Soil Gas Radon and Natural Radioactivity Studies related to the North American Soil Geochemical Landscapes Project

Kenneth L. Ford

Natural Resources Canada - Geological Survey of Canada – Ottawa

and

Jing Chen

Health Canada – Radiation Protection Bureau - Ottawa

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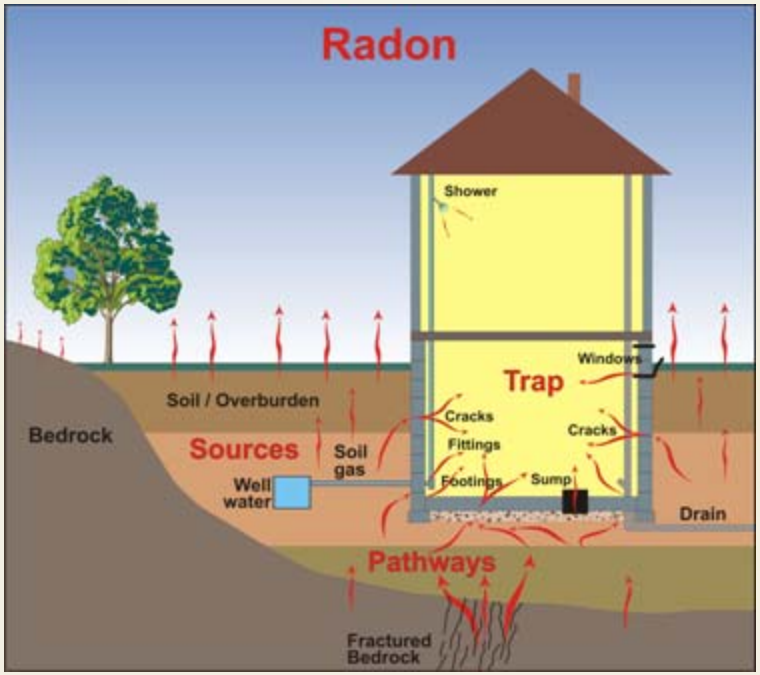
What is radon and why is it important?

- Naturally occurring radioactive gas
  - colourless, odourless, tasteless
  - can only be detected by testing
- Soil gas radon is contributing to the indoor environment
- Main source of exposure to natural radiation by the population
- 2nd leading cause of lung cancer (WHO, 2005)



Health Canada's New Radon Strategy

- Prior to 2007 HC guideline for maximum allowable Rn in homes was **800 Bq/m^3**

- In 2007 HC implemented a "New Radon Strategy"
  - remedial measures should be undertaken whenever average Rn concentration exceeds **200 Bq/m^3**
  - new strategy harmonized with international guidelines, practices and action levels
  - recognized the need to develop and use radon potential maps to focus attention for testing in high risk areas and to guide risk management; supplementary data from airborne gamma ray spectrometry, bedrock and surficial geology maps and soils maps will be used to develop radon potential maps.

Assessment of Radon Potential

Types of geoscience data considered to be of primary importance for estimating variations in radon risk potential

Bedrock geology – for example: rock types naturally high in uranium (granites, black shales)

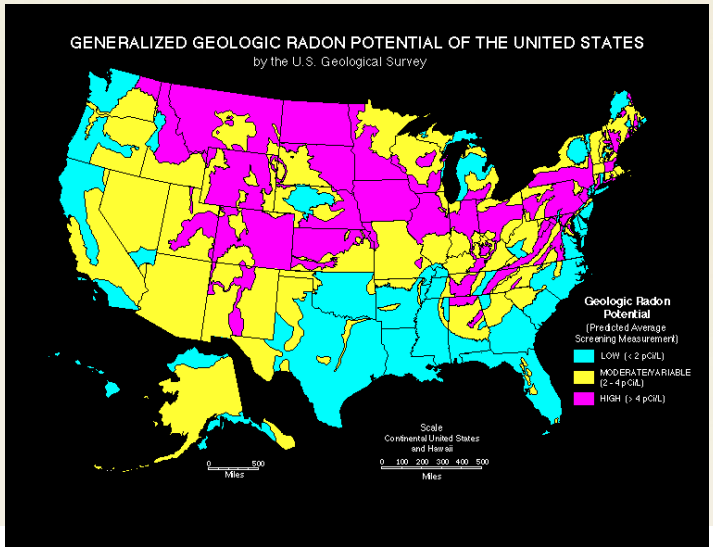
Surficial geology – for example: certain glacial deposits derived from U-rich rocks and certain types of glacial lake deposits

