

Differentiation of Chloride Source Using Stable Chlorine Isotopes

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An industrial site, located in Fort Saskatchewan, Alberta, had elevated chloride concentrations in the alluvial aquifer upon which the plant was located. Chloride was thought to be coming from brine wells and associated mud pits installed in the mid-1960s to early-1970s. Elevated chloride was also measured in the bedrock.

A previously completed hydrochemistry study found that the brine water chemistry was distinctively different from the bedrock water chemistry. Upward hydraulic gradients were also measured at the site. The study concluded that the brine wells and pits were unlikely to be responsible for elevated chloride in the bedrock.

Stable chlorine isotopes were used to investigate the origin of chloride in the bedrock at the industrial site. The brine pond had a ^{37}Cl isotope signature range of +0.17 to +0.32 ‰ SMOC. This is consistent with a seawater evaporate deposit. The bedrock (Belly River Formation) at the site had a ^{37}Cl isotope signature range of -2.37 to -2.68 ‰ SMOC. This strong corroborative evidence suggests that the source of chloride in the bedrock is not the brine ponds.

It is not known whether this is a typical isotopic signature for the bedrock due to a paucity of chlorine isotope data in bedrock. Physical processes such as ion filtration and diffusion are the main mechanisms to fractionate the chlorine isotope signature. This is consistent with the hydrochemistry study of groundwater flow at the site that inferred flow over a long path, through low permeability materials (such as shale), and then discharge to the North Saskatchewan River.

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Dr. Blyth has a doctorate degree in earth sciences with a specialty in hydrogeology from the University of Waterloo. He has worked as a geologist and hydrogeologist in Alberta, BC, Ontario, NWT and Australia. He has extensive experience in contamination research, with a focus on isotopic and other geochemical techniques, which he has applied to coal bed methane and geological storage of carbon dioxide and radioactive waste. He sits on the Scientific Panel evaluating the Standard for Baseline Water-well Testing for CBM/NGC in Alberta. He is currently a Research Hydrogeologist at the Alberta Research Council (ARC) where he is involved in water resources and energy sector research.