

Common Ground: Blue Zones and the Geologic Drivers of Health



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February 3, 2023, at 8:55 p.m. EST (UTC-5), when 38 cars of a Norfolk Southern freight train carrying hazardous materials derailed in East Palestine, Ohio, United States.



Ohio derailment: CDC begins investigation of toxic train disaster

<https://www.nbcnews.com/health/health-news/ohio...>

Web 1 day ago · When the Norfolk Southern train derailed on Feb. 3, a highly flammable chemical called vinyl chloride caught fire and began spewing from the scene. It is used to make polyvinyl chloride, or...

As crews remove contaminated soil and liquid from Ohio toxic ...

<https://www.cnn.com/2023/02/27/us/ohio-train...>



Web 10 hours ago · After a brief pause, shipments of contaminated liquid and soil from the toxic train derailment in East Palestine, Ohio, will resume Monday amid concerns ...

Author: Nouran Salahieh,...

NTSB: Overheated wheel bearing led to Ohio train ...

<https://www.npr.org/2023/02/23/1158972561>

Web Feb 23, 2023 · Norfolk Southern train 32N, a 149-car, 9,000-foot-long train traveling east along the railroad's Fort Wayne Line across Ohio, derailed near East Palestine just before ...

See USA Track & Field, Inc. results for new palestine ohio train derai... >

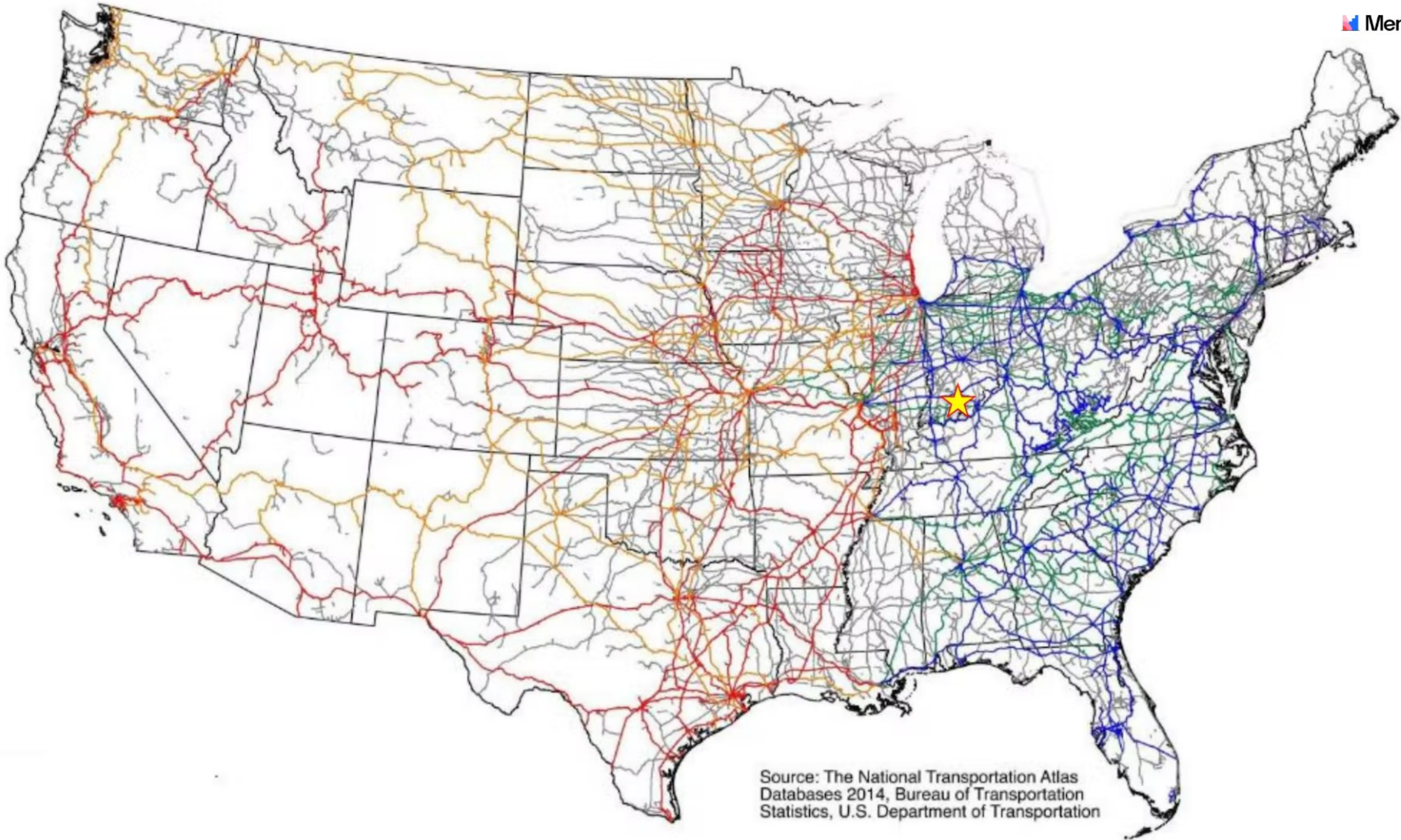
Ohio train derailment fact check: What's true and what's ...

<https://www.usatoday.com/story/news/factcheck/2023/...>

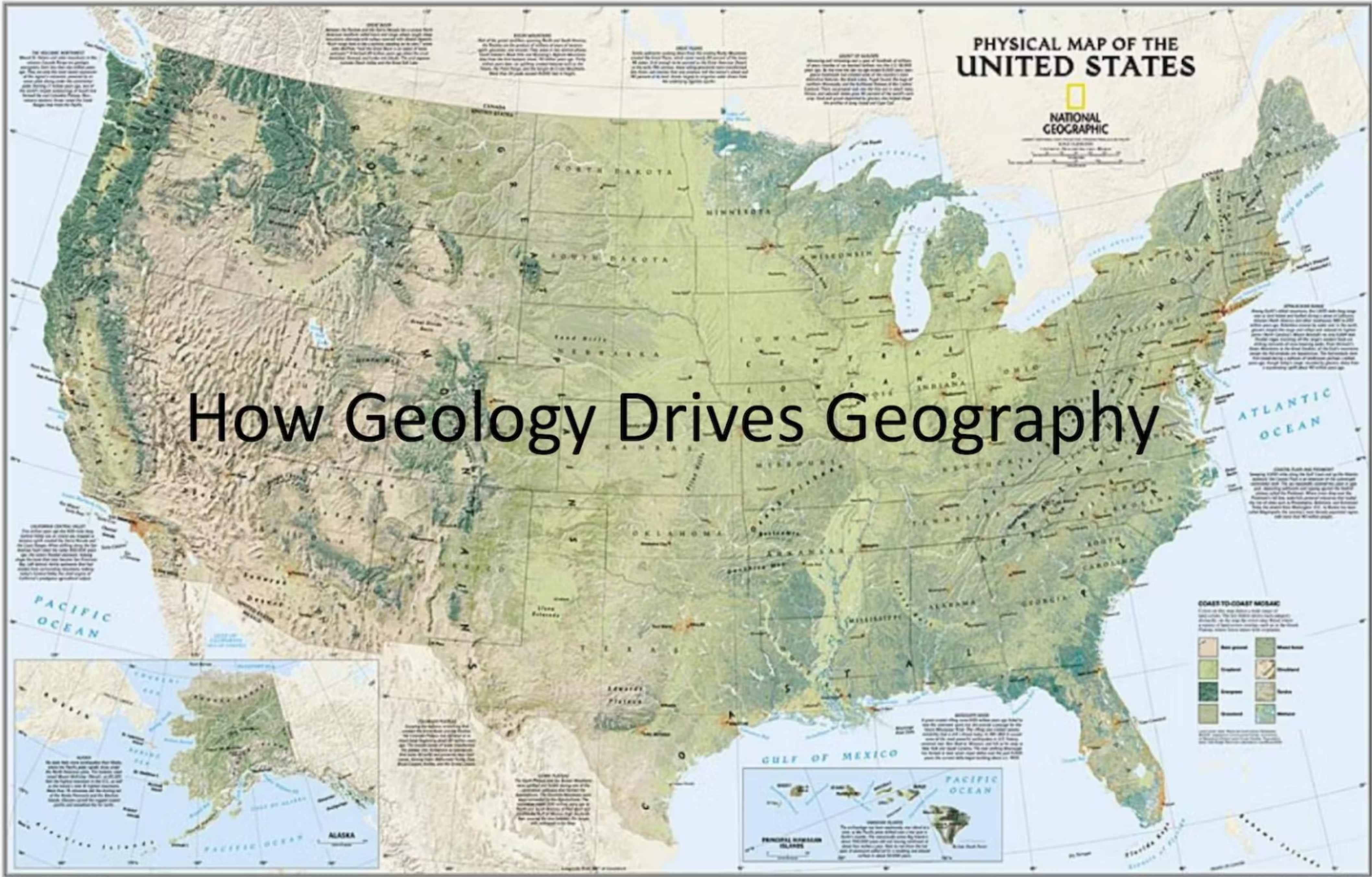
Web Feb 16, 2023 · Immediately after the train derailment on Feb. 3, about half the 4,761 residents of East Palestine were told to evacuate, USA TODAY previously reported. More ...

