Investigating soil texture as a control on microbial carbon cycling

PRESENTER:

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BACKGROUND: Over the course of a three-month lab incubation, we tracked the fate of a carbon-13 (^{13}C) tracer in agricultural soils to explore **whether microbial carbon cycling dynamics vary predictably across texture gradients** in an ecosystem

We used a naturally-occurring gradient of soil texture found at a long-term agricultural research site in central Pennsylvania

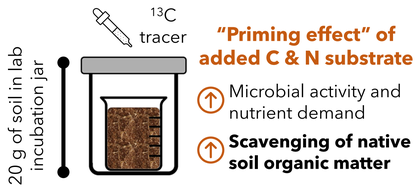
We also developed a **novel method to construct a gradient of soil texture** using field materials from the same site

To create the constructed texture gradient, we isolated sand from the coarsest field soil, then added it in incremental amounts to the finest-textured field soil

Our method addresses the difficulty of isolating the effect of soil texture on nutrient cycling dynamics in spatially heterogeneous field soils

Across the two gradients, we assessed how the **^{13}C tracer** and **native soil organic matter** were mineralized into CO_2

Our isotope tracing approach allowed us to evaluate microbial priming effects



Insight from this work has applications for management of agricultural fertility and soil carbon stocks

METHODS:

Constructing a soil texture gradient from field materials

- Isolate sand from field soil by sieving
- Mix isolated sand with clay-rich field soil to create 5 distinct textures
- Set up microcosms of field gradient soils and constructed gradient soils

Using ^{13}C tracing to evaluate microbial carbon cycling

- Add ^{13}C-enriched C & N substrate (glucose + alanine) to microcosms
- Over 3 months, measure ^{13}C in CO_2, destructively harvest microcosms
- Prep samples for ^{13}C analysis in MB & SOM

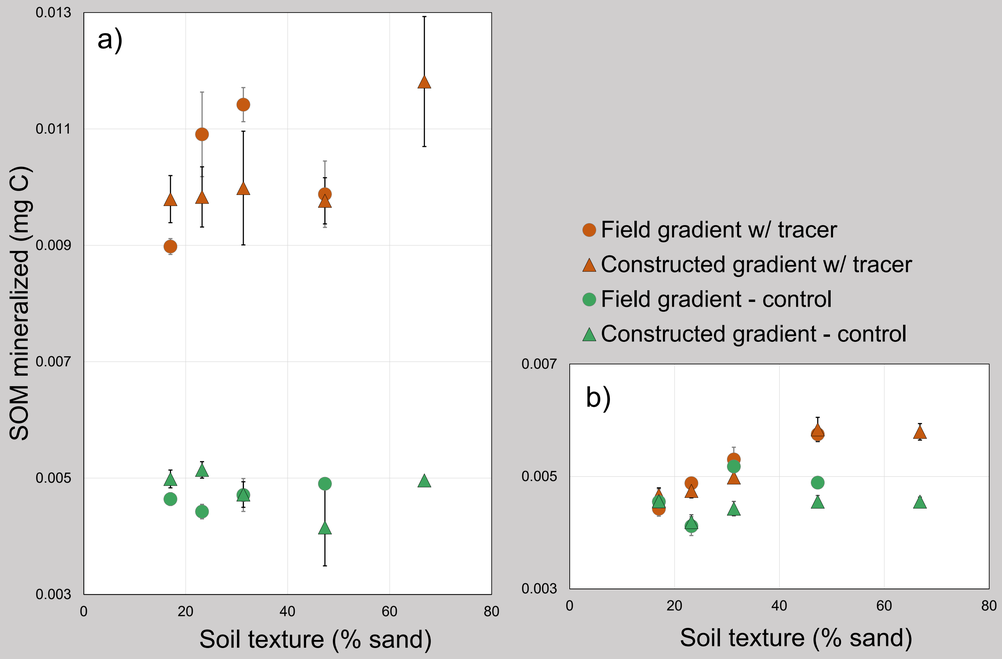
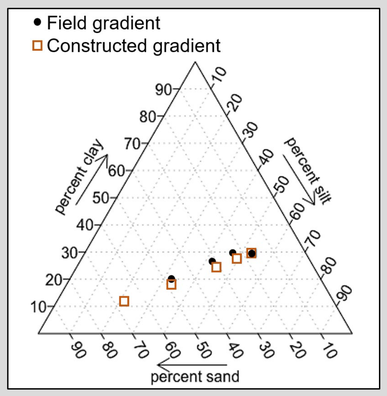
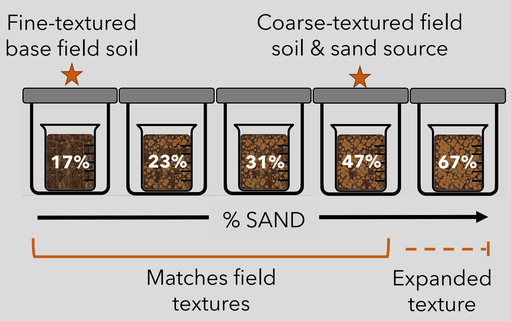


