Pedogenic Formation of Montmorillonite from A 2:1 – 2:2 Intergrade Clay Mineral*

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Abstract: Montmorillonite was found to be the dominant clay mineral in surface horizons of certain soils of the North Carolina Coastal Plain whereas a 2:1 – 2:2 intergrade clay mineral was dominant in subjacent horizons. In all soils where this clay mineral sequence was found, the surface horizon was low in pH (below 4 · 5) and high in organic matter content. In contrast, data from studies of other soils of this region (Weed and Nelson, 1962) show that: (1) montmorillonite occurs infrequently; (2) maximum accumulation of the 2:1 – 2:2 intergrade normally occurs in the surface horizon and decreases with depth in the profile; (3) organic matter contents are low; and (4) pH values are only moderately acid (pH 5 – 6).

It is theorized that the montmorillonite in the surface horizon of the soils studied originated by pedogenic weathering of the 2:1 – 2:2 intergrade clay mineral. The combined effects of low pH (below 4 · 5) and high organic matter content in surface horizons are believed to be the agents responsible for this mineral transformation. The protonation and solubilization (reverse of hydrolysis) of Al-polymers in the interlayer of expansible clay minerals will occur at or below pH 4 · 5 depending on the charge and steric effects of the interlayer. A low pH alone may cause this solubilization and thus mineral transformation, but in the soils studied the organic matter is believed to facilitate and accelerate the transformation. The intermediates of organic matter decomposition provide an acid environment, a source of protons, and a source of watersoluble mobile organic substances (principally fulvic acids) which have the ability to complex the solubilized aluminum and move it down the profile. This continuous removal of solubilized aluminum would provide for a favorable gradient for aluminum solubilization.

The drainage class or position in a catena is believed to be less important than the chemical factors in formation of montmorillonite from 2:1 – 2:2 intergrade, because montmorillonite is present in all drainage classes if the surface horizon is low in pH and high in organic matter.

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