# Redox Fluctuation Shapes Microbial Community Structure and Mineral-Organic Relations in a Humid Tropical Soil

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Redox oscillations characteristic of wet tropical soils constrain both the metabolic capacity of soil microbes and mineral-organic matter relationships that regulate the fate and availability of soil C, Fe and P. With a suite of soil redox manipulation and isotope tracing studies, we tested the effects of different redox regimes on microbial communities, soil metabolites and fates of soil C and P, using soils from the Luquillo Experimental Forest, Puerto Rico. Adding $^{13}C$ rich plant litter allowed us to specifically target the fate of new detritus. While gross soil respiration was highest in static oxic soils, $CO_2$ flux from added litter was highest in static anoxic soils, suggesting that decomposition of preexisting SOM was limited by $O_2$ availability. Microbial community composition, while generally resilient to redox oscillations, responded to prolonged anoxia (which promoted Firmicutes); fluctuating treatments maintained higher relative abundances of both bacterial and fungi. Under oxic conditions, soil microbes maintained a near constant C:P ratio, independent of the C:P of their substrates. However, anaerobic conditions disrupted microbial C:P homeostasis and microbial C:P ratio changed with the stoichiometry of available resources. We also find that microbe vs. mineral competition for P is strongly controlled by microbial ability to immobilize P and not by its sorption strength to the mineral phase. Finally, our results indicate that redox fluxtuation pattern affects both the concentration and molecular composition of dissolved organic carbon (DOC, measured by FTICR-MS). These results, along with parallel studies of biogeochemical responses (pH, Fe speciation, P availability), suggest a highly responsive microbial and geochemical system, where the frequency of low-redox events controls exchanges of C between mineral-sorbed and aqueous pools.