EH&S of Nano: Now What? Connecting Environmental Nano Research to Trace Element Biogeochemistry

HEILEEN HSU-KIM

Duke University, Department of Civil & Environmental Engineering, Durham, NC USA hsukim@duke.edu

The environmental and geoscience research community has invested substantial efforts over the past two decades in understanding the environmental health and safety (EH&S) risks of engineered nanomaterials. As this field has matured, researchers are now asking: *What have we learned from all of this environmental nano research*? *What is next?*

Naturally-occuring and engineered nanomaterials in the environment share similar processes that affect their distribution, transformation, and bioavailability. Moreover research tools used in one context such as natural nanoparticles can often be directed toward understanding the environmental impacts of synthetic nanomaterials. This presentation will describe the broader relevance of EH&S research for nanomaterials, and in particular, the relevance of this work for trace element biogeochemistry.

The first part of the presentation will described experimental research on dissolved organic matter (DOM) interactions with soluble nanoparticles CuO and ZnO. This work highlights the multi-purpose role of DOM for influencing a combination of processes including particle dissolution, aggregation, surface sorption, metal chelation, and biouptake to target organisms. Moreover, the extent of these processes correlate to DOM molecular composition such as aromatic carbon content and molecular weight. Collectively, these results highlight the need to consider rates of competing processes in understanding and modeling trace element and nanoparticle distribution and bioavailability.

The second part of this presentation will describe how experiments with well-characterized nanomaterials can enable the development of functional methods to assess trace element reactivity or bioavailability. In this example, nanoscale mercury sulfides of known reactivity have been used in microcosm experiments to test extraction approaches for mercury bioavailability. This work is leading to new methods for quantifying mercury biomethylation potential in anaerobic sediments and soils.

In summary, the use of nanomaterials in laboratory or field simulations of environmental systems has helped to improve models for trace element transformation and exposure.