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Mineralization of organic artefacts: implication for carbon early dynamics in Technosols

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Abstract

Technosols are soils strongly impacted by human activities. They often contain high quantity of artefacts (*i.e.* parent materials from anthropogenic origin) that impact their functioning, notably their carbon (C) cycle. The resistance to degradability of a wide and representative range of organic artefacts found in Technosols was assessed under controlled conditions.

Artefacts tested were green waste compost (GWC), papermill sludge (PS), biochar (BC), coal (CO) and coke (CK). Artefacts were mixed with mineral materials and sometimes with natural organic matter to create artificial soil materials. Four methods were used to assess the resistance to degradability of these materials during a two-month incubation experiment: i) CO2 fluxes measurement, including the modeling of kinetics parameters; ii) particle size-density fractionation method; iii) Rock-Eval analysis (related to thermal resistance to degradation); iv) δ13C analysis.

After the incubation, organic artefacts global degradability was strongly variable, ranked as follow: PS >> GWC >> BC > CO ≈ CK. Chemical signature of artefacts did not vary widely through the experiment except for PS. Most of the C loss originated from coarse light particles, while C in finer particles was more protected. Rock-Eval and δ13C analyses permitted to differentiate C of natural organic matter from C of artefacts, 20% to 1% of the C mineralized was from artefacts (for PS and BC respectively). Notably, we recorded negative priming effects for artificial soils BC, CO and CK when mixed with natural organic matter.

All the methods employed provided complementary information on the resistance to degradability of artefacts. Typology of organic artefacts can be addressed according to the results from this study: (i) highly to moderately mineralizable artefacts; (ii) weakly mineralizable artefacts and (iii) very weakly mineralizable artefacts. This might imply different strategies for the management of the Technosols to optimize their carbon sequestration.