

PROPERTIES OF VERMICULITES AND SMECTITES: EXPANSION AND COLLAPSE

by

M. E. HARWARD and D. D. CARSTEA

Soils Department, Oregon State University, Corvallis, Oregon

ABSTRACT

RECENT reports have suggested that the smectites and vermiculites exhibit a continuum in properties. This, in association with differences in methods and criteria between investigators, suggests the need for detailed comparisons of these groups of minerals. A study was conducted on a range of samples believed to represent members of the two groups. Precautions were taken to obtain "mono-mineralic" specimens. Comparisons involved variation in 00 l lines in response to solvation, cation saturation, and hydration.

All of the smectite samples expanded to the duo-interlayer thickness upon solvation by condensation of ethylene glycol from the vapor phase or by application of glycerol liquid. Similar results were obtained with Ca- and Mg-saturated samples and regardless of moisture status prior to solvation. The vermiculite samples did not expand past the mono-interlayer spacing regardless of saturating cation, prior moisture, or solvating agent. Extra steps were taken to induce the expansion of vermiculites to the two-layer complex, but the efforts were largely unsuccessful.

Upon K-saturation, both vermiculites and smectites exhibited collapsed lattice in a dry atmosphere. Hydration of smectites occurred in the range of 20–35% R.H. with resulting diffraction maxima of 11–12 Å. The higher orders of 00 l were absent or non-integral indicating mixed layer systems. The K-saturated vermiculites tended to retain the collapsed lattice and exhibited diffraction maxima of 10–10.4 Å with integral higher orders. Some hydration occurred as evidenced by peak asymmetry or the appearance of a small 14.2 Å line at higher humidities, although the collapsed spacing predominated. For both vermiculite and smectite systems, the tendency to hydrate decreased as the exchange capacity increased.

A continuum in the properties of expansion and collapse between the smectites and vermiculites was not observed. The data indicate two discrete populations. These properties may be used as differentiating criteria for identification.