
Properties of Hydroxy-Al and -Cr Interlayers in Montmorillonite

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Abstract: In environments contaminated with Cr, the interlayers of expandable layer silicates may serve as sinks for this potentially toxic element. As a means of determining the potential for smectites to serve as sinks for Cr, the precipitation products of Al and Cr in the interlayers of a montmorillonite were examined. Five montmorillonite (SWy-1) day suspensions were treated with preweighed amounts of AlCl₃ and CrCl₃ to give five Al/(Al + Cr) molar ratios (1.0, 0.67, 0.5, 0.33, 0) with a total trivalent cation (M³⁺) concentration of 600 cmol(+)/kg clay. The clay-cation suspensions were titrated with 0.1 N NaOH to give a NaOH/M³⁺ molar ratio of 2.5. Analysis of the solid-phase reaction products showed that the cation exchange capacity and specific surface of all clays were reduced. Chromium reduced the exchange-ability of the interlayers while Al increased the thermal stability. X-ray diffraction analysis revealed that all Al-containing interlayer materials formed similar gibbsite-like polymers. Data from infrared spectroscopy indicated that both Al and Cr were present within the same polymer. Differential thermal analysis and thermogravimetric tracings showed that the rapid collapse of the interlayer in the Cr end-member upon heating was due to a low-temperature loss of hydroxyls. It was not possible to identify all interlayer structures in the Cr end-member. Data from X-ray photoelectron spectroscopy showed all Cr to be Cr(III). Displacement of the interlayer material became more difficult as Cr content increased. The least exchangeable interlayers, therefore, may be found in environments containing the most Cr.

Key Words: Aluminum • Chromium • Interlayering • Montmorillonite • XPS

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