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Method for characterising small-scale composition of organic matter on structural soil surfaces using diffuse reflectance spectroscopy

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The properties of aggregate and biopore surfaces or coatings may affect reactive transport processes in structured soils. Particles at the surfaces are mostly covered by soil organic matter (SOM), which may be temporally and spatially heterogeneous in terms of SOM content and composition of functional groups. The chemical reactivity and sorptivity of SOM determine wettability and affects cation exchange. Although some heterogeneity on aggregate surfaces may be observed by visual inspection, small-scale quantitative analyses of SOM are missing or are mostly destructive. The objective is to develop a method that allows for in-situ characterisation of the spatial arrangement of SOM composition on such surfaces. The Fourier transform infrared spectroscopy (FTIR) in diffuse reflectance (DRIFT) mode was used for analyzing the functional composition of SOM. The contactless analysis of undisturbed soil aggregates was first tested to detect visually identifiable SOM differences along a transect of bedded soil samples. The results show that differences in SOM composition at millimetre resolution could be identified for artificially prepared samples. Differences in SOM composition on artificially prepared soil surfaces are showing effects of the soil type and the land use in the relative amount of C=O and CH group contents. Moreover, small-scale differences in CH/C=O ratios resulting from litter with discrepancies in qualitative and quantitative SOM properties could be determined on the surface of a soil sample as well. Variation of C-H/C=O ratios indicates the degree of hydrophobicity of aggregate surface areas. The results show that DRIFT allows the analysis of small-scale SOM differences on ‘internal’ surfaces of soil structural components.