

Electrochemical evidence of malonate specific sorption to hematite

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The environmental iron cycling is governed by several geochemical processes, including dissolution/precipitation, sorption, exchange, redox and photochemical reactions [1]. However, our current knowledge of how organic matter interactions with minerals affect iron bioavailability is limited, in part due to limited experimental information on binding mechanism of organic molecules.

In this work, we present an electrochemical study of the effect of malonic acid interactions with hematite on the electrical double layer properties. The electrokinetic [2,3], potentiometric [3-5] measurements show that malonate adsorbs specifically between pH 3 and 8.3. We show that isoelectric point shifts towards lower pH-values, whereas the point of zero charge shifts towards higher pH values as the malonate concentration increases – a clear evidence of the specific sorption [5]. By combining, aqueous and surface speciation calculations, we show that malonate can adsorb as either monodentate or bidentate complexes, with a varying degrees of protonation.

Our findings are relevant for the understanding of the role of organic matter interactions with iron oxides in the elemental cycling of iron, as well as heavy and radioactive cations in the environment.

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