Geology and Radon in Alabama

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[Geological Survey of Alabama]

EPA Region 4 Radon Stakeholders Meeting

01 APR 2025; Huntsville, AL

types of Uranium deposits

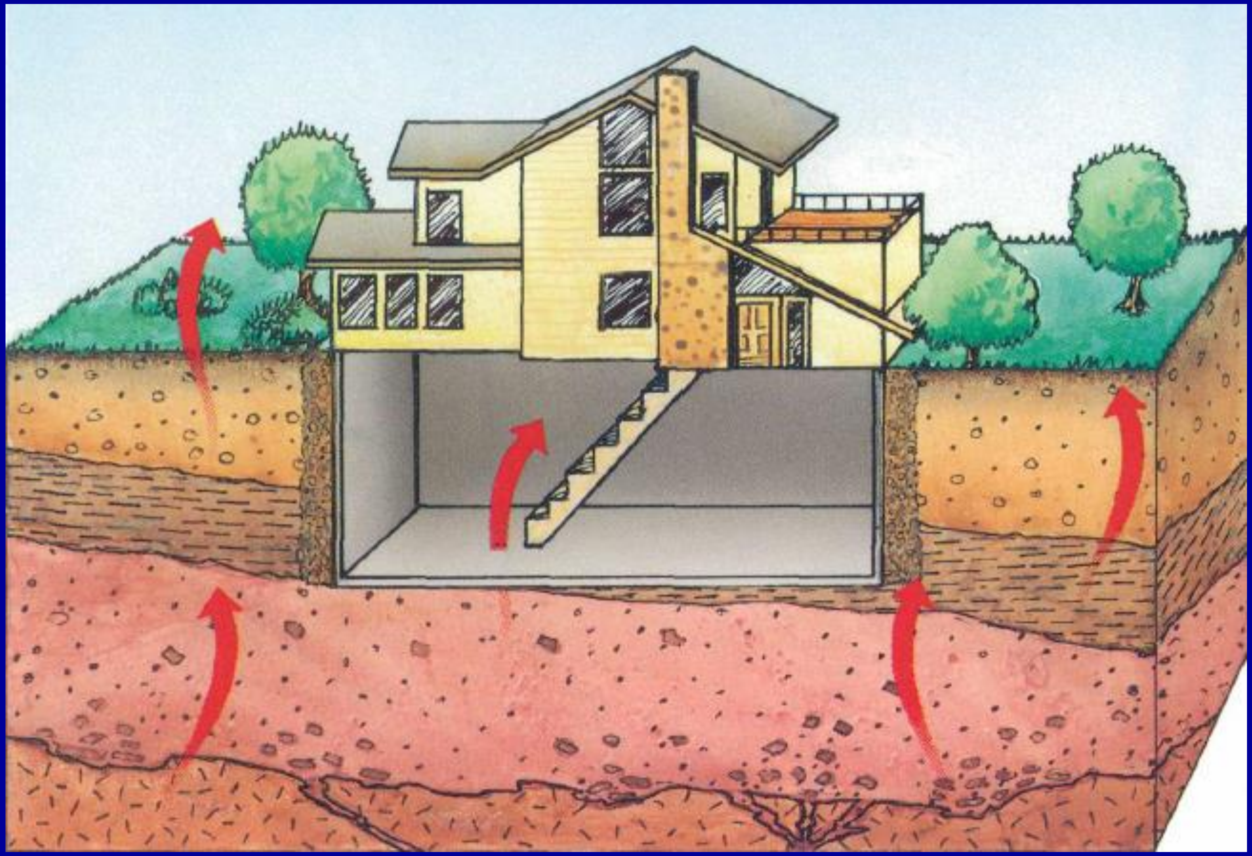
IAEA geological classifications

1) intrusive
2) granite-related
3) polymetallic Fe-oxide breccia
4) volcanic-related
5) metasomite
6) metamorphite
7) Proterozoic unconformity
8) collapse-breccia pipe
9) sandstone
10) paleo-quartz pebble conglomerate
11) surficial
12) **lignite and coal**
13) carbonate
14) **phosphate**
15) **black shale**

Bruneton *et al*. (2014)

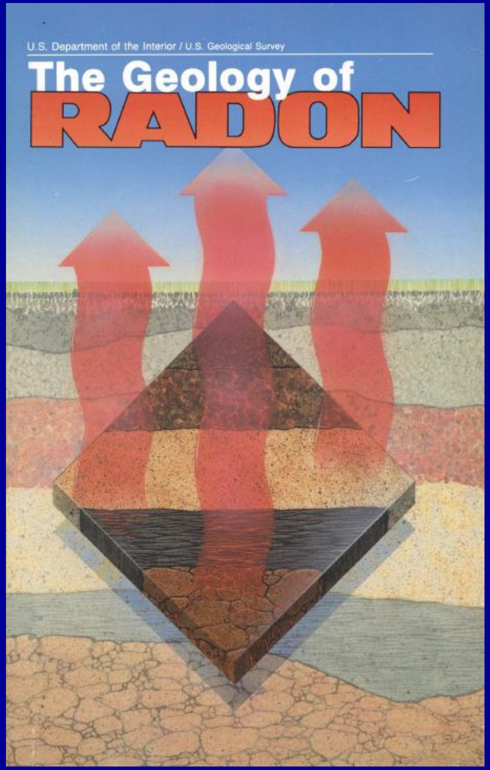
- list in order of ~T (rather than economic importance)
- geologic perspective, includes subeconomic
- very little recovery from three deposit types with *largest* estimated U totals (most common in AL)
- three of the next-most abundant account for most identified recoverable resources: 9 (Kazakh), 3 (Australia), and 7 (Canada)

basic sources of radon



Otton (1992)

