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Influence of Humic Acids in the Oxidative Transformation of As(III) by Acid-Birnessite

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Arsenic (As) contamination of groundwater is a serious global problem on account of its toxicity to humans. The release of As from soils is affected by various and complex geochemical processes, of which As(III) oxidation to As(V) with subsequent sorption onto metal oxide surfaces are of the outmost importance. Manganese (Mn) oxide minerals, particularly those with poorly-crystalline layered structures or acid-birnessite, play a vital role in the aforementioned processes. The environmental fate and mobility of As is predominantly driven by interaction with these Mn oxides. Humic Acids (HA) also play a substantial effect; however, no research has been performed on its influence of As removal by acid-birnessite. We investigated the main influencing mechanisms of HA on the surface of acid-birnessite, including competition for sorption sites, formation of aqueous complexes, and changes in redox potential, thus speciation, of chemical components. The formation of As-HA aqueous complexes occurs to an appreciable extent and seems to compete with sorption on acid-birnessite, promoting As mobility. The redox activities of HA and acid-birnessite are also affected in this system. Additionally, we studied the role of the release of Mn(III) followed by the formation of Mn(III)-HA aqueous complexes in limiting As(III) oxidation.