Looking for PON in fluviatile and marine sediments: Insights from nitrogen isotopic compositions

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Processes involved in the cycling of organic matter can be preserved in sediments and recent studies have unravelled the importance of the erosion of the continents to the global organic carbon transfer [1-3]. The significance of such transfer to the biogeochemical cycles of other chemical elements associated to the organic matter (H, N, O, P, S, …) is, however, hampered by the small (<1%) abundance of particulate organic carbon in sediments transported by river in active margins and the occurrence of inorganic phases. This is particularly the case when N is considered since nitrate particulate deposition and ammonium in phyllosilicate can both be present in sediments. Here, we present case studies from modern systems investigating soil and river sediments from Taiwan and the Swiss Alps with modern marine clastic sediments from Taiwan and their Cenozoic analogue from the foreland basins of the Alps and the Pyrenees. Sediments have been decarbonated using hydrochloric acid and the decarbonatation process can have a significant impact on the N-isotopic composition, depending on how well lithified the sediments are. However, variations in the isotopic composition of bulk soils and common plant species are correlated in the tropical mountain forest of Taiwan. This suggests that the physical erosion of fixed-N in organic debris can be significant for the N cycle in vegetated active mountains belts. It also suggests an accurate quantification of the particulate organic nitrogen (PON) in these types of material [4]. The offset of ~4 permil between soil PON and standing biomass PON can be a powerful tool to distinguish erosional regimes where the erosion of the vegetation is insignificant (Swiss Alps) or not (Taiwan).

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Speciation of trace elements in Strengbach soil solutions by ultrafiltration

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This study deals with colloidal phases of soil solutions collected in the Strengbach watershed (OHGE). These solutions carry the chemical elements in the first meter of soil. The sampling has been performed below spruce at different depths (-5cm, -10cm, -30cm and -60cm) of a brown acidic to ochreous podzolic soil with help of lysimetric plates. The colloidal phase has been studied by frontal filtrations (1μm, 0,45μm and 0,22μm) and tangential ultra-filtrations (300kDa, 30kDa, 10kDa and 5kDa). Then, the initial solution, the different permeates and retentates have been analyzed for major, trace element and Dissolved Organic Carbon (DOC) concentrations.

The study elucidates the behavior of the different chemical elements in the various colloidal fractions separated from the soil solutions. The retention rate, derived during the ultra-filtration experiment, allows determining the proportion of each element in different forms, i.e. proportions in dissolved form and in the different colloidal fractions. The comparison of each element with DOC indicates that only some of the elements are correlated with DOC. Among the latter, it is possible to distinguish two elemental groups showing different behaviors: those correlated only with DOC and those correlated with DOC and another secondary phase such as iron oxy-hydroxides. The mass balance of the ultra-filtrations showed that in the >1μm filtrates some elements (REE, PO_4^{3-}, Pb, Fe, Al) occur as precipitates, as colloids or as dissolved phase. The precipitates contain among others secondary minerals fluorencite and pyromorphite. The formation of these minerals occurs below 5 cm depth.

The ultra-filtrations of samples taken at different depths of the soil profile indicate that the chemical compositions of the colloidal fractions change in function of depth. Such depth variations may point to indicate the occurrence of different levels of colloid formation in these soil solutions.