The news already reports health impacts from this event...
but what role did geology play? (up to three entries)





Source: The National Transportation Atlas Databases 2014, Bureau of Transportation Statistics, U.S. Department of Transportation

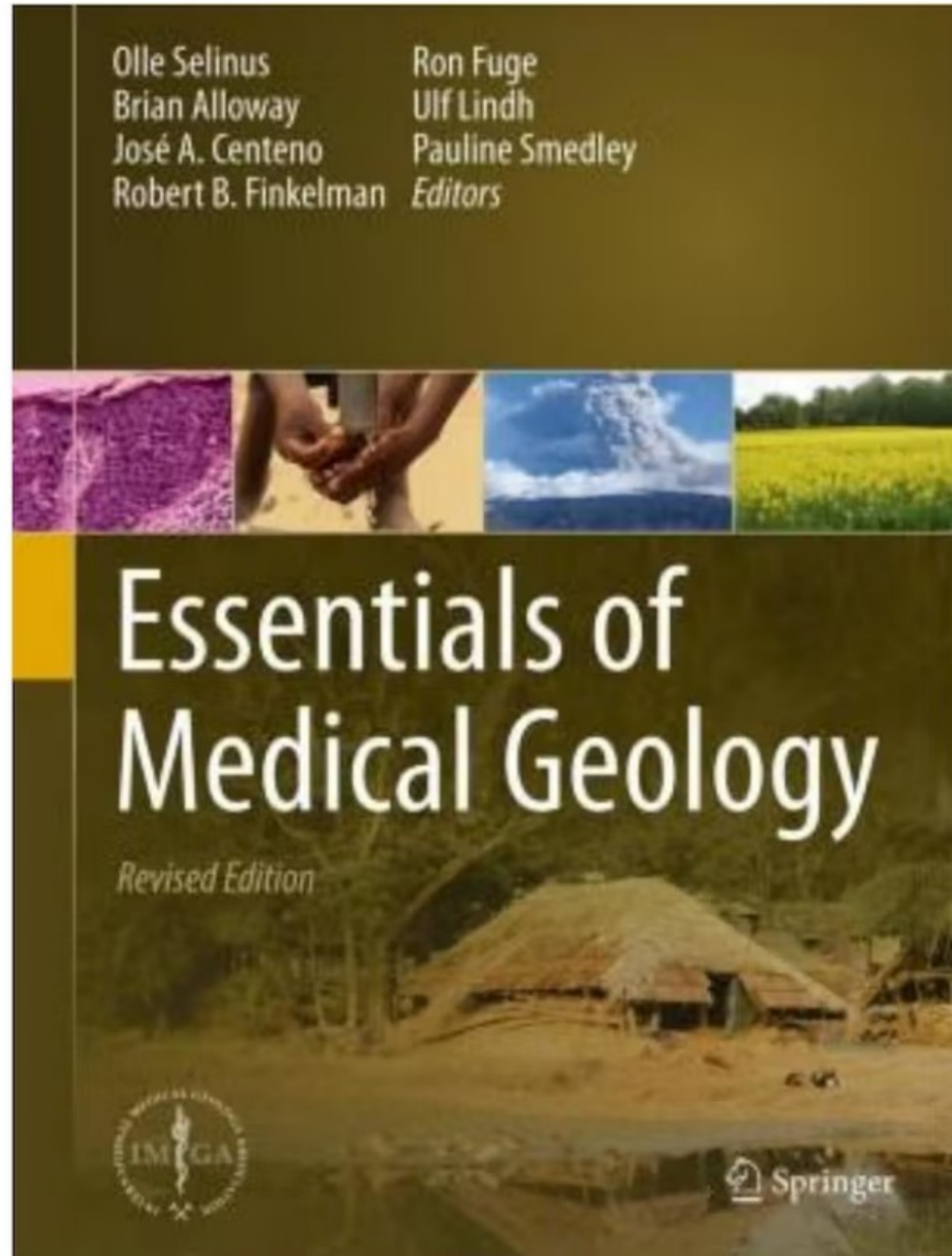


How Geology Drives Geography

Geology – Medicine – Blue Zones and why you should pay attention to bigger picture



Medical Geology...



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 Essentials of Medical Geology
 Revised Edition

Addresses key topics at the intersection of environmental science and human health

Developed by 60 international experts from 20 countries and edited by professionals from the International Working Group on Medical Geology

Written in non-technical language for a broad spectrum of readers, ranging from students and professional researchers to policymakers and the general public

