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Local-scale distribution of organic matter composition and wettability at surfaces of preferential flow paths

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Surfaces of preferential flow paths in structured soils consist of clay-organic coatings (i.e., cutanes) on soil aggregates or linings on biopores (i.e., worm burrows and decayed root channels). The outermost layer of such surfaces is mostly covered by organic matter (OM). The composition of this OM finally controls wettability and sorption properties that are relevant for transport along the flow path. However, the local distribution of OM-properties along such surfaces is largely unknown because analyzes without disturbing the coating layer surfaces have not been possible to date.
The objective of this study is to compare the local 2D distribution of soil OM composition at intact aggregate and biopore surfaces with that of the wettability. The OM composition is determined using Fourier transformed infrared spectroscopy in diffuse reflectance mode (DRIFT) in terms of the ratios of CH/CO functional molecular groups. Intact surfaces of aggregated soil samples were scanned using a DRIFT mapping procedure in a 1 mm grid. Wettability was observed by means of contact angle measurements using a Goniometer with a high-speed camera. The aggregate sample surfaces were distinguished into regions of earthworm burrows, root channels, clay-organic coatings and uncoated regions. In contrast to the uncoated surface areas, organic coatings on worm burrows and root channels show relatively higher CH/CO-ratios that correspond with longer water drop infiltration. Both, the OM composition of coatings along preferential flow path surfaces and the water repellence are spatially variable at this local scale. The results indicate yet unknown implications for preferential flow and transport especially for reactive solutes.