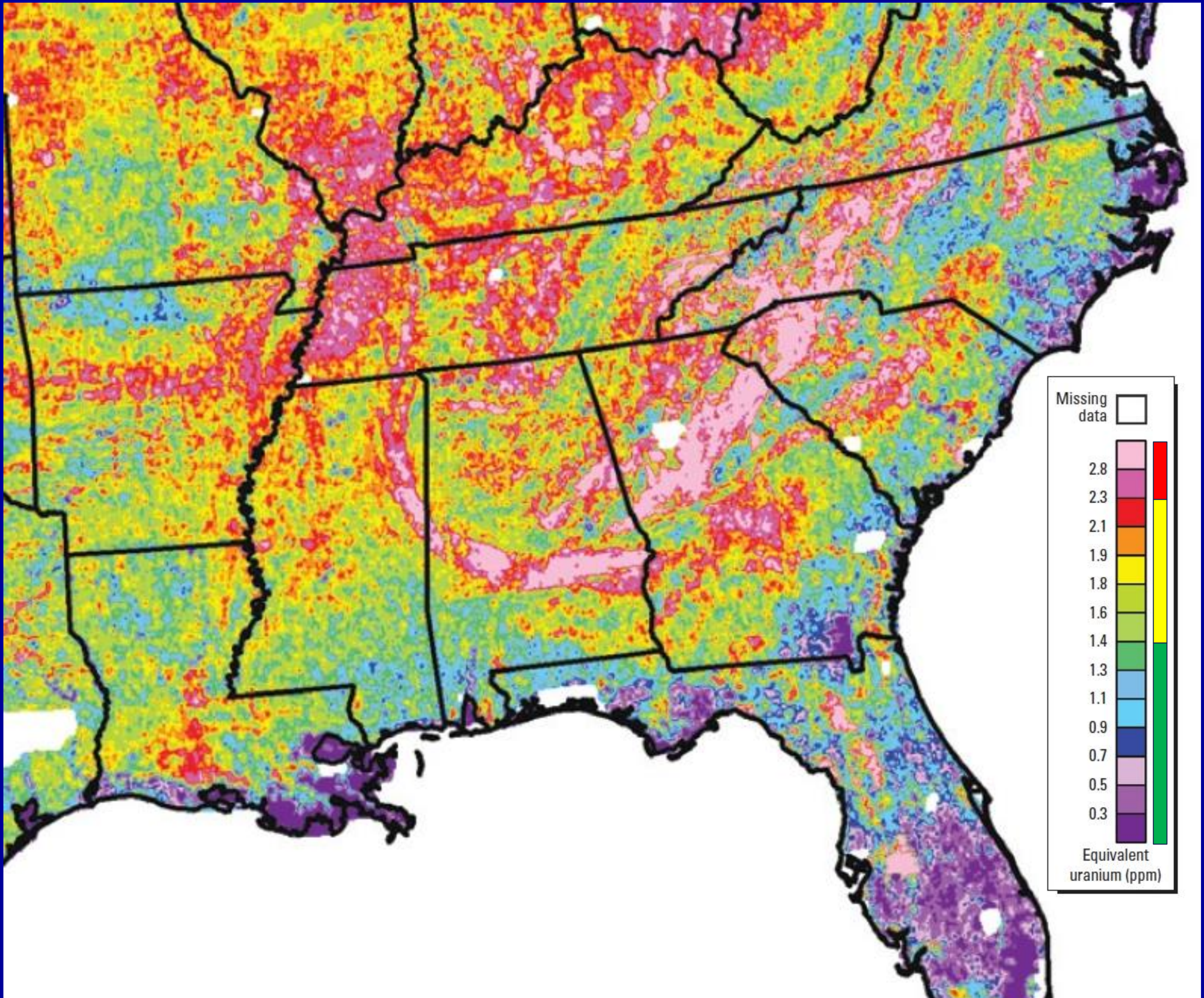
- obviously, *mainly* decay of ^{238}U
- bedrock → soil
- <u>groundwater</u>
- *cf*. The Geology of Radon by J. K. Otton (1992)



info sources for radon potential maps

- geologic maps
- radioactivity maps
- soil surveys
- indoor radon data
- *cf*. Otton (1992)

Alabamapublichealth.gov,
modified from EPA data (2014)

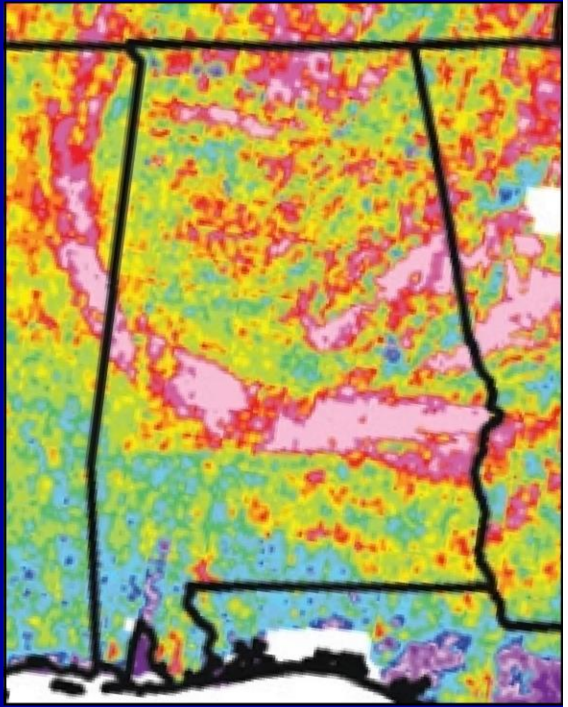


Seiler & Wiemels (2012)
adapted from Duval *et al*. (2005)

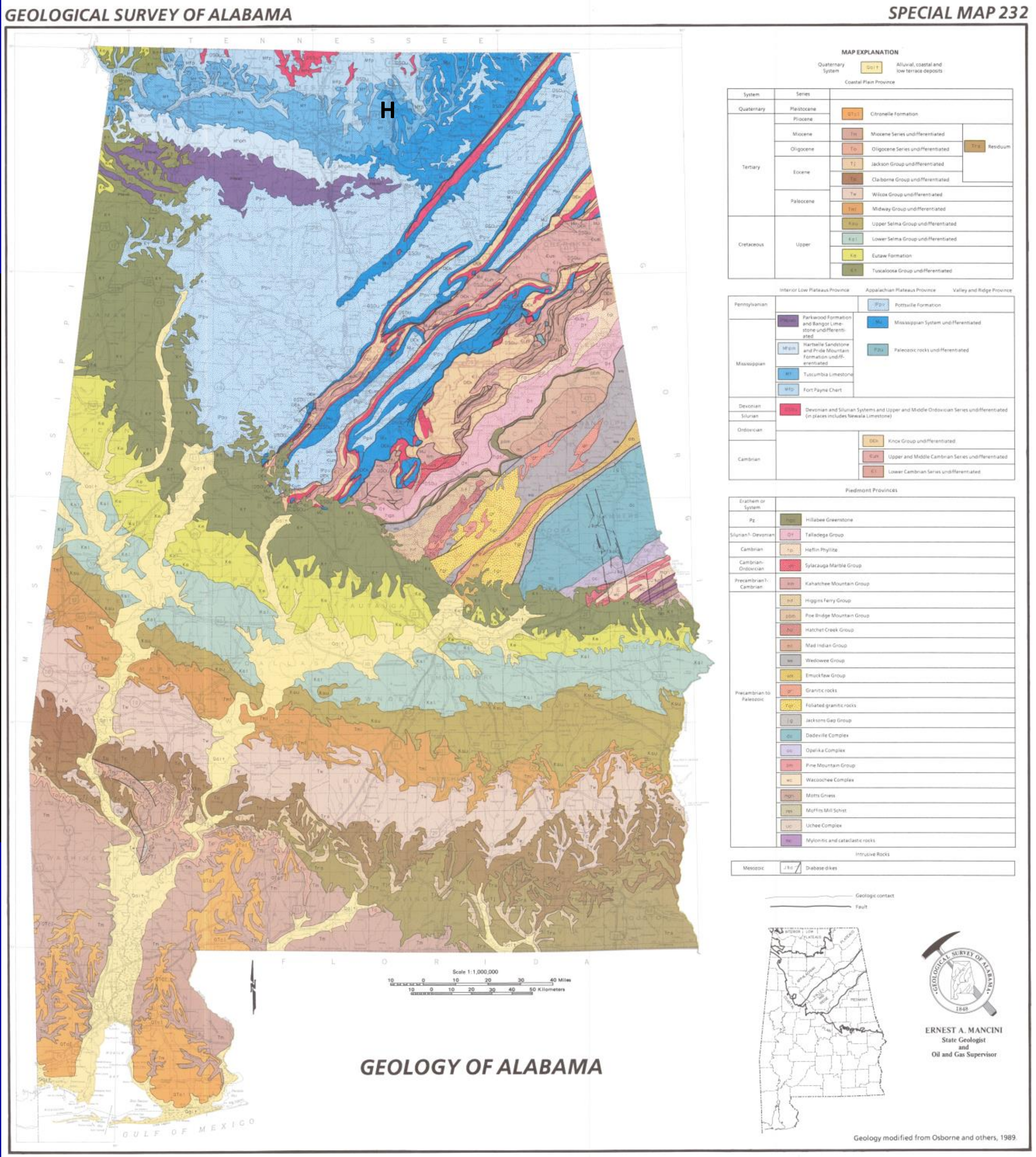
equivalent Uranium concentrations (ppm eU) at the surface

