Carbon dynamics at the land-ocean interface through a boreal subterranean estuary

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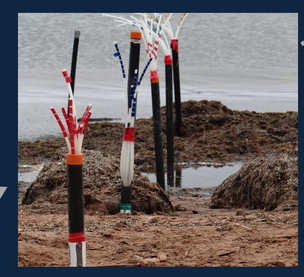
Introduction

Subterranean estuaries (STE) are reactive zones where fresh and saline groundwater mix. These reactive zones are fed by marine and terrestrial input which provide organic matter, nutrients and oxygen. STE may significantly influence biogeochemical processes and thus the export of C *via* submarine groundwater discharge (SGD). Microorganisms also play a key role in the transformation of this C that transits to coastal ocean. However, little is known on the impact of the origin of organic matter on free bacteria consortium in beach groundwater. This study take place in boreal region where hydrology and terrestrial organic carbon dynamics are evolving in response to global changes.

Here we propose to 1) characterize the composition and the origin of organic matter by combining optical and isotopic approach and 2) link the organic matter origin and composition to the free bacteria abundance and diversity using multi-variate analyses.

Study site: Îles de la Madeleine, Quebec, Canada



A cross-shore transect of multi-level samplers

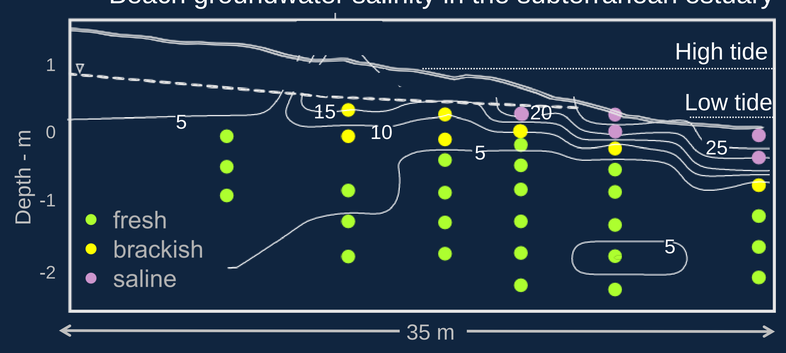
Filtered groundwater beach samples

Data sampled along a cross shore transect of a subterranean estuary in **June 2013 and 2015**

- Salinity
- DOC
  δ^{13}C-DOC
- **CDOM** (only in 2013)
  MW, aromatic content
- Abundance of free bacteria
- **Two differents clades**:
  HNA and LNA bacteria
  Nucleic Acid content

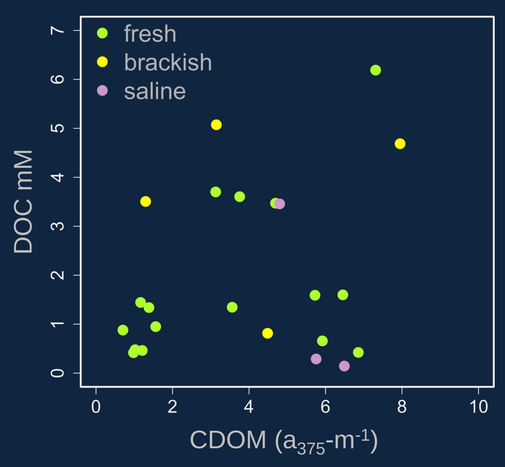
A coastal dynamic environment

Beach groundwater salinity in the subterranean estuary



Micro-tidal beach system dominated by fresh groundwater discharge

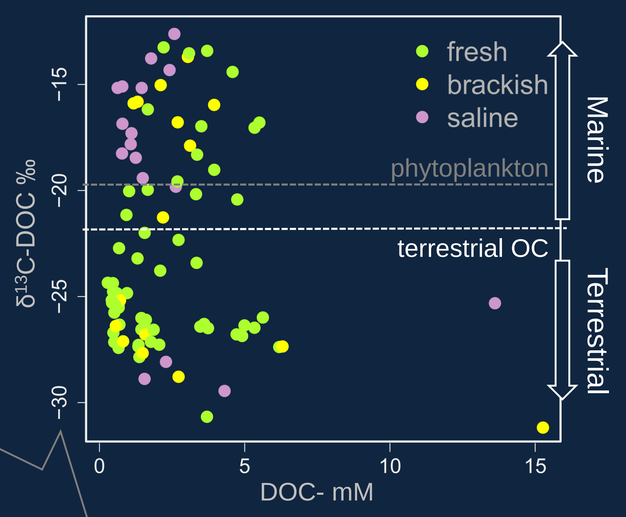
Rich in organic matter



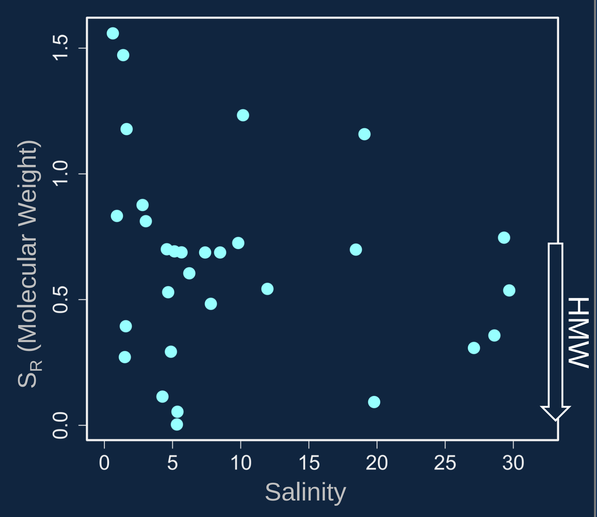
Groundwater sandy beach are highly concentrated in DOC. It's 2 to 5 times higher than previous studies in coastal shelves

