



Composition and reactivity of ferrihydrite-organic matter associations

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The formation of organo-mineral associations affects many soil forming processes. On the one hand, it will influence soil organic matter composition and development, because the complex organic matter mixtures usually fractionate during their association with mineral surfaces. Whereas the associated fraction is supposed to be stabilized, 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 strongly influence their reactivity towards nutrients and pollutants, the adsorption of new organic matter, and the availability of ferric Fe towards microorganisms.

To better understand such processes we produced ferrihydrite-organic matter associations by adsorption and coprecipitation in laboratory experiments. As a surrogate for dissolved soil organic matter we used the water-extractable fraction of a Podzol forest-floor layer under spruce. Sorptive fractionation of the organic matter was investigated by ¹³C NMR and FTIR. Relative to the original forest-floor extract, the ferrihydrite-associated OM was enriched in polysaccharides but depleted in aliphatic C and carbonyl C, especially when adsorption took place.

Liquid phase incubation experiments were carried out with an inoculum extracted from the podzol forest-floor under oxic conditions at pH 4.8 to quantify the mineralization of the adsorbed and coprecipitated organic matter. These experiments showed that the association with ferrihydrite stabilized the associated organic matter, but that differences in the degradability of adsorbed and coprecipitated organic matter were small. We therefore conclude that coprecipitation does not lead to a significant formation of microbial inaccessible organic matter domains.

Microbial reduction experiments were performed using *Geobacter bremsensis*. We observed that increasing amounts of associated OM led to decreasing initial reaction rates and a decreasing degree of dissolution. Reduction of coprecipitated ferrihydrites was faster than reduction of ferrihydrites with adsorbed OM.

Our data demonstrate that the composition of coprecipitated OM differs from surface-adsorbed OM and that the association with ferrihydrite can effectively stabilize labile polysaccharides. Vice versa, these polysaccharides may protect ferrihydrite from reduction by geobacter-like bacteria.