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Thermogravimetric-calorimetric characterisation of organic matter in oxide-rich tropical soils

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Tropical soils are increasingly subjected to both site conversion and intensification of agricultural practices, leading to cultivation-induced losses of soil organic matter (SOM) and associated nutrients. Hence, robust techniques for the qualitative characterisation of SOM in heavily weathered tropical soils are required. While thermogravimetric methods are widely used for the characterisation of temperate soils, thermal degradation features of pedogenic oxides typical for many tropical soils can confound the analyses, particularly in thermolabile SOM fractions. We used thermogravimetry coupled to differential scanning calorimetry and mass spectrometry (DSC-TGA-MS) to discern mineral and organic thermal degradation patterns in a kaolinitic soil from Cameroon receiving different mineral and organic amendments. We quantified endothermic mineral degradation features overlapping with OM combustion and thus corrected the exothermic OM degradation signal for pedogenic oxide dehydroxylation. The addition of thermostable biochar interfered with the identification and quantification of clay mineral dehydroxylation features. Between three and four thermal OM fractions of different energy density were identified, among which a distinct cellulosic fraction marked the continuous C4 vegetation on the site. The addition of compost led to a reduction of the thermolabile fraction, while the absence of organic input resulted in a reduction of the thermostable fraction. We conclude (I) that the addition of nutrient-rich fresh OM (compost) may lead to faster OM turnover as indicated by a reduction of the thermolabile OM fraction, and (II) while DSC-TGA-MS is generally suitable for OM characterisation in tropical soils, the presence of pyrogenic C represents a challenge if clay dehydroxylation is to be determined simultaneously.