Nonlinear correlation between the concentrations of DOC and CDOM

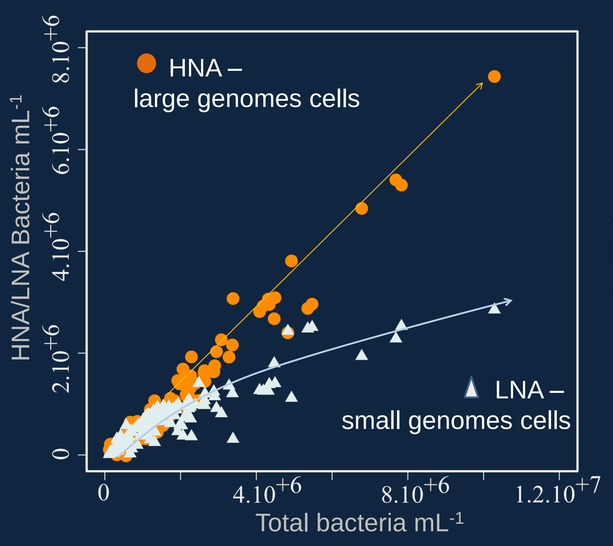
Biogeochemical processes alter carbon dynamics in the subterranean estuary



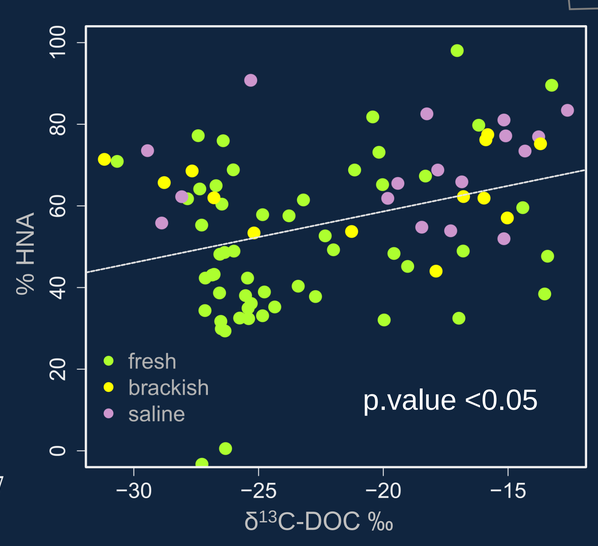
Both terrestrial and marine organic matter are present in the groundwater sandy beach.



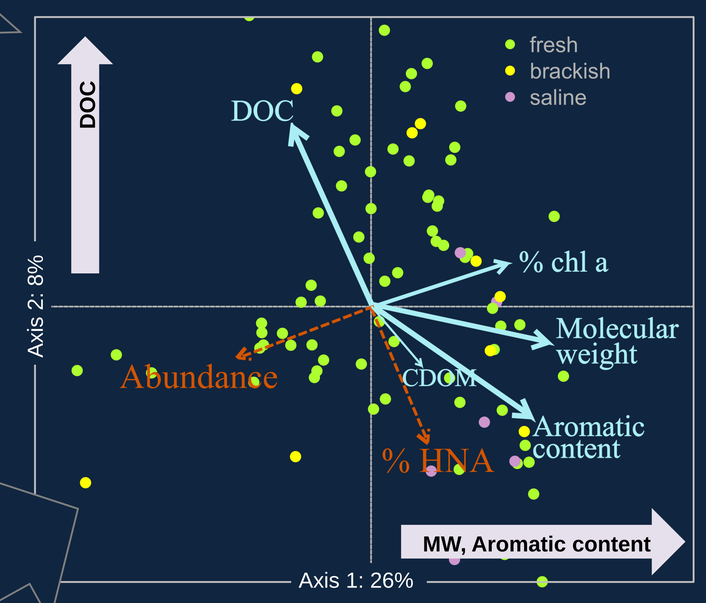
Organic matter composition is heterogeneous but dominated by high molecular weight



Two distinct phylogenetic clades were analysed. The total free bacteria are dominated by the HNA bacteria



The HNA bacteria are significantly correlated to the isotopic signature of DOC



Redundancy analyse

Bacterial variation in response to organic matter characteristics based on optical signatures

- **Molecular weight** and **aromatic content** directly related to the bacterial abundance
- Abundance and bacterial diversity correlated to the **terrestrial signature of organic matter**

Conclusion

- Contrasting origin of organic matter but a strong influence of terrestrial organic matter.
- Abundance and nucleic acid content of bacterial community controlled by both the origin and molecular weight of OM

Further question:

- What is the impact of terrestrial organic matter on micro-organisms diversity ?
- **What is the fate of terrestrial carbon in coastal environment?**

Acknowledgements

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