Figure 1. Mass of soil organic matter (SOM) mineralized at a) 24 hours and b) one week after ^{13}C tracer was added. Each soil with added tracer was paired with a control soil with no added tracer to allow for comparison between background SOM mineralization and additional SOM mineralization as a result of microbial priming.

Greater mineralization of native soil organic matter with **increasing sand content** in the soils that received the ^{13}C tracer is evidence for microbial priming





By pairing the natural field soil texture gradient with the constructed gradient created from field materials, we aimed to:

- Reduce environmental co-variates
- Isolate effect of texture on microbial carbon use
- Preserve microbial community from field site
- Maintain similar pool of active microbes

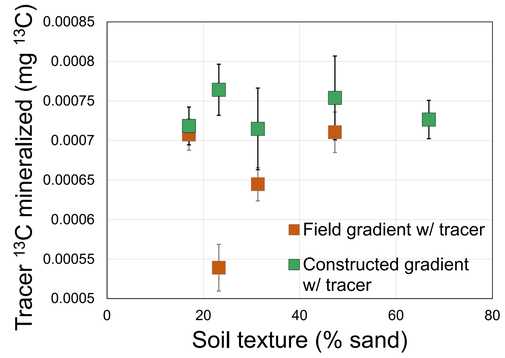


Figure 2. Mass of ^{13}C from enriched tracer mineralized 24 hours after tracer addition

RESULTS: Mineralization of ^{13}C tracer

Constructed soils mineralized a more consistent mass of the ^{13}C tracer across the gradient compared to field soils

No relationship is evident between percent sand and mass of tracer mineralized

Because the constructed soils are mixed from the same field materials, they display a more predictable microbial respiration response to the tracer addition

RESULTS: Mineralization of SOM

The addition of the ^{13}C tracer, a glucose and alanine mixture with C:N ~21, stimulated microbial growth

As a result of this nutrient addition, microbial decomposition of soil organic matter was enhanced, indicating a priming effect that is dependent on the soil texture

SOM decomposition increased with sand content in soils with added tracer, but showed no relationship with sand content in control soils with no added tracer

DISCUSSION:

Because the microbial respiration patterns in constructed texture gradient soils were similar to field soils, future researchers can apply this constructed soil method in lab incubation studies to isolate the effect of texture on various nutrient cycling and microbial processes

A relationship between SOM mineralization and percent sand, evidence for priming effects, could indicate that soil C stocks in sandy soils are vulnerable to microbial scavenging when a nutrient source is introduced

We will expand upon this work by assessing Microbial Carbon Use Efficiency across the texture gradients, comparing the ^{13}C in microbial biomass and SOM to the ^{13}C in CO_2

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