EGU22-11816
https://doi.org/10.5194/egusphere-egu22-11816
EGU General Assembly 2022

Two-dimensional imaging of arsenic concentration and speciation with diffusive equilibrium in thin-film (DET) gels

Andrea Castillejos Sepulveda[1], Edouard Metzger[2], Sten Littmann[3], Heidi Taubner[4], Arjun Chennu[5], Lais Gatti[1], Dirk de Beer[1], and Judith M. Klatt[1]

[1]Max Planck Institute for Marine Microbiology, Microsensor Working Group, Germany (acastill@mpi-bremen.de)
[2]Laboratoire de Planétologie et Géosciences, CNRS, Université d'Angers, Nantes Université, Le Mans Université, Angers, France
[3]Max Planck Institute for Marine Microbiology, Biogeochemistry Group, Celsiusstraße 1, 28359, Bremen, Germany
[4]MARUM Center for Marine Environmental Science and Faculty of Geosciences, Organic Geochemistry Group, University of Bremen, Leobener Str. 8, 28359, Bremen, Germany.
[5]Leibniz Centre for Tropical Marine Research, Data Science und Technology, Fahrenheitstr. 6, 28359 Bremen, Germany

Arsenic is common toxic contaminant in soils, but tracking its mobility is difficult because microscale processes govern its speciation and affinity to minerals. We aimed to unravel such dynamics in contaminated soils of Harz brook using a novel approach. By combining diffusive equilibrium in thin-film (DET) gels, spectrophotometric methods and hyperspectral imagery we were able to determine the spatial variability of arsenite (As(III)), arsenate (As(V)) and phosphate at submillimeter resolution. Iron was imaged simultaneously using the established colorimetric mapping of dissolved iron. The 2D-DET gel probes combined with XRF based element mapping in the solid and liquid phase, revealed microstructures and distinct mm-scale lamination surrounding porewater channels. Small-scale correlation analyses of arsenic and iron hotspots in the gels suggested active iron-driven local redox cycling of arsenic. The local processes overall point towards net release of sorbed As(V) in the form of As(III) into the porewater. These results show that 2D-DETs can deepen our understanding of the differential leaching of As(V) vs As(III) from iron oxides under anaerobic conditions. This study is the first fine-scale 2D characterization of arsenic speciation in porewater and represents a crucial step towards understanding the redox cycling and transfer of arsenic in heavily contaminated sediment and soil ecosystems. These insights may further lead to in-depth characterization of arsenic transfer mechanisms into the food web.