- measure of radioactivity
- aerial gamma-ray surveys, *cf*. Duval *et al*. (1989)
- ~400 feet altitude
- some limitations (calibration issues, actually measuring γ-ray flux of daughter product, etc.)
- can classify as H-M-L

- Seiler & Wiemels (2012): health-related hazards of ^{210}Po (another daughter product of ^{238}U decay)



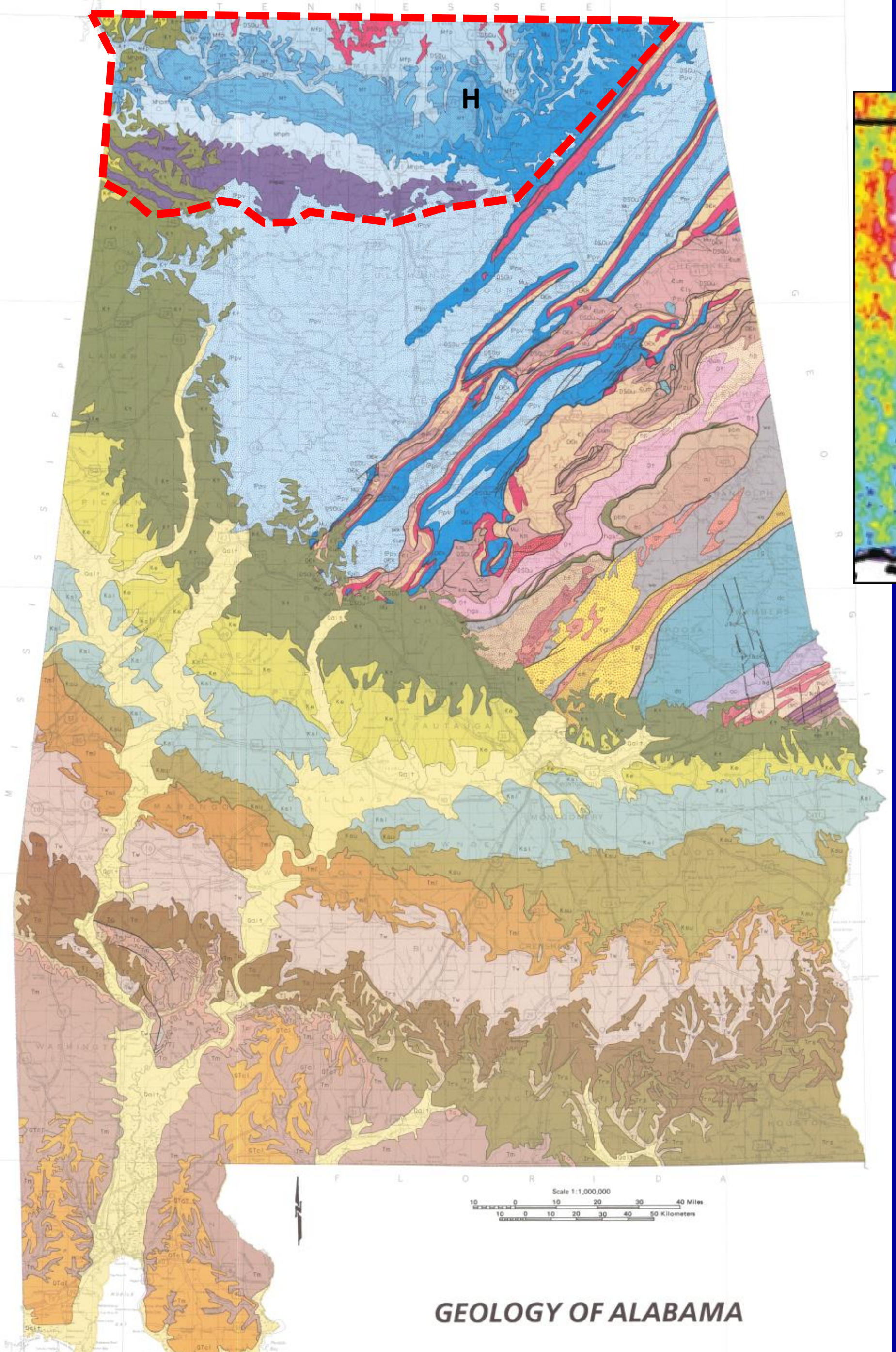
Seiler & Wiemels (2012)



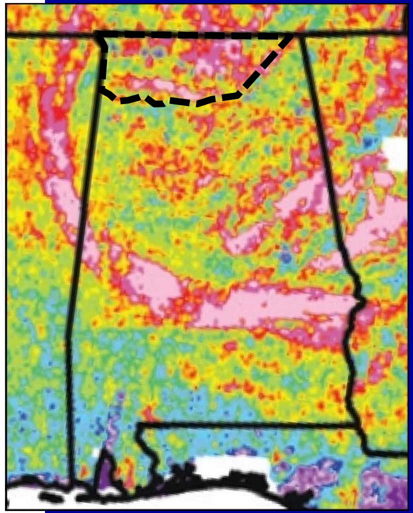
relating surficial ppm eU back to geology

- simplified geologic map
- correlation is apparent
- now to briefly discuss geology under "hot spots"
- for more data, *cf*. Gundersen *et al*. (1993) and Gunderson (1993) <u>*in*</u> USGS Open-File Report 93-292-D

Osborne *et al*. (1992); geology modified from Osborne *et al*. (1989)



