Long-term carbon stabilization in African Dark Earth soils

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African Dark Earths

Anthropogenic Dark Earths are soils generated through long-term human inputs of organic and pyrogenic materials. These soils were originally discovered in the Amazon, and more recently in Africa [1]. African Dark Earths (AfDE) are formed through a soil management system that has long been an important feature of the indigenous West African agricultural repertoire. The results are black, highly fertile and carbon-rich soils that contrast from the original highly-weathered infertile yellowish to red Oxisols and Ultisols.

The objective of the current study was to characerize soil organic carbon stability in AfDE and non-DE surface soils.

Carbon stabilization in AfDE

Previous studies on Amazonian Dark Earths demonstrated significantly different organic matter properties compared to adjacent non-DE soils, attributable to high concentrations of ash-derived carbon [2,3]. We characterized carbon stability in several AfDE and non-DE pairs of soils using a novel combination of thermal analysis and radiocarbon techniques [5].

Results of thermogravimetric (TG) and CO_2 evolved gas analyses (CO_2-EGA) showed contrasting patterns during ramped combustion of AfDE vs. non-DE soils, with a distinct peak centered on 425-430°C in the AfDE soils. Four to five thermal "fractions" associated with different CO_2-evolution regions were identified by peak deconvolution and analyzed for radiocarbon via NOSAMS' custom thermal analyzer and accelerator mass spectrometer to further distinguish carbon stability of potentially pyrogenic versus non-pyrogenic inputs.

[1] Solomon *et al* (2014) submitted. [2] Glaser *et al* (2012) *Geochim. Cosmochim. Acta* **82**, 39. [3] Solomon *et al* (2007) *Geochim. Cosmochim. Acta* **71**, 2285. [4] Plante *et al* (2013) *Radiocarbon 55*, 1077.