
Quantitative Determination of Clinoptilolite in Soils by a Cation-Exchange Capacity Method

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Abstract: A cation-exchange capacity (CEC) method based on ion-sieving properties was developed for the quantitative determination of clinoptilolite in soils. In this method, both zeolitic and non-zeolitic exchange sites in the soil sample are saturated with Na⁺. The CEC of the non-zeolitic exchange sites is determined by replacing the Na⁺ in these sites with tert-butylammonium ions. The tert-butylammonium ion cannot be exchanged into the zeolitic exchange sites because it is too large to pass through the channels in the clinoptilolite structure. The sample is next washed with NH₄OAc to replace the Na⁺ in the zeolitic exchange sites. The amount of soil zeolite is then estimated by comparing the CEC of zeolitic exchange sites to the total zeolite CEC (175 meq/100 g for pure clinoptilolite). Prior to the CEC analyses, carbonates and organic matter must be removed to minimize interference with the exchange process. A high correlation ($r^2 = .96$) was observed between the abundance of clinoptilolite estimated using the CEC method and the abundance estimated by semiquantitative X-ray powder diffraction analysis.

The CEC procedure was used to quantify clinoptilolite in an Aridic Calciustoll soil from south Texas. About 2– 5% clinoptilolite occurs in the A and B horizons, and concentrations progressively increase with soil depth to as much as 20% in the CBk2 horizon.

Key Words: Cation-exchange capacity • Clinoptilolite • Quantitative mineralogy • Smectite • Soil • Tertbutylammonium • Zeolite

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