Distribution of soil molybdenum across a soil nitrogen gradient

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The supply of nitrogen (N) exerts a strong control on the function of terrestrial ecosystems, but controls on biological N fixation are not well understood. Availability of molybdenum (Mo), which forms a cofactor in the nitrogenase enzyme, is one factor that can limit N-fixation in asymbiotic and symbiotic soil bacteria.(3) Yet, the degree of Mo limitation may also depend on soil N availability, which influences soil chemical properties and microbial communities. Overall, the relationships between N, Mo, and P (which may also limit N-fixation) are poorly characterized.(2) To determine how N, Mo and P interact, we examined the distribution of Mo and P in multiple soil phases across a natural soil N gradient (0.16 – 0.88% N, 0-10 cm) in conifer forests of the Oregon Coast Range. We used selective chemical extractions to estimate soil Mo and P fractions that are exchangeable, oxidizable (OM-associated), and reducible (Fe-Mn-oxide bound), and compared these to foliar and soil chemistry and selected soil forming factors.(1)

Our preliminary results show that oxidizable Mo accounts for 3-9% of bulk soil Mo; increasing with soil N and OM content, and decreasing with soil pH. Oxidizable soil Mo did not correlate with foliar Mo. We also found that the oxidizable Mo pool is 30x larger than the reducible and exchangable Mo pools. This relatively large oxidizable Mo pool is thought to be bioavailable to free-living soil bacteria, which access Mo complexed with catechol and polyphenolic functional groups in soil OM using molybdophores.(4) The correlations between oxidizable Mo, total soil N, and soil pH are stronger in soils derived from sedimentary rock than basalt-derived soils. This suggests that parent material and associated pedogenic processes and secondary minerals are acting to control Mo behavior. Ongoing research will focus on characterizing Mo and P limitation of N-fixation across this N gradient to help elucidate the complex interactions between potentially growth-limiting macro and micronutrients in terrestrial ecosystems.

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