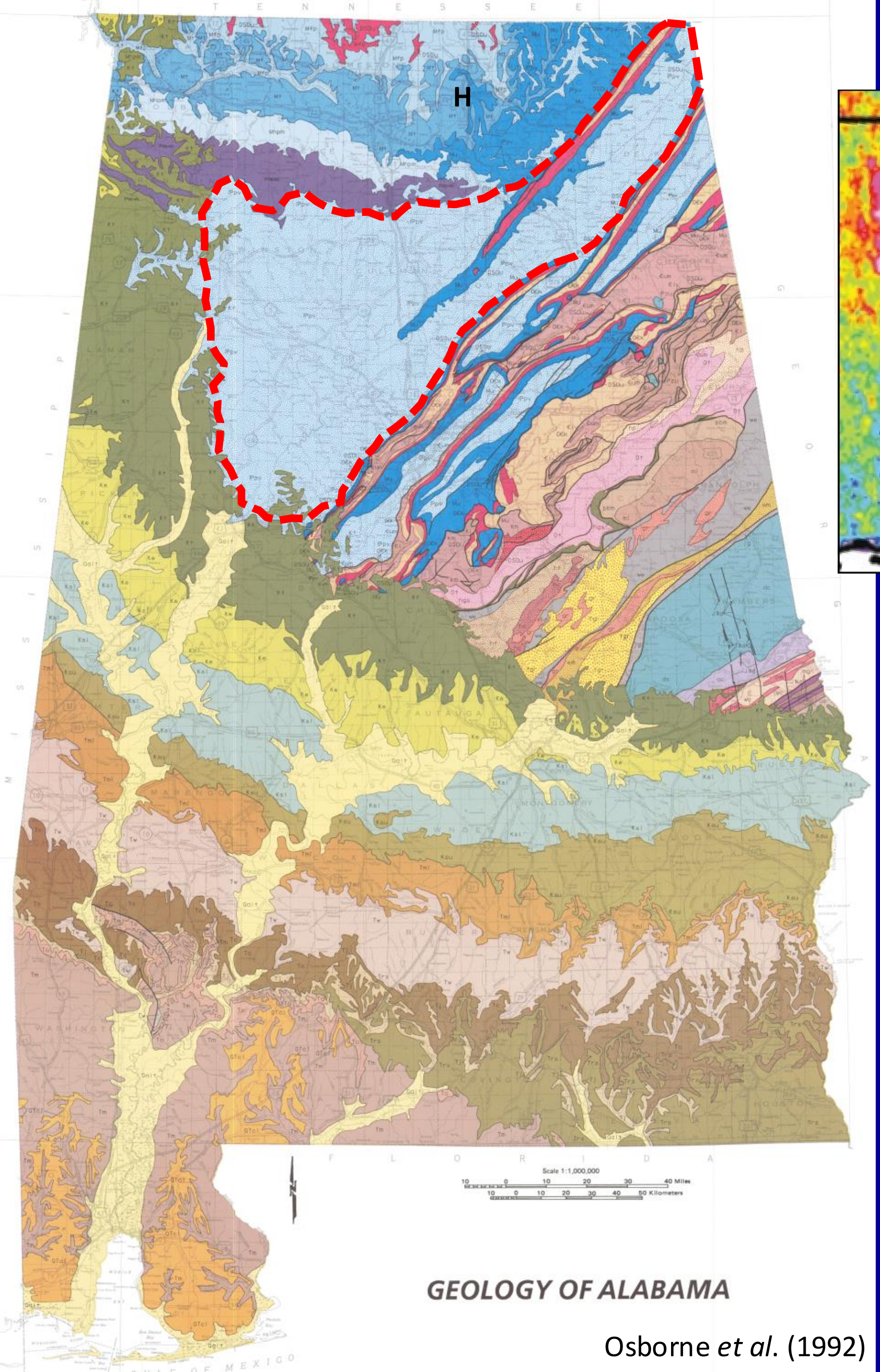
Osborne *et al.* (1992)



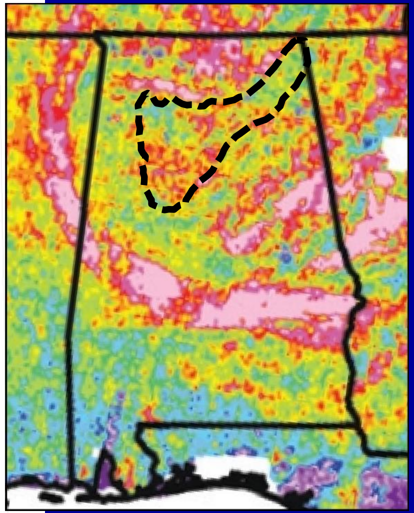
Seiler & Wiemels (2012)

relating surficial ppm eU back to geology: Interior Low Plateau region

- ranked high in geologic radon potential (USGS OFR93-292-D)
- limestones and shales (including Chattanooga Shale)
- limestones can be dissolved away in places (think sinkholes, caves)
- residuum can have high U concentration



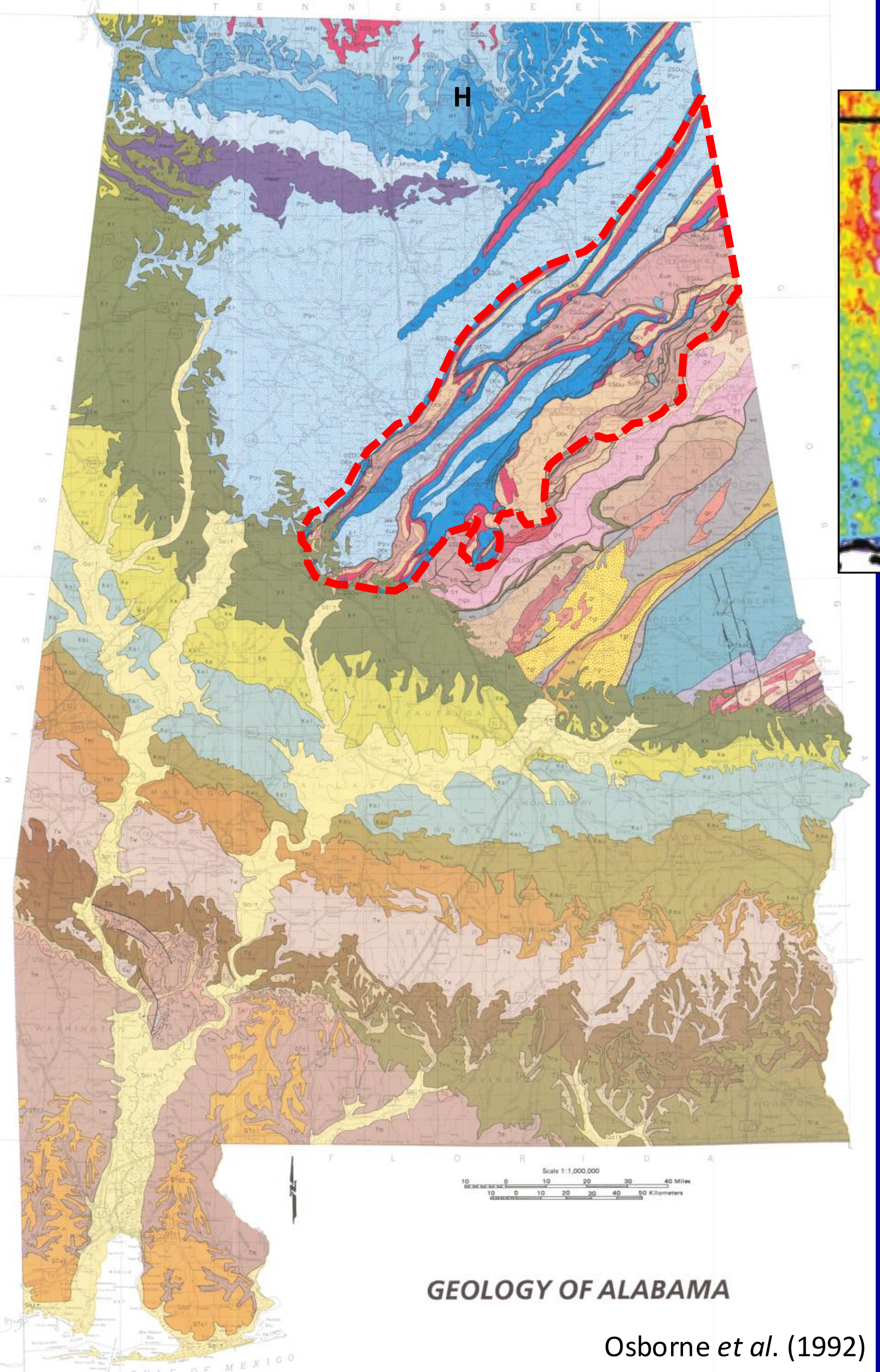
Osborne *et al.* (1992)


