



## CHEMISTRY/PHYSICS SEMINAR SERIES

**Dr. Scott Smith**

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**Wednesday, April 3, 2024**

**11:00 a.m. to 11:50 a.m. in ENW 115**

### **Research towards remote and in-situ monitoring methods for metals risk in aquatic systems**

#### **ABSTRACT**

It is well established that water chemistry can influence the toxic effects of metals. The effect of dissolved organic matter (DOM) as a toxicity modifying factor can quantitatively be predicted using established biotic ligand models (BLMs). For this modelling, DOM is represented by the measurable quantity of dissolved organic carbon (DOC; i.e., mg C/L). Typically, DOC in aqueous samples is determined in a laboratory using a specialized instrument called a carbon analyzer. Many governments recommend use of the BLM, and other related bioavailability approaches, for establishing site-specific water quality criteria, or for risk assessment. Unfortunately, many local jurisdictions lack the ability to consistently and accurately measure DOC or have logistical difficulties accessing sites for routine sampling. There are two strategies that could circumvent the need for routine sampling and lab-based carbon analysis: (1) remote sensing of DOC, or (2) direct in situ measurement of bioavailable metal. Advantages of these approaches will be discussed along with recent progress in our research laboratories assessing the feasibility of these approaches to assess metals risk without sampling and subsequent laboratory-based carbon analysis. As a proof-of-principle, we demonstrate that by using the intrinsic colour of DOC, for un-impacted lakes in Quebec, using both drone- and Landsat-based methods, it is possible to estimate DOC remotely. Using BLM modelling, the estimates of DOC can be converted to metals risk estimates (i.e., effects concentrations). Similarly, we demonstrate that DNAzymes have the potential to directly sense the bioavailable fraction of total metal in surface waters. Catalytic DNA (so called DNAzymes) based sensors are a promising new technology for possible bioavailable metal monitoring that have not yet been fully tested in real waters. Our research utilizes GR5, an existing RNA-cleaving DNAzyme specific for Pb<sup>2+</sup>. In GR5, lead acts as a specific co-factor in DNA catalyzing the cleavage of an RNA-containing fluorogenic substrate. The GR5 sensor response is compared to geochemical models for lead speciation, as well as comparison with lead ion selective electrode measurements. Field-based metal bioavailability sensors are the ultimate goal for this DNA-based technology. The two approaches presented here represent potential alternatives to traditional DOC monitoring for metals risk assessment but both methods require further research and development. Funded by NSERC, International Copper Association and Global Water Futures.

#### **BIOGRAPHY – SCOTT SMITH**

**Dr. Scott Smith obtained BSc (1994) and PhD (1999) degrees in geochemistry from McMaster University. Scott was a PDF in the Geology department at the University of Toronto before starting at Wilfrid Laurier University in 2001. He is now a full Professor in the Department of Chemistry and Biochemistry at Wilfrid Laurier University. Dr. Smith is an associate member of the Canadian Rivers Institute and a board member of the Laurier Institute for Water Science. Scott is an applied chemist who often collaborates with other scientists and engineers. His areas of expertise include nutrient removal and recovery, aquatic geochemistry, speciation analysis (P,N,S and metals), surface complexation, chemical equilibrium modelling, numerical methods, dissolved organic matter and molecular spectroscopy.**