Speakers 9 of MS14.1 - Frontiers of soil microbial ecology

Subject
11.45 - 12.00 "It's activity not growth: Quantifying milli-niches using positron emission tomography of psychrotrophic bioremediation in permafrost soils"
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It's activity not growth: Quantifying milli-niches using positron emission tomography of psychrotrophic bioremediation in permafrost soils

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Soil ecosystems are managed on a landscape scale, but soil microbial communities operate on a millimetre scale. The combined activity and distribution of these innumerable microscale communities gives rise to ecosystem services that protect groundwater, regulate climate, and/or produce food. Recent advances in detector technology, now make it possible to image microbial distribution and activity, at the millimetre scale throughout intact field soil cores. Using positron emission tomography (PET), we evaluated if a novel biostimulatory solution would allow isolated Arctic communities to bioremediate hydrocarbon polluted soils in situ. We characterized microbial distribution, activity, gene expression, metabolism, and composition in 15 different boreholes collected from the permafrost microbial community. In soil volumes of ca. 48 cm^3, microorganisms filled approximately 60% of soil pore space (ca. 17 cm^3), with the remaining pore space (ca. 10 cm^3) filled with gas or water. Biostimulated microbial communities metabolized approximately 26% of the Fludeoxyglucose (^{18}F) tracer, whereas control microbial communities only metabolized 11%. Microbial community distribution in situ was not necessarily linked to the active soil pores, with microbial communities completely filling pore areas in which the non-biologically reactive tracer, ^{18}F, could not. The in situ distribution of soil microbial communities was linked ($r=0.45$, $p<0.05$, $n=80$) to traditional measures of gene expression, pollutant degradation and basal respiration. Despite higher metabolism, pollutant degradation, 16S rRNA abundance, and gene expression, biostimulated community biomass was not increased compared to control communities. In situ remediation under psychrotrophic conditions works by stimulating microbial activity but not growth.