Airborne gamma ray spectrometry

Geochemical data for surficial media, including lake and stream sediments and till

Soil survey data – including soil gas radon and permeability measurements

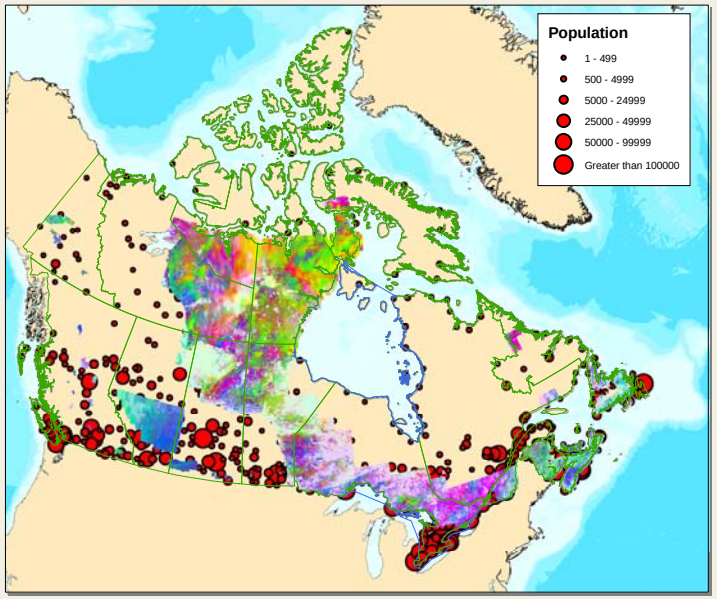
Indoor Radon data



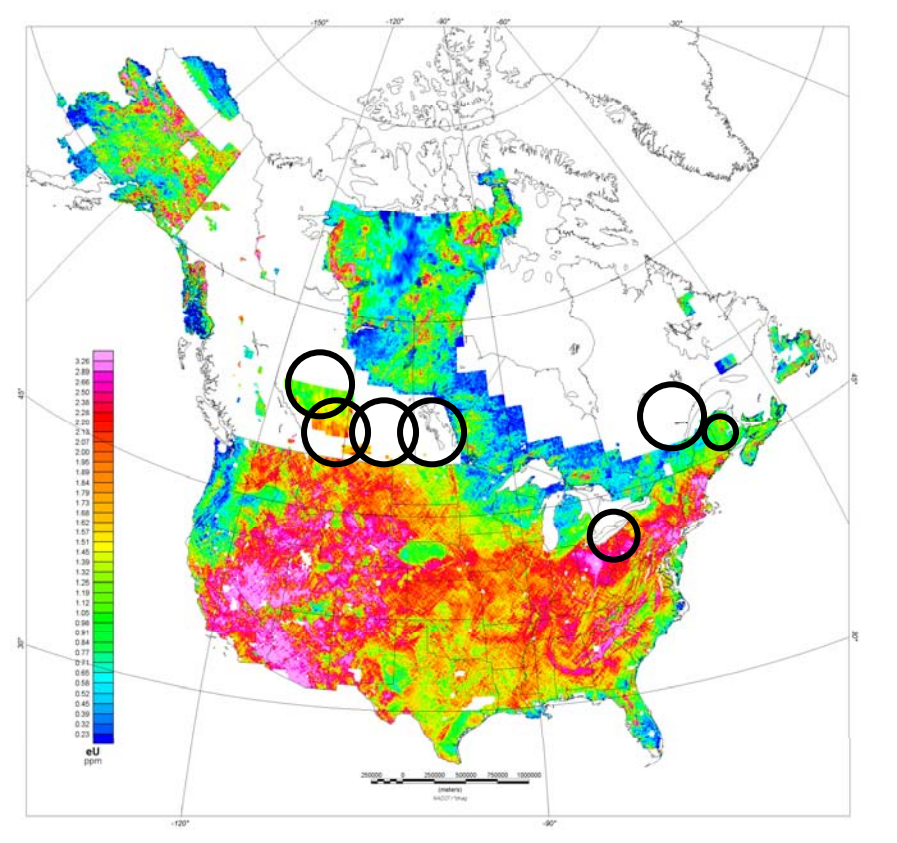
Map source: United States Geological Survey http://energy.cr.usgs.gov/radon/rnus.html

In 2007, Health Canada and Natural Resources Canada entered into a partnership to acquire new geoscience data relevant for identifying radon prone areas in selected parts of Canada

- New airborne gamma ray spectrometry surveys where there are gaps.