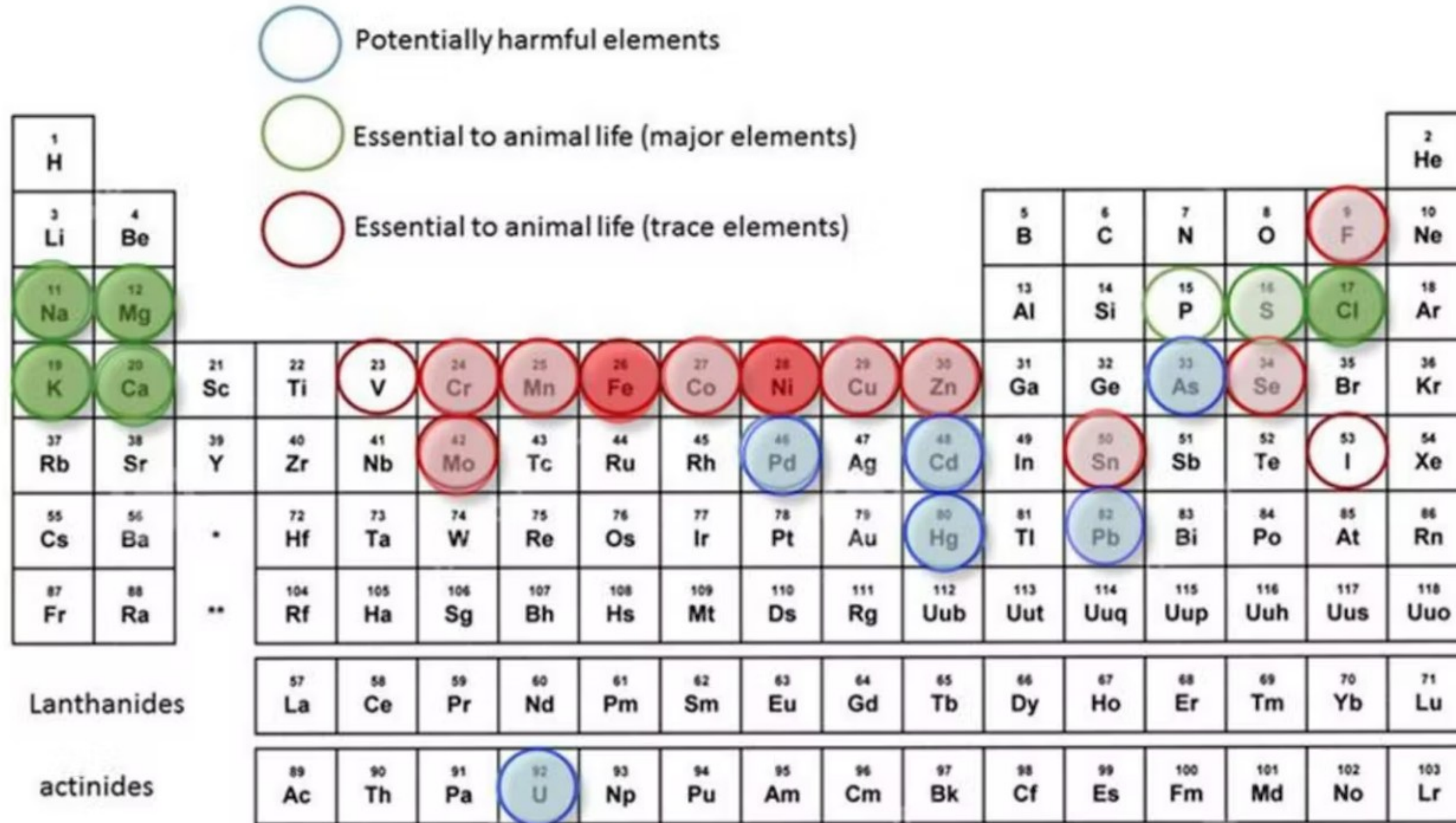
Includes color illustrations throughout, references for further investigation and other aids to the reader

From this Geologist perspective:

805 pages

Almost entirely devoid of maps

Elemental Table: medicine meets minerology



● ● Common in Rock forming minerals
 ○ ○ ○ Common in Local Concentration

Medical Geology – a different application

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Article

Potential Health Risks from Uranium in Home Well Water: An Investigation by the Apsaalooke (Crow) Tribal Research Group

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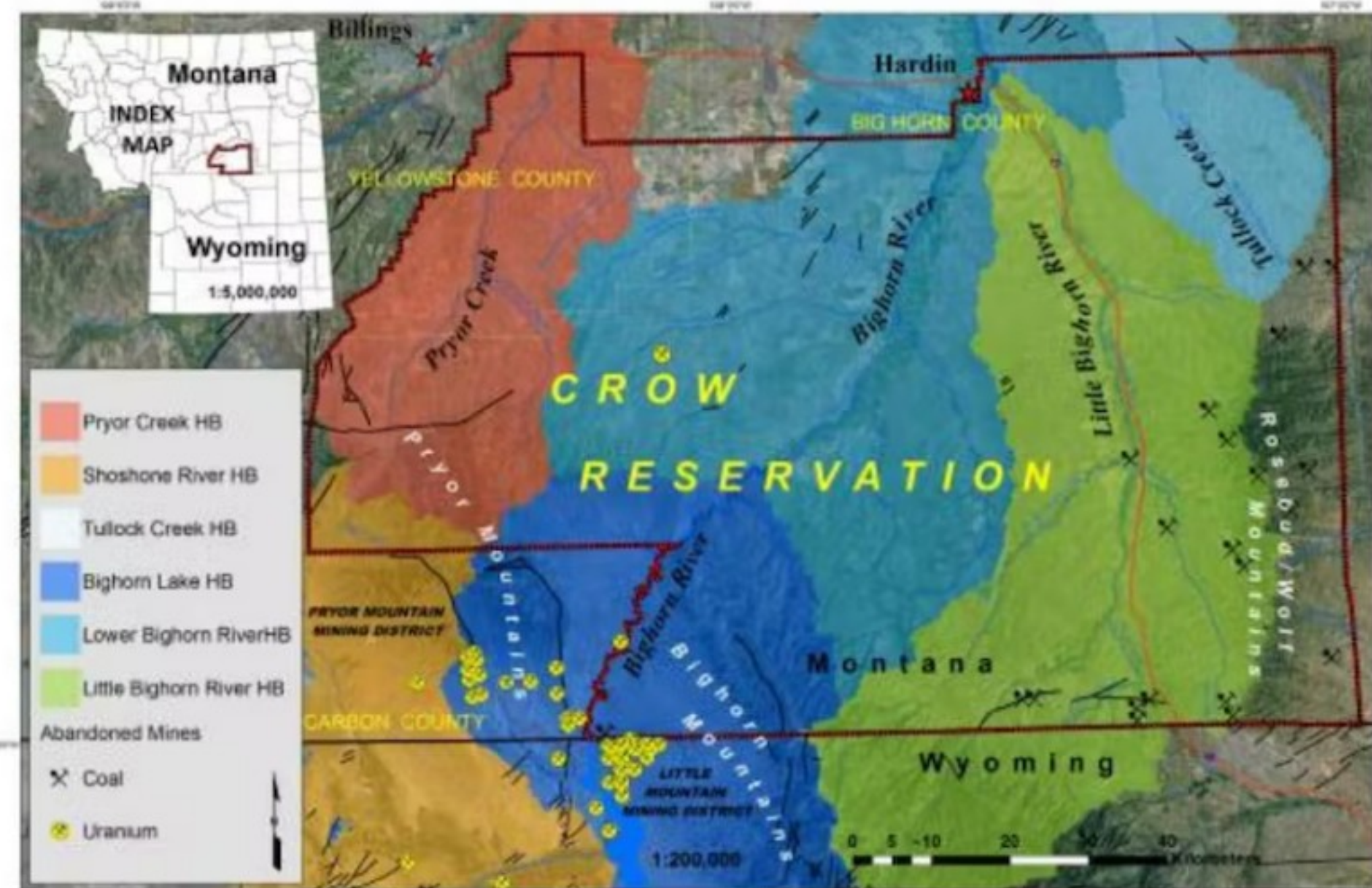
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Northwest view of Pryor Mountains from Devils Canyon

Image: Walton, D., 2020, in Regale, R. & G., and Otstot, R, Jan. 23, 2020,

The Bigger Picture.....



- The Uranium observed in the Crow Reservation water is not likely to have originated from mine waste.
 - The mines were insignificant producers, were largely active in the 1960's and 70's
 - There is no direct path for runoff to the River.
 - Many of the mines were reclaimed prior to the study
- Uranium has been naturally leaching into the waters of the Bighorn River for the better part of the last 500,000 years
- Yellowtail dam (1960's)
 - constructed to control seasonal floods
 - The reservoir created a veritable settling pond for any Uranium salts that can settle out of solution
- Uranium in well water along the river valleys most likely was carried by annual floods and deposited along with the silts that made the farm land rich and then carried into the groundwater system where is concentrated
- The problem is that the river valleys are where the population is and people will take their water where they can
 - Monitor well water to look for changes in concentration (abandon high concentration wells)
 - Monitor for health effects and change water use habits of affected individuals

Public Health criteria for prioritizing and addressing exposures to environmental chemical mixtures:

Usually accepted criteria

- Breadth of exposure.
 - 50% of Crow families rely on well water
 - 80% of these families drink well water
- Nature of exposure
 - Consume daily for many years.
 - Half of families whose water is unfit to drink still use for cooking
- Severity of effects.
 - Know that lead exposure worsens kidney disease in DM type 2 patients.
 - Uranium is also nephrotoxic, effect on DM not known.
- Interactions
 - Ecological framework natural, built, sociopolitical factors contributing to health impact from water contamination.
 - Contribute to and exacerbated by existing health disparities in twenty-year difference in life expectancy between Native American and non-Native American in Big Horn County.

