

Geology of the National Parks

Evolution of North America with Nicole Myers

Focus on the green shapes & watch North America slowly form

This map will show the continents colored by current location.

Africa

Antarctica

Australia & Oceania

Eurasia

North America

South America

Does not belong to any

Video Link:

<https://www.youtube.com/watch?v=UwWWuttntio&t=32s>

63 US National Parks

- Earth history
- Human history
- National history
- Conservation

Video link:
<https://www.youtube.com/watch?v=lva1m8cl9-Q>

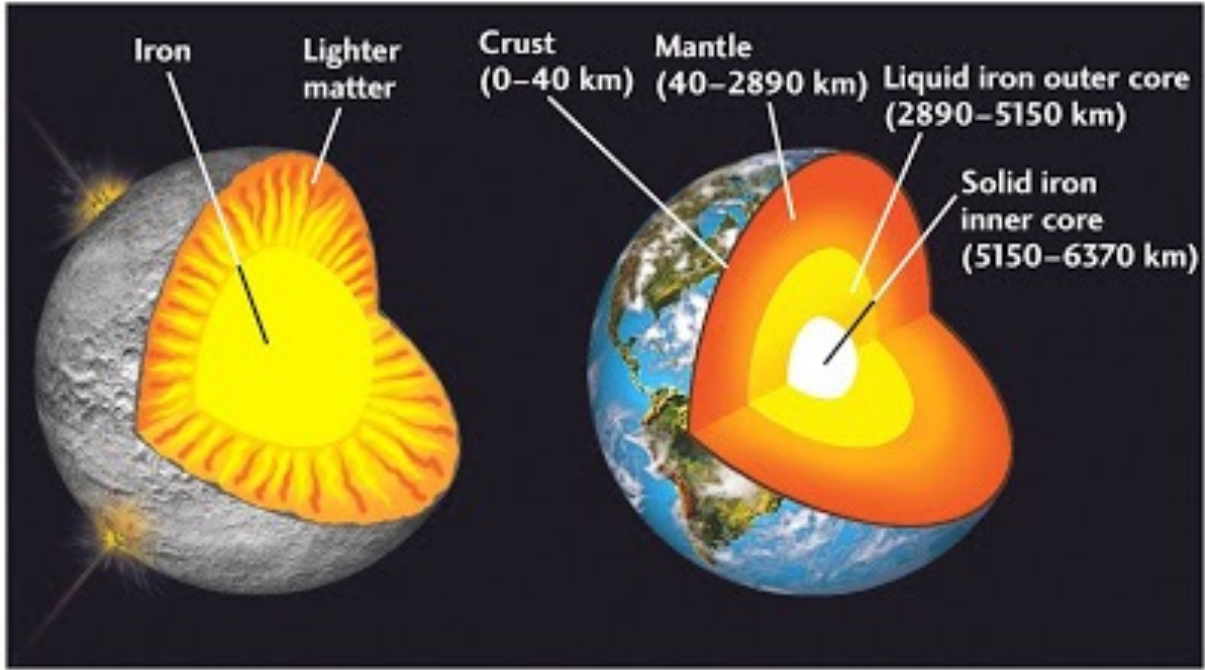
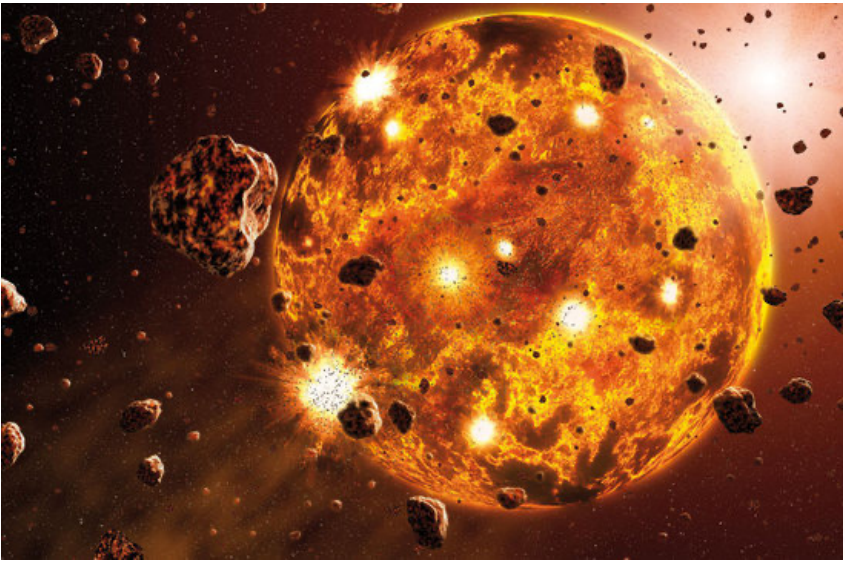
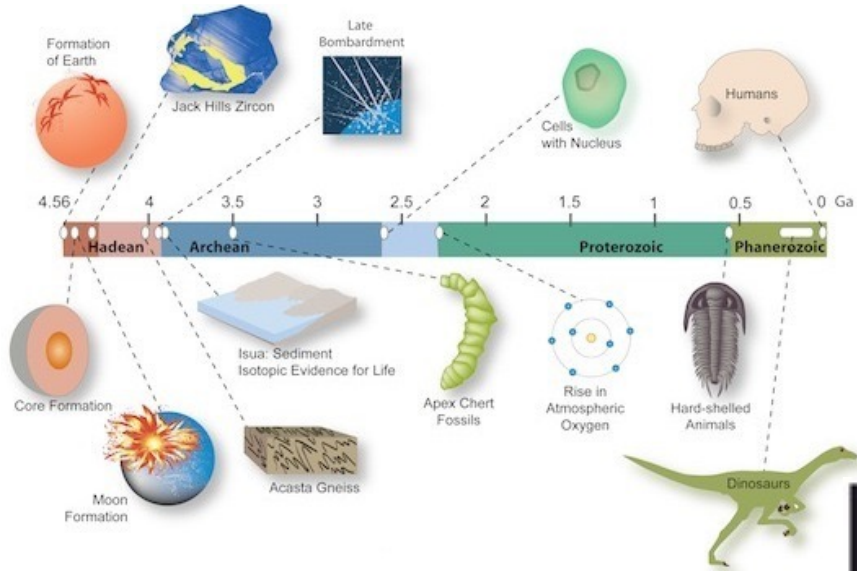
Week 1

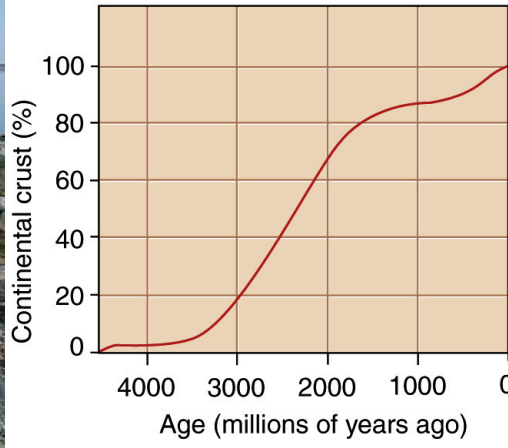
The Formation of Planet Earth, North America & the Geologic Heart of the USA



