

Composition of natural organic matter coatings on Fe oxides

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Sorption of organic matter on minerals will entirely change the surface properties and the reactivity of these minerals. We used atomic force spectroscopy (AFM) and X-ray absorption spectromicroscopy (STXM-NEXFAS) at the C1s and Fe2p absorption edges to quantify the extent and the chemical composition of organic coatings on Fe oxides (and clay minerals if present). The investigated Fe oxides came from three settings, which differed in the origin of the available organic material: (1) synthetic goethites, that had been in contact with biofilms, (2) natural Fe oxides, which precipitated from Fe-rich springwater, most likely triggered by microbial oxidation, and (3) natural, goethite-rich Fe oxides from the Bg horizon of a Gleysol.

First results show that the mineral associated organic matter from the three settings is rather different in composition: The organic matter on goethite from biofilms is dominated by proteins and alkyl C. In comparison, the organic coatings on Fe oxides from the spring are clearly enriched in aryl C and O-alkyl C, but depleted in alkyl C. Coatings on Fe oxides from the Gleysol are rich in alkyl C and carbonyl C. In addition to the Fe oxides, the Gleysol also contains chlorites. On these chlorites the carbon specific absorption at the C1s edge is much weaker than on the Fe oxides and the adhesion between AFM-tip and mineral surface is clearly higher than on the Fe oxides. We therefore assume, that the chlorites bind less organic matter than the Fe oxides.

On the scale of the spatial resolution of AFM (2 nm) and STXM (30 nm), the organic coatings are not patchy, but stretch continuously across the mineral surfaces.

Our observations are in accordance with the high reactivity of Fe oxides towards organic matter sorption. Even when found in close proximity to bacterial cells, like in the spring samples, the Fe oxide associated organic matter has a strong contribution of OM of non-microbial origin.