Microbial environmental feedbacks and the evolution of soil organic matter

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The vast majority of Earth's organic matter is stored in soil. The products of microbial metabolism as well as dead microbes (necromass), along with residues from plants and other organisms at different stages of decomposition, constitute a large fraction of that soil organic matter (SOM). The ability of microbes to modify and degrade SOM depends on physicochemical characteristics of the soil, affecting SOM stability and persistence. While the contributions of microbes to the decomposition and loss of SOM have been intensively studied, their role in maintaining the terrestrial SOM is poorly understood. Specifically, how fungi, bacteria, and archaea participate in SOM production, its interaction with minerals, and the formation of soil aggregates remains a significant gap in our understanding of the terrestrial nutrient cycle. The chemical composition of SOM is in large measure determined by soil bacterial metabolism, which is impacted by changes in rainfall patterns. This research will conduct field and laboratory experiments and computational modeling to understand the role of microbial communities in stabilizing SOM under different water availability conditions in tropical soils. The results of this project will increase our understanding of the effects that microbes have on the global geochemical and nutrient cycles, addressing DOE's mission in energy and the environment.