Direct Measurement of the Relation Between Swelling Pressure and Interlayer Distance in Li-Vermiculite[1]

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Abstract: To test the double-layer theory of swelling as applied to layer silicates, the interlayer separation, λ, in a Li-saturated vermiculite from Grouse Creek, Utah, was measured as a function of the swelling pressure, II. An oriented sample of the vermiculite (46 – 105 μm) was placed in an environmental chamber mounted on an X-ray diffractometer and compressed between N_2 gas and a porous membrane in contact with a solution draining to the outside atmosphere. After equilibration at each of several successively higher gas pressures, the c-axis spacing was measured by X-ray diffraction, and the corresponding λ was calculated by subtracting the thickness of an elementary silicate layer. The results of these measurements showed that: (1) the relation between II and λ for vermiculite is the same as that previously observed for Na-montmorillonite, i.e., II is an exponential function of 1/λ; (2) the values of II predicted by double-layer theory are much smaller than those observed if the surface potential is assigned the appropriate value; and (3) the observed relation between II and λ does not have the form predicted by this theory. On the basis of these results, a repulsive force not ascribable to double-layer overlap must be primarily responsible for swelling; this force must result from the in-depth perturbation of the water by the surfaces of the vermiculite layers.

Key Words: Double-layer theory • Interlayer distance • Swelling pressure • Vermiculite • X-ray diffraction

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