Chemical Complexity Matters

Differential Mobilization of Mineral-Associated Organic Matter Driven by Functionally Distinct Rhizodeposits

Tobias Bölscher, *Hui Li, Mariela Garcia Arredondo, Zoe Cardon, Carolyn Malmstrom, Matthew Winnick, Marco Keiluweit*

LUND UNIVERSITY UMassAmherst

Research questions

What exudate-driven mechanisms cause the mobilization of mineral-associated organic matter (MAOM)?

MAOM mobilization mechanisms

Direct mechanisms:

- Ligand-promoted dissolution (e.g., oxalic acid)
- Reductive dissolution (e.g. catechol)

Indirect mechanisms:

- Microbial-mediated mobilization stimulated by less reactive rhizodeposits (e.g. sugars)

Hypothesis

1. Direct mechanism (e.g. ligands, reductants) mobilize more MAOM than indirect microbial-mediated mechanisms (e.g. sugars).

2. Reducible minerals (e.g. ferrihydrite) are more susceptible than non-reducible minerals (e.g. Al hydroxide)

Microcosms – MOA in soil

Ferrihydrite $Al(OH)_3$

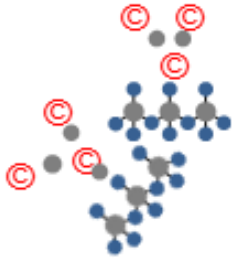
+ ^{13}C-labeled glucose

Addition of distinct rhizosphere compounds (3 pulses over 72 h):

- Oxalic acid (i.e. ligand)
- Catechol (i.e. reductant)
- Glucose (i.e. less reactive)
- Water (i.e. control)

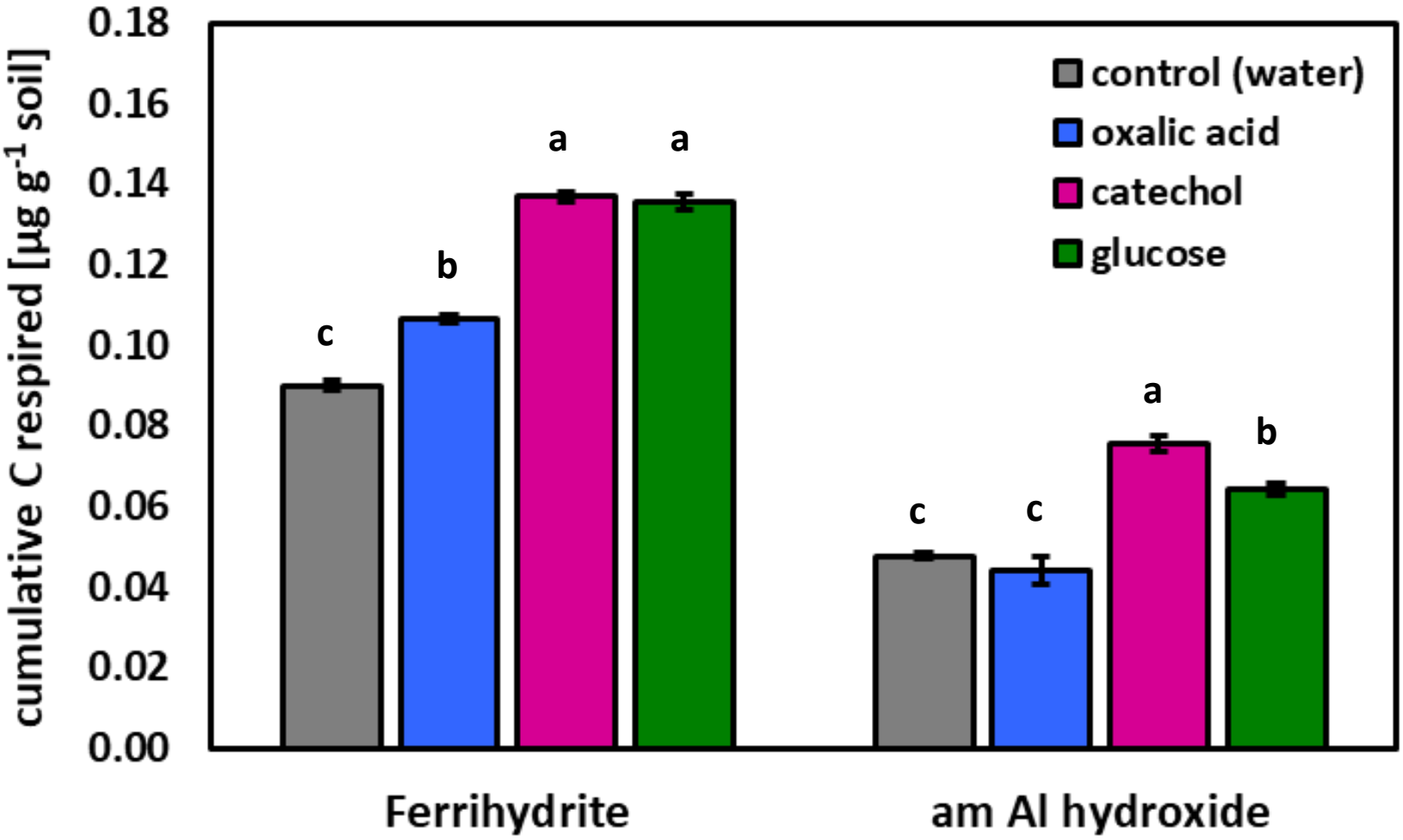
Measurements:

- ^{13}C respiration
- Sequential extraction (data not shown)

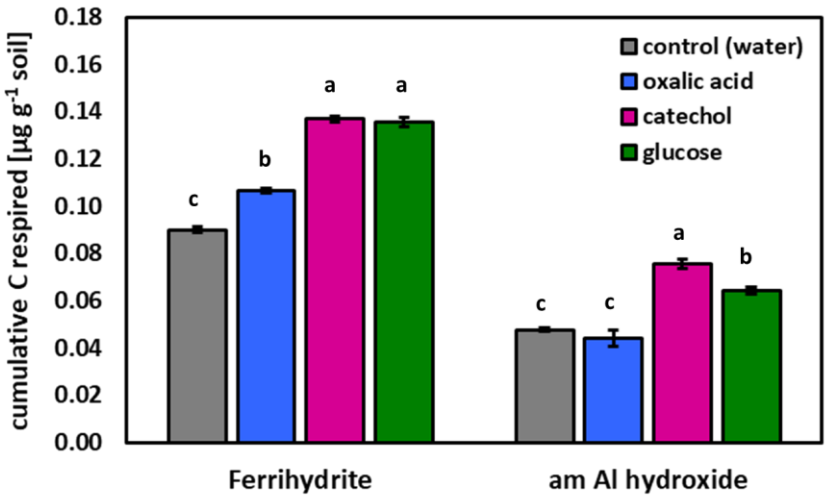


Artificial, ^{13}C labelled MOAs mixed into soil

Mineralization of liberated MAOM



Summary



- Ferrihydrite more vulnerable than am Al hydroxide
- Catechol and glucose mobilize more MAOM than oxalic acid
- Catechol (reductant) mobilized MAOM from non-reducible am Al hydroxide ➔ microbial mediation?

Conclusion

Root exudates mobilize equally or more MAOM via microbial-mediated mechanisms compared to direct mineral dissolution.

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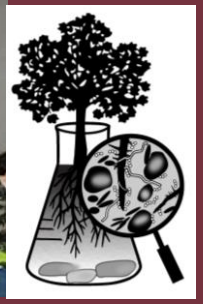

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