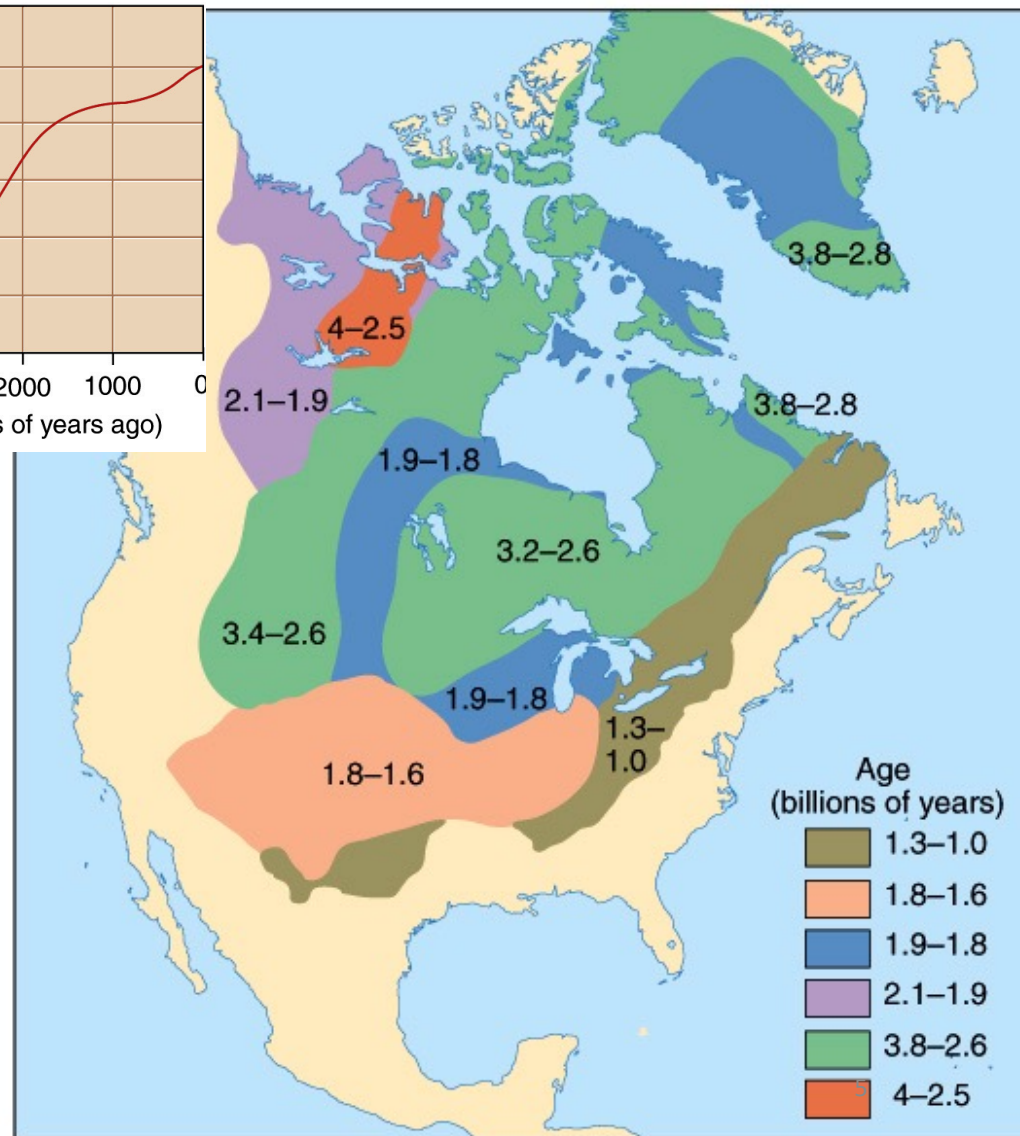
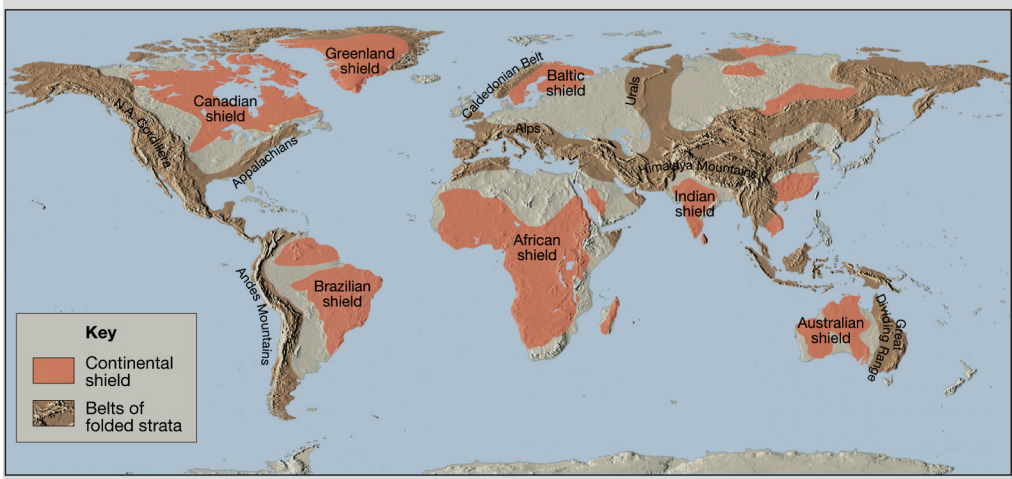
Birth of the Earth

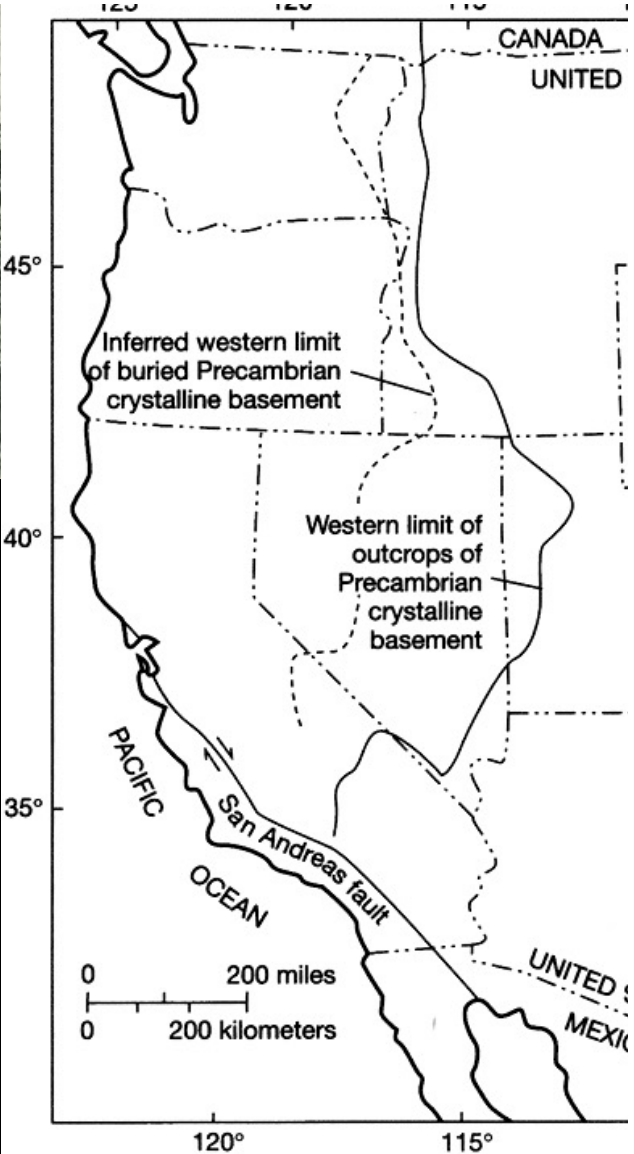
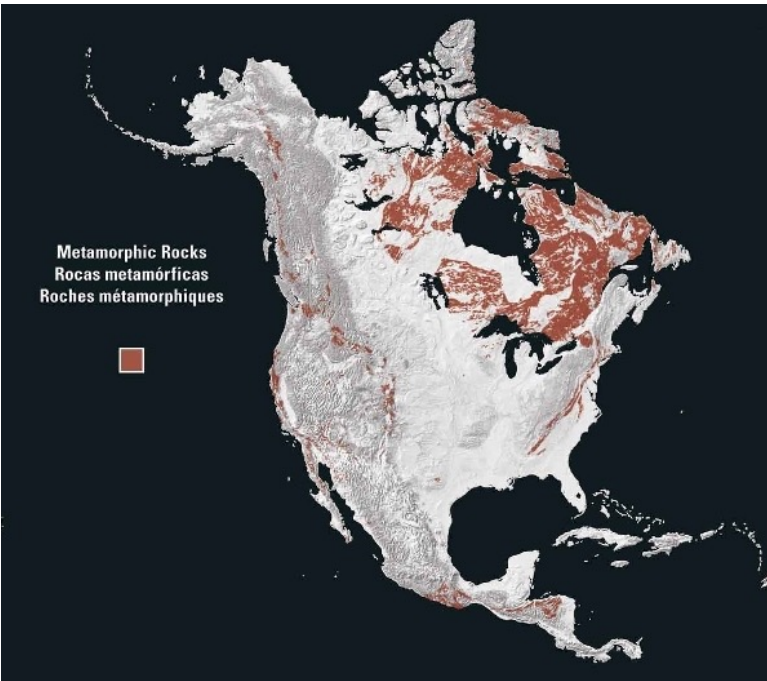
The beginning of a 4.6 billion year history of planetary evolution starts with the formation of the first rocks





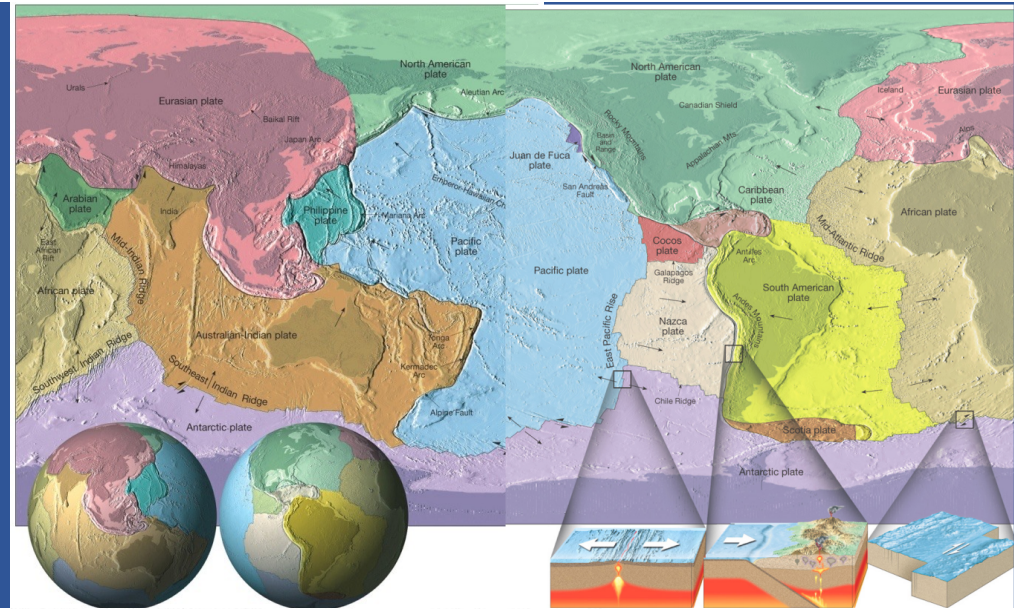
Oldest rock in North America is 4.03Ga
Greenstone, part of the Canadian Shield



