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# The Use of Color to Quantify the Effects of pH and Temperature on the Crystallization Kinetics of Goethite Under Highly Alkaline Conditions

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**Abstract:** The crystallization kinetics of goethite were studied colorimetrically under highly alkaline conditions (pH 10.1–12.2) at temperatures from 40° to 85°C. Color changes during crystallization from fresh precipitates, plotted on a\*–b\* colorimetric diagrams, were used to discriminate between pure goethite and mixtures of goethite and hematite. Only the b\* value increased as goethite crystallization proceeded, and even a minor increase in the a\* value revealed the existence of hematite. The rate of goethite crystallization, estimated from the b\* value, could be modeled by a pseudo-first-order rate law. This rate depended both on pH and on temperature. Apparent activation energies for the reactions of 56.1 kJ/mol at pH 11.7 and 48.2 kJ/mol at pH 12.2 were estimated from Arrhenius plots.

**Key Words:** Color • Colorimetry • Crystallization • Goethite • Hematite • Kinetics • L\*a\*b\* color space

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