Seiler & Wiemels (2012)

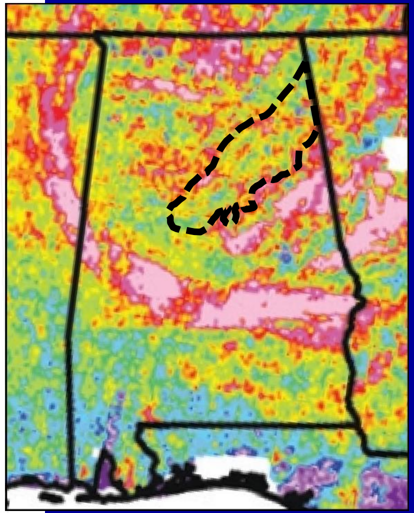
relating surficial ppm eU back to geology: Appalachian Plateau region

- ranked moderate in geologic radon potential (USGS OFR 93-292-D)

- sandstones and carbonaceous shales (including coal)
- “Uranium uptake” of certain plants



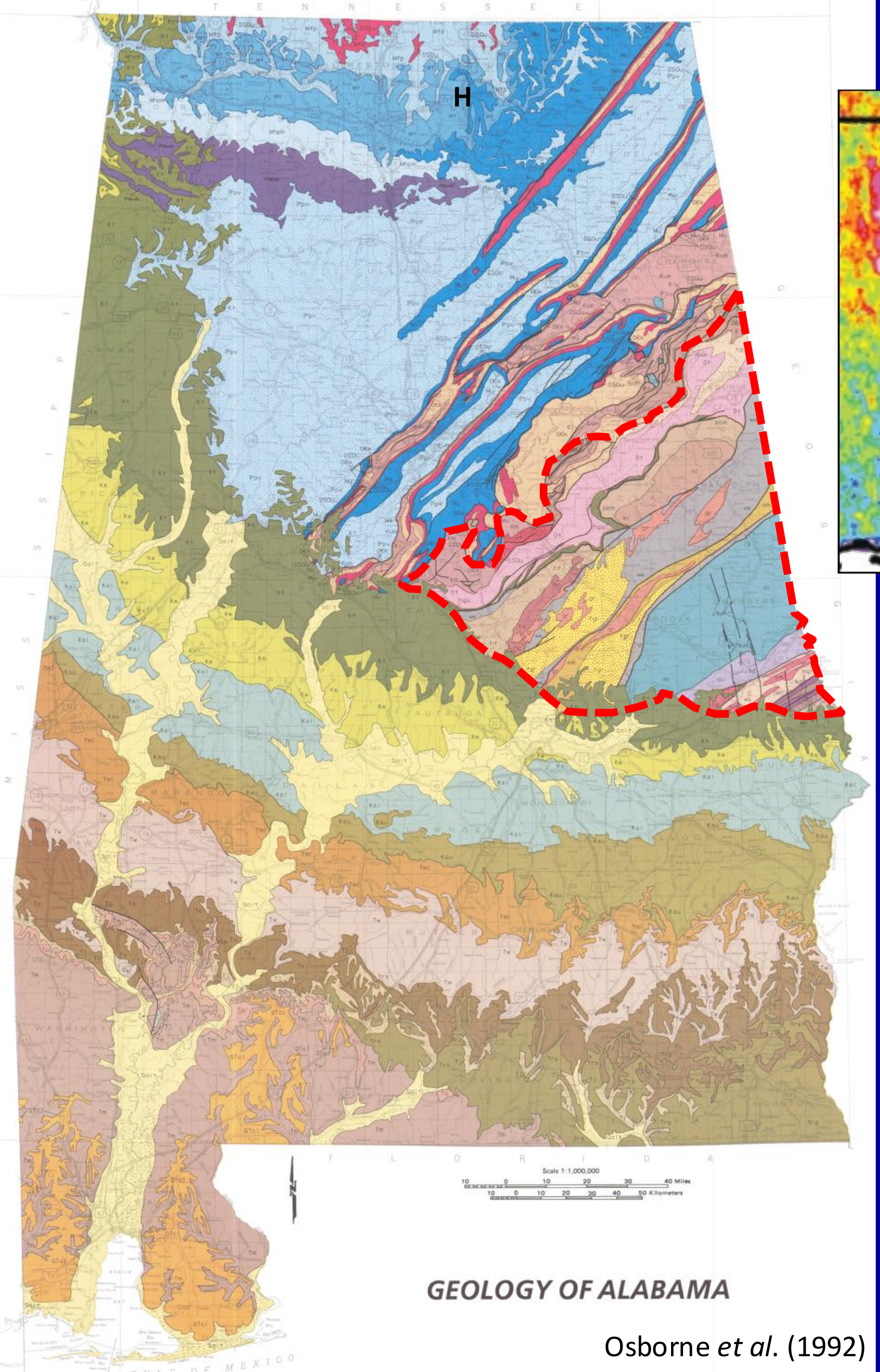
Osborne *et al.* (1992)


Seiler & Wiemels (2012)

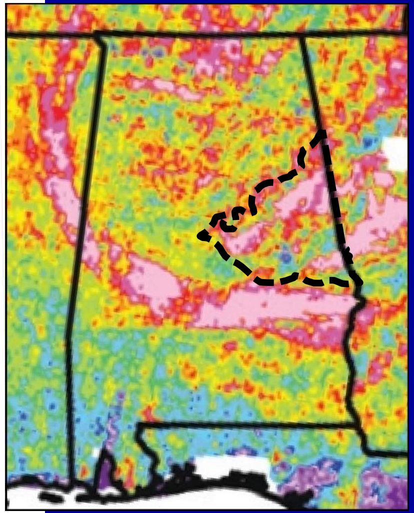
relating surficial ppm eU back to geology: Valley and Ridge province

- ranked moderate in geologic radon potential (USGS OFR 93-292-D)

- rock types vary (radon mainly from Chattanooga Shale, limestones, coal)
- rock units can be deformed (fractures, faults…folds → thickening)