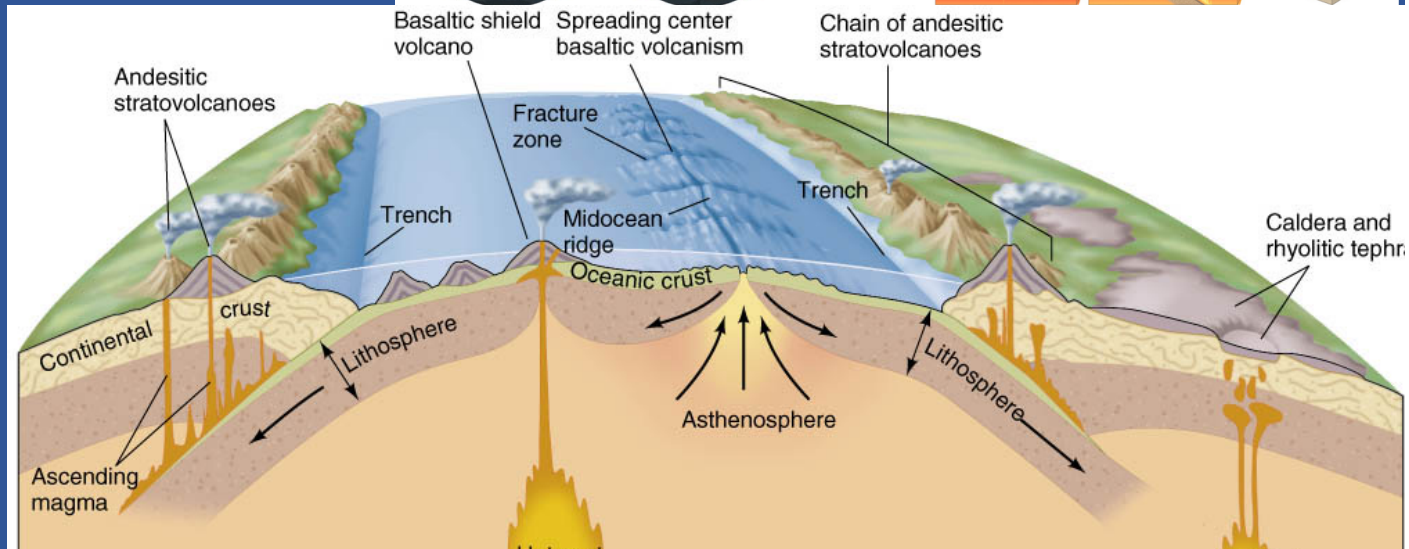


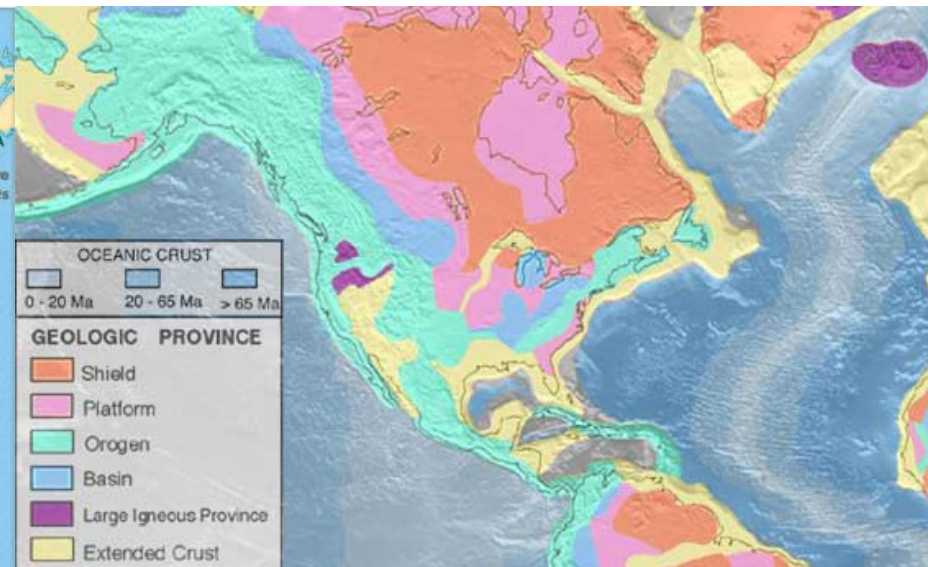
Precambrian Super-Eon
Continental Growth
2.8-2.7Ga: oldest USA rocks in Northern Rockies & Western Great Lakes

Continents Grow Through Accretion as Plate Tectonics Combines Cratons to Create Larger Landmasses



Video link:
<https://www.youtube.com/watch?v=ryrXAGY1dmE>



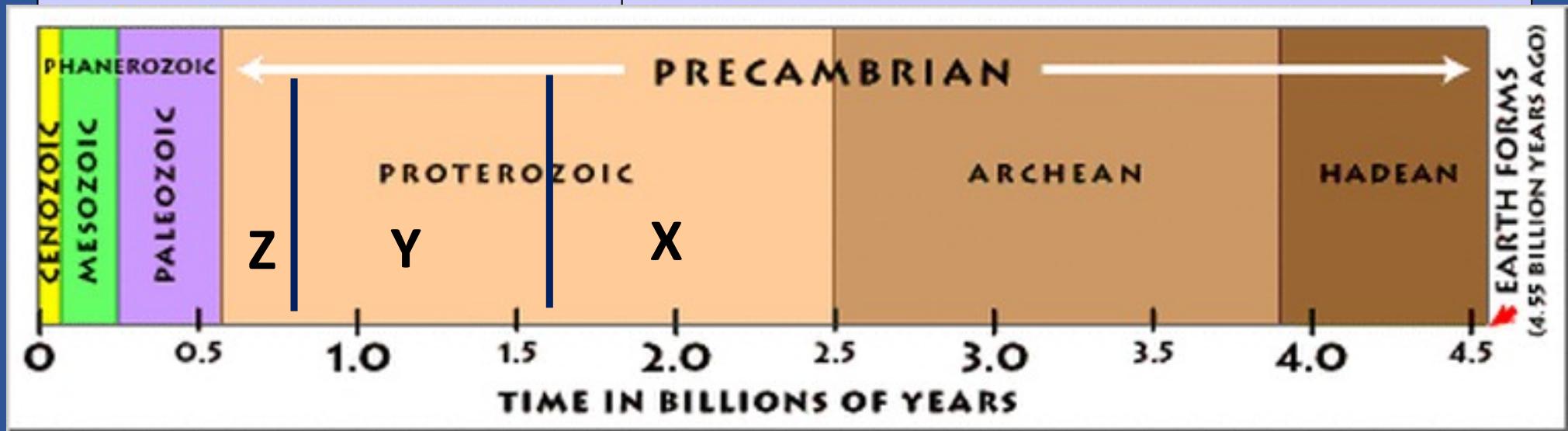


Video Link:
<https://www.youtube.com/watch?v=UwWwUtntio&t=32s>

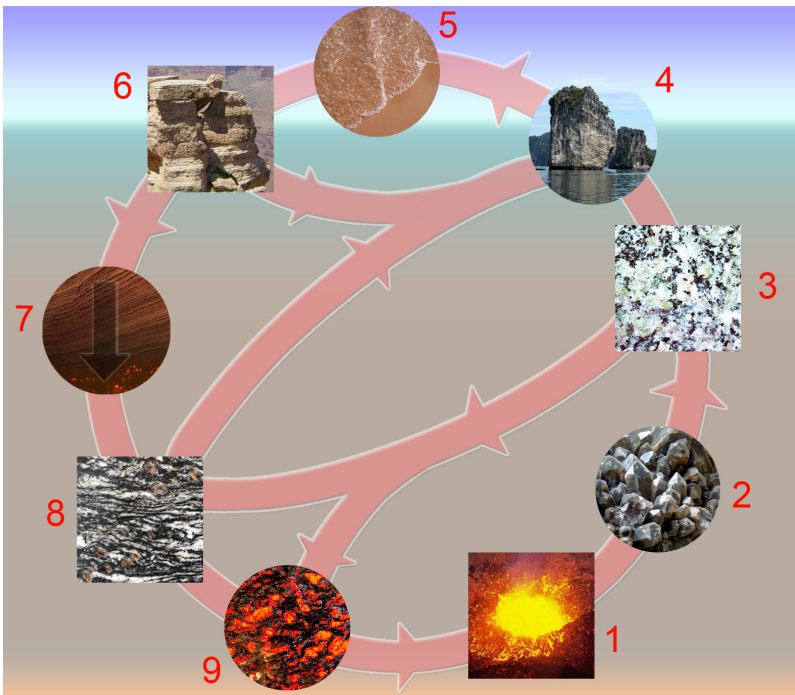
USA National Parks Record the Geologic History of: continental accretion, rock formation & plate tectonics

Geologic Time: Precambrian Super-Eon

January 1	Earth forms
January and early February	Earth organized into core, mantle, and crust
February 21	Life evolves
October 25	Complex organisms, including those with shells and hard parts, evolve

