



## **Fe(III) fate after complexation with different soil organic matter fractions: retention capacity and mechanisms**

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Soil organic matter (SOM) protection, stability, and long-term accumulation are controlled by several factors, including adsorption onto mineral surfaces and pedo-climatic conditions. Iron (Fe) oxides have been suggested as a key regulator in the soil organic carbon (SOC) cycle; however, Fe speciation in soils is highly dependent on environmental conditions, such as climate and land use.

In this study, we investigated the dynamics of Fe and organic C (OC) in soils characterized by different land uses, including coniferous forest, grassland, technosols, and agricultural soils. We focused particularly on the interactions between Fe(III) and several distinct, physically isolated SOC fractions. These pools included fine silt plus clay (FSi+Cl) and fine sand (FSa) fractions, which were obtained by ultrasonic dispersion and wet sieving, and mineral-associated (Min) SOM fractions, which were obtained using a densimetric physical fractionation. Batch experiments at pH 7 were carried out where Fe(III) was reacted with each pool. Solid phase products and liquid supernatants were analyzed for OC and Fe content. X-ray diffraction (XRD), Brunauer-Emmett-Teller (BET) and Attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR) were used to characterize the solid phase.

Our findings indicate that Fe plays an important role in regulating the stability and transformation of OC in land uses where C is mainly sequestered in the coarser fractions (e.g., the fine sand). For all different land uses, an increase in added Fe caused a decrease in OC released into the reaction solution. The OC that was most strongly sorbed to each fraction after Fe-mediated stabilization was also less prone to desorption. This was confirmed by the decrease in OC released into solution caused by Fe binding and stabilization via carboxylic moieties. Lastly, the specific surface area (SSA) of clays did not seem to be a good indicator of the capacity of clays to sorb OC. This was because high clay and SSA values did not correlate to increasing OM stabilization in the reacted samples.