium, with values on both sides of 1 (secular equilibrium): from 0.978±0.002 to 1.061±0.002. Moreover, these data could suggest a variation of ($^{234}U/^{238}U$) activity ratios in relation with the mineralogical composition of the sediments (smectite and illite percentage).

The sediments also exhibit significant ^{230}Th-excess, with ($^{230}Th/^{238}U$) values reaching 1.30 or more. These disequilibria could correspond to a Th adsorption on the particles during their transport in the streams, or could be a signature inherited from pedogenetic processes. The understanding of the origin of Th/U ratios becomes a key point for a correct use of ^{238}U-^{234}U-^{230}Th disequilibria of sediments as tracer of the weathering processes.

References

[1] Singh et al. (2002) *EPSL* **202**, 645-662.

[2] Sarin et al. (1990) *GCA* **54**, 1387-1396.