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Charcoal molecular marker quantity and pattern do not change over a century in a tropical climate

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Charcoal, also referred as pyrogenic carbon (PyC), is a residue of incomplete combustion of biomass and is ubiquitous in found soils (Preston & Schmidt, 2006), but loss processes and rates are still poorly understood. Up to now there are few studies investigating the long-term (i.e. decadal) fate of PyC in soils, and results are ambiguous. There are only two published field studies, which investigate loss of PyC over 100 years: in tropical soil by spectroscopy (Nguyen et al., 2008: 70% loss), and in a steppe soil by molecular marker measurements (Hammes et al., 2008: 25% loss), respectively. Qualitative changes of the remaining bulk PyC could not be found in the tropical soil but became evident in the Russian steppe soil under continental climate (Hammes et al., 2008), showing a preferential accumulation of the more condensed aromatic backbone of the PyC structures. However, it was not clear how results from two different soils obtained with different methods are comparable.

Here we employed the molecular marker technique used for the steppe soil and applied it to the tropical soil samples to follow the PyC in a soil chronosequence (2, 3, 5, 20, 30, 45, 80, 100 years since the last PyC deposition). Following a space-for-time approach, the soil samples (0-10cm) were collected in an area where forests were converted from forest to agricultural land by slash-and-burn practice up to 100 years ago with no new fires or other PyC inputs (Solomon et al., 2007; Kimetu et al., 2008). In this study we used benzene polycarboxylic acids (BPCA) molecular markers for pyrogenic carbon (PyC) assessment (Glaser et al., 1998; Brodowski et al., 2005; Schneider et al., 2010).

After conversion and with increasing time of agricultural use, OC stocks decreased rapidly. For PyC stocks, our results suggest that the spatial variability of PyC stocks in this space-for-time approach is in a similar range as changes of PyC stocks over time, and thus, we found no clear decrease of PyC stocks over a century. The most striking feature of our data is that the proportions of B6CA, a measure for the degree of condensation of PyC, remained constant over a century at about 35%. Thus, our results did not indicate a preferential accumulation of highly condensed aromatic PyC fractions.

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