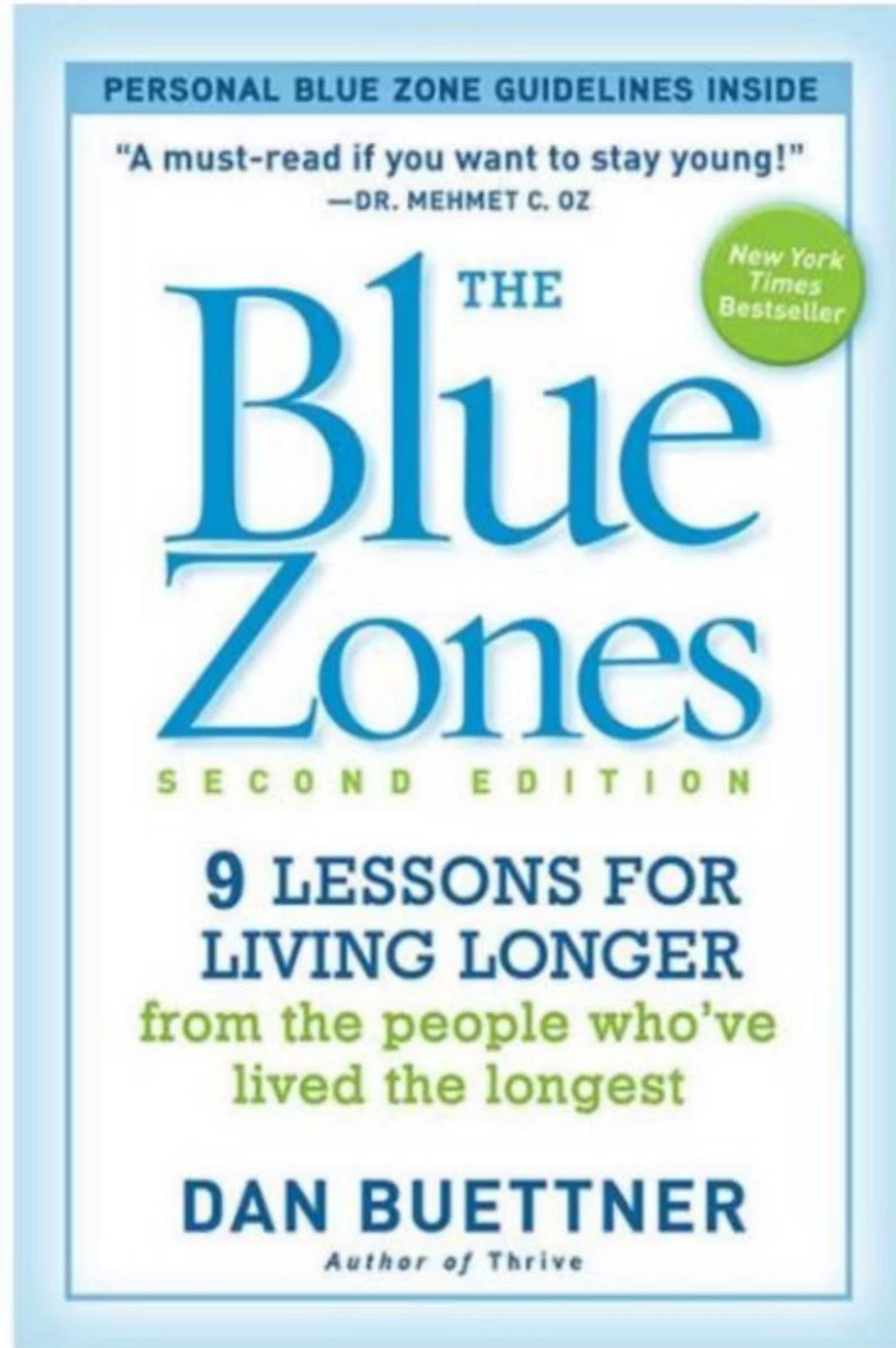
Geologic driver of health?

- Most of Montana/Wyoming's rural population relies on water that is primarily sourced by individual wells or diversions.
- All of this water is subject to local and subregional geology for its most fundamental qualities
- In the case of the Apsaalooke (Crow) Tribal Research Group study;
 - Uranium is an especially insidious contaminant that cannot be detected by taste, smell or discoloration
 - Uranium is not a commonly thought of contaminant
 - Population health screening is the primary tool to indicate non-standard tests.
 - Sometimes it is difficult to determine the origins and significance of population health findings (bias may impact outcomes)

From a Medical Geology standpoint

- **Inequity (locational or cultural) could arguably be considered a fifth criteria for recognizing an environmental exposure as a priority public health issue.**

Medical Geology from a Different Perspective...



- Blue Zones –
 - Lifestyle
 - Diet
 - Outlook
 - stress-coping practices
- If you adopt the right lifestyle - chances are you may live up to a decade longer.
- Our wonder:
 - How does the geologic setting influence choices made in Blue Zones?

Demographically defined, Geographically defined areas with the highest percentage of centenarians (people over the age of 100)

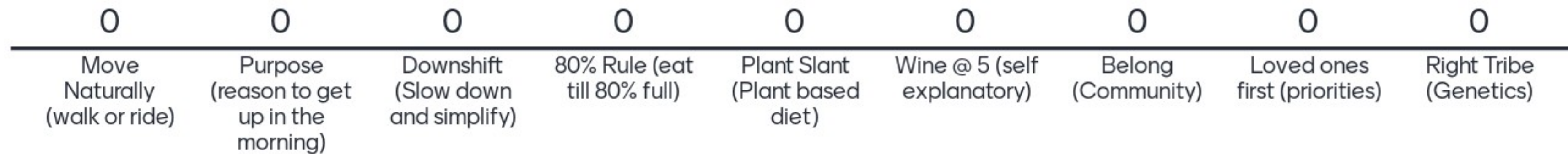


Power Nine:

- 1 Move Naturally
- 2 Purpose
- 3 Downshift
- 4 80% rule
- 5 Plant Slant
- 6 Wine @ 5
- 7 Belong
- 8 Loved ones First
- 9 Right Tribe

