
Effect of Hydrostatic Pressure on the Swelling of n-Butylammonium Vermiculite

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Abstract: The osmotic swelling of an n-butylammonium vermiculite in a 0.1 M solution of n-butylammonium chloride has been studied as a function of temperature and hydrostatic pressure by neutron diffraction. On application of a pressure of 1050 bar the vermiculite swelled macroscopically at 20° C, the *c*-axis spacing changing from 19.4 to 126 Å. The phase transition was completely reversible with respect to both pressure and temperature, and a complete study of the temperature-pressure phase diagram was made at pressures as high as 2000 bar. The heat capacity change with temperature across the swelling transition was measured at atmospheric pressure, and the enthalpy and entropy of the change from crystalline to osmotic phases were found to be, respectively, 5.2 J/g and 0.0183 J/K·g of dry clay. The combination of the entropy change with the gradient of the pressure-temperature phase boundary gave the volume change accompanying the transition. The total volume of the swollen phase was less than that of the crystalline phase plus the appropriate amount of solution, corresponding to a fractional decrease of about 0.1% in the water volume from bulk solution to between the plates.

Key Words: DLVO theory • Gel • n-Butylammonium • Neutron diffraction • Pressure • Swelling • Vermiculite

Clays and Clay Minerals; October 1989 v. 37; no. 5; p. 474-478; DOI: [10.1346/CCMN.1989.0370513](https://doi.org/10.1346/CCMN.1989.0370513)

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