

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/m³ (Red Deer) and 64,000 Bq/m³ (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