
Beidellite in E Horizons of Northern Idaho Spodosols Formed in Volcanic Ash

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Abstract: While soils formed in tephra are typically dominated by poorly crystalline clay minerals, the occurrence of smectite in E horizons of podzolized soils (Spodosols) has been well-documented. We have observed a well-crystallized smectite mineral dominating the clay fraction of E horizons in tephra-derived soils of northern Idaho. This study was initiated to examine properties and distribution of this mineral along a developmental sequence of high-elevation, forested Spodosols formed in 6800-yr-old Mazama tephra. Three soils exhibiting strong, moderate, and weak E horizon development were sampled along an elevational and climatic gradient. The smectite mineral was identified as beidellite based on expansion and layer charge characteristics. Heated, Li-saturated samples from the most strongly developed E horizon exhibited relatively complete expansion to 1.8 nm with glycerol solvation and mean layer charge was calculated to be 0.44 mol_c/formula unit using sorption characteristics of alkylammonium ions. Apparent crystallinity and relative abundance of the beidellite in clay fractions decrease with decreasing E horizon development. The more poorly crystalline beidellite is associated with a non-expansive 1.4-nm mineral with considerable Al-hydroxy interlayering. Beidellite was not detected in underlying glacial drift or in a thin layer of 200-yr-old ash that mantles these soils, suggesting it is not inherited from these materials. Rather, our results indicate that beidellite forms in these soils in an environment characterized by low pH and a large flux of organic metal-complexing agents.

Key Words: Northern Idaho • Podzolization • Smectite • Soil genesis • Tephra

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