Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18906

Hydrological and biogeochemical processes controlling heterogeneity in groundwater Mn contamination: Insights from two lake catchment systems

DEBRA HAUSLADEN, MUHYMINUL ISLAM, JULIANA SMILLOVICH AND VANESSA DI BATTISTA

Université de Sherbrooke

Presenting Author: debra.hausladen@usherbrooke.ca

Groundwater manganese (Mn) contamination poses a global threat to ensuring access to clean drinking water. Even at concentrations below current health standards, Mn in drinking water has been linked to severe health issues, such as infant mortality rates, heart defects, and cognitive and behavioral impairment. Understanding Mn sources and cycling dynamics within the soil profile and underlying aquifer is essential to manage groundwater resources and mitigate public health risks. Elevated Mn concentrations in groundwater are typically associated with shallow, anoxic water tables and organic-rich soils. Recent work has reported higher Mn and dissolved organic carbon (DOC) concentrations near rivers and thus suggest surface water-derived DOC may promote Mn mobilization [1]. However, predicting Mn concentrations in drinking water wells is challenging due to the complex interplay of local geology, hydrology, and biogeochemical processes.

In this study, we investigate the groundwater composition for private drinking water wells (n=49) in two lake catchment systems with contrasting wastewater infrastructure to better understand the heterogeneity of groundwater Mn and identify key hydrobiogeochemical processes influencing groundwater quality. Differences in the built environment between the two catchments (i.e., presence of a sewer system vs. septic systems) enabled us to investigate the impact of differing anthropogenic organic inputs on groundwater Mn concentrations. Groundwater samples were collected along six transects around each lake to examine changes in water quality at varying distances from surface water bodies. These samples were then analyzed for geochemical parameters and stable isotopic signatures ($\delta^{18}O$, $\delta^{2}H$) to investigate the influence of surface water mixing and anthropogenic inputs on the release of Mn in bedrock aquifers. Our findings provide insight into the spatial heterogeneity of groundwater Mn concentrations and how localized physical and hydrological variations, especially at the interface of surface and groundwater, impact the biogeochemical processes controlling Mn mobilization. Ultimately, this knowledge can inform strategies to minimize Mn contamination and develop treatment technologies to improve access to safe drinking water.

[1] McMahon, P.B., Belitz, K., Reddy, J.E. & Johnson, T.D. *Environmental Science & Technology* **53**, 29–38 (2019)