THE IDENTIFICATION OF THE CLAY MINERALS IN FIVE IOWA SOILS BY THE
THERMAL METHOD

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THE establishment of the fact that the clay fraction of soils is composed of crystalline minerals has provided the geologist, the ceramist, and the soil scientist with a new and useful criterion for the characterization of clays. Recent work by Hendricks and Alexander (6) and by Edelman (3), Marshall (9), and others indicates that the mineralogical composition of clays is of considerable value in interpreting the nature and occurrence of the base-exchange phenomena in soils. Ewell and Insley (4), Noll (11), and Gruner (5), by synthesizing several of the clay minerals, have made substantial contributions to our knowledge of the factors governing the formation of these minerals and have thereby increased the value of mineralogical studies of soils particularly in connection with soil genesis investigations.

Since the mineralogical nature of the clay fraction of soils has been shown to be of considerable value in interpreting the physical and chemical reactions of soils, as well as providing a useful criterion for indicating the present position of the weathering process, a study of the distribution of the several clay minerals among Iowa soils has been initiated. It is hoped that data from these studies will be useful in characterizing these soils and will aid in the interpretation of their properties.

The methods used in identifying the minerals in clays may be divided into four groups as follows: (A) Petrographic methods in which some method of orienting the small crystals must be employed; (B) chemical methods which are of considerable value when used in conjunction with other methods of identification, the interpretation of chemical data being complicated by the many isomorphous substitutions that occur in the clay minerals; (C) X-ray methods in which the powder diffraction method is most frequently used; and (D) thermal methods which may be divided into dehydration and differential temperature methods. Since a review and evaluation of the several methods listed above have been made recently by Nagelschmidt (10), it is unnecessary in this article to consider any of the methods other than the one used in this investigation.

The differential temperature method, as opposed by LeChatelier (8), consists of measuring the difference in temperature between a sample and an inert material as they are heated simultaneously. Endothermic reactions, as the evaporation of water from the sample, cause the temperature of the sample to rise above that of the inert material. Exothermic reactions cause the temperature of the sample to fall below that of the inert material. The differential temperature method has been used by Hendricks and Alexander (6), Agatonoff (1), Insley (4), and others as a method for identifying the clays in soils and soil colloids by comparing the characteristic curves of the samples with similar curves of the clay minerals.

MATERIALS AND METHODS

The investigations were conducted on colloids extracted from samples taken from five Iowa soils. Three soils were obtained at depths of 0-6 inches, 13-18 inches, and 36-42 inches from a profile of Clarion loam, a Prairie soil developed on uplands from unleached glacial till. Grundy silt loam, a Planosol developed under grass vegetation on topography from acid loess, was sampled at the 0-6 inch, 26-30 inch, and 48-56 inch depths. A sample was also obtained from the 0-6 inch depth of Tama silt loam, a Prairie soil developed on gently rolling topography from acid loess. A Webster silt loam was sampled at the 0-6 inch depth. The Webster soil is a Wiesenboden occurring in depressions in the landscape. The material was obtained from a profile of a Webster silt loam, a Wollenwiesenfield occurring between the normal Gray-Brown Podzolic Group and the fully developed Planosols. The Wollenwiesenfield was sampled at the 0-6 inch depth. Organic matter was removed from the soil by repeated treatments with 15% hydrogen peroxide, when necessary, by one or two treatments with 30% hydrogen peroxide. After the removal of the organic matter, four samples were treated six times with 2N CaCl₂ and eight washings with distilled water. Subsequently, eight washings with distilled water. Subsequently, the CaCl₂ treatment was ineffective in completely removing the organic matter from the soil colloids. The removal of organic matter from the soil colloids was confirmed by the absence of a peak at 0.0° C in the thermal analysis of the soil colloids.