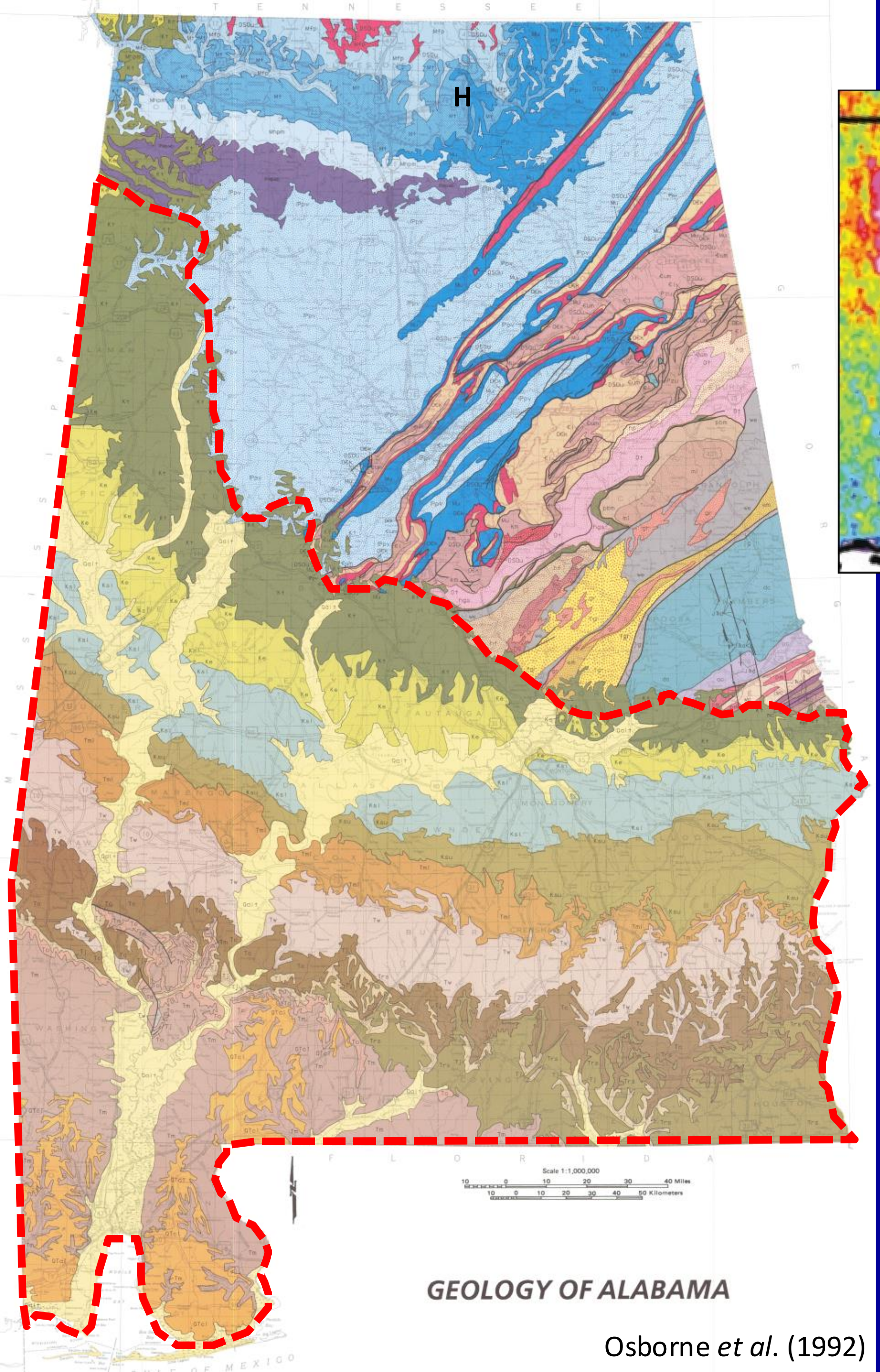
Osborne *et al.* (1992)


Seiler & Wiemels (2012)

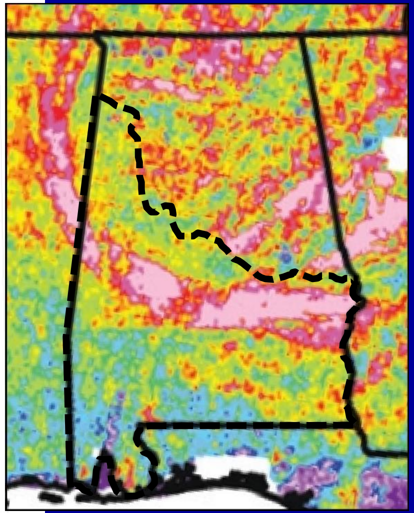
relating surficial ppm eU back to geology: Piedmont province

- ranked moderate/high in geologic radon potential (USGS OFR 93-292-D)

- rock types vary (radon mainly from altered carbonaceous or granitic rocks)
- also, faulting creates conduits



Osborne *et al.* (1992)



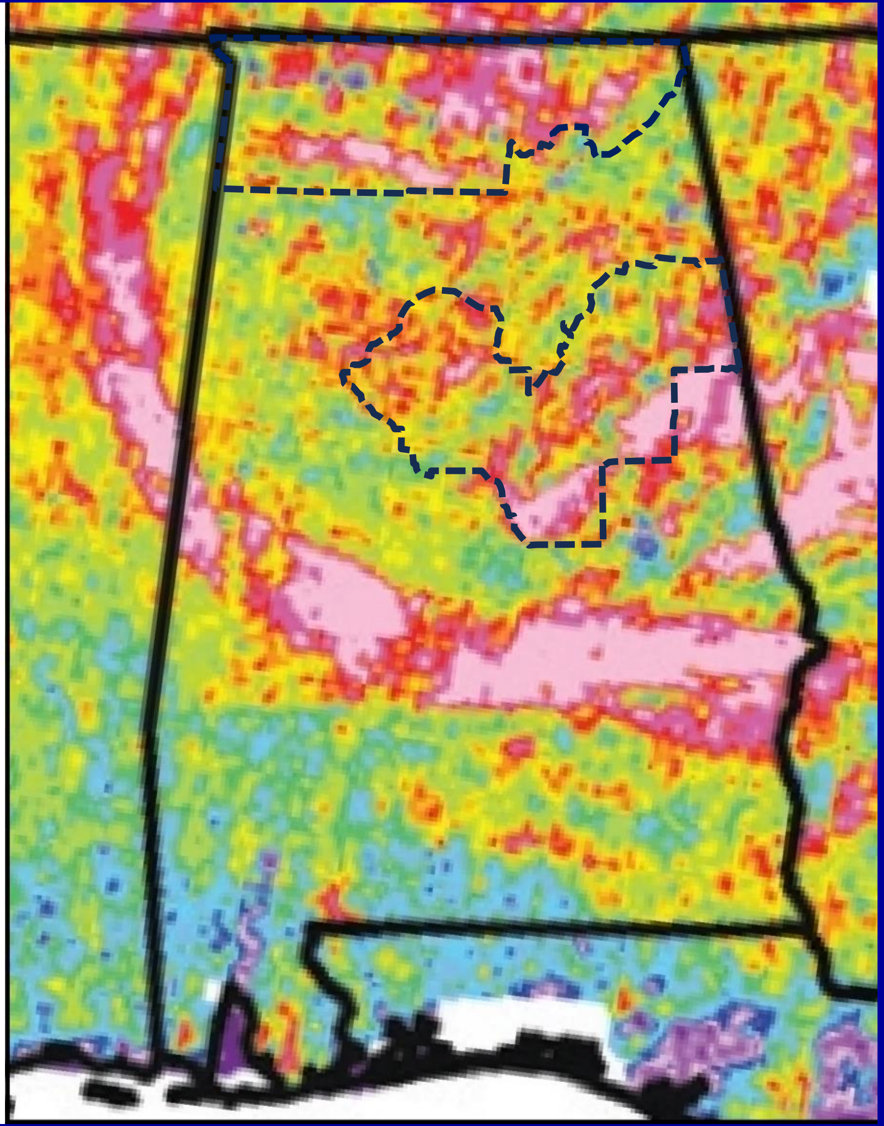
Seiler & Wiemels (2012)