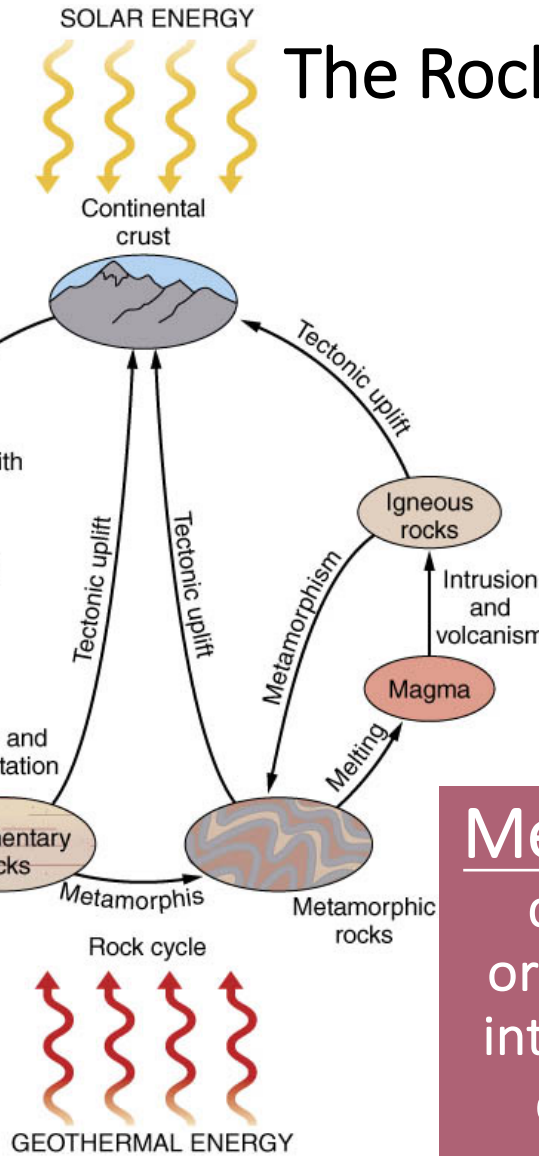


Earth Materials:



Sedimentary Rock:

sediments buried & compacted into solid layers of rock formed of accumulated fragments

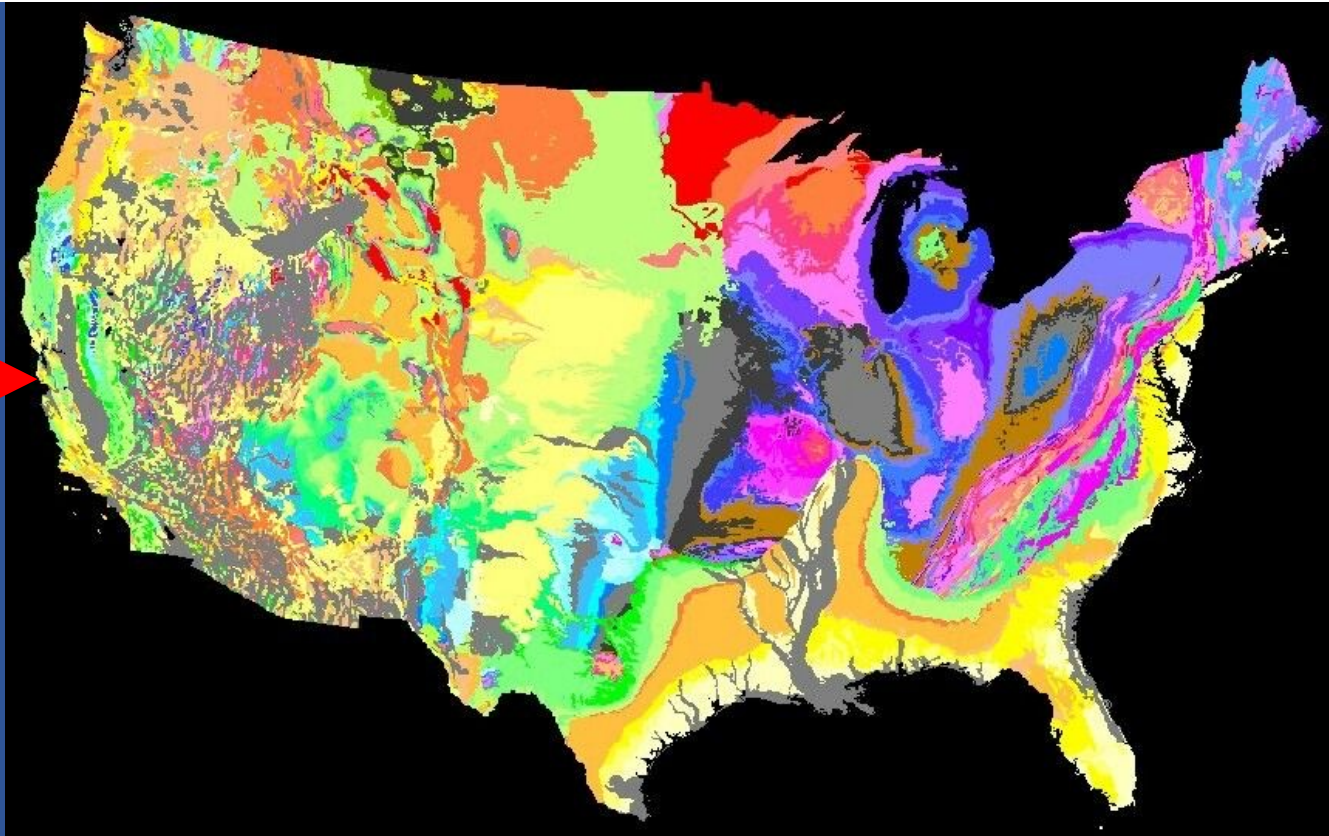


The Rock Cycle

Igneous Rock:
melting forms magma, which cools into a solid rock made of interlocking crystals &/or glass

Metamorphic Rock:
deep burial reforms original rock (protolith) into patterns of crystals deformed by stress

Geologic Maps provide locations of Precambrian rocks, which are mostly within red & dark orange on the geologic map →



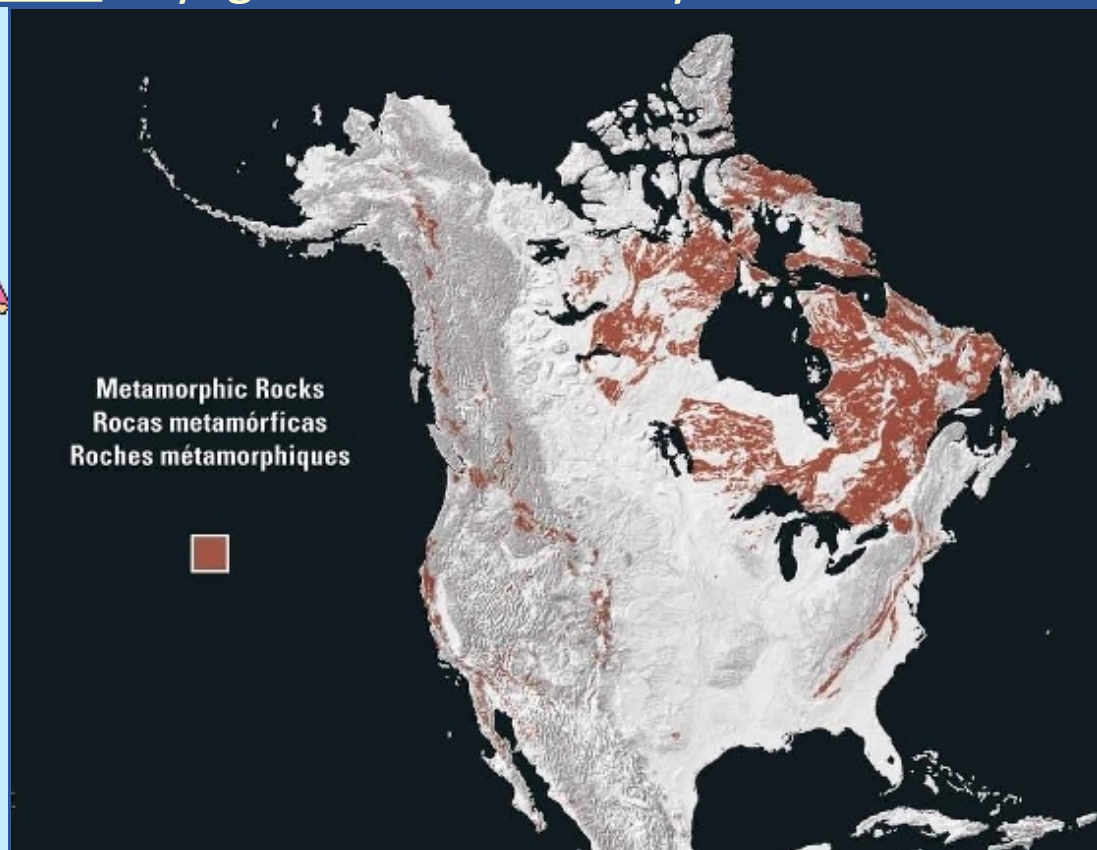
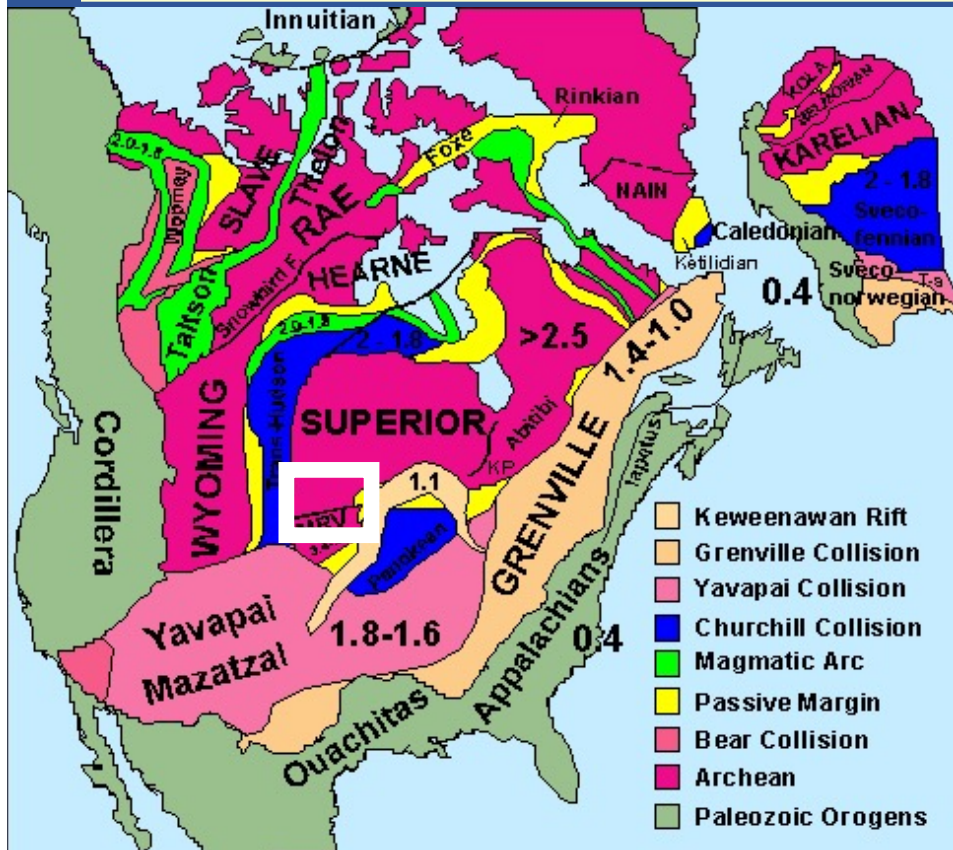
The above geologic map of North America is interactive!

