

Unraveling Metal Speciation in Sediment Using Advanced Surface Characterization Techniques

This initial project will focus on manganese chemistry however there is a fantastic opportunity to move beyond single metal analysis to explore other metal contaminants of interest in subsequent iterations. This project aims to elucidate the speciation of manganese (Mn) in sediment, a crucial factor influencing water quality and biogeochemical cycling. We will leverage the visiting Ph.D. students' expertise in Mn speciation and combine it with our established proficiency in advanced surface characterization techniques, specifically X-ray photoelectron spectroscopy (XPS), scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS), and potentially Raman spectroscopy. This collaborative effort will provide unprecedented insights into the chemical states and distribution of Mn within sediment matrices, directly impacting our understanding of environmental risk and remediation strategies. Furthermore, this project will prioritize the students' leadership development and community engagement through targeted activities. Importantly, this project will strengthen collaborations between institutional members of the IIES, specifically Trent University and the University of Edinburgh, building upon initial visits and laying the groundwork for expanded future partnerships.

Research Objectives:

- 1) Characterize the surface speciation of Mn in sediment samples using XPS and Raman.
- 2) Map the spatial distribution of Mn and associated elements using SEM-EDS.
- 3) Correlate Mn speciation with environmental parameters including seasonal variation and aerobic variation

Significance and Impact:

Manganese plays a vital role in environmental processes and as such will contribute to an enhanced understanding of Mn biogeochemistry. In addition to the specific scientific advancement, this project will leverage infrastructure that is infrequently applied to environmental systems demonstrating the value of interdisciplinary research. As we better understand Mn sediment interaction and chemical cycling we will contribute to the development of robust remediation strategies. Furthermore, this exchange opportunity will provide the visiting student to participate in peer mentorship and community engagement through laboratory interactions as well as guest classroom lectures, departmental seminar presentations and exploration of overlapping water quality challenges in the Trent Severn Waterway ecosystem.

This project aligns with the goals of the IIES QES program in supporting environmental research, facilitating international collaboration, enhancing student training, developing leaders and strengthening IIES member collaboration.

This proposed project is a direct result of initial collaborative visits by Dr. Vreugdenhil to the University of Edinburgh, and will build upon this foundation. The students' visit will facilitate knowledge exchange, establish lasting research connections, and pave the way for future joint projects between Trent University and the University of Edinburgh, strengthening the IIES network.