Soil texture mediates the biogeochemical association of soil organic matter with mineral surfaces in an arable Cambisol

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The biogeochemical association of soil organic matter with mineral surfaces depends on the availability of adsorptive mineral surface area. In soils with low content of fine-sized mineral particles, the coverage with mineral-associated soil organic matter (MOM) should be higher than in clay-rich soils at constant MOM. In this study, we analyzed MOM and further indicators of its binding in the topsoil (0-20 cm) of an arable Cambisol with a gradient in soil texture (clay-sized particles 6-35 %). The research site in Scheyern (SE Germany) was homogeneously managed and supplied with organic matter. For this study, we obtained mineral-associated (>1.6 g cm^{-3}) density fractions further split into fine silt-sized (2-6.3 μm) and clay-sized (0.2-2 μm) size fractions. We analyzed the concentration of mineral-associated carbon (MOC) and measured the chemical composition of the MOM by solid-state ^{13}C nuclear magnetic resonance spectra. In the clay fractions the spatial distribution of MOM was determined by image analysis based on nanoscale secondary ion mass spectrometry (NanoSIMS) of $^{12}C^-$, $^{12}C^{14}N^-$ (indicative for SOM) and $^{16}O^-$ (indicative for mineral surfaces). We found that the MOC concentration of the fine silt and clay-sized fractions was higher at 6 % clay (80 mg g^{-1}) than at 15 % clay (40 mg g^{-1}). In soils with 15 to 30 % clay the MOC was constantly 40 mg g^{-1}. Further investigations with NanoSIMS showed a higher coverage in sandy soils than in the clay-rich soils. Our data reveal that both the MOC concentration and the MOM coverage increase with decreasing clay content in the soils <15 % clay. In the analyzed soils with >15 % clay the MOC concentration and the MOM coverage is constantly lower, due to suffienct availability and accessability of adsorptive mineral surfaces at this soil texture.