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The utilisation of municipal waste compost for the reclamation of anthropogenic soils: implications on C dynamics.

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The application of municipal waste compost (MWC) and other organic materials may serve to enhance soil fertility and increase C stocks of earthen materials and mine spoils used in land reclamation activities, particularly in the recovery of degraded areas left by exhausted quarries, mines, abandoned industrial zones, degraded natural areas and exhausted landfill sites. Such land management options may serve as a precondition for landscaping and reclamation of degraded areas, reforestation or agriculture. In fact, previous results have shown that compost application to the capping layer of a landfill covering soil significantly enhanced the fertility, evidenced by an improvement in soil structure, porosity and water holding capacity, an increase in the relative proportion of recalcitrant C pools and an increase in soil nutrient content, microbial activity and soil microbial biomass.

Proper management of MWC requires a capacity to understand and predict their impacts on C dynamics in the field subsequent to application. Although numerous works deal with the effects of compost application in agricultural systems, little is known on how land rehabilitation practices effect C dynamics in such relatively young soil systems. The estimation of SOC pools and their potential turnover rates in land reclamation activities is fundamental to our understanding of terrestrial C dynamics. In the framework of a long-term field experiment, the objective of this work was to evaluate the temporal and spatial dynamics of compost-derived organic matter with respect to the major processes involved in organic matter cycling in an anthropogenic landfill covering soil originally amended with a single dose of MWC. We investigated long-term organic C dynamics in such systems by collecting samples at different depths over a 10 year chronosequence subsequent to compost application to the top layer of the landfill covering soil.

Variations in the stable isotope composition (delta 13C) of the soil samples show that even after 10 years, amended topsoils were significantly enriched in compost-derived organic matter, confirming that the utilisation of such organic inputs in land reclamation activities has the potential to enhance the C stocks of degraded areas. The addition of compost to the superficial layer also resulted in a significant input of soluble organic compounds subject to leaching along the soil profile. Sorption isotherms for compost-derived water-extractable organic matter onto mineral materials used for landfill covering suggest that sorptive preservation was primarily responsible for the increase in C content and the shift in the C isotopic signature to values similar to that of the applied compost, in the deeper soil horizons over the 10 year experimental period. This was also confirmed by the accumulation of lignin-derived phenolic compounds. Nevertheless, analysis for non-cellulosic carbohydrates in soils samples and their respective water-extractable fractions suggest that a proportion of compost-derived, labile organic matter fraction is leached through the soil profile and potentially lost from the soil system, particularly in the years immediately after compost application.