Transformation of Akaganéite into Goethite and Hematite in the Presence of Mn

R. M. Cornell[1] and R. Giovanoli[2]

[1] ETH Zentrum Zürich, Laboratory for Inorganic Chemistry CH-8092 Zürich, Switzerland
[2] University of Bern, Laboratory for Electron Microscopy Freiestrasse 3, 3000 Bern 9, Switzerland

Abstract: The interaction of Mn and akaganéite in neutral to alkaline media has been investigated using X-ray powder diffraction and transmission electron microscopy. Akaganéite transformed into goethite and/or hematite, whereas Mn precipitated as hausmannite and birnessite at pH > 12 and as manganite at pH 7.5 – 8.5. Mn influenced the kinetics of the transformation of akaganéite: the rate-determining step, i.e., the dissolution of akaganéite, was retarded by adsorbed Mn species. Hematite formation was not suppressed. By catalyzing the air oxidation of adsorbed Mn(II), akaganéite promoted the formation of birnessite. Akaganéite did not retard recrystallization of the Mn phases. The incorporation of Mn in the structure of goethite formed in this system was negligible, and jacobsite ($MnFe_2O_4$) did not form. The formation of mixed Mn-Fe phases appeared to require a ratio of Mn^{2+}: Fe_{total} > 0.02; this ratio was not achieved due to the oxidation of Mn^{2+} at the akaganéite surface.

Key Words: Akaganéite • Goethite • Hematite • Manganese • Transmission electron microscopy • X-ray powder diffraction

Clays and Clay Minerals; April 1991 v. 39; no. 2; p. 144-150; DOI: 10.1346/CCMN.1991.0390205