Plant-Driven Mineral Weathering: Role of Rhizospheric Biofilms

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Plants are documented drivers of weathering processes in soils. Their rhizospheric microbial associations affect mass transfers, facilitate plant nutrient acquisition, and greatly influence soil formation. However, the role of rhizospheric biofilms in these processes is still poorly understood. The goals of our study are to determine how biofilms affect mineral weathering, plant nutrient uptake, soil water chemistry, and cation mass fluxes.

This study summarizes three laboratory and meso-scale field experiments that investigated plant-microbe-mineral interactions, biofilm formation, water chemistry, and cation-mass transfer in soil and mineral systems [1, 2, 3]. Two laboratory column experiments studied the effect of red pine seedling growth on mineral weathering in sand and mineral mixtures under the impact of varying degrees of cation-nutrient stress and varying microbial community development. A field "sandbox" experiment examined mineral weathering by adult mature red pine trees under controlled conditions. Microscopy revealed biofilm formation on mineral surfaces in all three studies but the percent of biofilm coverage on mineral surfaces was higher for the field experiment and one laboratory study in both of which fungi formed mycorrhizal association with plant roots. Soil water pH, plant biomass development, and cation mass fluxes were correlated with the biofilm coverage on mineral surfaces. Our results suggest that biofilms may mediate mineral-microbe-root chemical exchanges, isolating these exchanges from denudation by water transport and creating resilient microenvironments, and holding keys to regulation of microbial and plant responses that directly impact ecosystem element cycling.

[1] Keller *et al* (2006) *Ecosystems* **9**: 634–646; [2] Balogh-Brunstad *et al* (2008) *Biogeochem*. **88** (2):153-167; [3] Shi Z *et al* (2014) *Plant Soil* in press; DOI: 10.1007/s11104-013-2016-2.