Occluded Mica in Hydroxy-Interlayered Vermiculite Grains from a Highly-Weathered Soil

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Abstract: Hydroxy-interlayered vermiculite (HIV) is a ubiquitous phyllosilicate in the <0.05-mm fraction of sandy soils on the U.S. southeastern coastal plain. Extensive areas of soils with abundant HIV (i.e., peninsular Florida) have no detectable mica; yet the coarseness, platy habit, and nonexchangeable K associated with HIV grains suggest a mica precursor. The objectives of this study were: (1) to probe for mica zones (1.0-nm) within HIV grains, using high-resolution transmission electron microscopy (HRTEM), and (2) to determine intragrain elemental distributions via electron microprobe analysis (EMA). HIV grains from a Quartzipsamment medium-silt fraction, which contained no detectable mica by X-ray diffraction (XRD), were concentrated via high-density liquid separation. EMA transects and X-ray dot maps showed zonation or trends of K depletion near edges of some grains, with K_2O contents ranging from trace levels to >40 g kg^{-1}. Elemental oxide data indicated a dioctahedral phyllosilicate structure, with some octahedral substitution of Fe and Mg for Al. Intermittent 1.0-nm lattice-fringe images obtained by HRTEM supported the presence of mica zones within grains. There were no detectable 1.4-nm fringes, despite the dominance of a 1.4-nm XRD peak, indicating the instability of the HIV specimen under the electron beam. Results support a transformational link between mica and HIV in these soils. Rapid incursion and polymerization of Al following loss of K from mica may limit the extent of the vermiculite intermediate. The latter idea is consistent with the paucity of vermiculite in Florida soils. Traces of occluded mica may be the last remnants of the precursor grain. A sand-sized mica precursor would likely have weathered in place during the period when colloidal components such as kaolinite illuviated to deeper zones. Thus, the transformation product (HIV) would comprise a significant proportion of the <0.05-mm fraction persisting in sandy eluvial horizons.

Key Words: Electron microprobe • High-resolution transmission electron microscopy • Mica transformation • Vermiculite

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