

## Microbial ecology of biogeochemical interfaces – diversity, structure, and function of microhabitats in soil

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In soils, a multitude of inorganic, organic, and biological constituents build up extremely large, heterogeneous, and hierarchically organized biogeochemical interfaces (BGIs). These interfaces affect a variety of soil processes, such as the formation and the stability of soil aggregates; the movement and the spatial distribution of solutes, colloids, and gases; or the bioavailability of inorganic and organic compounds. As environmental conditions prevailing in soil frequently change over time and in space, the structural and the compositional heterogeneity of BGIs offers a multitude of microhabitats and supports growth of highly diverse microbial communities. Yet, microorganisms not only inhabit these interfaces, but they also actively participate in their formation and reorganization, as well as in their destabilization and destruction. They may thus be seen as both “architects” and “actors” in shaping their proximate microenvironment. Nonetheless, our understanding of the quantitative role of soil microorganisms in the development, maturation, and functioning of BGIs is yet mostly speculative. Also, little is known about the factors controlling microbial growth and activities at BGIs, as well as about the abiotic and the biotic variables shaping the structural and the functional microbial diversity.

Motivated by this highly interesting, yet fairly unexplored aspect of soil microbial ecology, the German priority program SPP 1315 “Biogeochemical Interfaces in Soil” (<http://www.spp1315.uni-jena.de>) called for an international symposium on “Life in Microhabitats of Soils – Microbial Ecology of Biogeochemical Interfaces”, which was held on 1–2 March, 2012, in Dornburg, Germany. The symposium was organized by the Department of Hydrogeology, Friedrich Schiller University of Jena, Germany and by the German Soil Science Society (DFB), the Commission III – Soil Biology and Soil Ecology, and it was supported by the Deutsche Forschungsgemeinschaft (DFG). The symposium program featured three invited speakers – Naoise Nunan (CNRS, Thiverval-Grignon, France), Karl Ritz (Cranfield University, UK), and James T. Tiedje (Michigan State University, USA).

This thematic issue of *FEMS Microbiology Ecology* is a compilation of nine topics presented and discussed at the symposium and of three additional regular submissions that are aligned with the issues addressed during the

symposium. The thematic issue starts with research articles on the development of BGIs in artificial (constructed) soils. They reveal that the phylogenetic diversity of soil microbial communities is strongly controlled by the composition of the soils’ mineral components. The spatiotemporal spatio-temporal diversity and the abundance of soil microbial populations with different functions are also discussed at larger spatial scales to examine the impact of substrate addition and the presence of earthworms on the activity of microorganisms inhabiting two prominent BGIs in soil – the soil-litter and the soil-burrow wall interfaces. The link between the physicochemical physico-chemical properties of the specific microhabitat and its biological functions, exemplified here by an enhanced degradation of organic compounds, is also addressed in this thematic issue. The important role of a microhabitat and its properties in shaping the abundance and the activity of the indigenous microorganisms is extensively discussed in the articles that examine: (1) microbial communities in differently sized soil particles and thus study the buffering capacity of a microhabitat protecting microorganisms against long-term fertilization; (2) the spatial diversity of soil prokaryotes in dryland soils as affected by water availability; and (3) the swimming patterns of soil bacteria in response to surface properties to understand, for example, bacterial motility in geometrically restricted microhabitats. The consequences of microhabitat–microorganisms interactions for carbon mineralization at the pore scale and for methane oxidation at larger spatial scales are discussed at the end of this thematic issue.

Overall, the 12 research articles provide a coherent insight into microbial ecology of inhabited BGIs and present a set of advanced and sophisticated techniques and methods enabling accurate isolation, quantification, and further characterization of soil microbial communities and determination of their activities. The editors of this thematic issue would thus like to thank all authors for their contributions.

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