Understanding radioactive disequilibrium in river-borne material: dependence on colloid/particle size

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Recent studies have used U-series isotopes in river-borne material to investigate the conditions and timescale of erosion at the basin scale (e.g. Vigier et al., 2001; Dosseto et al., submitted). Because U is more soluble than Th and ^{234}U can be preferentially ejected from the solid, ^{234}U excess over ^{238}U, ($^{234}U/^{238}U$) >1, and ^{238}U excess over ^{230}Th, ($^{230}Th/^{238}U$) <1, are expected in the nominally "dissolved" phase (<0.2 or 0.45 μm) and the opposite in suspended particles. However, in some cases, opposite trends have been observed (e.g. Porcelli et al, 2001). To better understand the size dependency of radioactive disequilibrium in river-borne material, U-series isotopes have been measured for different colloid/particle sizes in waters from the Murray River Basin, SE Australia. Preliminary results show that all fractions <1 μm have ($^{234}U/^{238}U$) >1 and ($^{230}Th/^{238}U$) <1, the extent of disequilibrium decreasing with increasing colloid/particle size. Douglas et al. (1999) have shown that the composition of colloidal matter (<1 um) in these rivers is controlled by mixing between detrital silicate and organic material. The increasing proportion of detrital silicate may be responsible for the decrease in disequilibrium. Hence, the "true" dissolved phase (free of detrital silicate) is probably characterized by a higher disequilibrium than that observed in the nominally "dissolved" phase. This observation may have implications for the lack of complementary nature between nominally "dissolved" phase and suspended particle compositions, currently used to discuss the steady-state nature of erosion in large drainage basins (Vigier et al., 2001; Dosseto et al., submitted).

References

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