Diffusional Constraints Affecting Microbial Habitats and Activity in Unsaturated Porous Media. (S01-or172951-Oral)

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Abstract:

Recent advances in soil pore space visualization and geometrical characterization coupled with improved models for liquid and gaseous behaviour provide the impetus for examination of physical influences on microbial habitats and activity. Desaturation of a porous medium is accompanied by marked changes in liquid-vapour interfacial configurations, which result in confinement and fragmentation of aquatic habitats, alteration of liquid and gaseous diffusion pathways, and introduction of mechanical stresses exerted by films and receding menisci. At the pore scale we examine relationships between liquid element size (at a given potential) and typical organism or colony size, in an attempt to explain physical triggers for enhanced biological production of extracellular polysaccharides (EPS) coating. The role of EPS in habitat alteration is deduced from its structural, mechanical and transport characteristics. The interplay between increasing liquid-vapour interfacial area and decreasing liquid diffusion pathways with decreasing water content can be formulated as a function of pore space geometry. Such relationships are potentially important for optimal biological control of various bioremediation activities taking place at the soil profile scale. Interactions between microorganisms and solid surfaces are investigated in the context of adhesion and formation of biofilms and aggregates. In such microbial communities, EPS forms complex three-dimensional structures that facilitate efficient transport processes and support a rich spatial arrangement of microorganisms with different affinities to oxygen and various nutrients. Effects of microbial activity on properties of solid surfaces including wettability and structural stabilization of the solid matrix are examined.

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