Sources: Population information from Atlas of Canada
Ternary Radioactivity Map of Canada from
GSC OF 4763.



Uranium

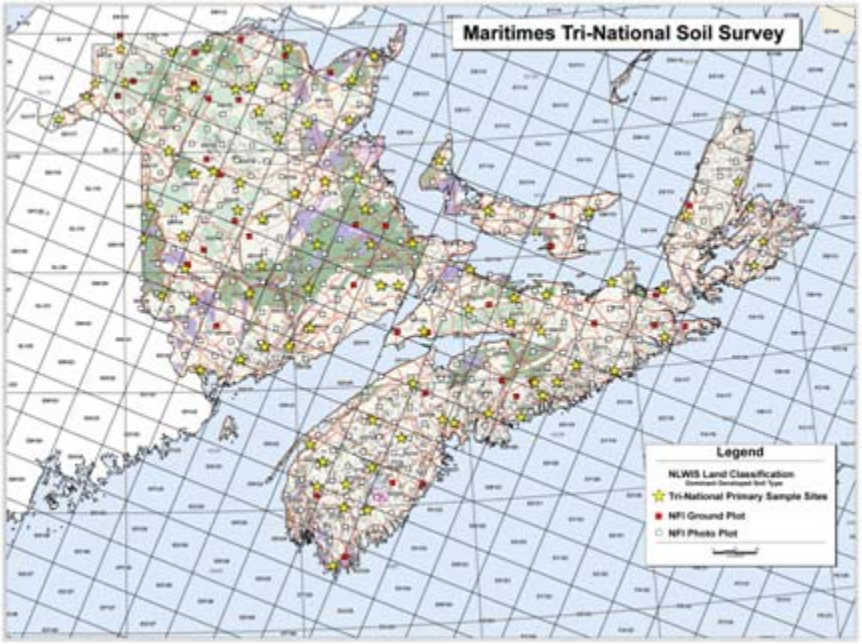
Source: Darnley et al., 2003;
Duval et al., 2003

In Addition …. Ground studies

As part of NRCan's - North American Soil Geochemical Landscapes Project (NASGLP), Health Canada is supporting activities to acquire, in Canada, the following types of data:

- Soil gas radon
- In-situ radioactivity (K, eU, eTh)
- Soil permeability and
- Laboratory gamma ray spectrometry

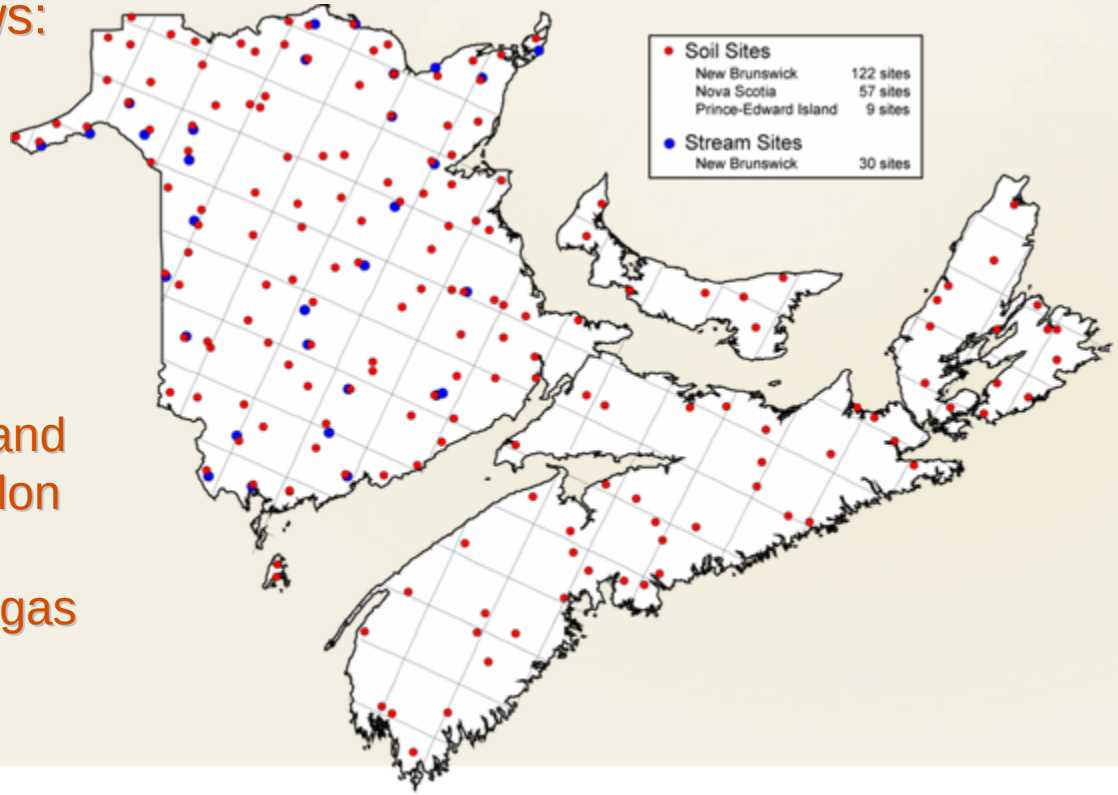
  (A-, B- and C-Horizon samples)



