CLAY ORIENTATION IN SOILS

by

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The lower limit for the study of the shape and optical properties of mineral particles with the petrological microscope is of the order of 5\(\mu\), but the clay material of soils and other sediments may show optical properties such as birefringence and extinction phenomena similar to those of larger crystalline individuals. This was recognised by the early workers in soil microscopy, and Fry (11) stated that "between crossed nicols, the aggregates of soil colloids may or may not be doubly refracting. Those showing some degree of double refraction are perhaps more common than those showing none. Absence of double refraction, isotropy, seems usually associated with high iron content." Attention was drawn to differences in the optical properties of the aggregates: degree of completeness of the extinction directions, character of the interference figure and refractive indices.

The clay fraction of the majority of soils consists mainly of the so-called clay minerals (hydrous alumino-silicates) with subsidiary amounts of finely divided oxides and organic matter. Clay particles differ in shape, but many of the common clay minerals are micaceous in habit and form thin hexagonal flakes or shreds with well defined basal cleavage. Advantage has been taken of their anisodimensional shape to prepare aggregates for X-ray analyses by allowing clay suspensions to sediment with the consequent orientation of the (001) planes parallel to the surface of deposition. The optics of such aggregates have been studied by Williamson (34) using a clay consisting of 60 percent kaolinite, 30 percent illite and 10 percent quartz. Sections normal to the (001) planes showed a high degree of extinction parallel to these faces, the extinction direction being one of positive elongation. The same orientational relationships would hold for most clays, as the majority of the clay minerals such as micas (illites), kaolinite, vermiculites and montmorillonites have similar properties to muscovite in that they are optically negative with X about normal to (001); their extinction is essentially parallel to the cleavage traces and sections normal to the cleavage will therefore show sensibly straight extinction and positive elongation (Fig. 1). It can therefore be assumed that the optical anisotropy of clay aggregates in sediments results from the orientation of the individual platelets and, further, that the degree of extinction gives information about the perfection of the orientation, while the character of the elongation reveals the spatial relationships of the aggregates.

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