Characterizing Karst Toposequences in Kentucky's Inner Bluegrass

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Introduction

- 25% of Kentucky has mapped karst features, and almost 50% of the state is underlain by bedrock with high karst formation potential[1]
- Study karst sinkholes are in Woodford County, KY in the Inner Bluegrass physiographic region (Figure 1)
- Karst sinkholes are very common in the Inner Bluegrass region because of pure limestone bedrock[2] (Figure 2)
- The evolution of the soils in these features is largely unstudied; unknown if they sequester carbon at high rates because of sediment movement processes

Figure 1. Digital elevation map of sampling locations, Woodford County, KY.

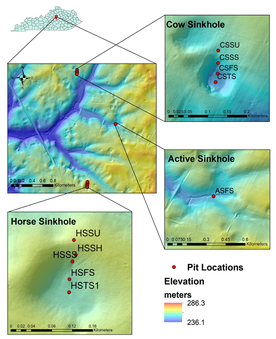


Figure 2. Mapped karst sinkholes in the study area. Study site circled in red.

Objectives and Hypothesis

- Complete characterization of physical, chemical, and mineralogic properties of the soils in karst sinkholes
- Compare carbon levels in sinkhole soils relative to other limestone soils
- Given the shape and accumulating nature of dissolution sinkholes, we hypothesize that they hold a disproportionately high amount of carbon relative to adjacent limestone soils

Results

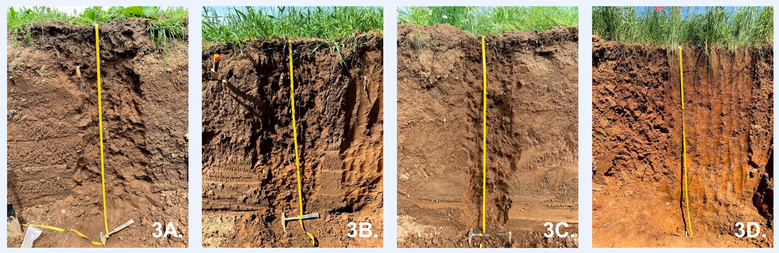


Figure 3. Selected images of the described profiles. Cow sinkhole, toeslope (**A**). Cow sinkhole, summit (**B**). Horse sinkhole, toeslope (**C**). Figure 6. Horse sinkhole, summit (**D**).

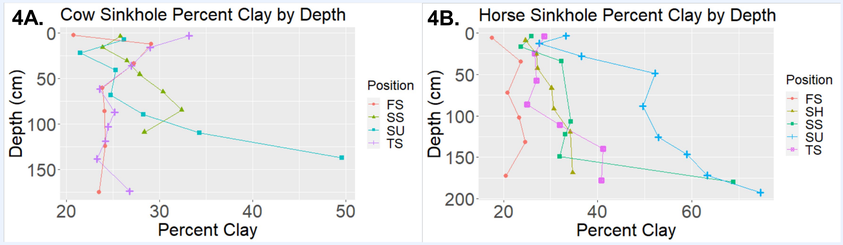


Figure 4. Cow sinkhole percent clay (determined using pipette method) plotted by horizon midpoint depth (**A**). Horse sinkhole percent clay plotted by horizon midpoint depth (**B**). Greatest clay contents were generally found at the summit positions, likely due to better drained soils.

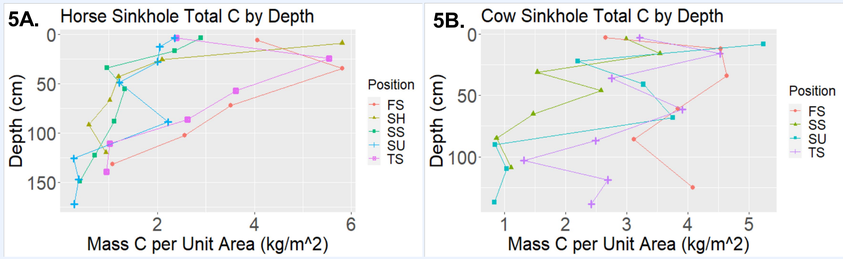


Figure 5. Cow sinkhole total mass carbon (determined via dry combustion) per kilogram air-dry soil, by depth for each position (**A**). Horse sinkhole total mass carbon per kilogram air-dry soil, by horizon depth at each hillslope location (**B**).

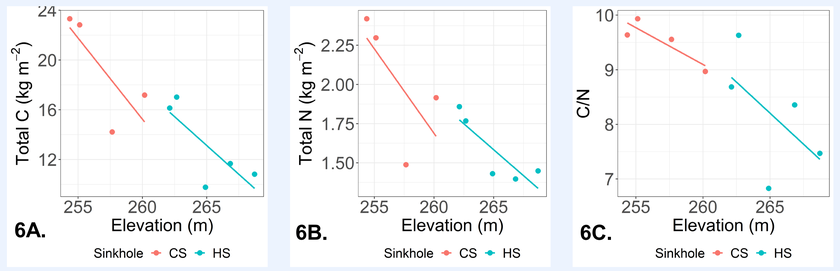


Figure 6. Trends between sample site elevation and: total carbon (**A**), total nitrogen (**B**), carbon:nitrogen ratio (**C**), iron concentration (**D**), and aluminum concentration (**E**).

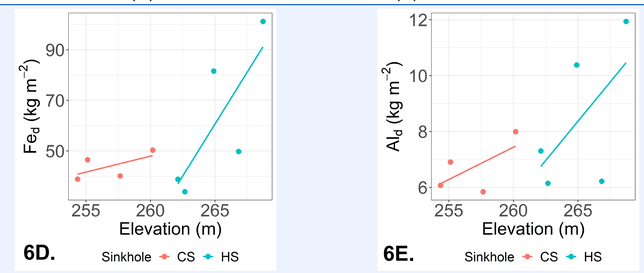
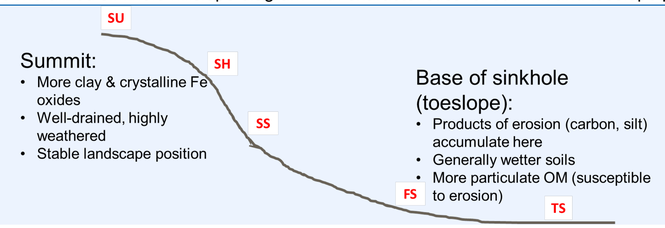


Figure 7. Generalized sinkhole hillslope diagram with characteristics for summit and toeslope positions.



Discussion

- Generally higher carbon in the toeslope relative to other sampled hillslope locations, suggests they are local carbon sinks
- Higher clay and higher Redness Ratings in Horse sinkhole suggests it is an older feature
- Challenging to compare karst sinkholes, even in such a small study area, because they are such dynamic features

Methods

- Sampled by genetic horizon
- Performed in lab: LOI, pH, EC, CEC, PSD (pipette), exchangeable bases, extractable Fe, Al, Mn, color (chromameter), quantitative mineralogy (XRD, forthcoming)
- Performed by UK's Regulatory Services: total carbon (dry combustion), total nitrogen (dry combustion)

References

1 Currens, J.C., 2002. Kentucky is karst country! What you should know about sinkholes and springs. *Kentucky Geological Survey Information Circular* 4.

2 White, W.B., R.A. Watson, E.R. Pohl, and R. Brucker, 1970. The central Kentucky karst. *Geographical Review* 60: 88-115.

Acknowledgements

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