The Effect of Weathering on the Clay Mineral Composition of Soils in the Miami Catena

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The dominant soil catena of the west central Ohio Late Wisconsin (Carey) glacial till plains is the Miami catena. Members of this catena include the Hennepin, Miami, Celina, Crosby, Bethel, Brookston, and Clyde soils. These soils are derived from the same or similar parent material, high lime glacial till, and differ largely because of differences in drainage as influenced by the topography. All of these soils were formed under forest vegetation with the possible exception of the Clyde soil, which, in the lowest depressions, may have been formed under sedges, rushes, and grasses.

This particular work was undertaken in order to determine: (1) the effect of soil formation processes, as influenced by differences in drainage, on the clay mineral composition of soils derived from the same, or very similar parent material, and, (2) to ascertain whether these differences in clay mineral composition might be partly responsible for the wide differences in the morphology of these soils of the Miami catena.

DESCRIPTION OF SOILS

Soil samples were obtained for the Miami, Celina, Crosby, Bethel, Brookston, and Clyde soils in Clark County, Ohio, where these soils appeared to be the most representative of the catena. The Miami soil is the zonal soil of the catena and is a member of the Gray-Brown Podzolic Great Soil Group. It is well drained internally and externally, and occurs neither on very steep slopes nor on level land. Of the six soils, this is the best drained member of the catena. The second best drained member, the Celina soil, is generally found on less steep slopes than the Miami soil, and with the exception of its slightly poorer drained condition, is quite similar to the Miami soil. It, too, is considered to be a member of the Gray-Brown Podzolic Great Soil Group.

The Crosby and Bethel soils, Gray-Brown Podzolic and Planosol soils, respectively, are most frequently found on nearly level or gently undulating topography. Surface runoff is slow and infiltration is slow because of the rather impermeable B horizons. The latter soil is usually found on the more level areas and is the more poorly drained of the two.

The Brookston and the Clyde, humic glei soils, occur in depressional areas where the accumulation of water is responsible for a high water table. The soils formed here contain considerable organic matter, and this condition, plus the fact that reduced conditions prevail in these soils, is responsible for a very dark gray or black appearance which occurs in the upper 2 feet of the profile. Five of these soils, the Miami, the Bethel, the Crosby, the Brookston, and the Clyde, are well described by Brown and Thorp (2).

EXPERIMENTAL PROCEDURES AND RESULTS

Differential thermal analyses, X-ray diffraction analyses, and cation exchange determinations were made on the 0.5-micron fraction of each horizon of the Miami, Crosby, Bethel, Brookston, and Clyde soils.

The soil samples had previously been treated with HCl to remove the free carbonates, treated with 10% H2O2 to remove most of the organic matter and subjected to hydrogen treatment as described by Jeffries (4) in order to remove much of the free iron oxide coatings in order to obtain a better dispersion of the clay. The clay fraction was washed by suspending in a sodium oxalate solution and with 0.1 N CaCl2 to remove the free carbonates, treated with 10% HCl, and then washed three times with 80% ethanol in order to remove the occluded chlorides. Washing a third time with acetone served to improve the physical condition of the clay fraction. Each fraction was then dried at 105°C on which it was ground in a mullite mortar just sufficiently to pass a 100-mesh sieve. The samples were then stored in glass vials for storage until they were needed. The distribution of the mechanical separates is shown in Table 1.

DIFFERENTIAL THERMAL ANALYSIS

This particular method of analysis is based upon the fact that upon heating, many minerals undergo characteristic physical and chemical changes that are...