Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24742

Socio-hydrogeochemical drivers and treatment challenges of co-occurring metal(loid)s in private wells

DEBRA HAUSLADEN, MD. MUHYMINUL ISLAM, QIANQIAN LI, VANESSA DI BATTISTA AND BINRUI LI

Department of Civil and Building Engineering, Université de Sherbrooke

Presenting Author: debra.hausladen@usherbrooke.ca

Naturally occurring contaminants threaten access to safe drinking water, particularly for users of private wells where low monitoring can result in sustained exposure. Effective management requires understanding the interplay between the built environment, biogeochemical processes, and human behavior regarding treatment maintenance. This study investigates the spatial variability of co-occurring metal(loid)s in household wells in two lake catchments with contrasting wastewater infrastructure to identify key processes influencing groundwater quality. Groundwater samples were collected from six transects established around each lake in the Eastern Townships region of Québec, Canada. These samples were then analysed for 51 geochemical parameters, stable isotopic signatures ($\delta^{18}O$, $\delta^{2}H$) of water, and dissolved organic matter composition to investigate the influence of surface water mixing and anthropogenic inputs on the release of metal contaminants from bedrock aquifers. Batch experiments investigated the influence of dissolved organic matter on Mn oxides - including speciation, colloid formation, and aggregation – to better understand drivers of Mn release. Half of all sampled wells exceeded the federal health guideline for Mn in drinking water (0.12 mg/L). Our results also revealed the presence of chromium (Cr), arsenic (As) and uranium (U) in exceedance of Canadian drinking water guidelines. Notably, we report the first detection of elevated chromium concentrations (up to 63 µg/L) in drinking water wells within this region. Assessment of residential treatment methods by analyzing post-treatment water samples (n=20) showed limited uranium removal, with concentrations increasing in 57% of treated water samples. Similarly, commonly employed treatment methods, such as activated carbon and greensand filter systems, sometimes resulted in worsened manganese levels, exceeding the recommended health guideline by almost 20 times in one case. Our findings highlight current treatment limitations and spurred us to develop a novel Mn removal method based on advanced oxidation processes. This innovative approach offers a more sustainable solution by eliminating the need for Mn-based oxidants in regeneration. Together, these findings inform a more holistic approach to private well water management, underscoring the importance of considering both socio-hydrogeochemical factors and human behavior to minimize exposure risks and safeguard public health.