Characterizing the dynamics of iron oxide aggregation and reactivity in the presence of natural organic matter

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Dissolved carbon in the form of natural organic matter can dramatically enhance or inhibit iron oxide nanoparticle aggregation depending on solution conditions. For example, at low concentration, goethite nanoparticle substantially aggregate, while at high concentration, goethite aggregation is inhibited. Here, we report results tracking reactivity with the degree of aggregation, using the rate of reductive degradation of 4-chloronitrobenzene as an assay of reactivity and dynamic light scattering and cryogenic transmission electron microscopy to quantify aggregation state. In general, reactivity drops once aggregation is strongly inhibited by the presence of the natural organic matter. Because the available surface area is greater when aggregation is inhibited, the reactivity decreases are likely due to blockage of reactive sites by natural organic matter.