In 2007 studies of soil gas radon and ground and laboratory gamma ray spectrometry (GGRS and LGRS) were undertaken as value-added activities to the NASGLP.

Project areas were as follows:

- Maritime provinces
- Southern Ontario transect
- Ottawa area to evaluate
  - correlations of soil radon and permeability with indoor radon potential.
  - seasonal variations of soil gas radon and permeability

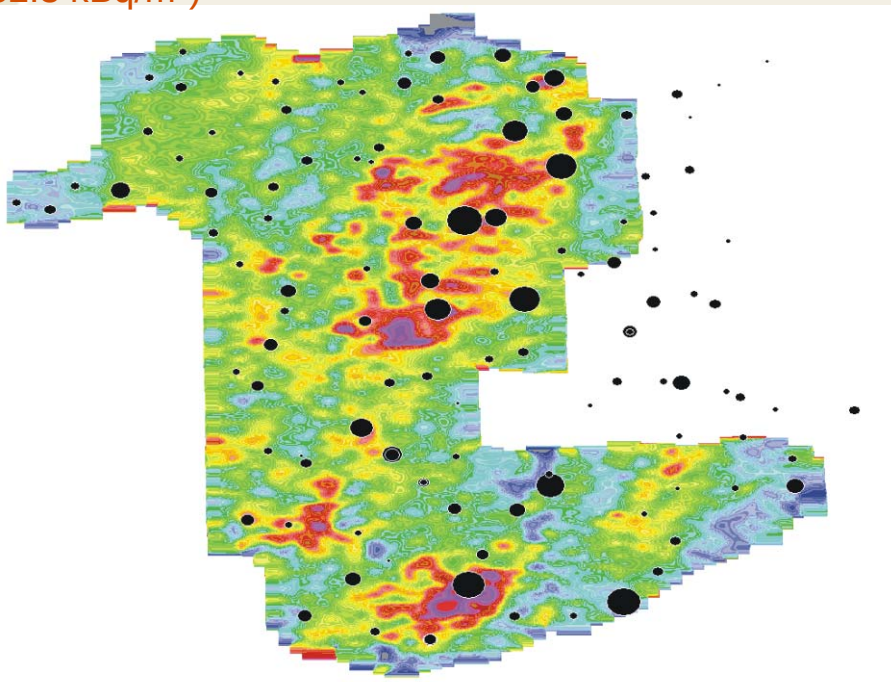


2007 Field Activities – Soil Gas Radon and Permeability

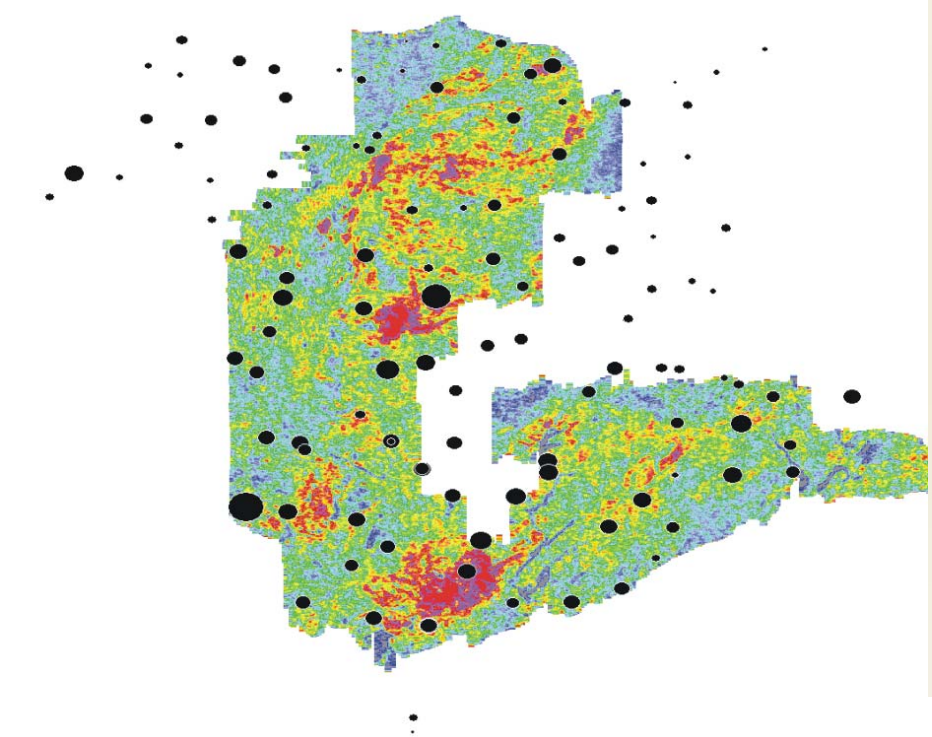
