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Plant-mediated weathering of granular basalt

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The goal of this study was to characterize weathering of granular basalt as influenced by grasses. The basalt was obtained from Flagstaff, AZ and contained 35.87% labradorite (feldspar), 6.53% diopside (pyroxene), 11.94% forsterite (olivine), and 45.67% basaltic glass by volume. Two grass species were used: Tanglehead, Heteropogan contortus, a species native to Arizona, and Buffelgrass, Pennisetum ciliare, an invasive species. A mixed treatment with both species present was also studied. This was a part of a larger study that looked at competitiveness of native and exotic grass species at different temperature regimes and during drought. Understanding differences in how native and invasive grasses weather soil and take up nutrients may explain the mechanism behind current invasion of Sonoran desert by exotic species and help predict response of native and invasive vegetation to expected increase in temperatures. The grasses were grown in containers placed in the Desert and the Savannah biomes in the Biosphere 2 to take advantage of a 4° C temperature difference between the biomes. Each biome also contained triplicate "control" pots without vegetation. Leachates from the pots were collected and analyzed for pH; electrical conductivity; total organic carbon, total nitrogen, and inorganic carbon by high temperature combustion coupled with infrared gas analysis; inorganic anions by ion chromatography; and cations and metals by ICP-MS. Chemistry of leachates from planted treatments was compared to controls without plants to evaluate influence of grasses on basalt weathering. Nutrient uptake, and carbon release by exotic and native grass species was also estimated. The data indicate that plants enhanced basalt weathering. All leachates exhibited higher pH than water used for irrigation indicating weathering in both control and planted treatments. pH of the leachate in grass treatments was also greater compared to control indicating greater proton consumption in the presence of vegetation. Concentrations of both organic and inorganic carbon were also higher in the grass treatments compared to controls. Since both dissolved CO2 and soluble organic exudates promote mineral dissolution, this effect could be contributing the weathering enhancements observed. This study demonstrated differences in denudation of nutrient elements between the treatments that can be related to plant uptake and possibly to secondary mineral formation. There were also differences in denudation as a function of plant species and temperature. This study gives unique insight into plant-mineral interactions as a function of plant species and temperature that is essential for understanding Earth systems under changing climate.