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Effects of mineral surface properties on the distribution and sequestration of organic matter pools in five German agricultural topsoils

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The distributions of total organic carbon (TOC), total nitrogen (TN) and iron species between soil fractions from five German agricultural topsoils were investigated. The results were related to the corresponding specific surface area (SSA) of the soil mineral fractions obtained after the organic matter removal by a thermal oxidation ($SSA_{mineral}$). Linear relationships were found between TOC, TN and iron species with increasing $SSA_{mineral}$ from soil fractions > 20 μm, bulk soils to soil fractions 2-20 μm. This dependence was related to the presence of clays in soil aggregates. Slope and intercept from linear regression analysis were used to discriminate between TOC and TN which are associated or non-associated to the soils mineral surface. Thus, the distribution of mineral-associated and non-associated TOC pools was determined in the investigated soils without any chemical extraction. A correlation between the non-associated TOC amount and the amendment practice was put in evidence while the mineral-associated TOC amount only depends on the sequestration capacity of the clay fraction. From the decrease of mineral surface associated to the dithionite-extractable iron, the distribution of SSA between metal oxide and silicate clay was calculated. A negative correlation between OC/N ratios from mineral-associated organic matter and the contribution of metal oxide to topsoils $SSA_{mineral}$ was observed. It can therefore be assumed that an increase of the contribution from free iron metal oxide surface favours the selective sequestration of rich nitrogen-containing matter. Porosity measurements put in evidence a filling mechanism of micropore (pore widths not exceeding 2 nm) and mesopore (pore widths between 2 nm and 50 nm) where micropore surface area were preferentially blocked. The results supported the view that

surface chemical heterogeneity and physical protection in pores are determining factors in the organic matter sequestration.