2007 Activities – Ground and Laboratory Gamma Ray Spectrometry

Preliminary Results …

Background map shows eU grid from airborne gamma ray spectrometry survey (AGRS) with flight lines spaced 5 km apart (GSC OF 4461 and 4462). Proportional black dots show average soil gas radon at NASGLP sites (Range: 0.0 – 128.7 kBq/m^3, Mean: 32.3 kBq/m^3)

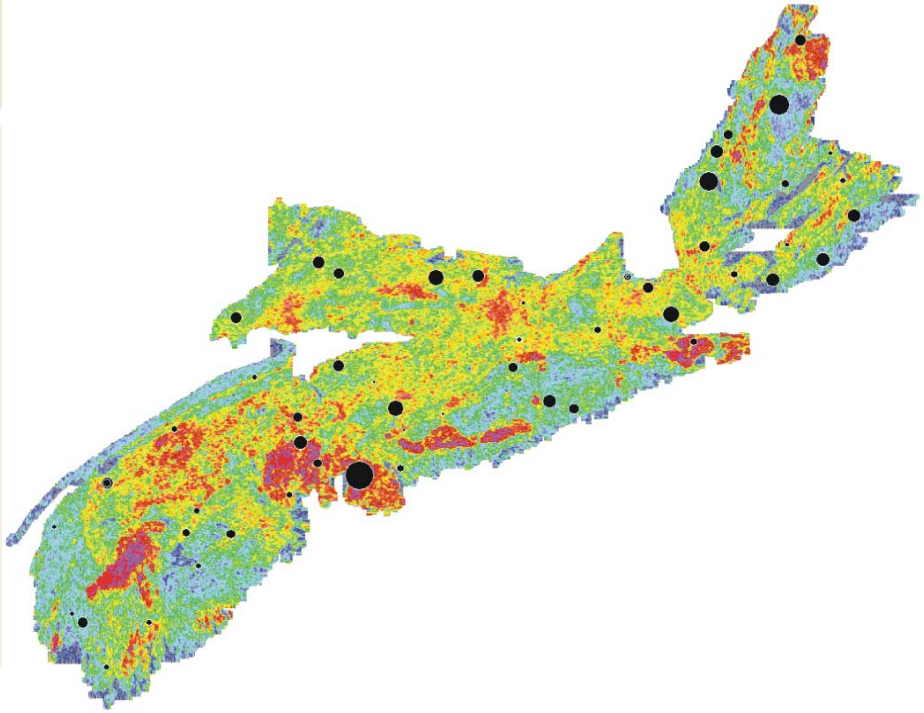


Background map shows eU grid from AGRS survey with flight lines spaced 1km apart (GSC OF 4496). Proportional black dots show eU from in-situ GGRS measurements at NASGLP sites (Range: 0.0 – 3.0 ppm, Mean 0.88 ppm)

