

Arsenic release in groundwater from a mineralized sulfide area of the Canadian Shield in western Quebec

R. BONDU^{1*}, V. CLOUTIER¹, E. ROSA¹ AND M. BENZAAZOUA¹

¹Université du Québec en Abitibi-Témiscamingue, 341 rue Principale Nord, Amos, J9T 2L8, Canada
(*correspondance : raphael.bondu@uqat.ca)

Context and results

In order to study the release of arsenic (As) to groundwater, bedrock cores and groundwater samples were collected from three mining exploration boreholes located in a mineralized area of the Abitibi-Témiscamingue region (Province of Quebec, Canada). The methodology includes 1) mineralogical characterization of bedrock cores, 2) implementation of leaching experiments and 3) chemical analysis of borehole waters. Mineralogical analyses of core samples indicate that As is mainly present as arsenopyrite (FeAsS) and gersdorffite (NiAsS). Core leaching experiments show that gersdorffite-rich samples release larger amount of As than arsenopyrite-rich samples, which is mainly attributed to the high reactivity of gersdorffite compared to arsenopyrite. Chemical analyses of groundwater reveal that As concentrations range from 0.11 to 0.46 mg/l but high As concentrations in groundwater are not associated with the occurrence and extent of gersdorffite-rich zones in the bedrock.

Interpretation and conceptual model

These results are interpreted as evidence that groundwater flow is the major control on As concentrations in borehole waters. First, the low permeability of the gersdorffite-rich zone suggests its limited contribution to the well discharges. Second, the groundwater composition indicates that the mobilization of As is likely related to the reductive dissolution of Fe and Mn oxyhydroxides in the downgradient part of the aquifer. Thus, the high As concentrations in groundwater would be mainly driven by (1) the initial release of As through sulfide oxidation under oxidizing conditions (recharge areas), (2) the sequestration by sorption onto Fe-Mn oxyhydroxides, (3) the transport of As in dissolved and particulate forms in groundwater, and (4) the (re)mobilization by dissolution of Fe-Mn oxyhydroxides under reducing conditions (downgradient areas). This work highlights the importance to consider groundwater flow and chemical evolution when evaluating and predicting As occurrence in bedrock aquifers.