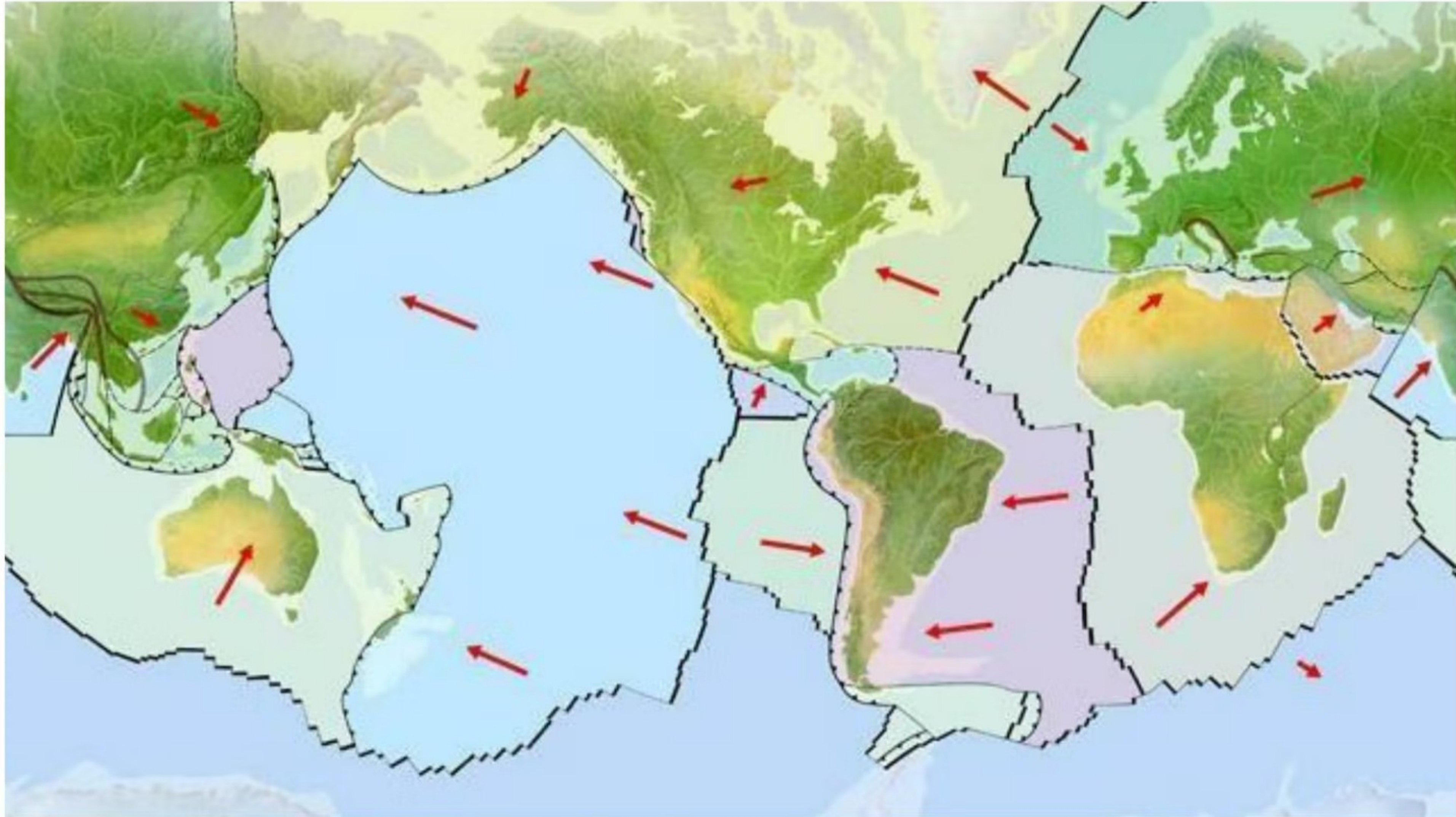
- Nine evidence-based common denominators among the worlds centenarians believed to slow the aging process
- (No mention of environmental setting)

In your experience pick the three most commonly practiced in your area

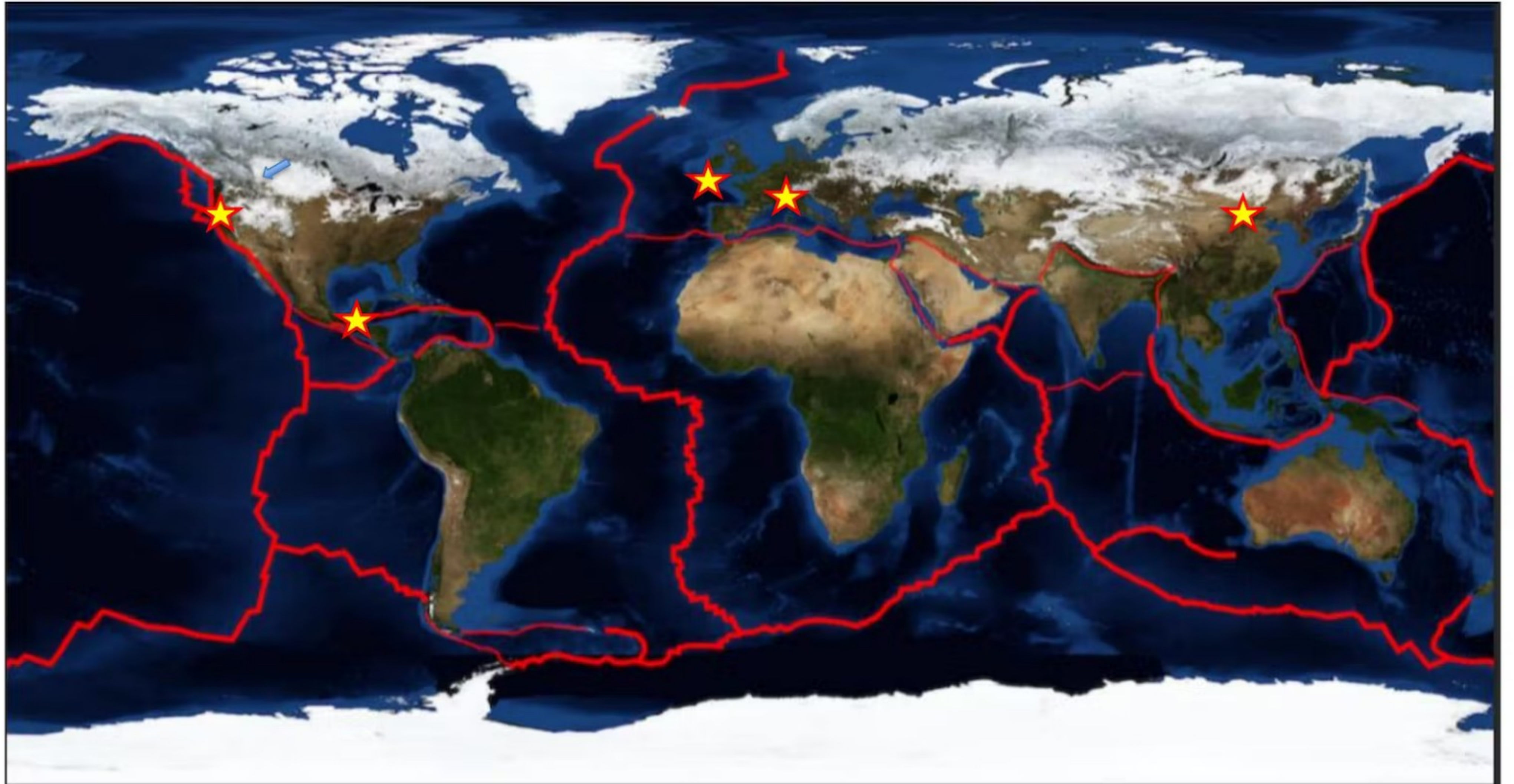


The Really... Really... Big Picture

- Our world is in constant motion.....



