Emerging Investigator Series

International Association of GeoChemistry (IAGC)

Carin Sjöstedt, June 2022

Carin Sjöstedt is a researcher at the Department of Soil and Environment at the Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden. She holds a Ph.D. in Land and Water Resources Engineering at the KTH Royal Institute of Technology, Stockholm, Sweden and a M.Sc. and B.S. in Environmental Science at Stockholm University, Sweden. Her expertise and interests are mainly in metal(loid) speciation in soil and water bodies, and has specialized in the techniques X-ray absorption spectroscopy and geochemical equilibrium modeling. Her current work is supported by the Swedish Research Council with a four-year project on metal binding to biochar. Her recent paper entitled "Evidence of the mineral ZnHAsO4·H2O, koritnigite, controlling As(V) and Zn(II) solubility in a multi-contaminated soil" was published in Applied Geochemistry and selected as Editor's choice.

Reference:

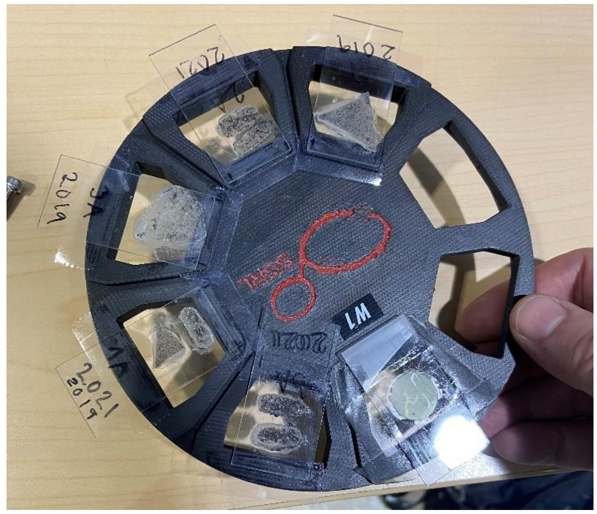
Sjöstedt, C., Kristofferson, Å., Gustafsson, J. P., Heldele, A. S., Kessler, V., & Kleja, D. B. (2022). Evidence of the mineral ZnHAsO4· H2O, koritnigite, controlling As (V) and Zn (II) solubility in a multi-contaminated soil. *Applied Geochemistry*, *140*, 105301. https://www.sciencedirect.com/science/article/pii/S0883292722001056

What excites you most about the work published in Applied Geochemistry?

The work was the most exciting I have ever done. It started off as an enigma, we saw that arsenic in a heavily contaminated soil was not behaving as if it was adsorbed to iron oxides; on the contrary it had a very low solubility at pH values around 6 according to batch studies performed by our M.Sc. student Ann-Sophie Heldele. Therefore, we started looking at the data trying to find a mineral phase that fitted the solubility data, but there were too many possible candidates since the soil contained many different elements in high concentrations: Ca, Cu, Cr, Mn, Fe, Pb,

At the beam line I18*, Diamond Light Source, where we performed the µ-XRF work for the current article. From left beam line scientist Konstantin Ignatyev, Carin Sjöstedt, Dan Berggren Kleja and Åsa Kristofferson.*

and Zn. Finally, we received beam time at the Diamond Light Source where we could do microscale X-ray fluorescence spectroscopy (µ-XRF) and map all these metals. To our great surprise, arsenic was correlated with Zn and not with Fe! We also recorded µ-extended X-ray absorption fine structure spectra (µ-EXAFS) of As and Zn hotspots to aid in determining the exact mineral. The story did not end there, because it took some time for me to figure out the correct mineral. From modeling the solubility data I could see that it should be a phase with stoichiometry $ZnHAsO_4$, and after much searching in literature I found the correct phase, the rare mineral koritnigite, $ZnHAsO_4 * H_2O$. When I did, all the pieces of the puzzle fit, because the structure of the mineral was captured in the µ-EXAFS spectra of both As and Zn.



Applying thin section soil samples for µ-XRF and µ-XAS experiments at the 2-3 beam line at Stanford Synchrotron Radiation Lightsource.

What are you working on right now and with whom are you collaborating?

I have specialized in determining metal(loid) speciation in soil, lake water, and bottom ashes from incineration of waste using the techniques X-ray absorption spectroscopy and geochemical equilibrium modeling. Apart from the group at my affiliation SLU, I also collaborate with Charlotta Tiberg and Anja Enell at the Swedish Geotechnical Institute, Kristin Boye at Stanford University, Karin Karlfeldt Fedje at Chalmers University, and Iso Cristl at ETH Zurich. My current project is on metal binding to biochar as a remediation option for contaminated soil. I will study the mechanisms involved in the binding using X-ray spectroscopy and other techniques. The ultimate aim is to create a semi-mechanistic model for the organic part of the biochar that can be used in geochemical modeling.

Where do you see your research program heading, and what topics are you most interested in pursuing?

Soil chemistry is fascinating because it is so complex, but also so important. One challenge is the heterogeneity of soil on the small scale, which can be captured well with the µ-XRF technique. I therefore would like to continue using this technique, but also to couple it with other techniques that can determine the chemistry at small spots. I believe it is one important way to be able to solve today and tomorrow’s problems regarding soil pollutants, soil fertility, and climate change.

As an early career investigator, do you have any advice to share with the audience of Applied Geochemistry?

To be aware that working with science is sometimes very exciting, and sometimes extremely frustrating with a lot of work and with experiments that fail. My advice would be to truly value when things go well, and keep on struggling when things go bad, eventually things will be better.

With the ICP instrument at our lab at SLU

The aim of the **IAGC Emerging Investigator Series** is to highlight excellent work by independent researchers in their early career that bring new insights into the field of geochemistry or to promote geochemical applications. Multidisciplinary work related to applied geochemistry, biogeochemical processes, and environmental geochemistry are also highly welcomed. Featured articles as well as the authors as emerging investigators will be extensively advertised to diverse disciplines and communities through multiple platforms of the journal and the International Association of GeoChemistry.