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Ferrihydrite formed in the presence of dissolved soil organic matter

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Ferrihydrite (Fh) - even if present at low concentrations - may control the available surface area and therefore, the behaviour of nutrients and pollutants in soils. Its precipitation often takes place in the presence of dissolved organic matter. This involves processes like adsorption, but also coprecipitation, flocculation/coagulation and poisoning of crystal growth. To simulate this process we prepared a series of organic matter-Fh coprecipitates using water extractable organic matter (OM) from a forest topsoil. Products were investigated by N_2-adsorption, TEM, XRD and Mößbauer spectroscopy. Precipitating Fh from solutions with increasing OM/Fe ratios yield products with up to 170 mg g^{-1} organic C. While the OM-free sample consists of Fh particles a few nm in size (TEM) and specific surface areas of 386 m^2 g^{-1}, Fh-OM coprecipitates are significantly smaller and display a surface area of only 5-23 m^2 g^{-1}. With increasing amounts of associated OM the d-spacings of the major XRD peaks increase linearly from 0.258 to 0.269 nm and from 0.149 to 0.151 nm, while peak shoulders at 0.22 and 0.16 nm weaken. The asymmetry of the 0.26 nm peak decreases and disappears at carbon contents $>$ 120 mg kg^{-1} C. The quadrupole split of the Mößbauer spectra at 300 K increases from 0.78 to 0.90 mm s^{-1} and the magnetic hyperfine field at 4.2 K drops from 49.5 to 46.0 T. These data reflect the interference of OM with crystal growth leading to smaller Fh crystals, increased lattice spacings and a lower crystallinity. Specific surface area values suggest an almost complete OM-coverage on all OM-Fh coprecipitates. By comparison to sorption experiments we conclude that coprecipitation produces OM loadings similar to adsorption and does not encapsulate large amounts of OM.