
Effect of Manganese on the Transformation of Ferrihydrite into Goethite and Jacobsite in Alkaline Media

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Abstract: In the presence of Mn(II), ferrihydrite transforms into Mn-goethite and/or jacobsite. Chemical analysis showed that as much as 15 mole % Mn replaced Fe in the goethite structure. If Mn(III) replaced Mn(II), the formation of jacobsite was suppressed; ferrihydrite transformed into Mn-goethite, and, at high Mn(III) concentrations, a 7-Å phyllomanganate. Low levels of Mn(II) retarded the transformation of ferrihydrite only slightly, whereas in an Mn(III) system the nucleation and growth of Mn-goethite were both hindered. Mn-goethite nucleated in solution, whereas jacobsite appeared to form by interaction of dissolved Mn(II) species with ferrihydrite. Mn suppressed the formation of hematite in these systems; however, Mn-hematite containing as much as 5 mole % Mn was induced to form at pH 8 by adding oxalate to the system. Transmission electron micrographs showed that goethite crystals grown in the presence of Mn were long ($\leq 2 \mu\text{m}$) and thin and commonly contained etch pits. The presence of Mn appears to have promoted twinning.

Key Words: Ferrihydrite • Goethite • Jacobsite • Manganese • Phyllomanganate • Synthesis • Transmission electron microscopy

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