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Relating composition of a pyrophosphate soluble soil organic matter fraction to polyvalent cations according to coordination chemistry

Ruth H. Ellerbrock, Horst H. Gerke

Institute of Soil Landscape Research, Leibniz-Centre for Agricultural Landscape Research (ZALF), Müncheberg, Germany (rellerbrock@zalf.de, Fax: +49-33432-82280)

The chemical stabilization of soil organic matter (SOM) depends on the interactions between organic and mineral components. For idealized systems, the interaction depends on the composition of organic matter (OM) and the type of polyvalent cation (PC^{x+}). For soil systems, however, such relations have not been reported since interaction mechanisms are complex and various SOM fractions are involved in controlling the process. This study adopts a concept, commonly applied in coordination chemistry, to analyze soil samples from long-term agricultural field experiments. The exchangeable cations, oxalate soluble PC^{x+} and organic carbon contents were determined from the soil samples as well as amount and composition of a sequentially extracted pyrophosphate soluble organic matter fraction, OM(PY). The composition of OM(PY) was described in terms of relative C=O group content in transmission FTIR. The extractability of OM(PY) was mostly found negatively related to the contents of Fe_{ox}. The relative contents of C=O groups could be related to the contents of exchangeable cations but not solely to oxalate soluble PC^{x+} contents. Including all PC^{x+} components ('adsorbed', oxalate soluble, 'free' (i.e., present in soil solution)) and weighting these according to their binding status, improved the relation between C=O of OM(PY) and PC^{x+} significantly. However, no site and management specific effects were detected for plots fertilized with farmyard manure (FYM). The application of coordination chemistry to interpret soil analytical and spectroscopic data suggests that OM(PY) composition depends not only on OM input and soil clay content but also on amount, availability and effectiveness of PC^{x+} in soil. However,

long-term FYM application may gradually shift SOM composition towards a ‘FYM-type’ SOM that reflects a steady- state balance between input rates and site-specific decomposition conditions.