**Parent Material and Temperature Interact to Control Soil Carbon Dynamics**

Introduction

* Parent material affects radiocarbon content of bulk soil
* Development and persistence of poorly crystalline minerals associated with depleted 14C content of soil organic matter and soil C persistence
* Respiration rates increase with temperature, suggesting ∆14C of heterotrophically respired CO2 will be closer to atmospheric ∆14C in warmer sites than in colder sites
* Climate and parent material interact on geologic timescales
* Weathering leads to formation of poorly crystalline minerals but eventually to degradation of these minerals over time, i.e. poorly crystalline mineral content highest in intermediate stages of soil development

Hypotheses: Time series

1. Bulk soil d∆14C/dt AN < BS < GR
2. Resp soil d14C-CO2/dt cold < cool < warm
3. Resp soil d14C-CO2/dt AN = BS = GR
4. PM will explain more of the variance in the change over time for bulk soil ∆14C than does ECO, because PM controls the ∆14C of slow cycling soil C that dominates the bulk ∆14C signal.
5. ECO will explain more of the variance in the change over time for bulk soil ∆14C than PM, because ECO controls the ∆14C of fast cycling soil C that dominates the respired ∆14C-CO2 signal.

**Intro**

*[from AGU abstract]*

* Soil C dynamics critical for climate change
* Mineralogy and climate key for predicting long term soil C persistence
  + Effect on short term soil C dynamics not well understood
* Soil C heterogeneous; mix of fast and slow cycling components
  + Bulk 14C useful, but not sensitive enough for determining responses to changes in stabilization or inputs over shorter time scales
* Goal:
  + Quantify change over time in bulk and respired 14C as a function of parent material and climate
    - Linear modeling approach

Results

1. Change in bulk 14C over time < than respired 14C
   1. Supports use of respired 14C as a proxy for faster cycling soil C dynamics
   2. Table: Absolute values and differences over time
2. Parent material affects both slow and fast cycling soil C dynamics
   1. Change over time in granite bulk soil ∆14C and ∆14C-CO2 was greater than what was observed in basalt soils and much greater than what was observed in andesite soils
   2. Figure: Marginal slope plots [averaged for whole profile]
3. Climate explained more of the variance in the change over time in both bulk and respired 14C of the top 10cm than did parent material, while the opposite was true below 10 cm
   1. Figure: Depth profiles
   2. Table: Explained variance (marginal means) [maybe SI?]
4. The oldest soil C was found in the andesite soils developed in the intermediate climate zone; these were also the soils with the highest concentration of pedogenic oxides
   1. The difference between bulk and respired 14C was highly correlated with pedogenic oxide content
   2. Figure: Ped Ox vs. Bulk – Respired [issue with depth or no? Maybe mark with size? Or SI plots showing same relationship with each depth?]

Conclusion

* The interaction of parent material and climate over time leads to the development of distinct soil mineral assemblages, which in turn exert strong controls over soil C dynamics. While explaining the mechanistic nature of these interactions is beyond the scope of this study, it is clear from our data that the mineralogical characteristics of soils are important not only for understanding the dynamics of slowly cycling soil, but for the dynamics of annual to decadal cycling soil C as well.

To Do:

* Average data over 0-30cm for overall trend analysis
* Fine-tune story
  + What do my measurements of respired 14C and bulk 14C really mean?
  + Can I use them as proxies for “short term cycling C” and “persistent C”?

*What is the story?*

Parent material thought to only impact mineral-associated soil C, therefore not considered important in the short term.

This work shows that both parent material and climate are important for explaining decadally cycling soil C dynamics, not just soil C dynamics over timescales of centuries and longer.

However, the interaction between climate and parent material on geological time scales, i.e. millennia, leads to differences in mineralogy and the distribution of carbon in different functional pools, cf. Rasumussen et al. 2018.

Notes:

* parent material seems to be of minimal importance for warm site 14C-CO2 (all depths)
  + cf. Marginal slopes plots (parent material w/in climate)
* Opposite seems to be true for bulk soil 14C, i.e. cold site most similar