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Characterization of the Natural Organic Matter (NOM) by ultrafiltration and fluorescence in a groundwater plume contaminated with ^{60}Co and ^{137}Cs

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Natural Organic Matter (NOM) is a collection of molecules originating from the decomposition of built biomass, and also from exudates from biological activities. The constituents of NOM are poorly characterized molecules of various molecular sizes and functional groups that could affect the fate of radionuclides and other contaminants. In this work, groundwaters have been sampled near a contaminated area in the Canadian boreal shield and size-fractionated by ultrafiltration (5000 Da cut-off) to determine the associations of selected radionuclides (^{60}Co , ^{137}Cs) with colloidal-sized fractions of NOM. Solid phase extraction (SPE) was also used in tandem with fluorescence analysis of the fractions, to elucidate the changes in the chemical nature of the NOM. Fluorescence is a powerful tool that can track the optical characteristics of the NOM constituents in an Excitation-Emission Matrix (EEM). The EEM, in turn, is numerically decomposed into individual and independent components, defined as humic-like, fulvic-like, and protein-like.

Our results have revealed consistent trends over the years (2004-2010): an uncontaminated station had a small colloidal NOM content (typically <7% was below the filter cut-off), whereas the colloidal NOM was higher in the contaminated sites (typically 12-41% of the total). Cesium-137 was dominant in the colloidal NOM fraction (>95% of the total), whereas ^{60}Co was mostly in the filtered fraction (70-90%). When the samples were submitted to SPE and fluorescence, a systematic removal of the protein-like NOM was found, without affecting the humic- and fulvic-like components. Cobalt-60 and ^{137}Cs were affected only to a small extent, suggesting that these were associated with the humic- and fulvic-like NOM, and not the protein-like NOM. This finding is intriguing and unique, as the protein-like NOM was found only in the contaminated sites. Applications of fluorescence, as a new tool to this sampling, will be discussed further.

Primary author: Dr CARON, François (Chemistry and Biochemistry Department, Laurentian University, Canada)

Co-authors: Mr RIOPEL, Rémi (Chemistry and Biochemistry Department, Laurentian University); Dr SIE-MANN, Stefan (Chemistry and Biochemistry Department, Laurentian University)

Presenter: Dr CARON, François (Chemistry and Biochemistry Department, Laurentian University, Canada)

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