# Composition of Dissolved Organic Matter in Arctic Soils

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## I. INTRODUCTION

classic decomposition kinetics[1]

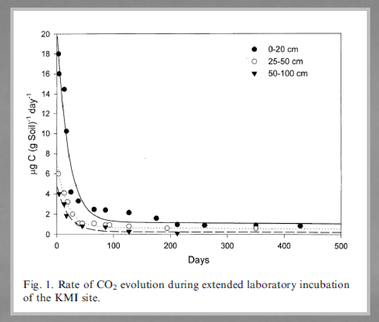



Fig. 1. Rate of $CO_2$ evolution during extended laboratory incubation of the KMI site.

tundra decomposition kinetics[2]

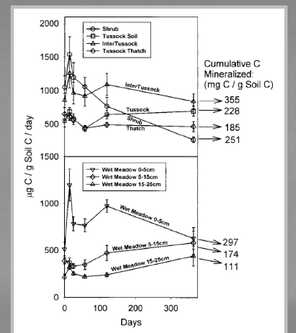
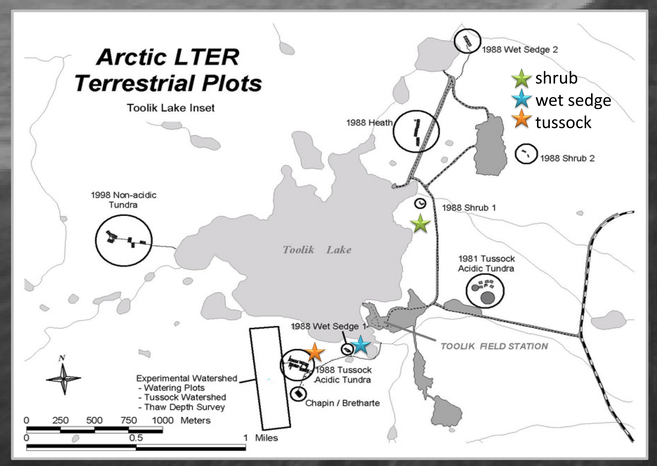



Figure 2. Respiration time courses from a year-long laboratory incubation of tundra soils. Soils were incubated at 20°C and 50% soil water-holding capacity. All values are normalized for soil C content.

- Why are tundra decomposition dynamics different from those of temperate soils?
- Important to consider when modeling response of decomposition to warming.
- Start by looking at the chemical characteristics of dissolved organic matter and microbial biomass constituents.

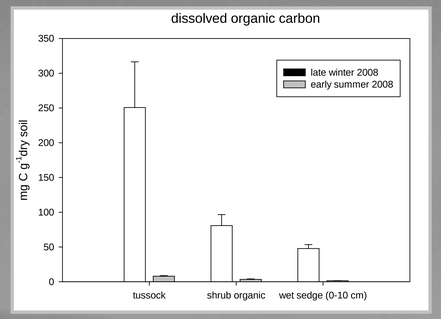
## II METHODS

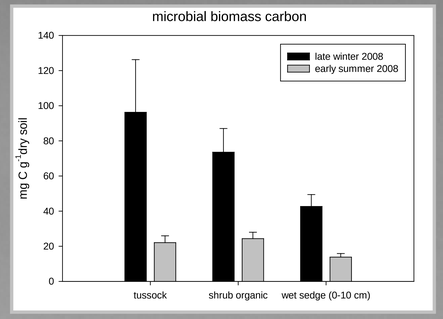
- collection:Toolik Lake LTER early/late winter and summer 2008 and 2009; moist acidic tussock (*Eriophorum vaginatum*), shrub organic (*Betula nana* and *Salix* sp.) and wet sedge (*Carex aquatilis* and *E. angustifolium*) soil
- processing: summer samples homogenized by hand at ambient temperature winter samples processed by hammering and grinding at -20°C
- soil extraction: 0.5 M $K_2SO_4$ and $H_2O$ both +/-$CHCl_3$
- pore water extraction: soil centrifuge filtered 0.45 μm
- measurements: extractable organic & microbial flush carbon/nitrogen, inorganic N ($NO_3^-$ and $NH_4^+$) (data not shown)
- small molecule profiles (UPLC-TOF-MS)




