Adsorption of phthalic acid on geothite surface as studied by infrared spectroscopy and surface complexation modeling

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It is known that the oxidation of organic matter and dissolution of minerals are promoted by interactions of organic matter and minerals. It is very important to examine the adsorption process of organic matter on the mineral surface for understanding these interactions. We are interested here in the adsorption behavior of humic acids to goethite, which are among the common organics and minerals on the earth surface.

The humic acid is a complex macromolecule containing reactive functional groups such as carboxyl (COOH). Phthalic acid, containing an aromatic ring with 2 carboxyl groups, was employed here as a model compound simulating the humic acid. The adsorption behavior of phthalic acid to goethite was studied by adsorption experiments and attenuated total reflection infrared (ATR-IR) spectroscopy. Results of adsorption experiments in pH 3-10 of phthalic acid on goethite were analyzed by surface complexation modeling (Extended Triple Layer Model: ETLM). The adsorbed states of phthalic acid on geothite are expected to be mainly in the inner-sphere complex in low pH solutions, while the outer-sphere complex is predominant in neutral pH. In the ATR-IR spectra of phthalic acids adsorbed on goethite under low pH conditions, the peak position of the symmetric stretching vibration of COO- shifted to the higher wavenumber region. This peak shift can be related to the formation of inner-sphere complex.

The adsorption of phthalic acid on geothite can be thus understood by different proportions of inner-sphere and outer-sphere surface complexes under different pH conditions.