Coprecipitation of Iron and Aluminum during Titration of Mixed Al^{3+}, Fe^{3+}, and Fe^{2+} Solutions

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Abstract: Potentiometric titration analysis was used to examine the hydrolysis behavior of Fe^{2+} Fe^{3+}, and Al^{3+} in pure solution and in mixture, in order to evaluate the potential for coprecipitation and mixed solid-phase formation. Mixtures of Fe^{3+} and Al^{3+} did not interact during neutralization; base consumed in their respective buffer regions was equivalent to the total metal added. Fe^{2+}-Al^{3+} solutions, however, showed excess base consumption in the Al^{3+} buffer region, indicating hydrolysis of Fe^{2+} at lower than normal pH. Ferric/ferrous iron analyses of systems at the Al endpoint (pH 5.5) showed amounts of oxidized Fe equivalent to the excess base consumption (~10% of total Fe), with substantial amounts of Fe^{2+} sorbed to or occluded within Al polymers present. Increased electrolyte levels or the presence of SO_4^{2-} inhibited oxidation and sorption of Fe^{2+} on Al surfaces, suggesting that Fe hydrolysis and oxidation was catalyzed at the surfaces. Increasing Al^{3+}: Fe^{2+} ratios in the titrated solutions also increased the amount of Fe^{2+} coprecipitation, supporting a surface-mediated reaction mechanism. Ferrous iron oxidation was sensitive to O_2 levels, which also affected the amount of coprecipitation. These findings suggest that surface-facilitated oxidation of Fe^{2+} may be important in the formation of mixed Fe-Al mineral phases in dilute soil solutions.

Key Words: Aluminum • Hydrolysis • Iron • Oxidation • Potentiometric titration

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