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Soil pores as drivers of micro-habitats for microbial decomposers and carbon protection

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Soil is a key component of terrestrial ecosystems that contains almost twice as much carbon (C) as atmosphere; and it is the C that can be easily lost under right environmental settings. Thus, understanding the mechanisms of C protection in soil is imperative for mitigation of climate change effects. A key component of soil C storage is its physical protection enabled by soil physical micro-environmental conditions. Soil micro-scale environmental conditions are primarily determined by the abundance, spatial arrangements, and characteristics of soil pores. While there is a large body of evidence for soil C physical protection, unfortunately exact mechanisms behind the protection are still not sufficiently understood.
Activity of the microorganisms involved in decomposition of soil organic C also takes place within intact soil with the entirety of its structural complexity. Microorganisms and the physical environments they inhabit are closely coupled. Heterogeneity in physical micro-habitats is one of the key drivers of variability in microbial community structure. However, direct experimental evidence of specific micro-environmental influences on microbial structure and activity is only beginning to emerge.
I will present a review of past and most recent results of my research team exploring various routes by which presence and characteristics of pores contribute to creation of contrasting micro-habitats and their contribution to C processes. First, the roles of pore sizes, connectivity, and origins (biological vs. non-biological) in defining the type of micro-environmental conditions they provide will be discussed. Then, further evidence of how these micro-habitat differences lead to differences in compositions of microbial communities, further expressed in differences in extracellular enzyme patterns, and in resulting soil organic matter decomposition products will be presented.