Characterization of Soil Clay Minerals: Decomposition of X-ray Diffraction Diagrams and High-Resolution Electron Microscopy

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Abstract: Fine clays (<0.1 μm) extracted from an acid soil developed in a granite saprolite from the Massif Central, France, were characterized by X-ray diffraction (XRD) using a curve decomposition program, and high-resolution transmission electron microscopy (HRTEM) associated with a method of impregnation of moist samples. Direct measurement of *d*-spacings were performed on HRTEM photographs. Decomposition of XRD patterns indicated 5 to 6 different clay phases including chlorite (and/or hydroxy-interlayered vermiculite), vermiculite/smectite, illite/vermiculite and illite/smectite mixed layers. Expandable phases with decreasing layer charge (vermiculite, high- and low-charge smectite) were shown in the clay assemblage. When performed on K-saturated samples subjected to wetting and drying cycles, HRTEM observations were consistent with the XRD results. The major clay mineral phases identified by the decomposition of XRD patterns were also found by direct measurement of *d*-spacings on HRTEM images. Vermiculite and high-charge smectite appeared to be impregnated with preservation of their initial hydration state, whereas low-charge smectite interlayers were penetrated by the resin molecules during the impregnation procedure. It was concluded that the decomposition of XRD patterns gave a realistic analysis of the clay phases present in a complex soil clay sample, as well as the direct measurement of a limited number (50) of clay crystals on HRTEM images.

Key Words: Acid Soil • Decomposition of X-ray Patterns • High-Charge Smectite • High-Resolution Electron Microscopy • Illite/Smectite Mixed Layers • Illite/Vermiculite Mixed Layers • Low-Charge Smectite • Soil Clays • X-ray Diffraction

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