Mineral Weathering by Red Pine Seedlings under Cation-Nutrient Stress in a Column Growth Experiment

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It is generally accepted that vascular plants drive mineral weathering to obtain nutrients. These processes are believed to have affected global climate and the chemistry of the oceans and atmosphere on geologic timescales, and to confer plants' ability to grow under stresses such as cation-nutrient limitation. However, it is still poorly understood how plant-driven mineral weathering is affected by varying degrees of cation stress.

We investigated the impact of cation-nutrient stress on plant uptake of K and Ca in a controlled experimental plant-mineral system [1]. Red pine (*Pinus resinosa* Ait.) seedlings were grown in columns containing sand medium amended with biotite and anorthite and supplied with varying concentrations of Ca and K in irrigation water. A subset of the columns were destructively sampled at 3, 6 and 9 months and mineral surfaces were analyzed using election microscopy and spectroscopy techniques. Based on cation concentrations in drainage water, nutrient solutions, and plant biomass, cation mass-fluxes were computed in the columns.

Microscopy revealed patchy biofilm formation, alteration of the crystal structure at the biofilm-mineral interface on biotite, lack of mycorrhizal associates and indicated that as Ca and K concentrations increased in solution, biofilm cover decreased and bacteria colonies became less diverse. Drainage pH decreased to about 4 after 6 weeks and remained low for rest of the experiment. The release of cations was strongly correlated to the water pH, and cation mass fluxes were correlated with cation nutrient supply from irrigation water. Our results highlight the complexity of plant response to cation-nutrient stress and consequent effects on nutrient cycling in ecosystems.

[1] Shi Z. *et al* (2014) *Plant and Soil* in press.