Geophysical Research Abstracts
Vol. 21, EGU2019-996, 2019
EGU General Assembly 2019

Are there “optimal” metal oxide-to-clay mineral ratios favoring carbon allocation by mitigating land-use induced carbon losses in the tropics?

Maximilian Kirsten (1), Robert Mikutta (2), Carsten W. Mueller (3), Didas N. Kimaro (4), Karl-Heinz Feger (1), and Karsten Kalbitz (1)

(1) Institute of Soil Science and Site Ecology, TU Dresden, Tharandt, Germany (maximilian.kirsten@tu-dresden.de), (2) Institute of Soil Science and Soil Protection, Martin-Luther-Universität Halle-Wittenberg, Halle/Saale Germany, (3) Institute of Soil Science, Technische Universität München, Freisingen, Germany, (4) Department of Nature Conservation, Sebastian Kolowa Memorial University (SEKOMU), Lushoto, Tanzania

The physical protection of carbon (C) within aggregates contributes to the total C storage capability of soils. Changes in land use may have an immense effect especially in the topsoil where most of the disturbances (e.g. organic matter input, soil cultivation, surface temperature) intertwine. In strongly weathered and acidic tropical soils, pedogenic metal oxides and low-activity clay minerals should be the most important determinants of aggregation in addition to organic matter. However, it is unknown how different contents of these oxides and clay minerals affect the storage of organic C in aggregates. Moreover, we do not know whether effects of land use change on aggregate related C storage depend on the content of pedogenic oxides and clay in these tropical soils. To answer these questions, we selected an area located in the East Usambara Mountains, Tanzania, with abundant highly leached, acidic Acrisols. We selected each six sites under natural forest and annual cropping, having a similar plant species composition at each land use. Site selection at each land use was done based on strongly different ratios between the contents of pedogenic Fe oxides and oxide-free clay. The long soil development (East Usambara Mountains formed more than 25 million years ago) under these tropical climate conditions resulted in a similar mineral composition, consisting mainly of hematite, gibbsite, and kaolinite. Topsoil material was sampled (0-5 and 5-10 cm) at three slope positions and subjected to an aggregate fractionation by dry sieving. Bulk soils were analyzed for total element contents as well as contents of pedogenic metal oxides, soil texture (including oxide-free clay), pH, soil organic C, and total N. The obtained five aggregate size fractions (>4000 to <250 μm) were analyzed for their C and N contents. The unique characteristics of our gradient enable us to elucidate the influence of contrasting contents in pedogenic oxides and clay minerals on soil aggregation and the related C storage. Forest topsoils contained significantly more C than topsoils under cropland (4.4 vs. 3.1 kg/m^2), whereas C storage under cropland was better related to mineralogical proxies. Therefore, we assume that mineral-organic associations are relatively more important for C storage under croplands, whereas labile particulate C contributes more to C storage in forest topsoils. Using all of our results, we will be able to estimate the impact of human disturbance on soil organic C storage along the gradient of pedogenic metal oxides and clay mineral contents. Thus, we will be able to identify the combination of these two factors resulting in the largest aggregate stability and the smallest land use-induced loss in organic C.