Long-term versus short-term weathering fluxes in contrasting lithologies at the Luquillo Critical Zone Observatory, Puerto Rico

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(Bio)geochemical and physical weathering processes in tropical watersheds produce most of the solutes and sediments discharged to the oceans. Thus, relative to their area, tropical systems are disproportionately important in terms of weathering, erosion, and global CO_2 cycles. In addition to influencing stream and ocean chemistry and sediment loads, weathering processes exert control over chemical transport in soils and regolith (e.g., saprolite), soil and saprolite formation rates, mineral nutrient availability, and microbial growth rates. Currently, the volcaniclastic Río Mameyes watershed is being investigated as a comparison to the nearby, well-studied, granitic Río Icacos watershed in order to better understand the influence of lithology on weathering processes, weathering fluxes, and mineral nutrient availability.

Both watersheds are located in the Luquillo Critical Zone Observatory in Northeastern Puerto Rico and are characterized by similar humid, tropical climate; high annual rainfall, high year-round temperatures, tropical montane vegetation, and high relief. In both watersheds, thick (37+ m in places) saprolites blanket the ridges, but the majority of the chemical weathering occurs at the bedrock-saprolite interface. Long-term weathering fluxes are calculated from mass losses in the weathering profiles between the bedrock and the saprolite and from the age of the regolith surface (determined by cosmogenic nuclides or U-Th disequilibria). Short-term weathering fluxes are calculated from solute chemistries and infiltration rates and can be compared to watershed flux rates. Comparison of these three calculations for each watershed can be used to identify the changes in weathering regime and environment over time. Comparison of the two different watersheds demonstrates the influence of lithology on weathering fluxes on different timescales.

Defining a landscape for microbial electron transfer to extracellular minerals

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The respiratory reduction of extracellular minerals poses a considerable challenge to microbes. Redox events associated with generating proton motive force across the inner membrane to drive ATP synthesis must be coupled to transfer of electrons to the extracellular matrix. In *Shewanella* multi-heme cytochromes support this translocation of electrons. The tetraheme containing protein CymA moves electrons from inner membrane quinols to the periplasm. Porin wrapped decaheme cytochromes provide a conduit for electron transfer across the outer membrane while additional cytochromes interface with the extracellular matrix. The redox activity of each of these cytochromes spans a distinct window of potential. Consequently when present together these cytochromes can provide both a reservoir to accommodate electrons arriving from quinol oxidation at the inner membrane and a variable driving force for delivering electrons to extracellular minerals.