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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# Diel cycles in stable isotopes of dissolved O₂ and dissolved inorganic carbon in the Big Hole River, Montana

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Large diel changes in the isotopic composition of dissolved oxygen (δ^{18}O-DO) and dissolved inorganic carbon (δ^{13}C-DIC) were measured in the Big Hole River, SW Montana. δ^{18}O-DO showed a diel range of 14‰ in August 2004, and 8‰ in September 2004. δ^{13}C-DIC showed a diel range of 1.4‰ in September 2004.
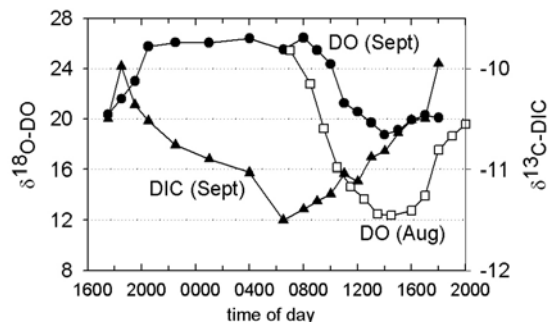
The results are explained by daytime photosynthesis with the net production of isotopically light O_2 and net consumption of isotopically light CO_2, and by night-time respiration which consumes isotopically light O_2 and produces isotopically light CO_2, together with gas transfer between the river and the atmosphere. Other measured river parameters (such as pH, DIC and DO concentrations) were consistent with this interpretation. The greater diel range of δ^{18}O-DO in August vs. September is consistent with a higher rate of biological productivity during August (warmer), and by the higher DO concentrations during September (cooler).

This study is one of the first to document diel changes in δ^{18}O-DO and δ^{13}C-DIC in a river, and is consistent with the preliminary data of Tobias and Bohlke (2004). The use of δ^{18}O-DO and δ^{13}C-DIC has potential to advance our understanding of the biological, chemical, and physical processes that take place in rivers and lakes.

Reference

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