Geophysical Research Abstracts
Vol. 15, EGU2013-9887, 2013
EGU General Assembly 2013

Organo-mineral associations of Fe oxides and soil organic matter: Formation, properties and functions.

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In many soils, Fe oxides and oxyhydroxides are assumed to be the most important substrates for the formation of organo-mineral associations. While field studies often report correlations between organic C and the amount of Fe oxides, laboratory experiments confirm high organic matter loadings on Fe oxides and different possible interaction mechanisms. In spite of their small mass proportion within soils, the particular importance of Fe oxides as organic matter carriers might be explained by their usual occurrence as poorly crystalline, nanoparticulate minerals: This leads to large specific surface areas of 100-700 m2 g-1, which may dominate a soils total mineral surface area. Another reason for their high reactivity towards organic matter is seen in the fact that the surface of Fe oxides is covered by conditionally charged hydroxyl groups.

Implications of the formation of Fe-oxide organic matter associations for pedogenesis are manifold and severe. On one hand, it will influence organic matter composition and development. Dissolved organic matter and extracellular polymeric substances are believed to be important sources for mineral associated organic matter. These complex mixtures usually fractionate during their association with Fe oxides. The associated fraction is supposed to be stabilized, whereas the non-associated fraction remains mobile and available to degradation by microorganisms. On the other hand, the organic coating will completely change the interface properties of Fe oxides such as solubility, charge and hydrophobicity. This in turn will affect their reactivity towards nutrients and pollutants, adsorption of new organic matter, the availability of ferric Fe towards microorganisms, the aggregation behavior and mobility of Fe oxides. In other words, for many soil forming processes it makes a big difference, whether the Fe oxide surfaces are coated by organic matter or not.