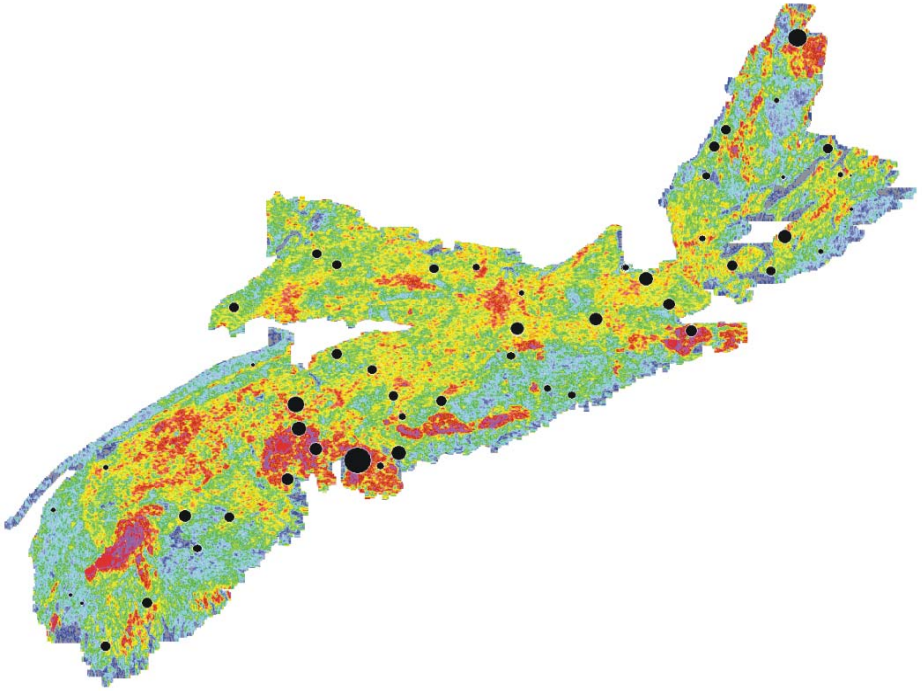


Preliminary Results …

Background map shows eU grid from AGRS survey with flight lines spaced 1km apart (GSC OF 4466). Proportional black dots show average soil gas radon Content at NASGLP sites (Range: 0.0 – 109.1 kBq/m³. Mean: 27.59 kBq/m³)



Background maps shows eU grid from AGRS survey with flight lines spaced 1km apart (GSC 4466). Proportional black dots show eU from in-situ GGRS measurements at NASGLP sites (Range: 0.4 – 2.5 ppm, Mean 0.97 ppm)



Preliminary Results For Southern Ontario and Ottawa Area

Long term (seasonal) variations at 2 Ottawa sites (May 17 to Nov. 18)

- results showed that multiple measurements at each site can characterize soil gas Rn levels within a deviation of 30%.

- in contrast, permeability values exhibited large variations at each site. Given the size and weight of the permeability apparatus, a qualitative proxy measurement is required for reconnaissance surveys. Permeability apparatus should be used only for detailed follow-up studies.

Correlation of soil gas Rn and permeability with indoor Rn potential

- results of a study of 32 sites and 167 homes across Ottawa showed that the average "Soil Rn Potential (SRP) Index" for a community area correlated well with indoor Rn potential (% of homes above 200 Bq/m^3) but not with individual sites with individual homes. The SRP Index is based on a combination of factirs related to soil gas Rn and permeability factors,

Preliminary Results from Southern Ontario and the Ottawa Area

Variation in soil radon across Southern Ontario (Ottawa to Sarnia)

Preliminary estimates, based on comparisons of SRP Index values for Southern Ontario and the Ottawa area, suggest that areally-significant portions of Southern Ontario may have a higher percentage of homes with indoor radon levels above 200 Bq/m$^{3.}$ At present there are no indoor Rn measurements to verify the estimates.

Highest average levels of soil gas Rn are generally associated with geologic formations dominated by black shale.

Thank You

References Cited

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