Do Thermokarst Events Effect the Production and/or Consumption of CO_2, CH_4, and N_2O?

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Introduction

- The Arctic is warming faster than any other region on Earth.[1]
- The thawing of permafrost leads to thermokarst events that expose deeper, ancient soil organic matter.
- Organic matter derived from permafrost may alter microbial metabolism and alter CO_2, CH_4, and N_2O emissions.
- Nitrogen availability may increase, stimulating the production of nitrous oxide (N_2O), a powerful greenhouse gas.

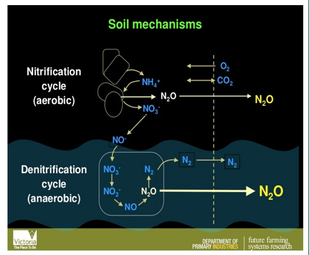


Figure 4: The N cycle showing production pathways of N2O

Figure 1: Landing Lake. Dots show location of transects.

Figure 2: Example of land slumping

Objectives

- **The objective of this project is to determine the effects of land slumping and other thermokarst events on production and emissions of N_2O, CH_4, and CO_2.**

Methods

Field Sampling

Six 30 m transects were sampled at each site, from slumps at the lake edge inland, including1-3 depressions.

Soil Gas Sampling

Soil gas samples were collected from three unburned sites, and each depression, slump, and undisturbed (control) along all transects.

Incubations and Gas Chromatography

Soil samples were collected from the edge and the center of a large slump and incubated under aerobic and anaerobic conditions.

N_2O, CH_4, and CO_2 samples were analyzed using a Shimadzu GC.

Results and Discussion

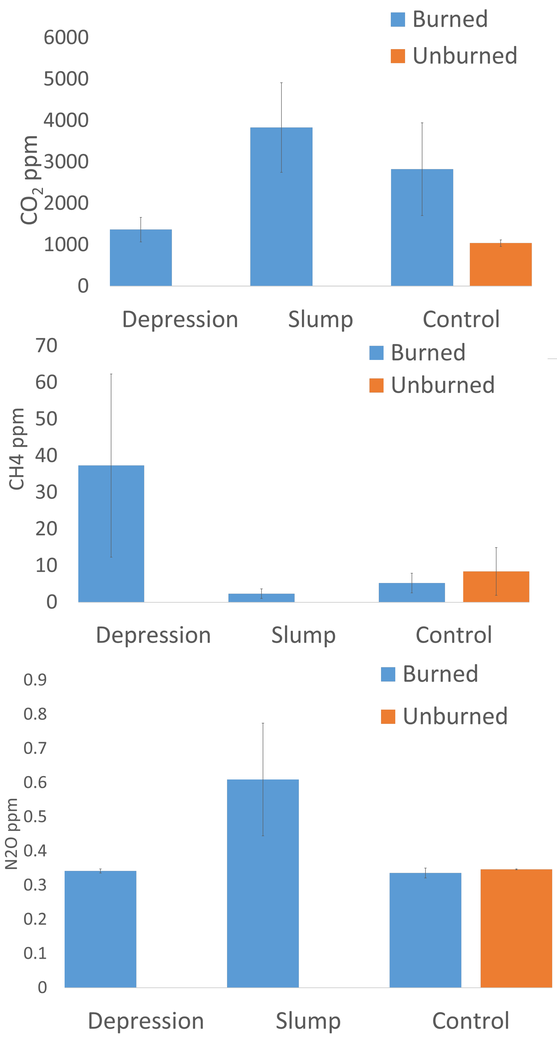


Figure 1: Soil gas concentrations collected from landscape features in burned and unburned sites. Slump soils were higher in CO_2 and N_2O, but lower in CH_4.

