High-Resolution Imaging of Ordered Mixed-Layer Clays

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Abstract: High-resolution transmission electron microscopy (HRTEM) has been used to examine illite/smectite from the Mancos Shale; rectorite from Garland County, Arkansas; illite from Silver Hill, Montana; Na-smectite from Crook County, Wyoming; corrensite from Packwood, Washington; and diagenetic chlorite from the Tuscaloosa Formation. Thin specimens were prepared by ion milling, ultramicrotome sectioning, and/or grain dispersal on a holey carbon substrate. Some smectite-bearing clays were also examined after intercalation with dodecylamine hydrochloride (DH). Intercalation of smectite with DH proved to be a reliable method for HRTEM imaging of expanded smectite (d(001) = 16 Å) which could then be distinguished from unexpanded illite (d(001) = 10 Å). Lattice fringes of basal spacings of DH-intercalated rectorite and illite/smectite showed a 26-Å periodicity. These data support X-ray powder diffraction (XRD) studies which suggest that these samples are ordered, interstratified varieties of illite and smectite. The ion-thinned, unexpanded corrensite sample showed discrete crystallites containing 10-Å and 14-Å basal spacings corresponding to collapsed smectite and chlorite, respectively. Regions containing disordered layers of chlorite and smectite were also noted. Crystallites containing regular alternations of smectite and chlorite layers were not common. These HRTEM observations of corrensite did not corroborate XRD data. Particle sizes parallel to the *c* axis ranged widely for each sample studied, and many particles showed basal dimensions equivalent to more than five layers. For all illite, smectite, and illite/smectite particles examined, crystallite sizes of about 20 Å in the basal dimension were not observed.

Key Words: Chlorite • Corrensite • High-resolution transmission electron microscopy • Illite • Lattice imaging • Mixed layer • Particle size • Rectorite • Smectite

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