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Soil mineral transformations in estuarine wetlands: Field-based observations

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Estuaries are dynamic transition zones between marine and terrestrial ecosystems which continuously receive fresh deposits of terrestrial sediments with high loads of weathered soil minerals such as gibbsite and phyllosilicates. These soil minerals are thermodynamically unstable in the reducing brackish porewaters of estuarine wetlands, rendering them susceptible to transformation into secondary mineral phases. Here we present results from field studies examining the fate of Al-oxide and phyllosilicate substrates incubated in low- and high-marsh locations in the New Jersey Meadowlands, a brackish tidal wetland area in the Lower Hackensack Estuary in northern New Jersey. We observe the neoformation of various aluminosilicate phases within weeks, mediated by chemical interaction of the soil minerals with the slightly alkaline and Si-rich marsh porewaters. These new aluminosilicate minerals not only incorporate major elements (Al, Si, and Fe), but likely also interact extensively with nutrients, trace metals, and organic carbon. Their formation therefore has considerable implications for the elemental budgets and geochemical behavior of estuarine wetlands if it occurs at the rate suggested by the initial data. This talk will present the results of the field studies, and discuss the geochemical controls and pathways of soil mineral transformation as inferred from the experimental observations and thermodynamic considerations.