Use of Thoron to Identify Preferential Pathways for Vapor Intrusion

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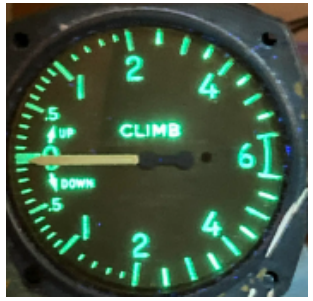
Background

- 12-acre watch factory campus 1850-1957, then a variety of industrial tenants
- Luminescent dial painting during WW2 era
- Owner hired H&A to investigate & remediate releases from metal plating tenant and radium paint
- Comprehensive Site Investigation: Heavy metals, CVOCs, petroleum, coal ash, radium



Regulatory requirements

- Investigation and mitigation of potential exposure to radium: Massachusetts Department of Public Health (MassDPH)
- Radiation dose from radium must meet release standards (10 millirem/year dose limit)
  - Ingestion of dust/particles
  - External (ionizing radiation)
  - Inhalation (radon)
- Cannot rely on radon mitigation systems to demonstrate compliance with dose limit

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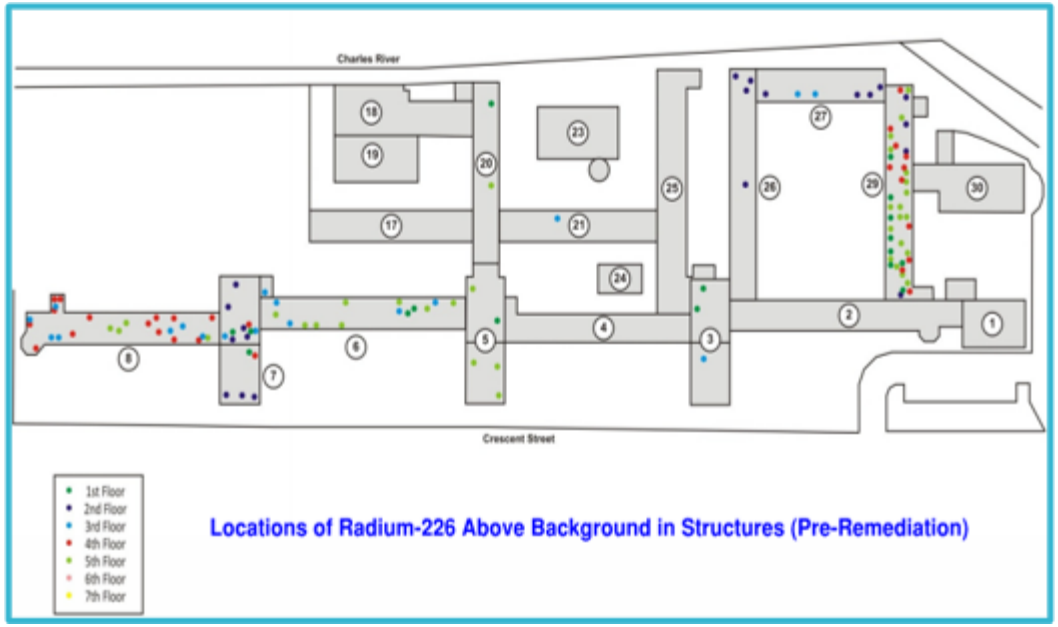
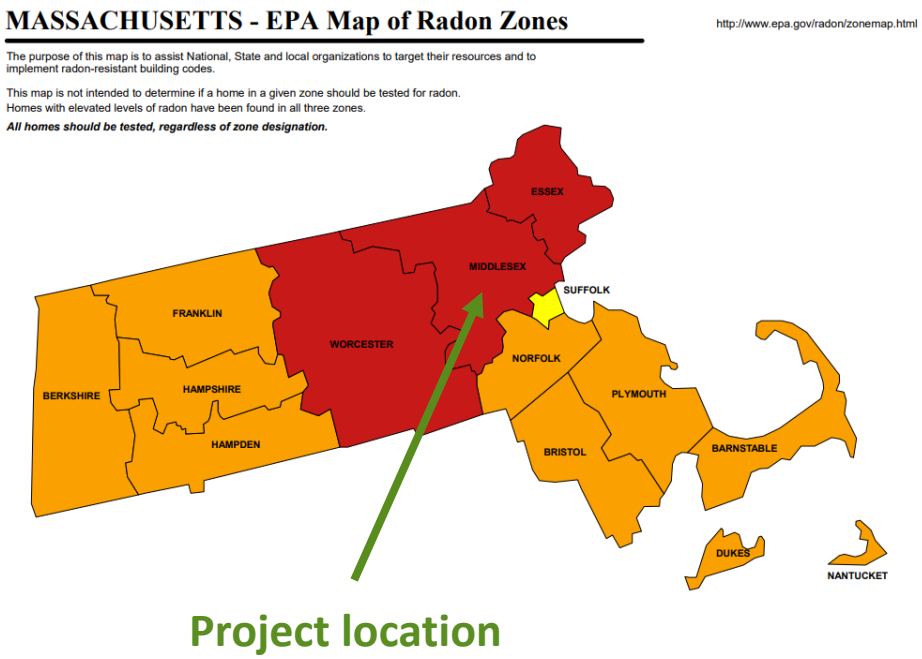
Radium mitigation