Geologically – Blue Zones tend to be in interesting places



Blue Zones

Sardinia Italy



Okinawa Japan



Loma Linda – California



Ikaria Greece



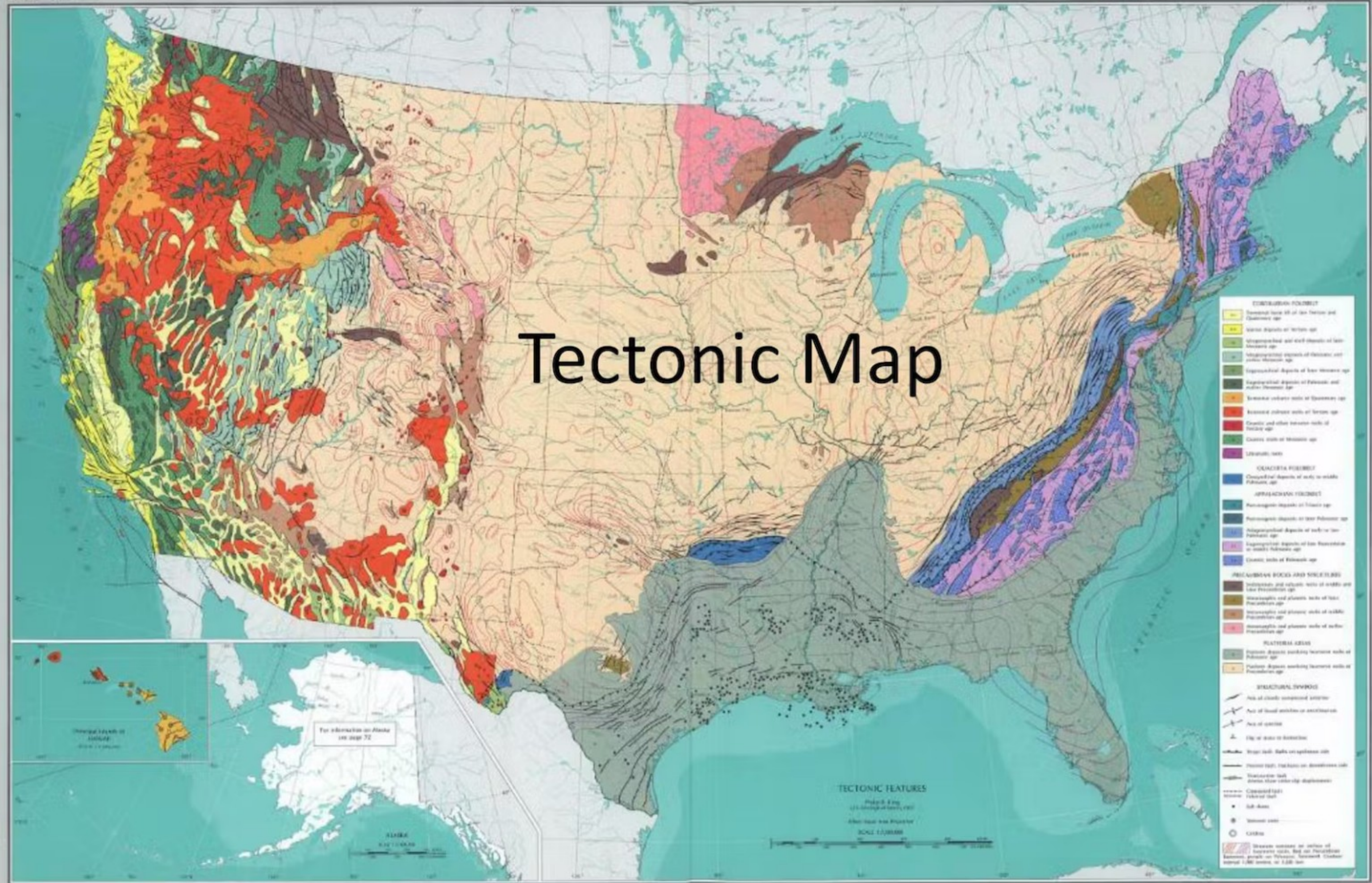
Costa Rica



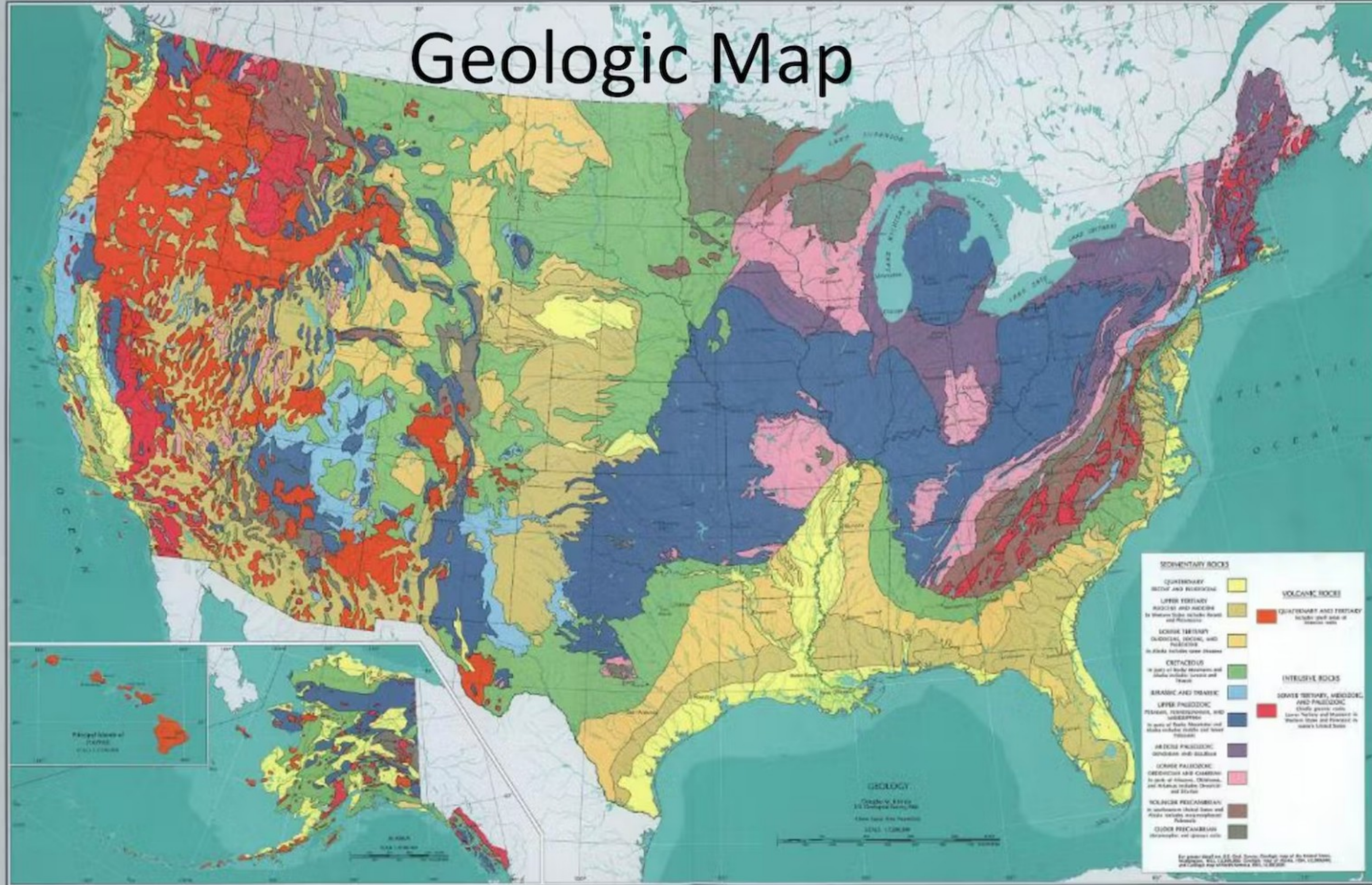
Geologic Commonalities of Blue Zones

- Geologically:
 - Blue Zone communities tend toward geologically rich settings
 - All of the Blue Zone communities are either on active, or historically active tectonic plate boundaries.
 - The minerology in 4 of the 5 blue zones is dominated by the elements that support animal and human life (Okinawa is the exception)
- Geographically:
 - The Blue Zone communities tend to be isolated
 - The geography is heavily influenced by the geologic setting.

