KINETICS AND THERMODYNAMICS OF POTASSIUM-CALCIUM EXCHANGE IN A MULTIREACTIVE SOIL SYSTEM

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Abstract

The kinetics and thermodynamics of K exchange were investigated in Ca- saturated samples from the Ap horizon of an Evesboro soil from Delaware. Biphasic kinetics characterized the first-order plots for K adsorption and desorption at 283 and 298 K with the two simultaneous reactions being attributed to exchange sites with varying reactivity for K^+ ions. The thermodynamic selectivity curves at 283 and 298 K showed preference for K at low values and for Ca at higher values. This selectivity reversal may also be attributed to exchange sites of varying reactivity for K+ ions. The rapid reacting sites were found to be ascribed to external surface sites which preferred Ca^{++} ions, while slower reacting sites were attributed to interlayer sites of 2:1 clay minerals which preferred K^+ ions. The characterization of sites was achieved through a thermodynamic and kinetic analysis of the various size fractions of the soil and soil treated with different organic compounds. At 313 K the initial rapid kinetics of exchange and the selectivity reversal were no longer present. Application of the parabolic diffusion law suggested that this phenomenon could possibly be attributed to the finite rate at which the polymer structure of soil organic matter changes in response to the adsorption and desorption of the two reacting cations.