## III. DATA

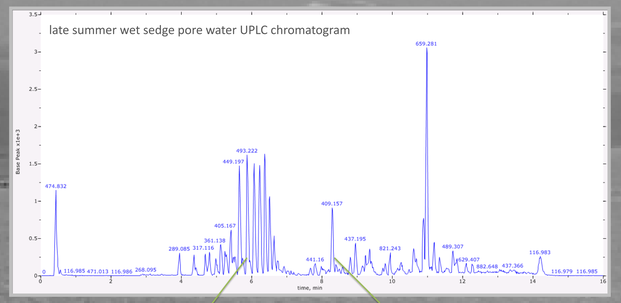
### a. carbon dynamics—soil extracts

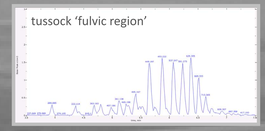


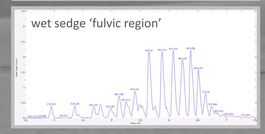



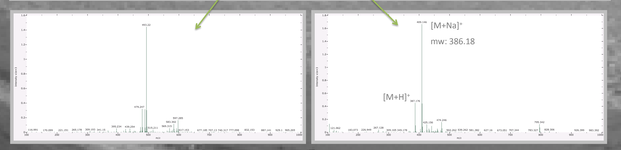

- late winter dissolved organic carbon is higher in all vegetation types due to:
  - microbial death through winter?
  - release from plant roots?
  - release of stabilized organic matter from freezing?
- late winter microbial biomass carbon is higher in all vegetation types due to:
  - accumulation of antifreeze compounds e.g. trehalose?

### b. small molecule profiles

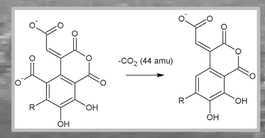


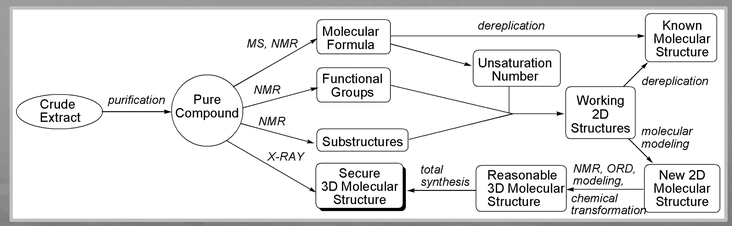

fulvic acids are separated by 44 amu due to loss by decarboxylation[3]




- UPLC-TOF-MS chromatograms for late summer 2009 tussock and wet sedge pore water show similar small molecule profiles (analysis for shrub soil ongoing)
  - 'fulvic region' is present from 3.5 to 7.5 min. with characteristic fragmentation
  - a series of other compounds are also present at 7.5 min +
  - 40-60 compounds total; 11 can be identified to molecular weight upon initial analysis
- Although DOC crashes as winter-summer transition, will it change chemically?

## IV. FUTURE WORK

- continue analyses of seasonal dynamics and additional vegetation types: dry heath, intertussock spaces, shrub mineral and wet sedge (10-20 cm)
- measure trehalose and amino acid profiles of microbial biomass at seasonal transitions
- analyze pore water collected winter 2009 (and future collections slated for seasonal transitions 2010 and early 2011)
  - continue with UPLC-TOF-MS
  - use fluorescence excitation emission spectroscopy
- analyze planned pore water collection from green house plots (in collaboration with Seeta Sistla, UCSB) to determine if warming changes chemical composition of DOM
- determine molecular characteristics of unknown compounds in DOM[4]
  - molecular formula
  - functional groups




## V. SUMMARY

- microbial biomass and dissolved organic carbon crash at the winter-summer transition
- late winter DOC composition does not vary between the tussock and wet sedge pore water
- by MS, late winter DOC is composed of a combination of 6-10 major fulvic components and a series of unidentified compounds

## VI. REFERENCES

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## VII. ACKNOWLEDGEMENTS

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please contact Claudia Boot: boot@lifesci.ucsb.edu for more information