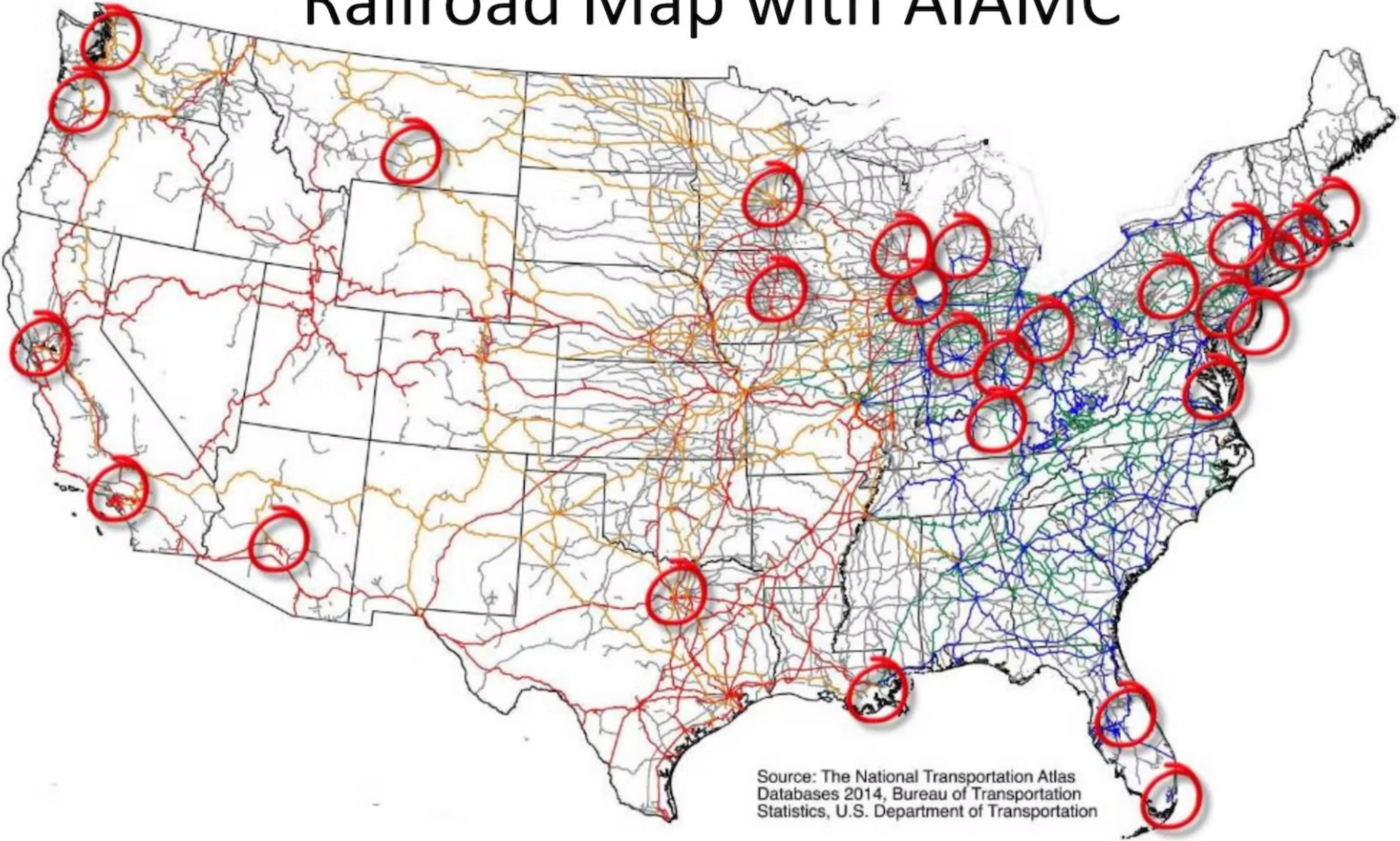
Tectonic Map



Geologic Map

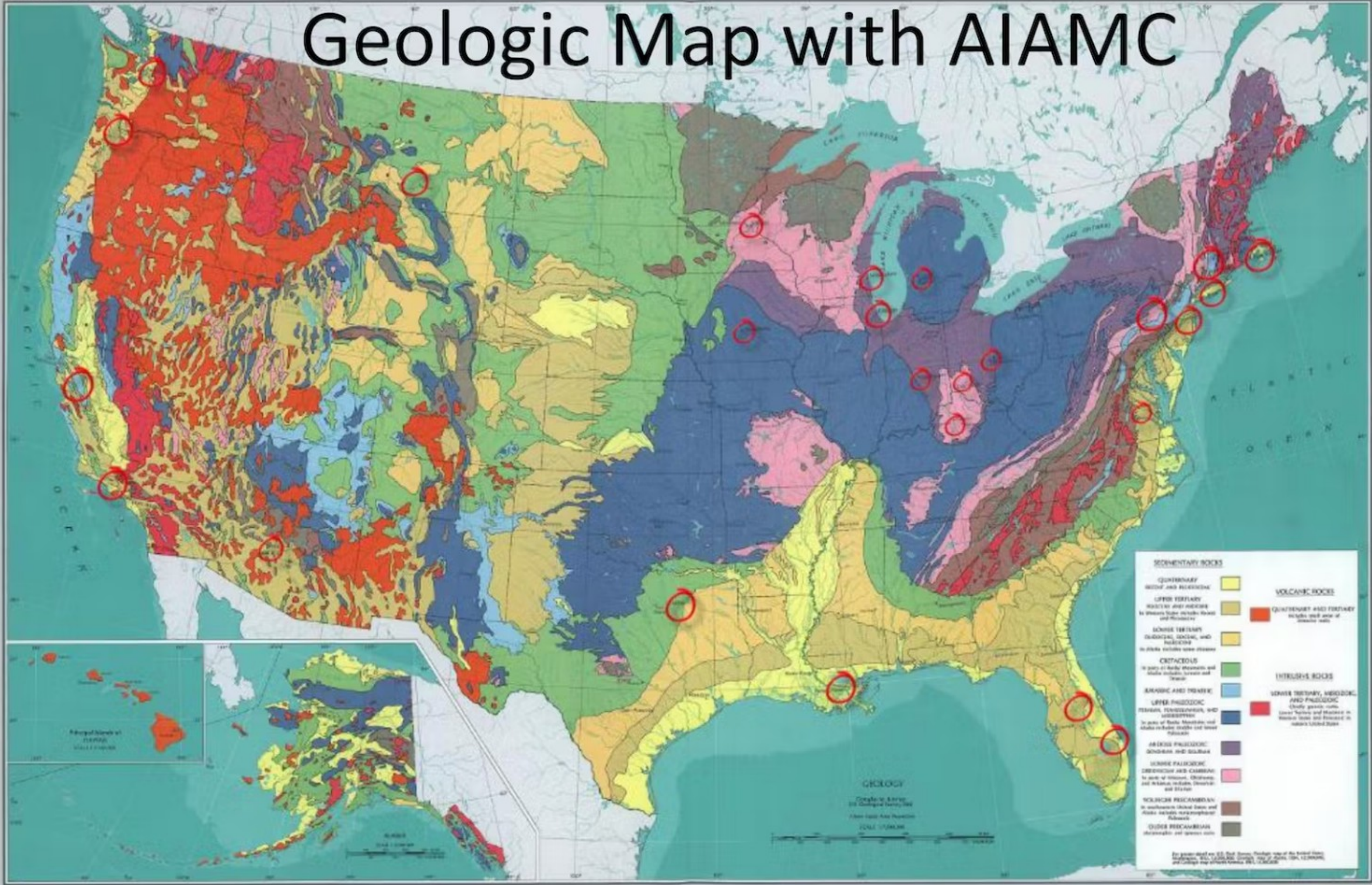


Railroad Map with AIAMC



Source: The National Transportation Atlas
Databases 2014, Bureau of Transportation
Statistics, U.S. Department of Transportation

