Intracellular selenium speciation in low-concentrated biological samples

P. BÉZIAT[1,2], L. SAUZÉAT[1,2], S. BOUCHET[1,2], J. TOLU[1,2], L.H.E. WINKEL[1,2*]

[1]Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, Switzerland (*correspondence: Lenny.Winkel@eawag.ch)

[2]Eawag, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland

Trace metals and metalloids play fundamental roles in environmental health. It is now well recognized that any excess or deficiency of essential trace elements can significantly affect metabolic processes and potentially induce severe health hazards. The essential micronutrient selenium (Se) has a wide range of beneficial properties including functions in the immune, antioxidant-defense and hormone system. Human Se exposure is strongly dependent on dietary intake, which in turn scales to concentrations in crops and agricultural soils for which atmospheric deposition is believed to be one key determinant.

It has been hypothesized that biovolatilization by marine phytoplankton, subsequent atmospheric transport and deposition on the land surface is a source of Se to terrestrial foodchains. To study biovolatilization of Se it is important to understand metabolic processes in phytoplankton under natural conditions. Particularly low concentrations render intracellular speciation analyses challenging; most of the currently available techniques (e.g., synchrotron-based ones) are not applicable to such levels. Spectrometry based approaches on the other hand face the challenge of first disrupting phytoplankton cell walls while conserving trace element speciation. Therefore, the analysis of intracellular speciation of trace elements in biological matrices under natural, i.e., non-amended background concentrations remains a challenge.

To address this problem, we developed a multi-step method to analyze intracellular speciation of Se and S for low-concentrated biological samples. In these analyses, we include S as it has a similar chemical behavior as Se but it is present in higher abundance. The new method involves microwave-assisted cell disruption combined with liquid chromatography and mass spectrometry. We will present preliminary results for intracellular speciation and transformations of Se and S in phytoplankton.