
Charge Heterogeneity in Smectites

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Abstract: The heterogeneity of sites for Ca→K exchange was examined by microcalorimetry in the <0.2- μm fractions of some selected smectites. Six groups of sites, ranging in exothermic exchange enthalpy ($-\text{d}(\Delta H_x)/\text{dx}$) from 5.7 to 10.9 kJ/eq were identified. In Wyoming bentonites, only three groups with enthalpies of 5.7 to 7.5 kJ/eq were distinguished, although in the 0.2 - 1.0- μm fraction, a 10.7-kJ/eq group was also observed. Redhill and Camp Berteau smectites contained, in addition, groups with enthalpies of 8.7 - 10.9 kJ/eq, but a New Mexico sample only had groups with the higher values. Thus, the exchange enthalpies of four main groups of sites (reclassified from those observed) appear to be inversely related to the extents of interlayer expansion in the samples by the adsorption of polar molecules. Consequently, a 'true montmorillonite,' such as a <0.2- μm Wyoming bentonite, contains only fully expanding layers with $-\text{d}(\Delta H_x)/\text{dx}$ values between 5.7 and 7.5 kJ/eq. As such, it is less heterogeneous and should have a much greater swelling capability than Camp Berteau montmorillonite which has, in addition, groups with exchange enthalpies of 8.7 and 10.3 kJ/eq.

Key Words: Cation exchange • Enthalpy • Smectite • Surface charge • Swelling

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