Soil phosphorus speciation on the Pygmy Forest Ecological Staircase

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Phosphorus speciation is an important factor in nutrient availability, but changes during soil development. The purpose of this research was to investigate the evolution of five marine terraces known as the "Pygmy Forest Ecological Staircase" in Mendocino County, California. There is less phosphorus uptake in plants on the older terraces as opposed to the youngest terraces, potentially due to changes in soil P speciation. Phosphorus speciation was investigated in soil samples using P *K*-edge X-ray absorption near edge structure (XANES) spectroscopy. Phosphorus species included Al oxide-associated P, Fe oxide-associated P, P adsorbed to calcite, apatite P, and potentially, organic matter P. Since the terraces are composed of acidic soils, trends in phosphorus speciation are likely due to weathering and leaching. Apatite is the primary species of P in the youngest terrace (Terrace 1). Terrace 2 is dominated by inorganic P, such as Fe-associated P. Terrace 3 is largely composed of organics and inorganic P, such as Al- and Fe-associated P (including P adsorbed to minerals). The pH of the soil decreases in Terrace 1 and Terrace 2 while the Al, Fe, and P contents also decrease. The Fe and Al contents increase in Terrace 3 due to leaching from the surface horizon, which directly correlates with the pH increasing with depth. However, P remains relatively uniform at depth. Due to a hardpan underlying the terrace associated with the pygmy forest (Terrace 3), plant roots are unable to penetrate deeper into the soil to obtain the nutrients necessary for growth. Plants exhibiting dwarfism may also have a surrounding environment that lacks phosphorus due to increased erosion of the topsoil layer. Since the vegetation canopy is smaller and less dense, the rate of erosion may be increased in the pygmy forest, which decreases the amount of available phosphorus. Decreased amounts of phosphorus may work in concert with changes in phosphorus speciation to decrease the availability of phosphorus to plants in the pygmy forest.