<https://www.ideo.columbia.edu/users/menke/envdata/quality/map/>

Ancient Cratons

Oldest North American rocks are ancient cratons that have been metamorphosed:

- Archean Eon 2.8-2.7Ga: Grand Teton NP & Yellowstone NP
- Archean & Proterozoic Eons 2.75-1.1Ga: Voyageurs NP & Isle Royale NP

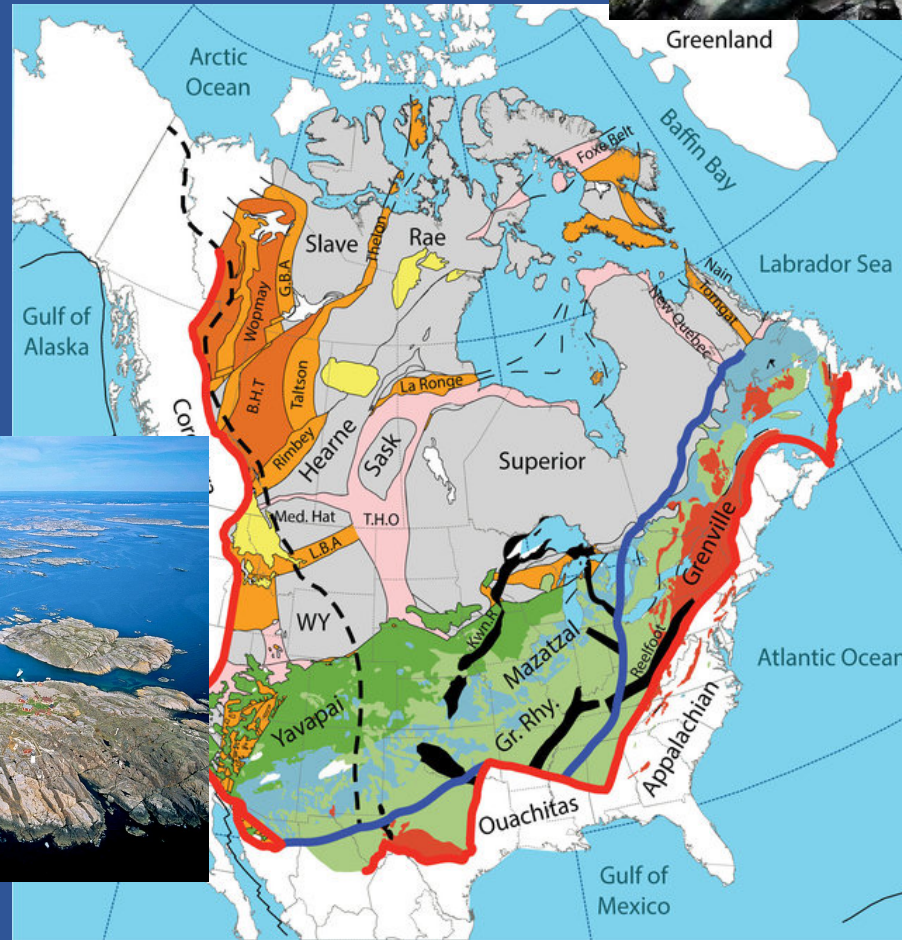


Superior Uplands: Voyageurs National Park, MN

• Archean Eon:

MN

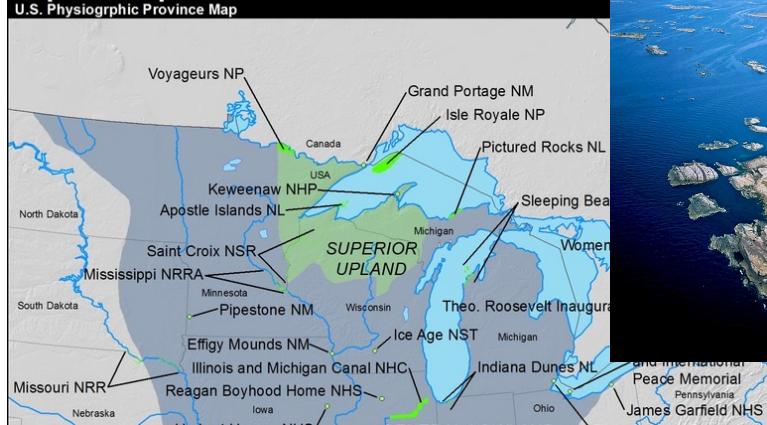
- Oldest bedrock: 2.75 Ga
- Kenoran Orogeny
- Metamorphosed batholith of greenstone with gold
- 1893-1898 gold mining boom



- ### Provinces
- > 2.5 Ga Archean crust
 - 2.0 - 1.8 Ga Juv. arcs
 - 2.0 - 1.8 Ga Juv. orogens
 - 1.9 - 1.8 Ga RW. Archean
 - 1.76 - 1.72 Ga Juv. crust
 - 1.69 - 1.65 Ga Juv. crust
 - 1.7 - 1.65 Ga Qu. Depos.
 - 1.55 - 1.35 Ga Juv. crust
 - 1.3 - 1.0 Ga coll. orogens

- ### Boundaries
- 1.3 - 1.0 Ga Grenville front
 - 1.2 - 1.1 Ga Midcont. rifting
 - 0.78 - 0.68 Ga Eastern - Western breakups
 - 0.62 - 0.53 Ga Failed rifting
 - Rocky mountain front
 - Tectonic plate limit

Central Lowlands and Superior Upland Provinces



Superior Uplands: Voyageurs NP

- Proterozoic Eon:
 - 2.1Ga mafic dikes
- Pleistocene Epoch:
 - Glacial deposits: lakes, outwash, peat
 - Lake Superior disorganized hydrology
 - Park Est.: April 8, 1975



10 Minute Break!

This map will show the continents colored by current location.