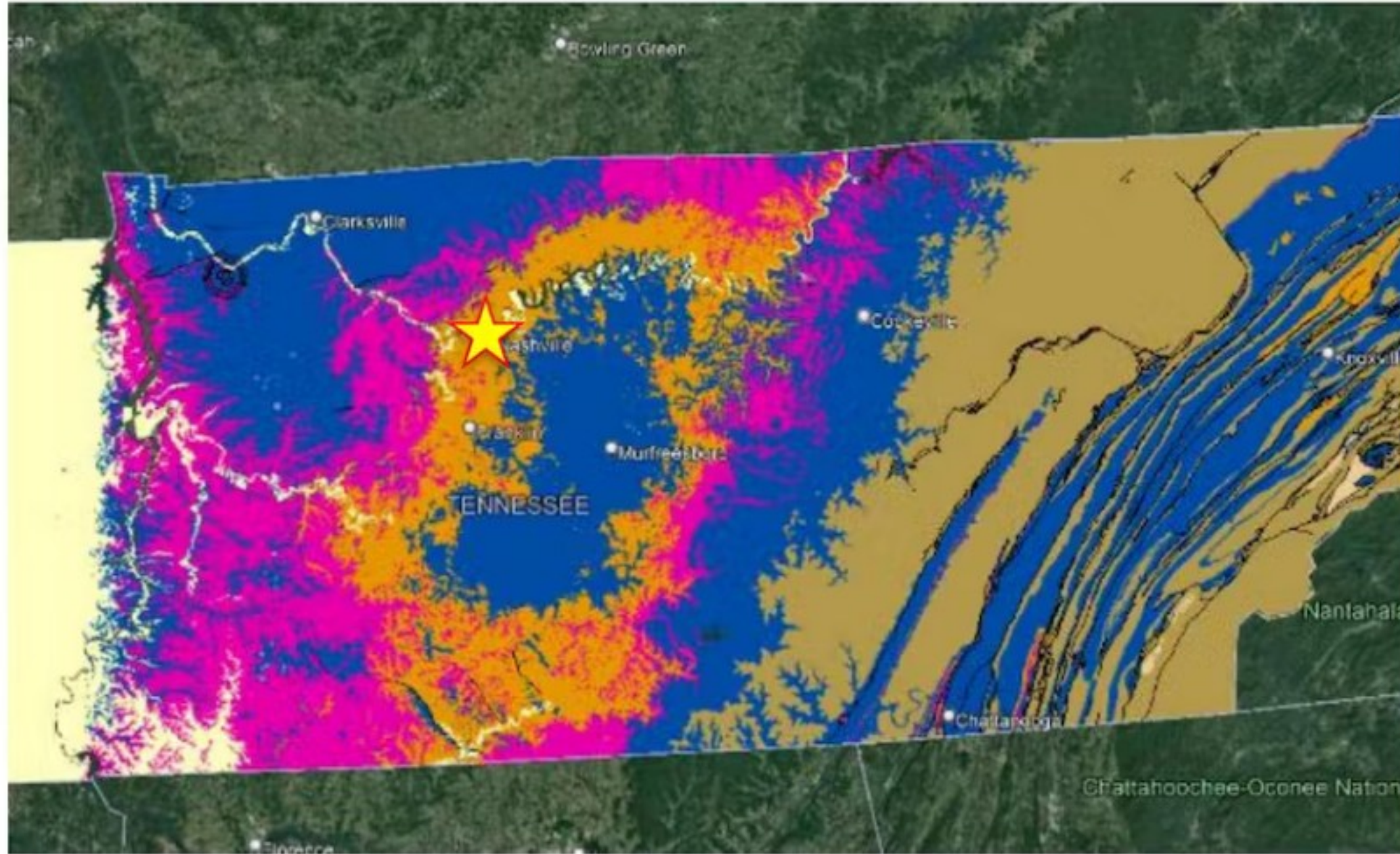
Geologic Map with AIAMC



Medical Geology Applications

- Environment
 - Naturally occurring
 - Fluoride
 - Heavy metals
 - Clean Water
 - Necessary Minerals
 - Toxic Spills
 - Mine wastes
 - Chemical plants
 - Man made issues
- Geography
 - Land use
 - Favorable or hostile environment
 - Resource availability
 - Food
 - Water
 - Energy
 - Shelter
 - Means of commerce
 - Rivers
 - Barriers

Nashville Area Geology



- Breached dome with old (Ordovician) rocks exposed in the center
- A lot of limestone – karst (sinkholes)
- Dissected by gentle streams – that slowly dissolves the rock
- In spite of abundant rainfall streams dry up quickly after rain
- Moderate relief (200' high hills)
- Commercial phosphate mining in the outer basin

Geology. The Nashville Basin rests on a dome of **Ordovician limestone**, the same formation that creates the Bluegrass and part of the Cincinnati Arch. The Inner Basin has a number of shale beds interrupting the limestone, while the Outer Basin includes a number of steep hills capped by chert.

Nashville Basin – Tom Kimmerer

kimmerer.com/woodland-bluegrass-nashville/nashville-basin-2/

Medical Geology Nashville area

- Environment
 - Naturally occurring
 - Fluoride
 - Heavy metals
 - Clean Water
 - Necessary Minerals
 - None identified
 - Toxic Spills
 - Mine wastes
 - Cement, sand gravel, clays
 - Minimal energy development
 - Chemical plants
 - None stand out
 - Man made issues
 - Airport fire fighting foam spills are an issue
- Geography
 - Land use
 - Favorable or hostile environment
 - Extensive urbanization
 - Pasture land and forest
 - Thin soils
 - Poor quality and unproductive – best now under urbanization
 - Prone to drought
 - Resource availability
 - Water
 - Water soaks in
 - Means of commerce
 - Rivers
 - Mostly define where communities locate
 - Barriers
 - Topography gentle, a lot of roads

Breakouts

- Geologic items to consider from Regional Geologic Characteristics
 - Geologic History
 - Rocks on surface
 - Mineral, energy, or industrial development
- Environmental
 - Industrial utilization
 - Historical industrial risks
- Land use
 - How much urban/non urban land use
 - Human use history
- Means of commerce
 - Infrastructure risks (railroads, roads, pipelines)
- What gaps in your area may keep it from being suitable for “Blue Zone”.
- What problems are you aware of that might be environmental?
- What issues might you expect that are not currently on your radar?
- What are your patients resources?
- What are your resources?

references

- On the road to personalised and precision geomedicine: medical geology and a renewed call for interdisciplinarity. Maged N Kamel Boulos , Jennifer Le Blond . *int J Health Geogr* 2016 Jan 28;15:5. doi: 10.1186/s12942-016-0033-0.
- Reprinted from *Geosciences*. Cite as: Eggers, M.J.; Moore-Nall, A.L.; Doyle, J.T.; Lefthand, M.J.; Young, S.L.; Bends, A.L.; Environmental, C.; Health Steering Committee and Camper, A.K. Potential Health Risks from Uranium in Home Well Water: An Investigation by the Apsaalooke (Crow) Tribal Research Group. *Geosciences* 2015, 5, 67-94.
- The Spread of obesity in a large social network over 32 years. Christaki, NA. Fowler, JH. *N Eng J Med*. 2007. Jul 26;357 (4) 370-9
- Blues Zones. Lessons from the world's longest lived. Buettner, D. Skemp, S. Frates, B. *Am J of Lifestyle Med* 2016. Sep-Oct. 10 (5) 318-321.
- Herskind AM, McGue M, Holm NV, Sorensen TIA, Harvad B, Vaupel JW. The heritability of human longevity: a population-based study of 2,872 Danish twin pairs born 1870-1900. *Hum Genet*. 1996;96:319-323

How has this experience changed your perspective on the world in which you live (Up to three - one word entries)

