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Stable Isotopes of dissolved inorganic and organic Carbon reveal photosynthetic Activity and Carbonate Dissolution

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Rivers provide integral geochemical information because they consist of groundwater, interflow, overland flow and anthropogenic input. In this context stable isotopes serve as ideal tracers for ecological processes in rivers. Ideal markers for such work are the stable isotopic composition of the dissolved inorganic carbon (d13CDIC) and/or the particulate organic carbon (d13CPOC). These markers react in specific ways to fundamental processes such as respiration and photosynthesis. In combination with other parameters such as dissolved oxygen, alkalinity, Ca2+, Mg2+ or chlorophyll-a measurements they can reveal important information about the health of ecosystems.

In a case study of the St. Lawrence River system combined d13CDIC and d13CPOC helped to show that the origin of particulate organic carbon is mostly from photosynthetic activity in near shore embayments (Barth &Veizer, 1998). This demonstrates that increased diffuse pollution may either cause more photosynthetic activity through increased fertiliser loadings or enhance the proportion of detrital material if photosynthesis is hampered by for instance organic or heavy metal diffuse pollution.

Another isotope case study on the Lagan River in Northern Ireland showed that despite excessive organic carbon and nutrient loading, the riverine carbon cycle remained dominated by carbonate dissolution (Barth et al. 2001). This natural effect influences the river in a diffuse manner that is integrated over the catchment. This is more evident in the river than in groundwater samples, which represent point information from wells.

References: Barth J.A.C., Cronin A., Dunlop, J. and Kalin R.M. (2003) Influence of carbonates on the riverine carbon cycle in an anthropogenically-dominated catchment basin. Groundwater-surface water interaction: Evidence from major elements and stable carbon isotopes in the Lagan River (N. Ireland). Chemical Geology, 200, 3-4, 203-216.

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