Soil carbon respiration in tropical forest soils along geochemical gradients

How does site specific geochemistry and soil microbiology interact to influence soil C respiration?

Basalt

Siliciclastic schist

Granite

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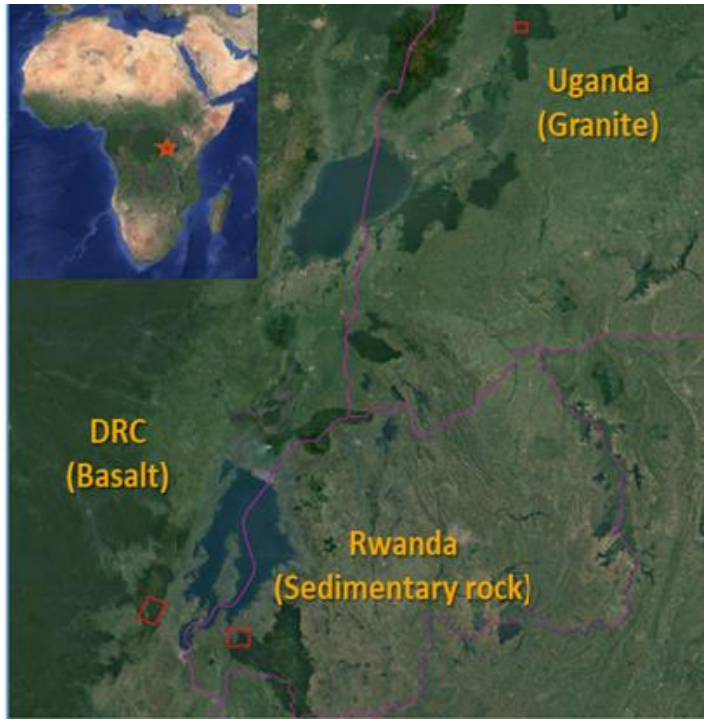
EGU 2020, Geoscience online

Session: SSS5.2/BG3.42, Wednesday 6th May, 2020

Study area , main objective and working hypothesis



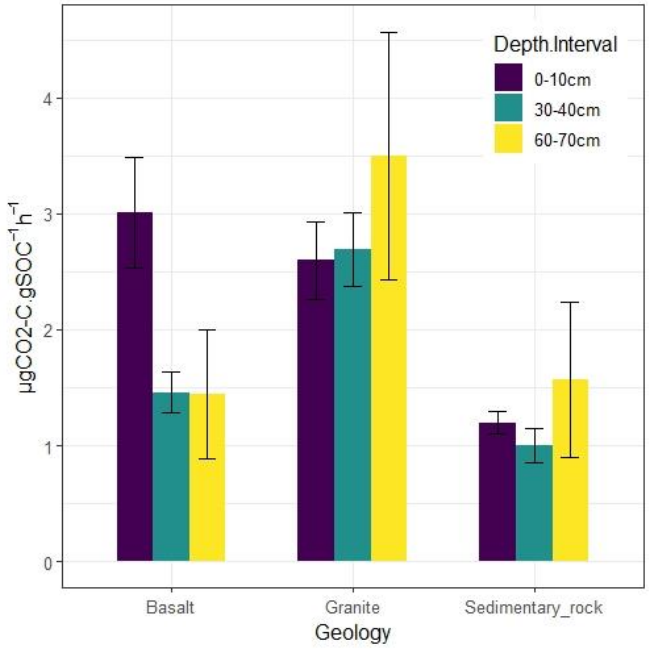
- Study sites cover soils under primary tropical forests along a geochemical gradient from felsic (granite) to mafic (basalt)
- At each study site we established replicated plots along slope catenae
- We collected composite samples from 1m soil cores in three depths: Topsoil, shallow subsoil, deeper subsoil

- The main objective of this study is to assess and develop an understanding of the controls on carbon(C) respiration in forest systems of tropical Africa along geochemical gradients

- We hypothesize that under similar tropical climate, depth explicit soil C respiration is primarily driven by changes in soil geochemical properties as they influence nutrient availability and C accessibility to microbial decomposers

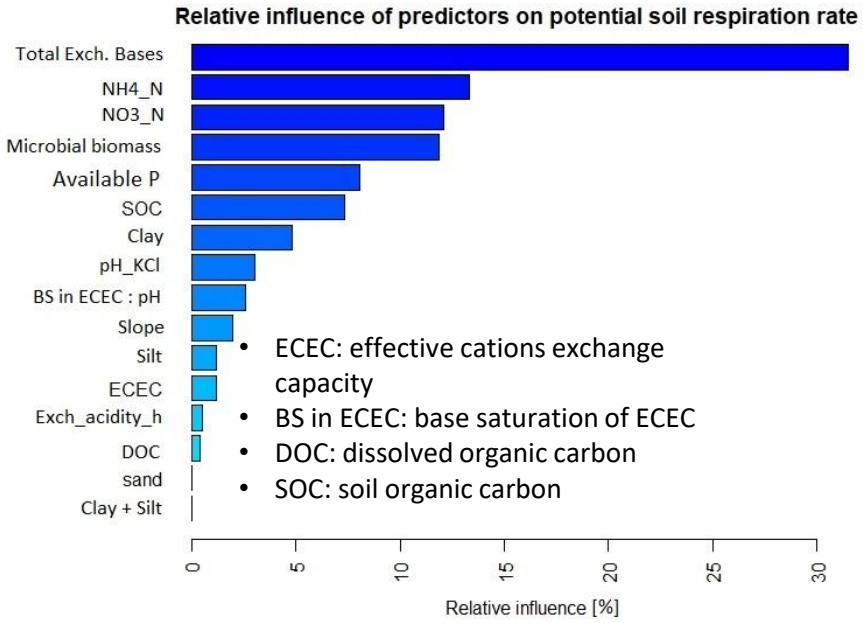
Results of incubation experiments and statistical analysis

Specific CO_2 respiration along different geologies and soil depths



- We measured potential specific soil heterotrophic respiration in a 90 days incubation at 20°C and 55% Water retention capacity
- The bars represent mean values of field replicates and error bars are standard errors

Statistical analysis of specific CO_2 respiration and soil parameters



- ECEC: effective cations exchange capacity
- BS in ECEC: base saturation of ECEC
- DOC: dissolved organic carbon
- SOC: soil organic carbon

- we assessed the influence of biogeochemical soil properties on C respiration using gradient boosting method
- the method helps also to rank variables influence on the response
- The influence is measure as % contribution of each predictor compare to the others

Main observation

- Soils developed on basalt and granite respired higher C per unit SOC than soils developed on sedimentary rock in top soils
- Respiration for soils from basalt decreased by twofold with depth but not on granite – respiration on sedimentary rocks remains unchanged

Main observation

- In general soil fertility indicators are the main drivers of C respiration
- Of all assed variables, rock derived nutrient accounted for 39.5% of relative influence, followed by available nitrogen 25% and microbial biomass 12%

Conclusion

- Assessment of variables contribution shows that 45% of the relative influence is rock derived nutrient and properties(Exch.Bases, P, pH & Base saturation of ECEC)
- Our results indicate that geochemistry is an important factor for understanding and predicting soil respiration
- Despite highly weathered, geochemically contrasting parent materials seem to be having a long lasting influence on nutrient availability and C accessibility to microbial decomposers

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