A Pan-Canadian study of Optical Properties of Dissolved Organic Matter in the Active Layer and Permafrost

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Permafrost soils store the greatest amount of terrestrial organic carbon on Earth [1]. Permafrost degradation associated with Arctic warming may enhance microbial decomposition of surface and deeply stored organic matter and increase the export of dissolved organic matter (DOM) to aquatic systems [2]. In this study, we focus on determining the composition of the water extractable DOM in the active layer and permafrost to better understand the permafrost carbon feedback to climate change.

We investigated 25 soil cores from the active layer and uppermost permafrost from 9 sites across the Canadian Arctic, covering sporadic to continuous permafrost regions. We analysed water extracts of these soils for dissolved organic carbon, nitrogen and inorganic nitrogen, and the composition of DOM was characterized using UV-Vis absorbance, fluorescence measurements and parallel factor analysis (PARAFAC).

The optical properties of the DOM differ between the active layer and permafrost layers and depend on permafrost nature. At all sites, the uppermost meter of permafrost is characterized by high contents of fresh and unhumified DOM while the overlying active layer is enriched in high molecular weight humic compounds. Our PARAFAC modelling shows that ~30% of the DOM in mineral permafrost samples is comprised of low molecular weight humic-like components. By contrast, protein-like components are particularly common in organic permafrost samples, accounting for up to 90% of the total fluorescence in sites located in the southern boundaries of the permafrost region.

Our findings suggest that permafrost degradation across Canada has the potential to release substantial amounts of fresh and relatively unhumified organic compounds. This pool of newly available DOM will likely be labile and may amplify the permafrost carbon feedback to climate change.

[1] Hugelius *et al.* (2014) *Biogeosciences* **11**, 6573-6593. [2] Schuur *et al.* (2015) *Nature* **520**, 171-179.