RADON AND URANIUM DISTRIBUTION AND CONCENTRATIONS ABOVE BURIED URANIUM ORE: THE PHOENIX DEPOSITS, SASKATCHEWAN

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Introduction

The Athabasca Basin is located in northern Saskatchewan and Alberta, and hosts one of the largest reserves of uranium in the world. The Wheeler River property is located on the south-eastern margin of the basin (Fig. 1) and hosts the Phoenix deposits, with currently defined resources of 70.2 M lb U₃O₈ (Roscoe, 2014). The deposits are situated along the unconformity between the Athabasca Group sandstones and metasedimentary basement rocks approximately 400 meters below the surface (Denison Mines, 2014). Sampling locations were selected based on whether or not drill holes intersected mineralization. Water was collected mostly from the top of the water column in each drill hole using copper and plastic-lined steel bottles. In addition, four samples were collected at various depths below the water table at drill holes WR-314 and WR-380 (Fig. 2).

Why Radon and Helium?

Radon and helium are decay products of uranium and both occur in a gaseous phase, allowing for easy transport and dispersion from the one body. Because of this intimate relationship between uranium, radon and helium, both are used extensively in the search for uranium ore bodies (e.g. Dyck, 1980). This study has shown elevated radon in groundwaters overlying the Phoenix deposits. Thus understanding their sources, how they are transported, and how radon and helium distribute is crucial to the use of these gases in the future exploration of concealed uranium deposits. Five possible sources and/or transportation methods are considered: contamination, diffusion, bubbling, water flow, and a local source.

Transport by Diffusion?

Two diffusion models are considered: vertical and spherical diffusion in water. Diffusion represents an unlikely transportation model for radon with a half-life of 3.8 days and the depth to one. Helium-4 stable, moves quickly and thus can diffuse great distances.

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Diffusion Transport Models

(a) Vertical Diffusion Model

(b) Spherical Diffusion Model

Gas Bubbling?

Bubbling was not observed from ground water, or in samples. Thus bubbling as a means of transportation for radon can be rejected.

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