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Arsenic and rare earth element concentrations in aquatic organic matter size fractions in two subarctic catchments

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Permafrost thaw mobilizes colloidal organic matter (OM) and trace elements (TE), but the role of colloid size and composition in governing TE transport remains poorly constrained. The aim of this project is to measure TE concentrations in size fractions of OM, with a focus on colloids. To do so, we sampled, in September 2025, freshwater sites at the mouth of two rivers on the eastern Hudson Bay Coast (Nunavik, Québec, Canada) and at one coastal site where the rivers intermix. The Great Whale River (GWR) drains permafrost underlain by marine clays and the Sasapimakwananisikw (SAS) River drains a peatland valley with thermokarsts ponds and sporadic permafrost. They both flow into the Hudson Bay, presenting a salinity gradient at their mouths. These two rivers allow studying two ranges of dissolved organic carbon (DOC) along a salinity gradient at equivalent pH.

Samples were either unfiltered or filtered at 10 and 30 kDa (ultrafiltration on Amicon cell) and 0.2 and 5 µm (PES syringe filter). Unfiltered samples yielded the total organic carbon (TOC), whereas 10 and 30 kDa-filtered samples were considered the dissolved phase. The ultrafiltration retentate was centrifuged and the supernatant measured on an Elementar TOC-Vario Cube TC/TN analyser to yield colloidal OM concentrations. The supernatant was also analyzed by Pyro-GC-MS to yield the colloids' molecular composition. Finally, TE were measured in the colloidal and dissolved fractions by ICP-QQQ-MS.

Results show that both rivers have a similar pH (pH 7.2), but that SAS has a 4-fold higher TOC (~12 mg L^{-1}) than GWR (~3 mg L^{-1}). Similar, SAS River is more charged in colloids (~ 6 mg L^{-1}) than GWR (~ 1 mg L^{-1}), consistent with its lower DOC concentrations. TE analysis in the colloidal fraction shows a strong correlation (SR 0.6-0.8) between colloidal OM and arsenic, iron, and calcium. A weak correlation (SR 0.2-0.4) was also observed between colloidal OM and REE (e.g., La, Ce, Pr, Nd, Sm and Gd). Pyrolysis-GC-MS reveals a dominance of large aromatic groups in SAS. Together, these results will be interpreted in the context of differential TE transport in the two rivers.