Strontium and $^{87}Sr/^{86}Sr$ in Granite and Groundwater in Canada's Underground Research Laboratory

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Strontium concentrations and isotopic ratios ($^{87}Sr/^{86}Sr$) have been determined for core samples of the Lac du Bonnet Granite and groundwater at Canada's Underground Research Laboratory, near Lac du Bonnet, in south-western Manitoba, as part of the Canadian Nuclear Fuel Waste Management Program, funded jointly by Atomic Energy of Canada Limited and Ontario Power Generation. Sixteen core samples (44 to 1068 m depth) of the late Archean granite have mean concentrations of 180 ppm Rb and 192 ppm Sr, and a Sr-weighted mean $^{87}Sr/^{86}Sr$ ratio of 0.8054. Mean $^{87}Sr/^{86}Sr$ ratios for the major minerals are 0.7246 for plagioclase; 0.8869 for microcline, and 24.942 for biotite.

Groundwaters in fractures range from dilute (<1 g/L total dissolved solids, TDS) Ca-Na-HCO_3 type in the upper ~200 m of bedrock to 50 g/L TDS Ca-Na-Cl type at depth. The $^{87}Sr/^{86}Sr$ ratios increase with depth ranging from 0.715 to 0.738 as reported by Li and others in 1989 indicating progressive interaction with plagioclase and perhaps clay and calcite in the fracture zones. A sample of highly saline pore water (85 g/L TDS, Ca-Cl type, containing 81 mg/L Sr) analyzed for the present study, has a $^{87}Sr/^{86}Sr$ of 0.7664, closer to the average whole-rock values. Large differences in Ca/Sr ratios occur between fracture waters and the pore water, (Figure 1). The pore-water points are from successive sampling of introduced deionized water in a borehole that was equilibrating with the saline pore fluid. The distinct differences in Ca/Sr ratios at Ca concentrations greater than 50 mg/L indicate the isolation and stagnant nature of pore water in the unfractured granite relative to groundwater in the fracture systems.

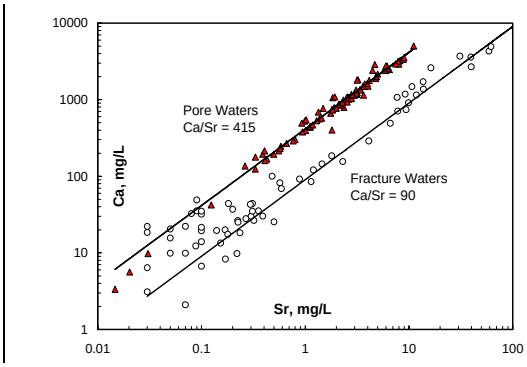

Figure. 1 Differences in Ca/Sr ratios between fracture water and pore water.