relating surficial ppm eU back to geology: Coastal Plain province

- ranked low/moderate in geologic radon potential (USGS OFR 93-292-D)

- various geologic units (mostly unconsolidated clays and sands)
- lower soil-gas radon: quartzitic units
- higher soil-gas radon: carbonaceous or glauconitic

radon zones in Alabama



Alabamapublichealth.gov

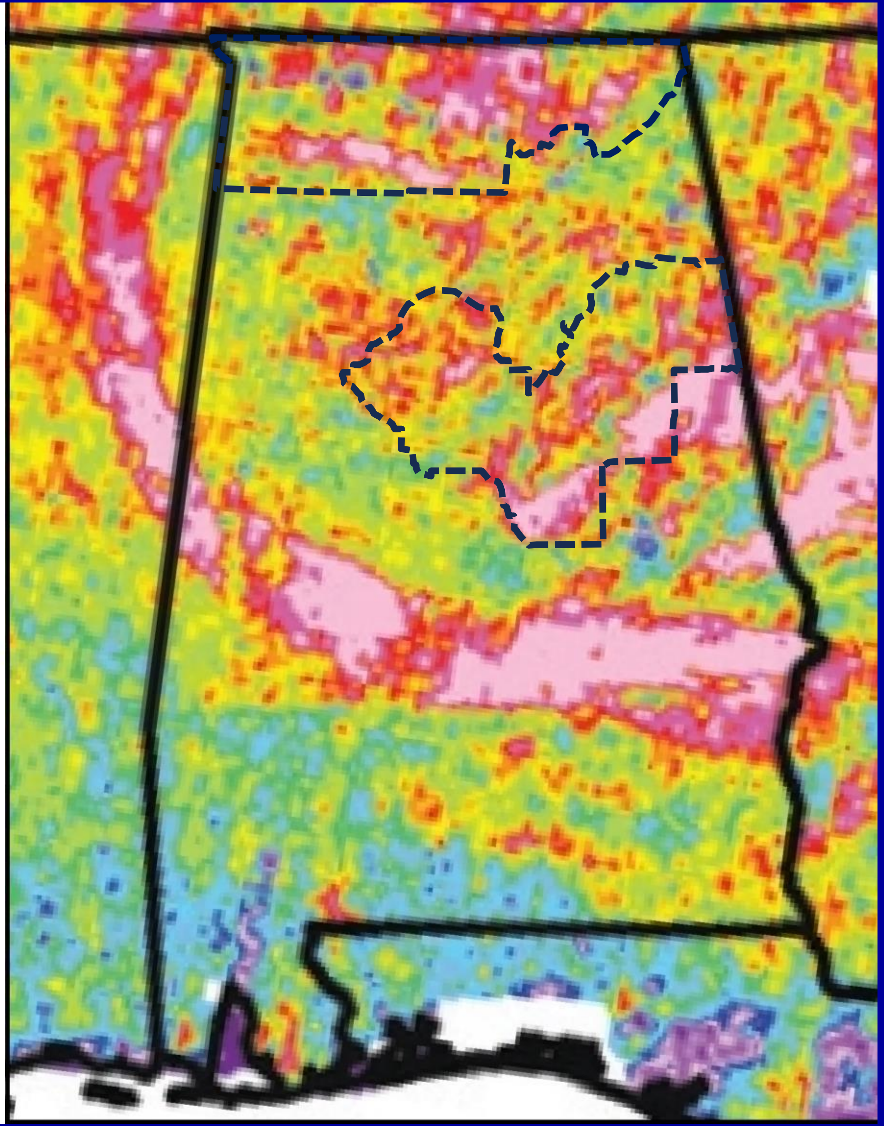
Seiler & Wiemels (2012)

- maps based on indoor radon test data
- limitations include calibration issues, etc.

- some correlation, but resolution contrast is obvious

- the “hottest” ppm eU values do not correspond to all highest radon potential areas

radon zones vs. surficial eU in Alabama



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Seiler & Wiemels (2012)

- state-wide highest radon potential corresponds to areas underlain by specific limestone, shale (incl. coal), and granitic units
- what about “black belt”?

