

Injection of surface water into an anoxic-suboxic aquifer: water/sediment interaction and groundwater geochemistry

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In the town of Cap-Rouge near Québec City, Canada, warm surface water from the St. Lawrence River was injected into an aquifer during summer so that its thermal energy can be used in winter to melt waste-snow. This waste-snow treatment project provided a unique opportunity to study some of the most important water/sediment interactions, such as mineral dissolution/precipitation, organic matter degradation, and sulphide mineral oxidation. These interactions were, in this case, intensified by the injection of a warm and well-oxygenated water mass into an anoxic-suboxic aquifer. With the abrupt change of geochemical conditions and the availability of detailed hydrological data and sampling opportunities, it is possible to investigate these interactions in a more systematic and quantitative manner. Knowledge obtained can help us better understand similar natural processes, where direct geochemical or hydrological observation is difficult or impossible.

Before the surface water injection, undisturbed sediment and water samples were collected at different depths in the aquifer. The sediments were examined by XRD and were subjected to chemical analyses and to a modified sequential extraction

scheme (Tessier et. al., 1979; Huerta-Diaz and Morse, 1990; Kostka and Luther, 1994) to determine their mineralogical and geochemical compositions. Chemical analyses were performed on the river water and aquifer water samples collected prior to the injection and on the water samples obtained periodically from the aquifer after the surface water injection. Based on the preliminary results, carbonate mineral precipitation and dissolution, organic matter degradation, sulphide mineral oxidation, and ferrous iron oxidation and ferric iron precipitation in the aquifer are discussed. The influence of these geochemical reactions on the mobility of trace metals and nutrient elements, some of them are potential contaminants, is examined.

References

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