- Radium removed from building surfaces and crawl spaces to levels consistent with background
  - Eliminates complete exposure pathways to source material (radium from luminescent paint)
  - Allows demonstration of compliance with dose limit
- To provide extra level of assurance to future building occupants, owner voluntarily considers testing occupied residential spaces for radon



Radon

- Complicating factor: naturally occurring radon
  - Granite bedrock typical of New England
- If tested, could show radon above EPA limit (4 picocuries per liter)
- How to manage perception that residual radium could be the cause?
- How to manage health risk from naturally occurring radon?



Project location

Radon mitigation system

- Owner elects to install radon mitigation systems prior to testing indoor air

Radon indoor air testing

- Testing on units with systems installed in first phase finds radon consistently non-detect
- Testing on units with systems installed in subsequent phases showed mixed results: non-detect to levels above 4 pCi/L
  - System adjustments yielded consistently similar results
  - Could not identify an obvious problem with the systems
  - Suspected preferential pathway

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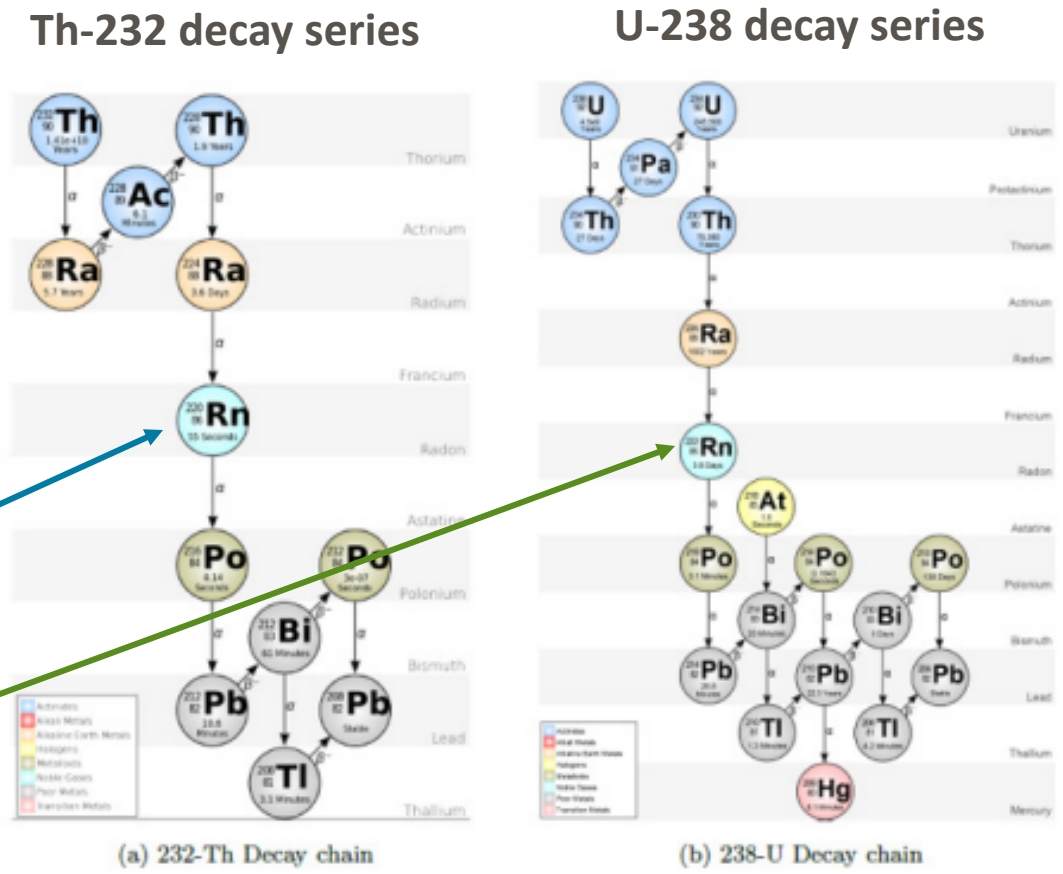
How to identify preferential pathway for radon VI?

