2-D imaging of light-dependent changes in arsenic speciation in microbial mat porewaters

LAIS M. GATTI[1], ANDREA CASTILLEJOS SEPULVEDA[1], BRITTA PLANER-FRIEDRICH[2], MARIA E. FARIAS[3], JUDITH M. KLATT[1]

[1]Microsensor Group, Max Planck Institute for Marine Microbiology, Bremen, Germany (correspondence: lgatti@mpi-bremen.de)
[2]Environmental Geochemistry, Bayreuth Center for Ecology and Environmental Research (BayCEER), University of Bayreuth, Germany
[3]Laboratorio de Investigaciones Microbiológicas de Lagunas Andinas, Tucuman, Argentina

Arsenite (As(III)) has been suggested to be amongst the most ancient electron donors for anoxygenic photosynthesis [1]. However, its cycling in modern analogues of ancient ecosystems, such as microbial mats, is poorly understood because arsenic can support an astonishing range of complex biogeochemical transformations. The arsenic cycle interacts with diverse solid and dissolved compounds such as iron, oxygen, sulfide, and is influenced by pH and physical factors such as temperature or light, making it a challenge to be studied. Furthermore, most methods used for arsenic determination cannot be used for *in-situ* data analysis and do not offer the resolution needed to understand arsenic cycling at the spatial and temporal scale needed for microbial mats.

Here, we present a novel 2D-imaging approach based on diffusive equilibrium in thin films (DETs). Our approach allows the simultaneous mapping of As(III), As(V) and inorganic phosphorus using a combination of a colorimetric assay and hyperspectral imaging.

We tested our approach in Lago Pozo Bravo in the high-altitude salt flat Salar de Antofalla of the Andes (altitude 3330 m) where carbonate-precipitating cyanobacterial mats flourish. DET-based imaging combined with *in-situ* microsensor measurements over a diel cycle indicated light-dependent and interrelated cycling of arsenic, oxygen, sulfur and iron. This shows that DETs are a promising tool to understand the mechanisms behind diel arsenic dynamics and potentially reveal arsenic-driven photosynthesis non-destructively *in-situ*.

[1] Lebrun E, Brugna M, Baymann F, Muller D, Lièvremont D, Lett M-C, et al. Arsenite Oxidase, an Ancient Bioenergetic Enzyme. *Mol Biol Evol* 2003; 20: 686–693.