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Effect of fulvic acid on Fe(III)-phosphate precipitates formed via Fe(II) oxidation under neutral conditions

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Oxidative transformation of Fe(II) in aquatic systems represents an important pathway for phosphorus (P) immobilization through the formation of Fe(III)-phosphate (Fe-P) phases. In natural waters, however, dissolved organic matter, such as fulvic acids (FA), can interfere with Fe-P stability. The extent to which fulvic acids destabilize Fe-P phases under oxic, near neutral conditions remains insufficiently constrained.

In this study, we examine the stability of Fe-P phases at neutral pH in a HEPES buffered solution under the application of fulvic acids. Fe-P solids were synthesized by reacting 1 mM Fe(II) with 0.5 and 0.75 mM phosphate at P/Fe molar ratios of 0.5 and 0.75 under aerated oxic conditions until complete precipitation. Standard FA was subsequently added at concentrations of 0.1, 0.3, 0.5, and 1.0 mM. Batch reactors were monitored over timescales ranging from minutes to 48 hours, and dissolved Fe and P concentrations were quantified spectrophotometrically using filtered solution (0.45 µm syringe filter) to evaluate potential Fe-P dissolution.

Fe-P precipitation proceeded to completion at both P/Fe ratios and produced stable solid phases. Across the full range of fulvic acid concentrations, no measurable release of Fe or P was observed over the experimental duration. Fulvic acids did not induce detectable dissolution or destabilization of Fe-P phases under the conditions studied. These findings indicate that Fe-P phases formed during Fe(II) oxidation still remain sinks for P in fulvic acid-rich environments under oxic, near neutral conditions.