- Radon (Rn-222) has 3.8-day half life – so once present within indoor air, difficult to find source
- Thoron (Rn-220) has 55-second half life – will only be detectable in indoor air near source

Thoron

Radon

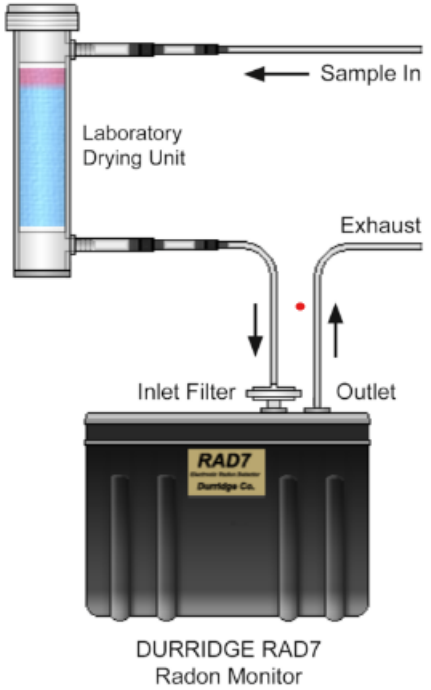


(a) 232-Th Decay chain (b) 238-U Decay chain

https://irispublishers.com/gjes/pdf/GJES.MS.ID.000666.pdf

Approach to identifying preferential pathways

- Used RAD-7 thoron detector with sampling wand directed toward suspect vapor entry points
  - Utility perforations
  - Stairwells
  - Floor / wall perimeter



DURRIDGE RAD7
Radon Monitor

Preferential pathway findings

- Identified high levels of thoron at wall-perimeter seam
- Further inspection revealed that vapor barrier was not properly sealed to wall
- Repair initiated
- Subsequent indoor air testing for radon yielded non-detect results

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Conclusions

- Use of thoron as a tracer can cost-effectively and identify preferential VI pathways for radon in real-time
- Can thoron be used to identify preferential pathways for VOCs?
  - Real-time
  - Inexpensive
  - No reporting of VOC results
    - May eliminate regulatory reporting for VOCs
    - May have benefits for control of liability