radon zones vs. surficial eU in Alabama

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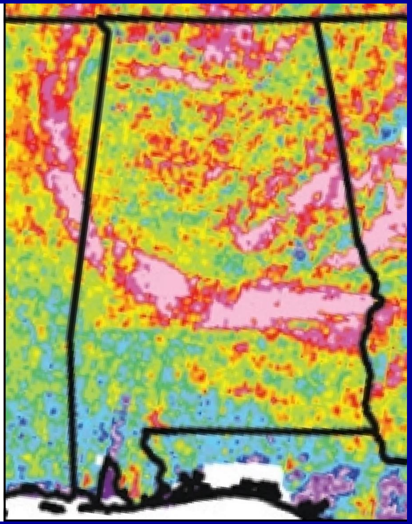
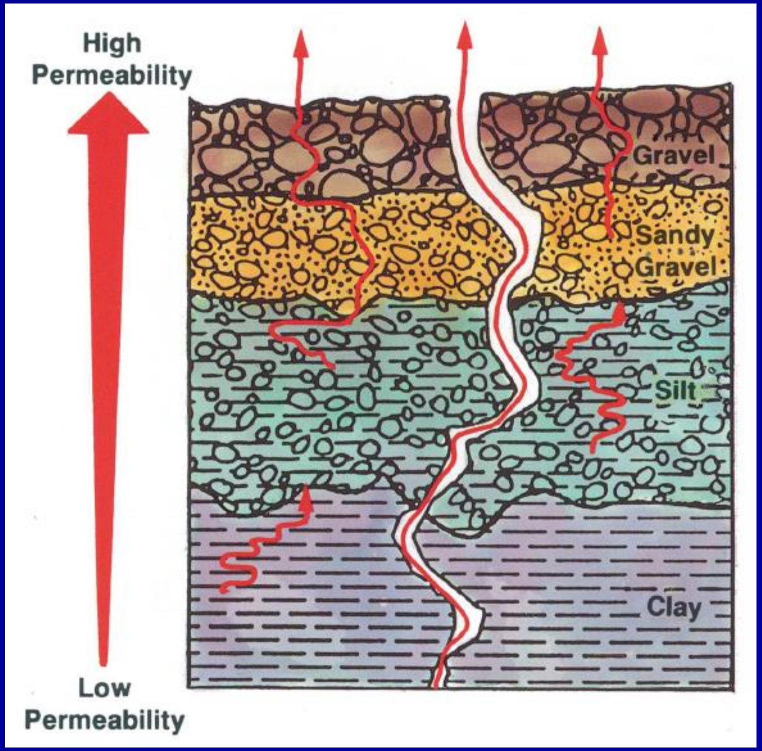
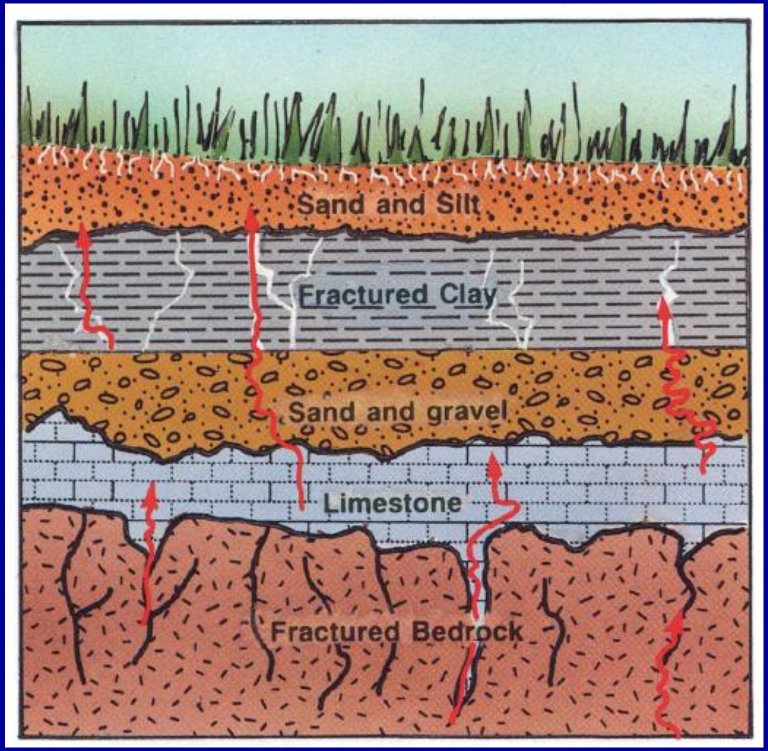


Seiler & Wiemels (2012)

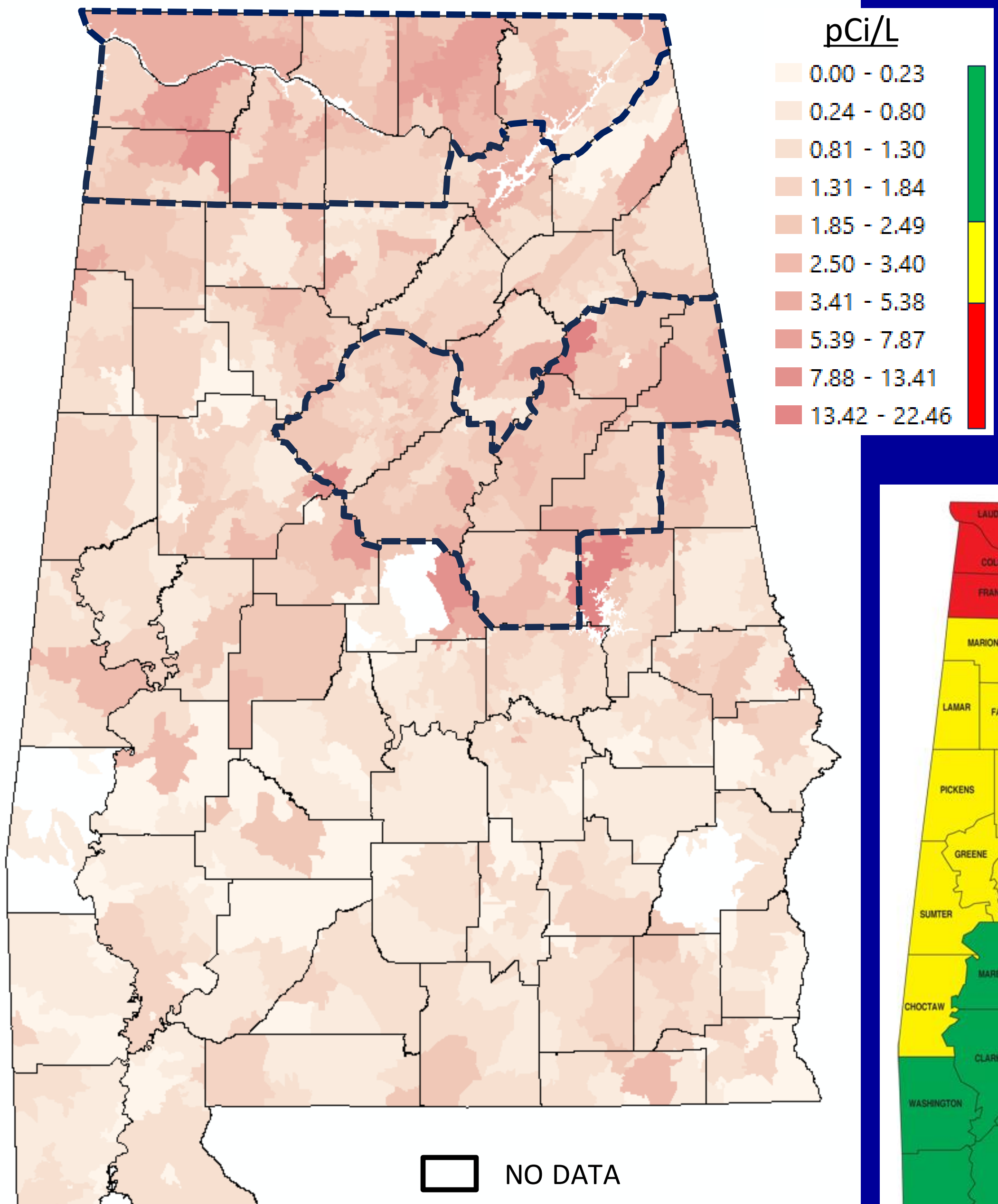
- the differences largely relate to porosity and, more importantly, **<u>permeability</u>**
- soil composition/type important…but can be enhanced by karst, faults, *etc.*
- other permeability enhancement (excavation, agriculture, construction, *etc.*)





Otton (1992)

updated GIS radon map of Alabama



map courtesy of
Sandy M. Ebersole (GSA)

- indoor detector data from 2011
- resolution improved
  (by zip code and range rather than county/threshold level)

Alabamapublichealth.gov

Thank you for inviting the Geological Survey of Alabama to be a part of this conference!

- Please feel free to contact the GSA with any questions or feedback

Sandy Ebersole, Ph.D., director: sebersole@gsa.state.al.us; my email is bcook@gsa.state.al.us

- Many years have elapsed since we have been involved with radon projects

- Please let us know how we can help you!

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