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Does Plant Growth accelerate Rock Weathering?

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A common paradigm holds that, to satisfy mineral nutrient demand, plants and associated soil microbiota accelerate rock weathering which in turn aids to regulate the silicate weathering – CO₂ cycle. However, from investigating the dependence of ecosystem nutrition on 1) erosion rate; 2) biomass growth a more complex picture emerges. To derive this picture, novel metrics for budgeting element fluxes were employed in a global gradient of field sites (refs 1,2,3) that differ in erosion rate and precipitation (and thus plant growth). The metrics are based on weathering zone geochemical composition, soil production rates from cosmogenic nuclides, biomass growth, and plant stoichiometry.

1) Dependence on erosion rate: From sites that differ in erosion rate it is found that in slowly eroding mountain landscapes mineral grains that contain nutrients in the regolith are depleted. As a consequence, plants are nourished by recycling, and losses are replaced by atmospheric inputs. In fast-eroding regimes, permanent natural erosion rejuvenates the weathering zone. Erosion exerts the principle control over weathering.

2) Dependence on biomass growth: Because these sites also differ in climate and biomass growth neither the degree of weathering nor the weathering rates increase systematically with precipitation or biomass growth along the gradient. A nutrient recycling factor can be quantified that increases inversely with erosion rate and shows that the increase in nutrient demand with increasing biomass growth is accommodated by faster nutrient recycling between plants and soil.

If weathering does not impact biomass growth and biomass growth does not impact weathering, what then is the influence of biota on element Critical Zone budgets? I hypothesize that plant growth might in fact dampen weathering rates. Deepening the rooting depth, modifying subsurface water flux, or reduction of porosity by precipitation of secondary minerals after enhanced mineral dissolution may induce such a negative feedback.

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