Geochemical analysis of uranium mobilization from the South Mountain Batholith and Horton Group siltstones in groundwater systems

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Many rock formations in Nova Scotia, particularly granitic rocks and siltstones of Devonian-Carboniferous age, may have an impact on the water quality of surrounding areas. Weathering and geochemical processes can mobilize uranium, which allows uranium to accumulate in groundwater systems in concentrations above recommended guidelines established by Health Canada. Certain geologic units consist of elevated uranium concentrations. Roll front-type mineralization is responsible for the high uranium concentrations found in the Horton Group siltstones that were used in this study. The South Mountain Batholith (SMB) is known to contain locally high uranium concentrations: late-stage mica-rich granites and monzogranites of the SMB contain elevated U concentrations. Uranium can also concentrate in late-stage fracture systems. Uranium mobilization is dependent on Eh and pH conditions as well as on the ions present in contact waters. In addition to naturally occurring U in groundwater, locally there are areas in Nova Scotia believed to have elevated U concentrations in groundwater systems credited to inputs from local construction waste disposal sites. This study focuses on the chemical agent or agents, both natural and anthropogenic that may be responsible for mobilizing uranium from U-bearing rocks. Road salts and sea water introduce ions into geologic formations that have a potential impact on uranium mobility. Gypsum, either in the form of gyprock in construction waste or as naturally occurring geologic formations, introduces calcium-sulfate into geologic systems, including groundwater. In this study ions such as chloride, sulfate, bicarbonate, calcium and sodium were added to crushed U-bearing rocks in an attempt to isolate the single variable (or variables) that mobilize uranium. The granite used in phase one of this study contained approximately 8.2 ppm U, but produced higher U concentrations in the resultant leachate than the Horton Group siltstone which contained approximately 20 ppm U. Interpretations from preliminary data suggest that the addition of $CaSO_4$ has a greater impact on U-mobilization than $CaCl_2$ which in turn has a greater impact than water alone. The effect of $NaHCO_3$ on U-mobilization is dependent on rock type. Data analysis suggests that construction waste, mainly gyprock, may have an impact on U-mobilization.

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