Editorial

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The formation, maturation, and persistence of soil minerals, soil organic matter, and their associations are strongly influenced by soil biota and in particular by microorganisms. The unique spatial arrangement of these three “ingredients” during pedogenesis results not only in an (hierarchical) aggregate system in soils, but simultaneously defines an extremely large, heterogeneous, and dynamic biogeochemical interface (BGI). This BGI has to be considered a three-dimensional domain of variable thickness ranging from nanometers to micrometers, which is formed and continuously transformed by the interplay of biota with organic and inorganic matter. It spreads within and throughout the soils' porous system and separates gradually or abruptly bulk immobile phases from mobile liquid or gaseous phases. Thus, BGIs are the locations where strong biological, physical, and chemical gradients will develop: As such, they are hotspots of a variety of soil-forming processes and processes that affect fluid flow and biogeochemical cycling of nutrients and contaminants in soil. Understanding and visualizing the architecture of biochemical interfaces in soil, enlightening the processes affecting their formation and maturation, and elucidating the processes occurring on biogeochemical interfaces have thus been identified as an emerging decadal challenge in soil science (Chorover et al. 2007; Totsche et al. 2010).

As a response, the German Research Foundation (DFG) has granted the priority program SPP 1315 “Biogeochemical Interfaces in Soil,” in which altogether 42 individual projects are funded between 2007 and 2013. Research within this

priority program includes the development of advanced characterization and probing techniques from molecular biology, analytical and computational chemistry, as well as material and nanosciences. The priority program aims at the systematic structural characterization and functional exploration of soil biogeochemical interfaces and at unraveling their role for transformations and storage of organic chemicals. The overall scientific goal is to gain a mechanistic understanding of the architecture, the formation and dynamics of biogeochemical interfaces in soils, and of the complex interplay and interdependencies of the physical, chemical, and biological processes which control the fate of organic chemicals at biogeochemical interfaces. Therefore, the major challenges of this research consortium are (1) to identify the factors controlling the architecture of biogeochemical interfaces, (2) to link the processes operative at the individual molecular and/or organism scale to the phenomena active at the aggregate scale in a mechanistic way, and (3) to explain the behavior of organic chemicals in soil within a general mechanistic framework (Totsche et al. 2010). To successfully attack the scientific challenges will require the cross-linking of advanced and emerging spectroscopic mapping and imaging techniques with soil physical, chemical and biological methods. Therefore, joint experiments connecting these different scientific disciplines are carried out within thematic groups. Details on the individual projects, the principle investigators, coworkers, and the methods applied are available online (<http://www.spp1315.uni-jena.de>). A further instrument to achieve the overall goal is to foster scientific exchange in international symposia. After a symposium in 2009 on “Advances of molecular modeling of biogeochemical interfaces,” a symposium on “Advanced spectroscopic and microscopic characterization techniques—tools to enlighten biogeochemical interfaces in soil” has

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been organized by the priority program and held in Dornburg (Germany) in October 2010. It was a consequence of the need to use high-resolution techniques in biogeochemical interface research owing to the micro- to nanosize of biogeochemical interfaces and the scale on which processes on their surfaces proceed. The symposium was organized together with the German Soil Science Society (Deutsche Bodenkundliche Gesellschaft, commission VII soil mineralogy). This special issue of the *Journal of Soils and Sediments* comprises selected contributions presented during the symposium in extended form together with a review on characterization techniques utilized to study biogeochemical interfaces in soil and the processes occurring on their surfaces.

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