Africa

Antarctica

Australia & Oceania

Eurasia

North America

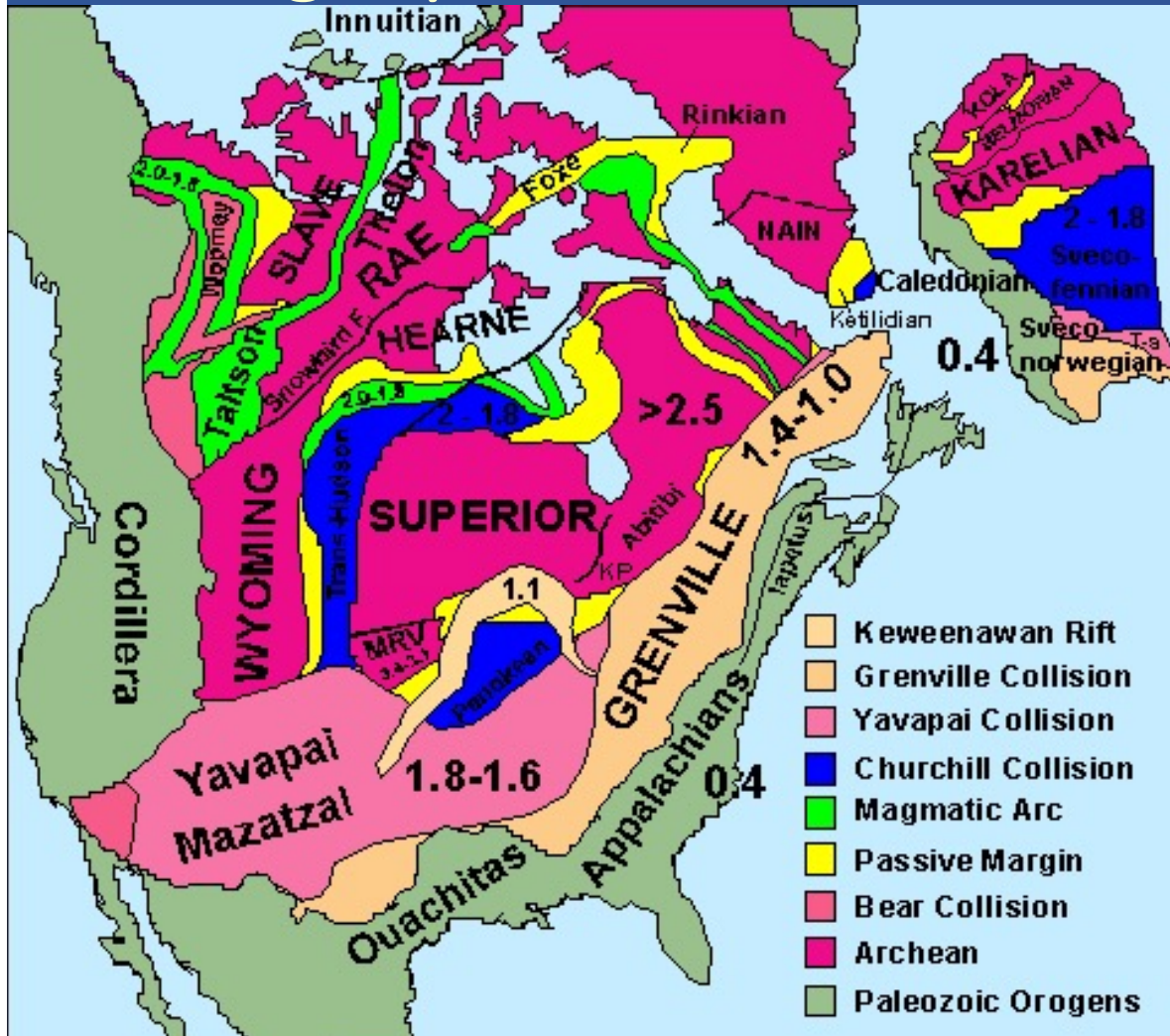
South America

Does not belong to any

Video Link:

<https://www.youtube.com/watch?v=UwWWuttntio&t=32s>

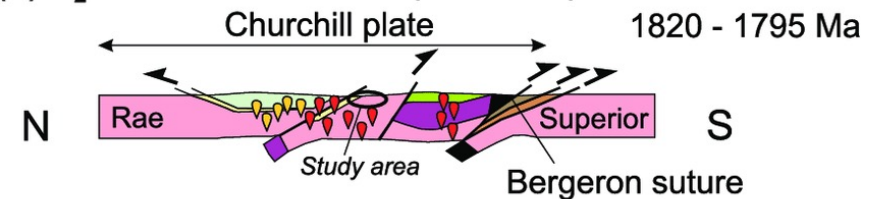
Orogeny = Mountain Building = Metamorphism



Proterozoic Eon ~1.8-1.7Ga:

- Wyoming & Superior Cratons accreted on to NA
- **Penokean Mountains** (blue) = Churchill Craton accreted

(e) D₂: Collision of Churchill plate & Superior craton:



Pipestone National Monument, MN

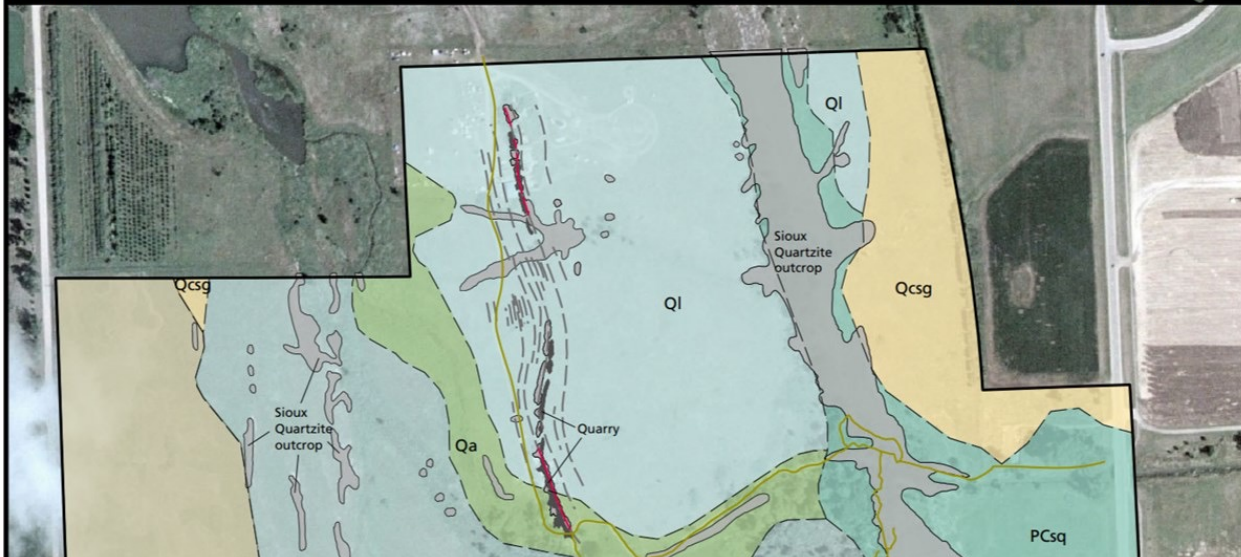
- Proterozoic Eon 1.75-1.63Ga: Sioux Quartzite
 - Contains Quartz-poor Catlinite (pipestone)
 - Erosion of Penokean Mtns
- Mined by Native Americans
- Monument Est. 8/25/1937

