EVALUATION OF RADIOGENIC AND NUCLEOGENIC PRODUCTS AS VECTORS FOR DEEPLY BURIED URANIUM MINERALIZATION

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Alpha decay of uranium and associated neutron-capture processes on both dissolved and solid-state elements can produce appreciable amounts of a variety of short- and long-lived radiogenic and nucleogenic products associated with uranium mineralization in deeply buried to surficial environments. Enhanced concentrations of dissolved and gaseous He-4 can originate from radiogenic decay of U and Th in orebodies. Similarly neutron capture reactions in Li-enriched, clay bearing sediments yield elevated specific activities of tritium (H-3) as HTO, as well as Cl-36 in areas of increased salinity from dissolved chloride. All of these processes, and their measured levels, can be a direct reflection of the geology, hydrogeology, diffusion, specific nuclide half-life, mineral age and amount of attendant uranium or thorium. Moreover, in the case of uranium oxide minerals, it may be possible to speculate on the mass, concentration and geologic history through the use of U-236.

The Athabasca Basin in northern Saskatchewan Canada contains a number of high-grade uranium ore deposits which occur at, or immediately below, an unconformity between Archean and Paleoproterozoic metasediments and intrusive rocks and overlying Proterozoic sandstones. These ore deposits have occurred as a result of fluid mixing, involving oxidized, saline basinal and reducing basement fluids, and focussed fluid flow along sub-vertical faults intersecting the unconformity between approximately 1500 and 900 Ma. Within this, enhanced fluid-rock interactions have resulted in defined mineralogical and lithogeochemical alteration haloes. While this may seem ideal, the small footprint and deeply buried nature of these deposits still presents a challenge to conventional geochemical exploration techniques and studies on the spatial distribution of dissolved, gaseous and solid state radionuclides have been deployed over the years to evaluate their potential in uranium exploration and deposit evaluation. This talk will present an overview of findings from these studies and comment on their overall effectiveness.