Contribution of minor minerals to the U-Th-Ra budget of Gandak River sediments.

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Transfer time of sediments in alluvial plains may be constrained by analyzing the variations of the U-series disequilibria in river sediments along the stream. However, previous estimates obtained for bank sediments of Himalayan rivers (1,2) can be questioned by recent 10Be and Sr-Nd isotope studies (3,4), which yield much lower transfer times than those estimated by U-series approach. The recent study performed on bank sediments from the Gandak River (Bosia et al, GES 10-Paris) confirms the occurrence of significant ^{238}U-^{230}Th-^{226}Ra disequilibria in river sediments, with no simple upstream-downstream variation, but with a clear decrease of the U/Th and ^{230}Th/^{232}Th ratios. The correlations observed between (^{238}U/^{232}Th) activity and Ti/Th ratios as well as between (^{230}Th/^{238}U) and (Nd, Ce, La, Sm)/Th ratios suggest that minor mineral phases, such as Ti-bearing minerals, REE-bearing minerals (in particular monazite and xenotime) and zircon are likely to control a significant part of the U-Th-Ra budget in these sediments. To test this assumption and quantify the real contribution of such minor minerals to the U-Th-Ra budget of the Himalayan sediments, we have undertaken a detailed analysis of the U-Th-Ra concentrations and isotopic compositions in the Gandak sediments, similarly to the approach developed in (5). Our results clearly demonstrate that budgets of U and Th but also of Ra in river sediments of the Gandak River are significantly influenced by such primary minor phases, especially monazite and zircon, and by clay fractions. The data therefore demonstrate that the relative abundances of U-series nuclides in these sediments do not only depend on their chemical evolution during their transfer within the plain and on the duration of the transfer, but also on the mechanical transformation of the sediments mineralogical composition. Both processes have therefore to be taken into account for interpreting the variation of U-series disequilibrium in river sediments to recover sound estimations of the transfer time of sediments along the Gandak River.

[1] Granet et al., 2010, *GCA*, **74** (10): 2851-2865 ; [2] Granet et al., 2007, *EPSL*., **261** (3-4): 389-406; [3] Lupker et al., 2012, *EPSL*., **333-334**: 146-156; [4] Garçon et al. , 2014, *Chemical Geology* **364**, 45-55.