Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28308

Bio- and photodegradation control on dissolved organic matter in permafrost peatland waters

LUCÍA PÉREZ SERRANO[1,2], LAURE GANDOIS[2], LAURENT JEANNEAU[3], OLEG POKROVSKI[1] AND JEAN-LUC ROLS[2]

[1]Géosciences Environnement Toulouse (GET) – Research Institute for Development [IRD]: Toulouse University, CNRS, Toulouse, France
[2]Centre de Recherche sur le Biodiversité et l'Environnement (CRBE) – Research Institute for Development [IRD]: Toulouse University, Toulouse INP, CNRS, Toulouse, France
[3]Géosciences Rennes, Rennes University,CNRS, Rennes, France

Permafrost degradation in the context of climate change results in the formation of new surface aquatic ecosystems. Particularly, permafrost peatlands show a huge potential for releasing of dissolved organic carbon (DOC), nutrients, and trace metals to surface waters [1]. Once the dissolved organic matter (DOM) is released, its reactivity will be determined by a combination of environmental factors (ex., microbial metabolism, temperature, sunlight radiation, chemical composition of the water column, etc.).

Microbial and plant-derived components impact on DOM stability, yet patterns of DOM turnover are modulated by bio- and photodegradability. Photolytic-driven processes impact molecular structure of DOM, producing bioavailable forms; moreover, bio- and photodegradation can influence organic complexes of toxicants and micro-nutrients [2]. Therefore, carbon export and emission are linked to susceptibility of DOM to degradation, which can be evaluated by initial composition conditions and surface exposure time.

To study the degradability of the DOM issued from a continuous permafrost peatland, a field campaign was conducted in the Hudson Bay Lowlands (Canada). Natural waters were sampled in Twin Lakes polygonal peatland from a stable pond, a developing pond, and subsurface water from the upper frozen layer. For each site, photodegradable fraction of DOM was estimated *in situ* under natural light and temperature conditions, whereas the biodegradable fraction was assessed in the laboratory at constant temperatures (5, 20°C). DOC, nutrients and trace elements were analyzed for a 15-day incubation period. Molecular composition for initial conditions was characterized using THM-GC-MS.

Preliminary results show a higher percentage of biodegradable DOC for the upper frozen layer water at 20°C incubation, whereas the photodegradable DOC is more significant in the stable/developing ponds. We hypothesize that (in)organic micronutrients may limit the growth of bacteria during biodegradation, whereas photolysis may impact the Fe-DOM bonds that stabilize collodial $Fe(OH)_3$ therefore leading to trace matel removal together with particulate Fe hydroxides.

1.Lim, A. G. *et al.* Dispersed ground ice of permafrost peatlands: Potential unaccounted carbon, nutrient and metal sources. *Chemosphere* **266**, 128953 (2021).

2.Chupakov, A. V. et al. Seasonal and spatial pattern of dissolved organic matter biodegradation and photodegradation in boreal humic waters. *Biogeosciences* **21**, 5725–5743 (2024).