Weathering of Micaceous Minerals

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X-ray diffraction studies indicate that weathering of podsols containing major amounts of both di- and trioctahedral micas results in a progressive breakdown of the latter, while dioctahedral structures remain unaffected. It is suggested that the one disintegrating releases potassium into solution inhibiting the other.

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Numerous studies on the weathering of di- and trioctahedral micas and illites to produce different end-products under different weathering environments have been reported (Stephen 1952, Jackson et al. 1952, Wilson 1970, Kapoor 1972), but the weathering processes involved in their alteration when both di- and trioctahedral micaceous minerals coexist in soil are not known. A study of some podsolic profiles containing both white mica (muscovite) and biotite, identified by optical analyses of coarse sand fraction as well as of unweathered rock (sandstones), has been approached through measurements of the diffraction intensities of 001 reflections of the weathered micaceous minerals present at different profile depths, in the hope that some information concerning the influence of one type of mica on the weathering of another, if any, might be obtained.

Results of mineralogical analysis and semiquantitative estimates of the clay minerals of a representative profile (Table 1) indicate a decrease in the amount of illite, and an increase of expansible minerals upwards in the profile. The relative magnitude of intensities of the 10 and 5Å reflections in the various horizons of the profile (not shown) apparently suggests the presence of dioctahedral illite. Their intensity ratio 001/002 (peak height), showing a decrease upward in the profile (Table 1), however, does not correspond to the trend reported for dioctahedral micas (White 1962), namely, that the intensity of 001 reflection increases more rapidly than 002 as the micas are depleted of their potassium during weathering. Brown

Table 1. Semiquantitative estimate (parts per 100) of the clay mineral assemblage.

Horizon	Chlorite	Mixed-layer	14 Å clay	Illite	001/002
A_2	–	55	17	27	1.1
B_2	13	25	5	57	1.5
C_1	11	11	4	74	1.6
C_2	12	9	3	76	2.4

(1955) has also pointed out that the theoretical effect of replacing interlayer potassium by hydronium ions in micas is to increase the absolute intensity of 001 reflection to a greater extent than 002.

A plausible explanation to account for the observed decrease in intensity ratio 001/002 of the 10Å mineral on going from the C to the A_2 horizon is the following: Both muscovite and biotite, showing strong first and third order reflections at 10 and 3.3Å respectively, are characterized by their second order 5Å reflection, which is almost absent in the latter compared with the former. When both muscovite and biotite coexist in soil, the contribution of the latter to the second order mica reflection is thus almost negligible. During weathering, as the concentration of biotite, which is unstable under natural weathering conditions, diminishes, it would result in a greater decrease in the intensity of 001 reflection than 002, and hence, a decrease in the intensity ratio upward in the profile. The fact that the greatest decrease in the intensity ratio is recorded at the top of the profile, where the degree of weathering is maximum, lends support to this belief. Furthermore, the absence of any observable replacement in muscovite as indicated by the trioctahedral nature of the interstratified as well as of the 14Å minerals (Kapoor 1972) suggests that the weathering of muscovite, which is present along with biotite in the soil studied, is inhibited. Possibly, the presence of potassium ions released from the weathered biotite into the surrounding solution prevents the potassium-depletion process in muscovite which is extremely sensitive to potassium in solution (Rausell-Colom et al. 1965).

It is therefore believed that when di- and trioctahedral micas are the principal minerals in the C horizon of podsols, the latter is degraded to various types of clays depending upon the degree of weathering, while muscovite remains practically unaffected.

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