Formation of Trioctahedral Illite from Biotite in a Soil Profile Over Granite Gneiss

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Abstract: Clay fractions separated from the A2, B, and C horizons of a soil formed on granite gneiss showed X-ray powder diffraction (XRD) spacings characteristic of trioctahedral illite. The trioctahedral illite was derived from biotite, and its development through various stages of weathering was followed by optical and electron microscopy combined with electron microanalysis. In the initial stages of weathering, Fe^{2+} within biotite was oxidized, without the loss of much K. During this process, biotite flakes became slightly buckled and fractured. Solutions moved into the damaged flakes leading to chemical weathering and exfoliation along cleavages and angular fractures. Major exfoliation broke up the flakes into segments, which themselves contained minor exfoliations and alterations along cleavage planes. The extent of exfoliation and alteration continued until thinner and shorter segments consisted almost wholly of thin (<0.25 μm), parallel wafers separated by less compact layers of particles and microaggregates. The segments finally lost their shape and divided into clay-size particles. Parts of the thin wafers had the same chemical composition (and structure) as the original, intact flakes of oxidized biotite. The same parts of wafers retained some of the optical properties of the original biotite, and, when broken down to clay, they produced the XRD spacings of 10 and 1.54 Å, typical of fine-grained, trioctahedral mica (illite).

Key Words: Biotite • Electron microprobe • Illite • Mica • Scanning electron microscopy • Trioctahedral • Weathering • X-ray powder diffraction

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