

# Assessing the Environmental Risk from Releases of Naturally Occurring Radioactive Materials (NORM) in the Western Canadian Oil Patch

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## Naturally Occurring Radioactive Materials in the Athabasca and Red Deer Rivers

### Background and Scope

- Uranium and Thorium exhibit high affinities for organic matter
- Widespread oil and gas formations exist in the Western Canadian Oil Patch
- Potential for release of U- and Th- series radionuclides into surface waters through weathering or oil and gas operations as shown in the figure below
- Current release limits for NORM radionuclides only consider doses to humans and do not account for biogeochemical behavior or effects to non-human biota
- Results from this project are relevant to Health Canada and the Canadian Nuclear Safety Commission and can ultimately be used to instruct future release limits for NORM

Radionuclides

### 2019 FY Activities

- Extensive sampling program (n = 22 sites) along the Athabasca and Red Deer Rivers in the spring and fall
- Collection of surface waters, sediment, suspended particulate, sediment pore water and concentrations of Rn in soil gas and water
- Radon in soil gas concentrations up to >100,000 Bq/m<sup>3</sup> (Red Deer) and 64,000 Bq/m<sup>3</sup> (Athabasca) observed. Surface water concentrations are 2-3 orders of magnitude lower.
- Higher average radon content in Athabasca River soil gas, but higher average radon content in Red Deer River
- Strong radon signals presence of U- series radionuclides.
- Development of methodology for Po analysis involving co-precipitation with Ti, dissolution in acid, and micro-precipitation with Cu

### Future Work and Collaborations

- o Radiological analyses of collected sample media for U- series radionuclides, including Th, Ra, Po, and Pb
- o In-depth analysis of the biogeochemical cycle of Po in the environment (behavior similar to Hg)

- o Compilation and publication of initial findings to raise public awareness about the project
- o Pursuing collaboration with the National Wildlife Research Centre (Carleton University) regarding effect of radioactivity on whitefish and with the Fort McKay First Nations

## Assessing the Role of Atmosphere-Soil Interaction on Radon Emanation from Soil

### Background and Scope

- Radon levels in underground enclosed spaces (such as basements) can vary considerably on a short timescale
- This variance can be attributed in part to changing atmospheric parameters such as barometric pressure and potentially precipitation, which affect pressure differential and permeability in soils
- Construction of a time-series of radon concentrations versus meteorological parameters and soil conditions can provide a better insight into these interactions and aid in modelling radon behavior
- Can a user-friendly monitoring apparatus be developed and implemented elsewhere?
- Results relevant to Health Canada as their will provide valuable insight into radon behavior

### 2019 FY Activities

- ✓ Development and installation of a radon monitoring experimental setup on the CRL site
- ✓ SARAD Radon Scout Detector in tandem with a meteorological station and soil moisture probes
- ✓ Radon appears to be negatively correlated with temperature and pressure, and positively correlated with relative humidity
- ✓ Indicates that precipitation events have a significant effect on radon concentrations in soil gas

### Future Work and Collaborations

- o To examine radon exhalation in a variety of substrates and settings over seasonal timescales
- o Potential collaboration with the Australian Nuclear Science and Technology Organization (ANSTO) for application of low-level radon detectors to investigate radon backgrounds and fluxes in Canada
- o To assess the role of radon as a risk driver for NORM associated with non-conventional oil and gas developments (fracking & oil sands) in Canada