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Spatial organization of bacterial populations in response to oxygen and carbon counter-gradients in pore networks

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Abstract:

Microbial activity in soil is spatially heterogeneous often forming spatial hotspots that contribute disproportionally to biogeochemical processes. Evidence suggests that bacterial spatial organization contributes to the persistence of anoxic hotspots even in unsaturated soils. Such processes are difficult to observe in situ at the microscale, hence mechanisms and time scales relevant for bacterial spatial organization remain largely qualitative. Here we develop an experimental platform based on glass-etched micrometric pore networks that mimics resource gradients postulated in soil aggregates to observe spatial organization of fluorescently tagged aerobic and facultative anaerobic bacteria. Two initially intermixed bacterial species, *Pseudomonas putida* and *Pseudomonas veronii*, segregate into preferential regions promoted by opposing gradients of carbon and oxygen (such persistent coexistence is not possible in well-mixed cultures). The study provides quantitative visualization and modelling of bacterial spatial organization within aggregate-like hotspots, a key step towards developing a mechanistic representation of bacterial community organization in soil pores.

Keywords: hotspots, micrometric pore networks, gradients, biogeochemical processes, heterogeneous resource distribution, soil aggregates