Dispersal of degrading bacteria impedes outgassing of organic contaminants

SALLY OTTO[1], THOMAS BANITZ[2], KARIN JOHST[2], THOMAS HÜBSCHMANN[1], HAUKE HARMS[1], LUKAS Y. WICK[1]

[1] UFZ - Helmholtz Centre for Environmental Research, Department of Environmental Microbiology, Permoserstraße 15, 04318 Leipzig, Germany, sally.otto@ufz.de
[2] UFZ - Helmholtz Centre for Environmental Research, Department of Ecological Modelling, Permoserstraße 15, 04318 Leipzig, Germany

Contaminants are only hazardous if they become bioavailable. The most effective remediation technique should lead to an optimal coverage with degrading microorganisms to prevent a release of contaminants bound to biogeochemical interfaces (BGI) to the environment.

Here, we investigated the impact of bacterial dispersal on BGI on the outgassing of phenanthrene (PHE). Our study was performed to challenge the hypothesis that the presence of dispersal networks of bacteria leads to: (i) bacterial distribution along the transport network, (ii) efficient bacterial distribution on the surface, and (iii) an increased biomass production allowing for the degradation of PHE releasing from the system. We therefore designed a laboratory microcosm mimicking a continuous PHE release from a PHE hotspot to a model BGI (agar surface) in presence and absence of model dispersal networks which facilitated the transport of unless poorly motile PHE-degrading Pseudomonas fluorescens LP6a on agar surfaces.

The presence of the glass fibres (as a laboratory mimic the widespread soil fungal networks) resulted in an (i) increased spatio-temporal spreading of bacteria, (ii) an increased bacterial coverage of and growth on the agar surface, and (iii) a subsequent effective degradation of outgassing PHE and effective reduction of PHE contamination beyond the PHE hotspot. Our data suggest that fungal mycelia may promote the formation of an adapted microbial population that will degrade contaminant molecules desorbing from that source. And such an activity potentially can result in zero emission of contaminants to the pore and groundwater and, hence, to higher organisms.