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The distribution of As, Fe, and Mn in groundwater of Alberta, Canada

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The release of contaminants into groundwater can negatively affect biodiversity conservation and human health. Hence, understanding the occurrence and extent of specific groundwater constituents in aquifer systems that provide fresh water sources is required to detect areas that might be susceptible to contamination and to protect ecosystems, and human health. The objective of this ongoing project is to evaluate the distribution of groundwater constituents including arsenic (As), iron (Fe), and manganese (Mn) on a province-wide scale in Alberta, Canada, and reveal geochemical processes that may control their release or attenuation in groundwater systems.

A large database containing chemical and physical parameters from more than 150,000 groundwater samples from shallow wells (<150 m below ground surface (bgs)) provides the basis of this study. This database integrates information about the characteristics of wells from which groundwater samples were collected such as water well depth and completion intervals for monitoring, public, and private wells. Relationships between concentrations of the target constituents and the geological units assigned to the screened interval of the wells were evaluated to gain insights into possible sources and controls on their distribution. Initial results indicate that higher concentrations of As, Fe, and Mn are found in groundwater samples from wells completed in sediments above bedrock. About 23% of the samples with detected Mn concentrations (n= 11,007) exceeded the Canadian drinking water guideline of 0.12 mg/L. Similarly, about 31% of the groundwater samples with detected As concentrations (n=1,594) exceeded the Canadian drinking water guideline of 0.01 mg/L. For iron, the Canadian aesthetic objective in drinking water of 0.3 mg/L was exceeded in 31% of the groundwater samples (n=149,074). Elevated concentrations of Fe and Mn are found all across Alberta while elevated As concentrations are mainly observed in the central area of the province, especially between the regions of Edmonton, Cold Lake, and Peace River. Further analyses will include geochemical modeling and statistical correlations to constrain the mechanisms controlling the mobilization and the fate of these groundwater constituents in Alberta.