The lability of different DOM sources on permafrost landscapes of Eastern Canadian Arctic

Flora MAZOYER 1,2, Isabelle LAURION 1,2, Milla RAUTIO 1,2

1 Institut national de la recherche scientifique - Centre ETE, CANADA
2 Centre for northern studies, Université Laval, CANADA
3 Université du Québec à Chicoutimi, CANADA

INTRODUCTION

In northern regions, permafrost thawing mobilizes soil organic carbon (C) as dissolved organic matter (DOM) into aquatic systems, including into small stagnant water bodies that can occupy a large fraction of the landscape in certain areas. The fate of that C pool is of great concern to the scientific community because its transfer to the atmosphere could accelerate climate warming through positive feedback effect if the mobilization of old C pools increases under climate change. Of great concern to the scientific community because its transfer to the atmosphere could accelerate climate warming through positive feedback effect if the mobilization of old C pools increases under climate change.

We hypothesize that discrepancies in lability to both BD and PD are mostly explained by DOM composition, and strongly linked to the local conditions. Specifically, we hypothesized that:
1) The DOM leaching from active layer, permafrost, primary producers and the one found in the ponds will show different composition affecting their lability
2) Permafrost DOM is particularly labile to BD but also to PD (balanced mixture of aromatic and aliphatic compounds)
3) Primary producers DOM is particularly labile to BD but not to PD (dominance of aliphatic compounds)
4) Active layer and pond DOM are less labile than permafrost DOM to both BD and PD (larger proportion of recalcitrant fraction remaining)

METHODS

- One site on polygonal landscape, continuous permafrost, 73°N and one site on organic palsa landscape, sporadic permafrost, 55°N
- 4 kinds of DOM sources tested
- 7-days equivalent incubation
- Beginning and end triplicates
- Light incubations in a solar incubator
- Black incubations in a dark incubator
- Bacteria quickly consumed the non-chromophoric fraction of DOM leached from primary producers (limited changes in CDOM and absorption slope
- Permafrost DOM was found to be biolabile but not as much as freshly produced DOM (from primary producers: plants and benthic microbial mats).
- Bacteria quickly consumed the non-chromophoric fraction of DOM leached from primary producers (limited changes in CDOM and absorption slope but high DOC loss over 1 week). We hypothesize that FDOM will show larger changes.
- Sunlight induced extensive changes in CDOM from all sources: from 42 to 75 % loss of a320 and an overall reduction in molecular weight.
- Since CDOM absorption spectra showed a large shift in the wavelength of minimum absorption (S285), we hypothesize that DOM mineralization with high SUVA254 (active layer and ponds).
- Contrary to bacteria, sunlight induced less mineralization of DOM presenting low SUVA254 (primary producers and permafrost), and more mineralization of DOM with high SUVA254 (active layer and ponds).
- The DOC leaching yield (gram of DOM leached per gram of material; not shown) was much higher for primary producers than for active layer and permafrost. This may suggest that in natural environments, rain runoff regularly brings pulses of fresh and biolabile DOM into ponds, inducing a very dynamic seasonality for such small water bodies.

Some results

- DOC and CDOM analyses to be completed
- FDOM EEMs and PARAFAC
- CDOM absorption spectra
- CDOM and SUVA254
- Bacterial abundance with flow cytometry
- Bacterial community effects
- Sunlight effects
- Sunlight induced extensive changes in CDOM from all sources: from 42 to 75 % loss of a320 and an overall reduction in molecular weight.
- Since CDOM absorption spectra showed a large shift in the wavelength of minimum absorption (S285), we hypothesize that DOM mineralization with high SUVA254 (active layer and ponds).
- Contrary to bacteria, sunlight induced less mineralization of DOM presenting low SUVA254 (primary producers and permafrost), and more mineralization of DOM with high SUVA254 (active layer and ponds).
- The DOC leaching yield (gram of DOM leached per gram of material; not shown) was much higher for primary producers than for active layer and permafrost. This may suggest that in natural environments, rain runoff regularly brings pulses of fresh and biolabile DOM into ponds, inducing a very dynamic seasonality for such small water bodies.