Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23130

Investigating Rhenium Biogeochemistry in a Heavily Enriched Wastewater Treatment Plant

MEGHAN BOYD AND DR. BAS VRIENS

Queen's University

Presenting Author: 23dty@queensu.ca

The trace metal Rhenium (Re) is one of the rarest elements on Earth, and therefore its biogeochemistry is relatively understudied. Recent work in our group has discovered elevated concentrations of Re in a wastewater treatment plant (WWTP) in Southern Ontario, Canada. The facility in question treats municipal wastewater as well as industrial effluent, stemming from a precious metal recycling plant. This site thus presents a unique opportunity to study the speciation, transport, and fate of Re within the treatment process and post-discharge, as well as to probe the fundamental biogeochemical cycling of Re under varying redox conditions.

Total concentrations of Re in the sewage sludge and effluent from this site, determined by ICP-MS after acid digestion, range between 185-1300 µg/kg and 1-5 µg/L, respectively, and were consistently high in samples collected between 2021 and 2024. To understand the apportionment of Re across the sewage sludge matrix fractions, we sequentially extracted freeze-dried sludge samples, using an adjusted BCR methodology. Rhenium appeared to be primarily associated with the residual (>50%) and organic matter fraction (25-30%) with the other fractions (exchangeable, carbonates, oxides, phosphates) having minor contributions (~<10%). This association suggests that there is an active uptake of Re by activated sludge, more so than geochemical precipitation of Re with oxide or phosphate phases in the treatment facility. Analysis of the sludge samples with scanning electron microscopy (SEM) revealed that there was no discernible particulate Re (>5 µm), implying that the Re is loaded to the treatment facility in dissolved or fine colloidal form. In addition to the above, I will also present data on the speciation of Re in solution across the various treatment steps, as well as Re concentrations in the water and sediments of the receiving river downstream of the WWTP.

The importance of this work is twofold. It will help the facility to improve Re elimination within the treatment steps and prevent potential environmental impacts. It will also elucidate knowledge pertaining to the aqueous speciation of Re and gain a deeper understanding of Re biogeochemical cycling in general.