Analytical advancements improve insights into the biogeochemical cycle of selenium

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Trace elements (metals, metalloids, non-metals) play a major role in human and animal health. Certain trace elements are toxic, even at very low concentrations. Other trace elements, referred to as micronutrients, are essential to humans and other organisms, however only in specific concentration ranges. To prevent over- or underexposure of trace elements, it is essential to better understand their cycling and distributions in the various environmental compartments, such as in soils, plants, ground- and surface water and the atmosphere. As the chemical speciation of trace elements largely determines their environmental mobility and bioavailability for uptake by plants and other organisms, it is of key importance to be able to identify and quantify trace element species in various environmental compartments. Furthermore, past research in environmental geochemistry has mainly focused on inorganic speciation of trace elements; however, in the environment, many trace elements occur in organic forms which remain largely unexplored due to the challenges posed by their analysis.

In this talk, I will present how advancements in analytical chemistry help elucidate the inorganic and organic speciation of the trace element selenium (Se) and therefore its environmental pathways and processes. Selenium, which is naturally present in rocks, soils, water and air, but also introduced into the environment via anthropogenic processes, is an essential micronutrient at low concentrations but toxic at to organisms at higher concentrations. Examples will be given of how liquid and gas-phase chromatography coupled to inductively coupled plasma mass spectrometry gives new insights into the speciation of Se in marine algae, the atmosphere and in soils. Finally, it will be shown how this information can be used to better understand processes connecting the different compartments and thus the overall biogeochemical cycle of selenium.