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Mapping the organic matter composition of coatings at preferential flow path surfaces by in-situ DRIFT spectroscopy

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In structured soils, interaction of percolating water and reactive solutes with the soil matrix is often restricted to the outer surfaces of the preferential flow paths. Such surfaces of soil aggregates and biopores are mostly covered by organic matter (OM) that finally controls wettability, sorption and transfer properties of the flow pathways. However, the local OM-properties along such surfaces are largely unknown to date since the coatings are relatively thin and vulnerable.

The objective of this study is to determine and compare the local 2D distribution of soil OM composition at intact aggregate surfaces that serve as preferential flow paths. The Fourier transformed infrared spectroscopy in diffuse reflectance mode (DRIFT) is applied to determine transects and grids of OM functional group data (i.e., CH/CO-ratios) on undisturbed and intact surfaces of soil aggregate samples using a DRIFT mapping procedure in 1 mm steps. The aggregate sample surfaces are distinguished in areas from earthworm burrows, root channels, and aggregate coatings. Wettability of these defined surface areas is observed by means of contact angle measurements. For the same locations, relatively high CH/CO-ratios correspond with higher water repellency as, for instance, for organic coatings on root channels or litter residues, while locations with quartz-sand grains correspond with relatively lower CH/CO-ratios.

The results show that OM coatings at preferential flow path surfaces differ locally in terms of composition, distribution and wettability, which indicate yet unknown implications for preferential movement of water and especially of reactive solutes.