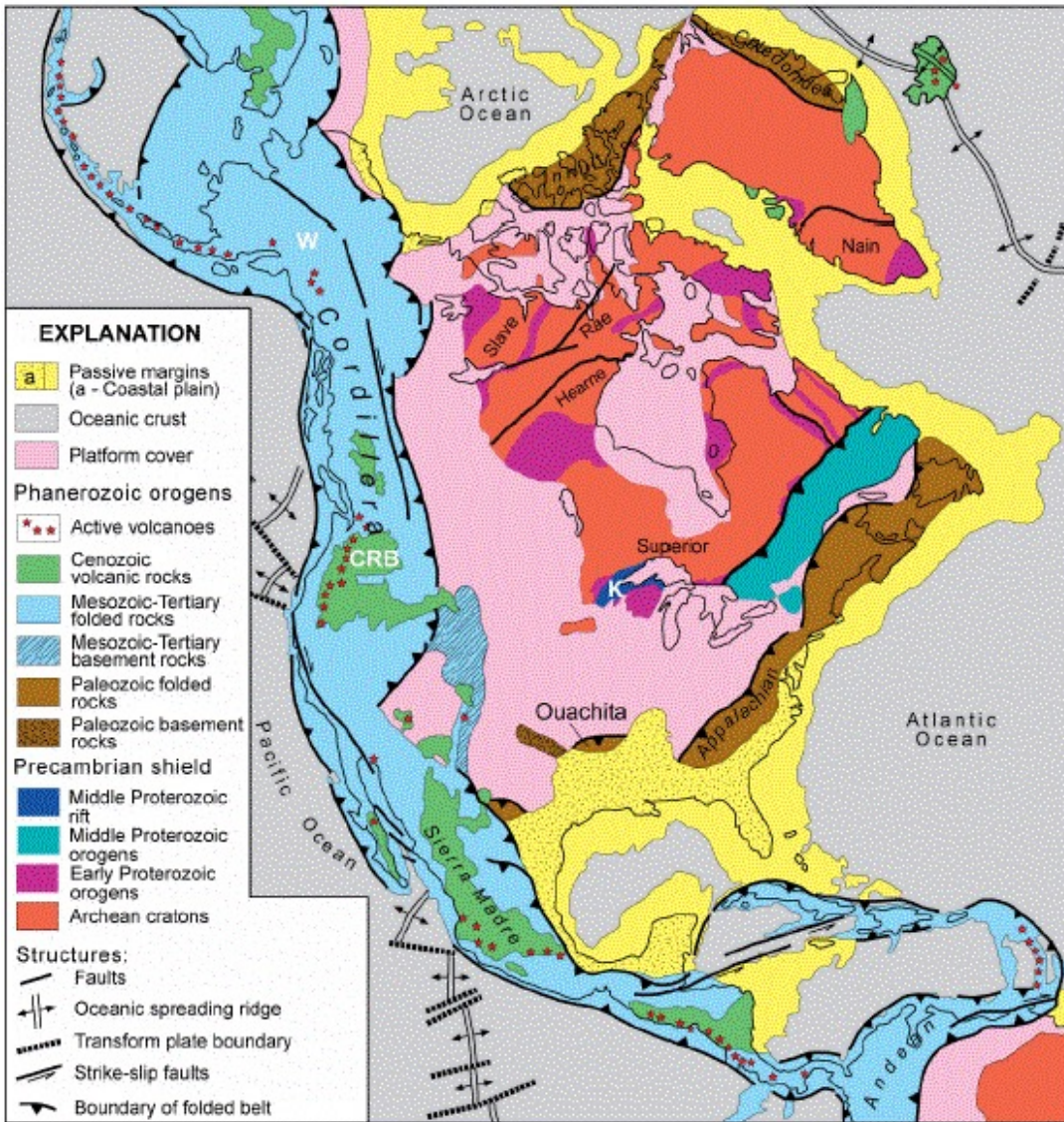


Geologic Map of Pipestone National Monument

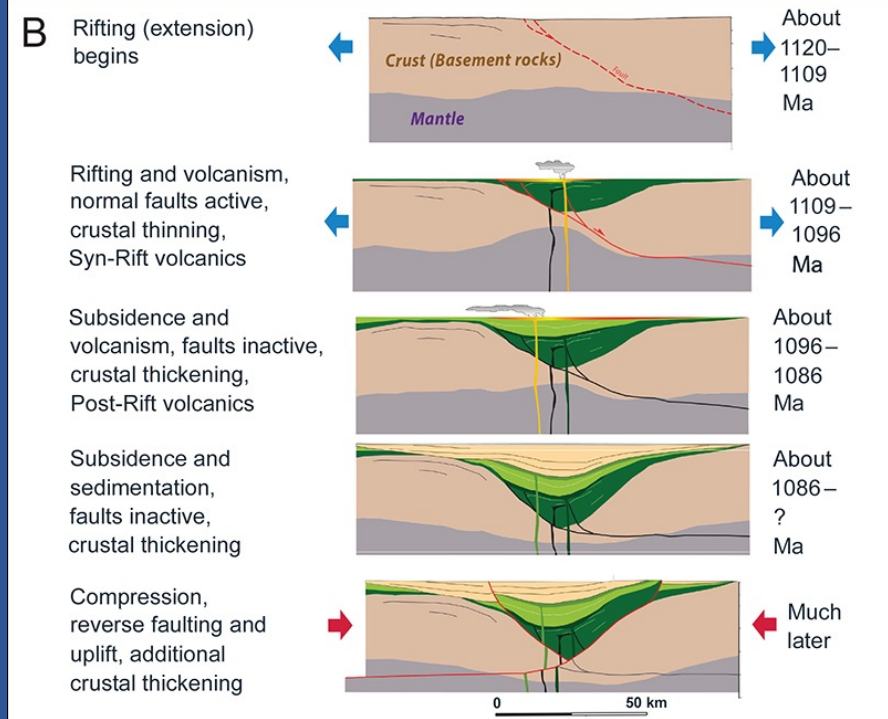
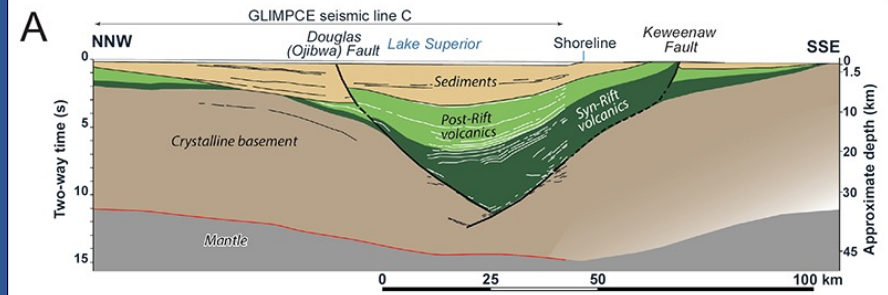
Minnesota

National Park Service
U.S. Department of the Interior
Geologic Resources Inventory



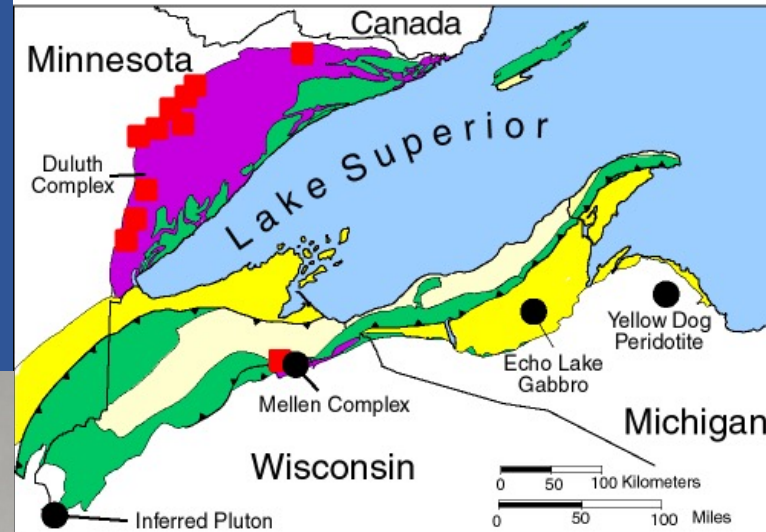
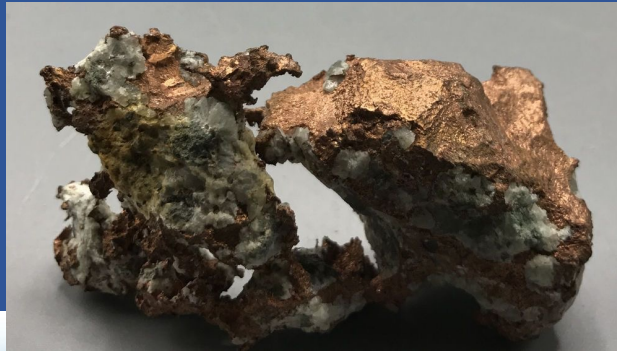


Precambrian Rifting



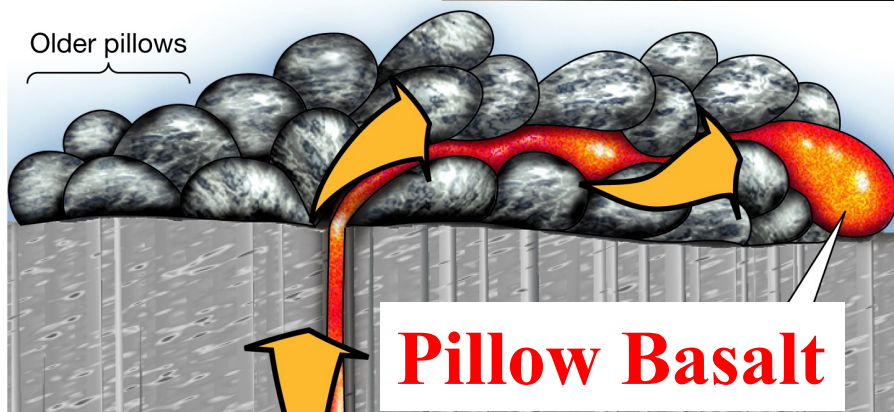
Isle Royale NP Continental Rifting

Proterozoic Eon 1.1Ga: continental rifting of NA for 24 million years = basalt flows, pyroclastic eruptions & hydrothermal metamorphism



EXPLANATION

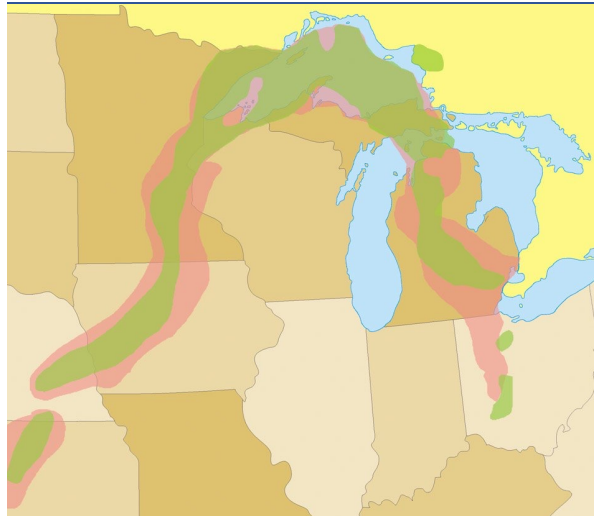
- Sandstone
- Gabbro
- Basalt
- Known nickel and copper sulfide mineralization
- Favorable target
- Faults, in part defining the edge of the rift



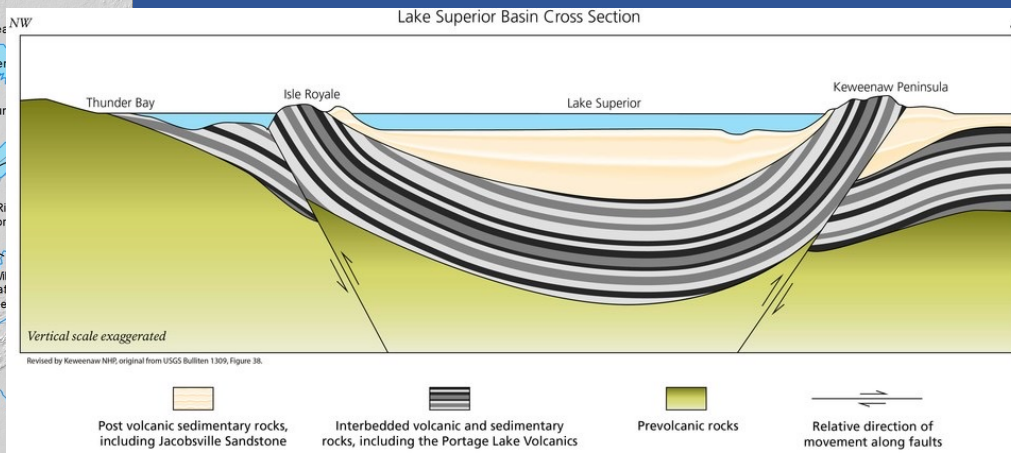
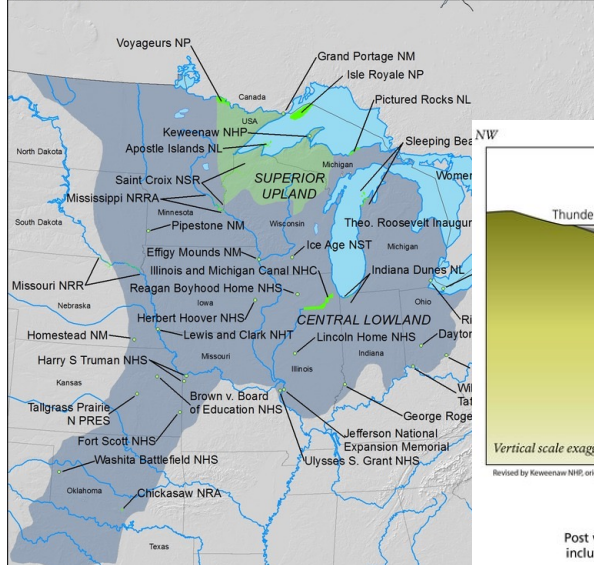
Video Link: <https://www.youtube.com/watch?v=0yWYlv3xG-c>