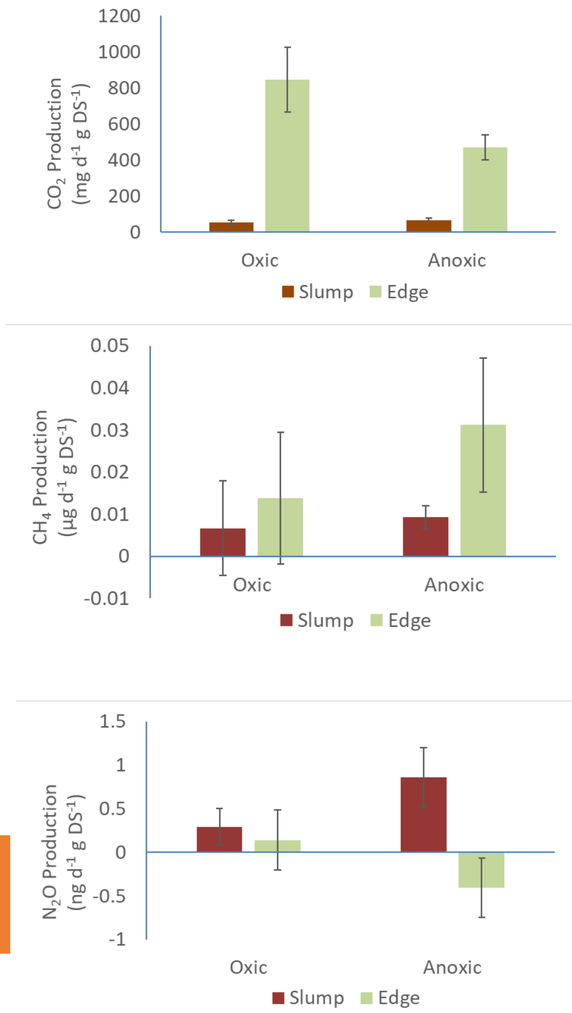
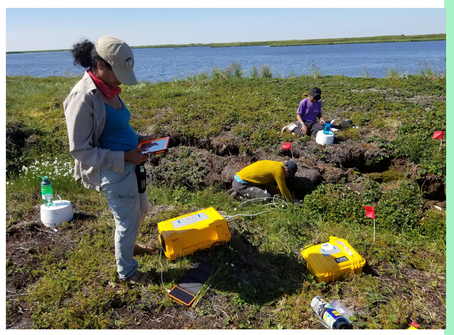


Figure 2: Greenhouse gas production from oxic and anoxic incubations. Edge soils produced more CO_2 and CH_4, while slump soils produced more N_2O.



Conclusion

- Lower CH_4 in soil gas in the slumps reflects lower CH_4 production in slump soils, which is likely because land slumping exposes mineral soils that have lower C concentrations.
- Additionally, increased N availability from the permafrost thaw in slumps may have stimulated denitrifying bacteria, increasing N_2O production.
- The depressions were wet, causing more anoxic conditions, This factor may have contributed to the increased amount of CH_4 production and reduced amount of CO_2.
- Finally, the data shows that the slumps are larger sources of N_2O production and emission.
- Our data also suggest that land slumping my lead to a shift from CH_4 to N_2O and lower CO_2 production. The implications of these changes for climate feedbacks from permafrost thaw require further research.

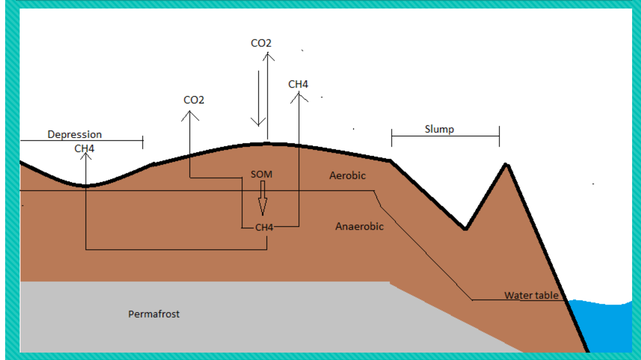


Figure 3: Carbon dynamics of tundra landscape

Acknowledgements

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