ESE Seminar – Faculty Candidate for Environmental Chemistry

Deconstructing Dissolved Organic Matter: Linking Chemical Composition with Reactivity

Rose M. Cory, Ph.D.

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133 Rosenau
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Abstract:
Aquatic dissolved organic matter (DOM) is a large, but poorly understood pool of organic carbon. DOM is derived from plant and microbial precursors, amorphous in composition, and plays important roles in natural and managed waters e.g., controlling the fate many organic, inorganic and bio-contaminants in natural waters and forming disinfection byproducts during water treatment. Research-to-date has repeatedly correlated DOM's environmental reactivity to its chemical composition.

It is increasingly possible to delineate DOM into distinct components with common physicochemical properties. For example, excitation emission matrix (EEM) spectrofluorimetry has been used in the past to qualitatively study DOM. Recent advances in statistical modeling using parallel factor analysis (PARAFAC) have identified 13 distinct groups of fluorophores that contribute to DOM EEMs. These fluorophores include known classes of organic compounds, e.g., quinones of varying redox states as well as specific amino acids. Our increased ability to resolve DOM fluorescence into distinct moieties, in conjunction with other techniques, has yielded new insights into the redox reactivity of DOM, for example.

More robust analytical techniques used to study DOM include ultrahigh resolution mass spectrometry (FTICR-MS), which has allowed us to identify groupings of compounds based upon both chemical properties and empirical formulas. We can apply these tools to quantify changes in the structure of DOM before and after a reaction. For example, singlet oxygen ($^1O_2$,), a reactive oxygen species (ROS) produced by the interaction between photo-excited DOM and dissolved oxygen, may contribute to "photo-weathering" of DOM, which results in altered DOM bioavailability. FTICR-MS analysis of DOM before and after reaction with $^1O_2$ revealed the compounds in DOM that are susceptible to degradation by this ROS.

The advent of these new methods have ushered in a new period where we can make significant in-roads into understanding the composition and reactivity of the most mysterious and abundant sources of organic carbon on this planet. The approaches and insights presented here can be applied to study other reactions of environmental interest in both natural and managed systems.

Bio:
Dr. Cory is currently a Director's Postdoctoral Fellow at Los Alamos National Laboratory in Los Alamos, NM. She received her PhD in Environmental Engineering from the University of Colorado at Boulder in 2006; her MS in Environmental Engineering from Michigan Technological University in 2001; and her BS in Chemistry (with honors) from Michigan State University in 1998.