Assessing solute sources and contaminant transport in Finnish mine sites

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Isotopic methods accompanied by hydrogeochemical studies can reveal solute sources, distribution processes and possible hydraulic connections of mine waters. Moreover understanding the hydrological systems and long-term changes in water chemistry enables predicting the mine drainage quality and behavior in long run as well as choosing the adequate water treatment method for each site.

Due to the predictable relationship between stable oxygen and hydrogen isotopes, they are widely used as natural tracers in water related studies. However, although they reveal the interaction of hydrological systems, they lack the hydrogeochemical information derived from the bedrock. The effect of the mineral composition of the bedrock on groundwater can be commonly seen not only in the chemical concentrations, but also in isotopic composition of waters. Due to differences in the isotopic compositions of different minerals and anthropogenic inputs, bedrock related isotopes (e.g. Sr and Pb) can be used to identify the solute sources and mixing processes in mine waters. These isotopes are released into mine waters due to natural weathering processes as well as mineral processing and can thus be used to distinguish ore-related emissions from natural solute sources. In addition, in case of several solute sources and watersystems, the isotopes may help to understand water mixing processes.

Although the isotopic method has been widely used in hydrological studies in Finland, the focus has not been in estimating the mining related emissions. Therefore the method is being tested in two mine sites in Finland. A set of isotopic data ($S(SO_4)$, Li, Sr, Pb, O, and H) will be combined with chemical information and physical parameters of water in order to assess the emission sources, migration and their reactions, mixing and dilution processes in watersystems. Special attention is given to the rates of processes that generate the contamination. The results obtained will be used for the prediction of chemical transformation and long-term impacts of mining at study site and its surroundings.