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Erosion effects on composition and dynamics of soil organic matter in arable landscapes in North East Germany

Ruth Ellerbrock, Detlef Deumlich, Dominique Niessner, and Horst H. Gerke
Leibniz Centre for Agricultural Landscape Research (ZALF); RA1; Hydropedology Group, (rellerbrock@zalf.de)

In hummocky landscapes, soil erosion is forming truncated profiles at steep slope positions and colluvial soils in topographic depressions thereby affecting soil organic carbon (SOC) storage and distribution. However, knowledge on (i) the spatial distribution and composition of differently stable organic matter (OM) fractions in arable landscapes and (ii) the dynamics in composition of OM in run-off and eroded particles during single erosion events is still limited. Our objectives are (i) to compare amount and composition of OM fractions from top-soils at eroded, colluvic, and non-eroded slope positions, and (ii) to analyze the dynamics in OM composition of material transferred during erosion. Soil samples were from a Luvisol at plateau, an eroded Luvisol at mid slope (6% slope gradient), a calcaric Regosol at steep slope (13%), and a colluvic Regosol hollow position. From these soil samples pyrophosphate soluble (OM-PY) OM fraction was extracted sequentially. Material transferred during erosion events were sampled at foot-slopes of neighbored (a) no-till and (b) a conventionally tilled experimental fields, and then separated into dissolved (run-off) and particulate fractions (sediment). Soil, OM-PY fractions, run-off and sediment samples were analyzed using transmission Fourier transform infrared (FTIR) spectroscopy.

FTIR spectra of OM-PY from top-soils at the steep slope position (caRG) show the highest intensities of C-H (alkyl groups) and C=O (carboxyl groups) absorption bands. The C-H/C=O ratio in OM-PY decreased with increasing contents of oxalate soluble Fe and Al oxides from steep slope (0.25 for caRG-Ap) towards plateau, and hollow position (0.09 for coRG-Ap) reflecting that the downslope-deposited Ap material, which is higher in poorly crystalline Fe and Al oxides, consists of relatively stable OM. The CH/C=O ratios in FTIR spectra of run-off and sediments sampled during erosion events at the foot slope of the no tilled site were found to decrease with time but also reflect differences in rainfall intensity. Temporal changes in CH/C=O ratios of run-off samples are different to the ones of the sediments samples, indicating different dynamics in OM that could be transferred over longer (run-off) or shorter distances (sediments). During erosion OM enriched in C=O may preferably interact with soil components like iron oxides since the C=O groups are known for their interaction with soil minerals. Knowledge on OM-mineral interactions may help to improve our understanding of organic matter processing at the interface between terrestrial and aquatic ecosystems.