



Influence of permafrost thawing on dissolved organic matter composition

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Impact of global warming will be different depending on the geographical area and tightly related to the actual context. Boreal regions will probably be among the most sensitive areas to the climate change and most studies suggest that the warming will be amplified in these regions. This is especially true for permafrost-affected boreal regions where the modification of the permafrost should significantly modified hydrosystems and terrestrial ecosystems in the future, affecting all hydrogeochemical cycles and transfers within boreal systems. A significant proportion of the world soil organic carbon (OC) stored in the high-latitude region could be released, resulting in a drastic change in amount and composition of organic matter exported to riverine system. The arctic/subarctic river basins have a great potential to mobilize and transport terrestrial OC to the Arctic Ocean, and represent dynamic ecosystems, which integrate different inputs related to drainage basin and autochthonous production. The response of permafrost soils to warming is crucial for understanding potential change in terrestrial carbon export to rivers. Recent structural and isotopic studies related to origin and fluxes of elements carried by rivers of high latitude permafrost-dominated areas, have demonstrated temporal variability of geochemical fluxes associated to hydrological variations, according to a specific hydro-geochemical system with two different fluxes over the year (deep underground waters during winter, surface water during spring flood and summer periods). Moreover, these results demonstrate a high mobilization of “insoluble” elements (Al, Fe, as well as Zr, Th, REE...) during the spring flood, highlighting the importance of colloidal transport in these rivers during flood periods, and suggest a modification in the source of colloids over spring and summer periods

The purpose of this study was to investigate the composition of the DOM during this flood period to determine if the mobilization of such elements could be related to noticeable modification. In addition to elementary analysis, a combination of spectroscopic (solid state ^{13}C NMR) and pyrolytic methods has been applied to samples collected at the beginning, the high discharge and the end of the flood. Solid state ^{13}C NMR affords information on the nature and relative abundance of the chemical functions occurring in macromolecules. The NMR spectra corresponding to the beginning and the maximum of the flood are rather similar and reveal an important carbohydrate input and a high branching level. At the end of the flood the composition of the DOM is quite different with a more complex spectrum especially in the C-O (70-80 ppm) and carboxylic/amide (168-180 ppm) regions, revealing a diminution of the carbohydrate along with an increase of the carboxylic signal. Curie point pyrolysis combined to gas chromatography and mass spectrometry leads to identification of characteristic pyrolysis products, some of them being specific of a macromolecular source. Preliminary results indicate differences between the three states of the permafrost thawing and confirm the NMR data. Additional information can be provided by thermochemolysis with tetramethylammonium hydroxide (TMAH). Isotopic biogeochemistry was also used to identify the origin of carbon and nitrogen of the DOM. The global isotopic values of $\delta^{13}\text{C}$ and of $\delta^{15}\text{N}$ are quite different for DOM during and after the flood. These data indicate, especially the $\delta^{15}\text{N}$ specific of OM, at least a part of the DOM is from a different origin. To improve the knowledge about the interaction between “flood” DOM and “insoluble” elements, a spectroscopic study, solid state ^{27}Al NMR, is under process.

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