Assessing the impact of mine dewatering and climate change on the mobility of trace elements in peatlands

Khaoula Loussif, Eric Rosa, & Vincent Cloutier
Groundwater Research Group, Research Institute on Mines and the Environment – Université du Québec en Abitibi-Témiscamingue, Amos, Quebec, Canada

ABSTRACT

Peatlands cover more than 4 million km^2 at the global scale, with nearly 30% located in Canada. These environments exert significant hydrological and geochemical functions in surface and groundwater flow systems and host important ecosystems. The functions of peatlands rely on a delicate balance between hydrological, chemical, and biological processes and external factors such as human activities and climate change can disrupt this balance. There is thus a growing interest for identifying efficient approaches for ensuring their protection and restoration. Among the challenges associated with peatland protection, evaluating the indirect impacts of human activities on the chemical composition of peatland porewaters represents a major challenge. In the Canadian Shield, the potential impacts of mine dewatering (and flooding) on peatlands represents a major issue. Fitting in this context, the objective of this study is to simulate the thermodynamic equilibrium of trace elements that are sensitive to redox and pH conditions in peatland porewaters and surrounding groundwaters. The focus is set on a boreal peatland of the Canadian Shield, in Abitibi-Témiscamingue located near the Akasaba West mining project (Agnico Eagle Mines). Water samples (n = 47) were collected at various depths in the summer and fall of 2019. Samples were analyzed for physicochemical parameters (pH, redox potential, temperature, electrical conductivity, dissolved oxygen), major ions, trace elements, dissolved organic and inorganic carbon (DIC-DOC) and stable isotopes of water (δ^2H-δ^{18}O). The available chemical data is used to evaluate the speciation and saturation indexes of targeted trace elements under natural conditions, using PHREEQC. The physicochemical conditions used in these simulations are then modified to represent the effects of peatland dewatering, re-flooding and to test the impact of climate scenarios on the mobility of trace elements. Ultimately, this research will provide novel insights on the geochemical response of peatlands face to human impacts and climate change.