

## Effects of organic compounds on Fe(III)-precipitates and on the retention of co-precipitated phosphate

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The fate of phosphorus in environment is coupled to the redox-cycling of iron (Fe). The oxidation of Fe(II) in natural waters leads to the precipitation of amorphous to poorly crystalline Fe(III)-solids that can bind phosphate (P). Dissolved organic matter (DOM) may affect the structure and colloidal stability of Fe(III)-precipitates and the co-precipitation of P. To date, mechanistic insights on the effect of DOM on the formation, properties, and P uptake of Fe(III)-precipitates formed by Fe(II) oxidation in the presence of other interfering solutes (Ca, P, Si) at environmentally common concentrations are still scarce.

We aim to assess how different organic ligands (oxalate, citrate, 2,4-dihydroxybenzoic acid, galacturonic acid, humic acid) affect the structure and colloidal stability of Fe(III)-precipitates and P co-precipitation. The laboratory experiments are performed in aqueous solutions (bicarbonate buffered, pH 7.0) containing Na or Ca as electrolyte cation, P (molar P/Fe ratios of 0.3 or 0.05), and the organic ligands (molar C/Fe ratios of 0.1–9.6). Fe oxidation and precipitation are initiated by spiking 0.5 mM Fe(II) to the aerated solutions. Solutions are analyzed for Fe, P, Ca (ICP-MS) and organic C (TOC-L). The local coordination of precipitated Fe is determined by extended X-ray absorption fine structure (EXAFS) spectroscopy, and particle sizes in colloidal stable suspensions by dynamic light scattering (DLS).

The Fe(III)-precipitates formed without DOM are mixtures of amorphous Fe(III)-phosphate and poorly-crystalline lepidocrocite. For 2,4 dihydrobenzoic acid, galacturonic acid, and humic acid, first experimental data indicate that higher C/Fe ratios did not reduce P uptake through competitive sorption, but instead resulted in lower residual dissolved P levels by inducing the formation more amorphous precipitates with a higher P sorption affinity (capacity). At the same time, higher C/Fe ratios also caused lower aggregate sizes. These organic ligands may thus enhance both the P binding and colloidal mobility of Fe-DOM co-precipitates.

The results from this study contribute to the goals of the EU project P-TRAP (<https://h2020-p-trap.eu/>), aimed at the reduction of diffuse P inputs into surface waters by using Fe-rich water treatment residues for P trapping in agricultural waters and lake sediments.