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Land use change in Amazonian Dark Earth and Acrisol: Responses of organic carbon, organic matter composition and microbial carbon utilisation

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The conversion of tropical forest for cassava cultivation is widely known to decrease the soil organic matter (OM) and nutrient contents of highly weathered soils in the tropics. Amazonian Dark Earth (ADE) might be affected less due to their historical anthropogenic amelioration with e.g. charcoal, ceramics and bones, leading to higher soil OM and nutrient concentrations. In this study, we analysed the effect of land use change on the OM dynamics and its composition under tropical conditions, using ADE and an adjacent Acrisol (ACR) as model systems. Soil samples were obtained south of Manaus (Brazil), from a secondary forest and an adjacently located 40-year-old cassava plantation. The land use change induced a severe decrease of organic carbon (OC) concentrations in ADE (from 35 to 15 g OC kg^{-1}) while OC in the adjacent ACR was less affected (18 to 16 g OC kg^{-1}). Soils were analysed by ^{13}C NMR spectroscopy to obtain information on how the conversion of secondary forest to cassava affected the chemical composition of OM. Our results show that land use change induces differences in the OM composition: The OM in ADE changes to a more decomposed state (increase of alkyl:O/N-alkyl ratio) whereas the OM in ACR changes to a less decomposed state (decrease of alkyl:O/N-alkyl ratio). According to a molecular mixing model, land use change influenced mostly the proportion of lipids, which might be related with a change of the plant input. The incubation of the soils with ^{13}C glucose enabled resolving how soil microorganisms were affected by land use change. In both soil types ADE and ACR, land use change caused a reduction of the total ^{13}C glucose respiration by approximately one third in a 7-days incubation, implying lower microbial activity. Microorganisms in both soil types appear to be more readily active in soils under forest, since we observed a distinct lag time between ^{13}C glucose addition and respiration under cassava planation. This indicated differences in microbial community structure, which we will assess further by determining the ^{13}C label uptake by the microbial biomass and the microbial community structure using ^{13}C PLFA analysis. Preliminary results from synchrotron-based STXM demonstrate a distinct arrangement of OM at fine-sized charcoal-particle interfaces. Samples of soils receiving ^{13}C label will be further analysed by

NanoSIMS with the hypothesis that charcoal interfaces foster nutrient dynamics at the microscale. Despite the high loss of OC in the ameliorated ADE through land use change, the remaining OM might improve the nutrient availability thanks to charcoal interactions compared to the ACR. Our results contribute to a better understanding of the sensitivity of OM upon land use change and how the microbial community is responding to land use change in highly weathered tropical soils.