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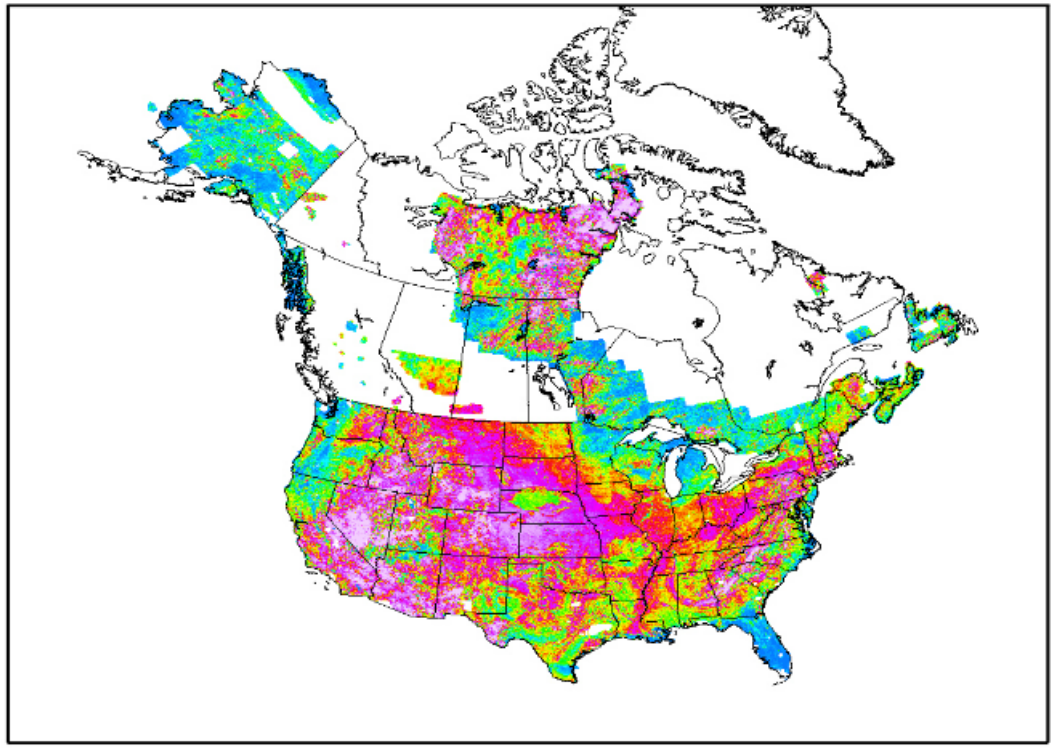
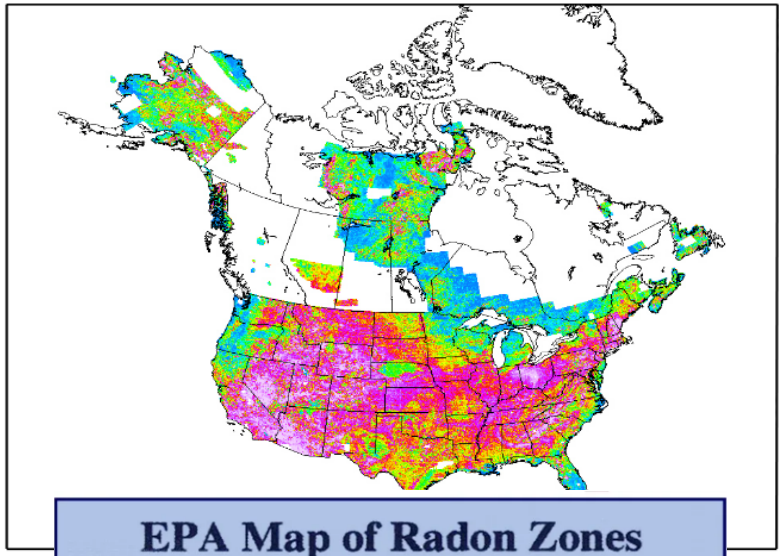
Viability of thoron as a tracer for VOC VI pathways

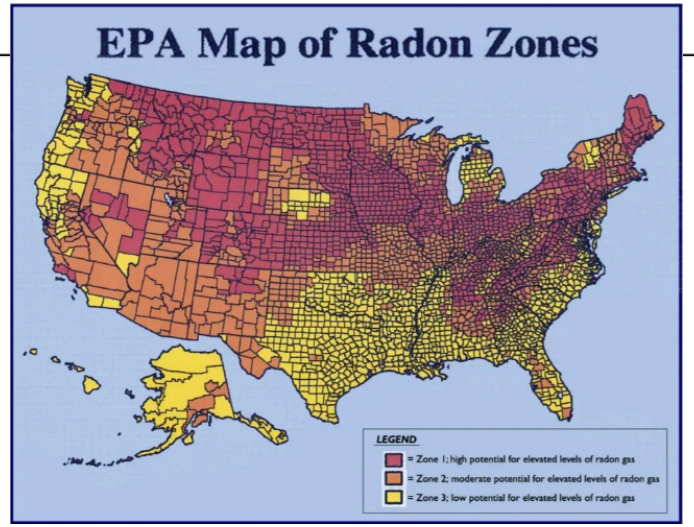
- Requires thorium in soil

Thorium in U.S. Soils



Uranium in U.S. Soils





Thank you

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