Isle Royale National Park, MI

- End of Precambrian: Lake Superior syncline + faulting
- Pleistocene Epoch: glaciation formed Lake Superior Basin
- 3800BC: Native copper mined by Native Americans
- Michigan State Gem = Chlorastrolite found in amygdules with pink agates
- Est. 4/3/1940 + UN International Biosphere Reserve 1980



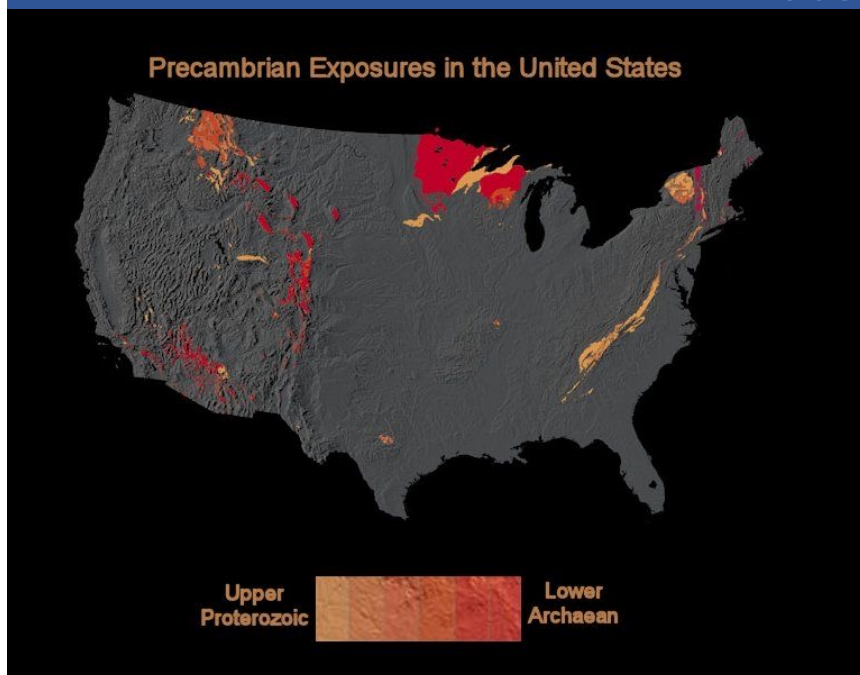
Central Lowlands and Superior Upland Provinces
U.S. Physiographic Province Map
Geologic Resources Division National Park Service U.S. Department of the Interior



Precambrian Mountains Rose & Fell as NA Assembled

- Grand Canyon NP 2.0-1.7Ga
- Rocky Mountains NP 1.8-1.45Ga
- Glacier NP 1.6-0.8Ga
- Joshua Tree NP 1.7-1.65Ga
- Death Valley NP 1.7-1.4Ga
- North Cascades NP 1.65Ga
- Gates of the Arctic NP ~0.6Ga

Erosional debris of ancient mountains flowed into oceans & metamorphosed as cratons combined



Video Link:

<https://www.youtube.com/watch?v=UwWWuttntio&t=32s>

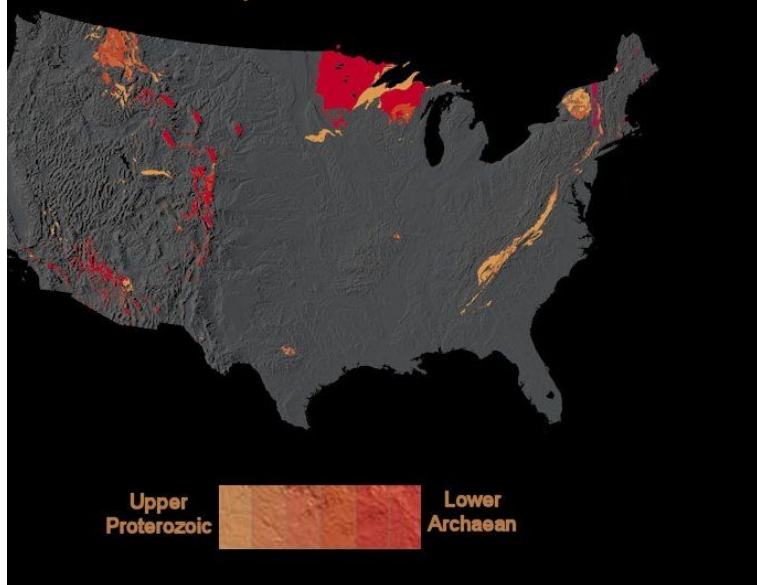
Formation of Supercontinent Rodinia

Grenville Orogeny formed Rodinia 1.4-1.1Ga

- Great Smokey Mountains 1.1Ga
- Shenandoah 1.1Ga
- Mountains eroded into sediments that metamorphosed during orogenesis



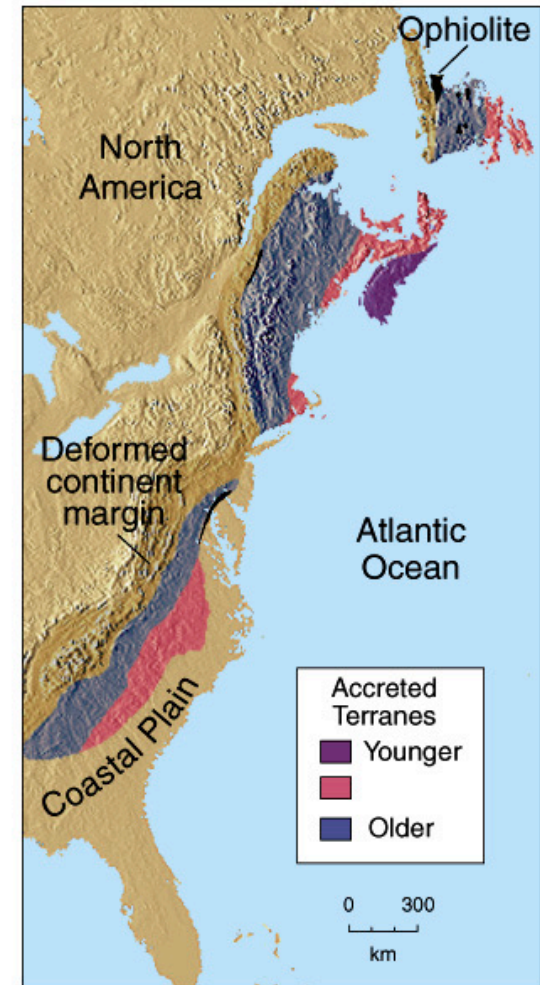
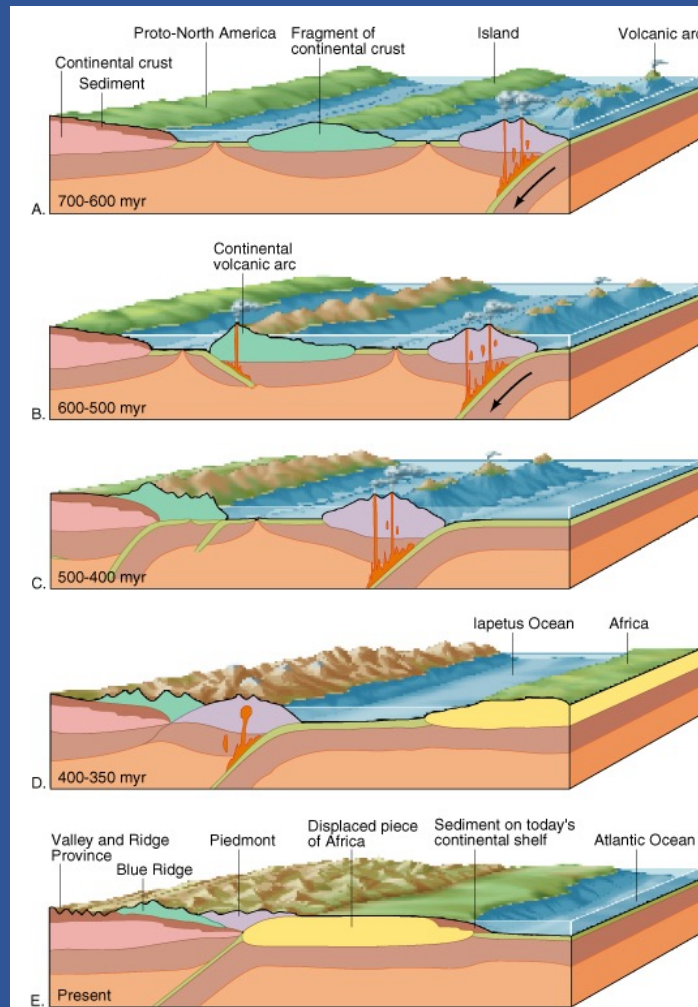
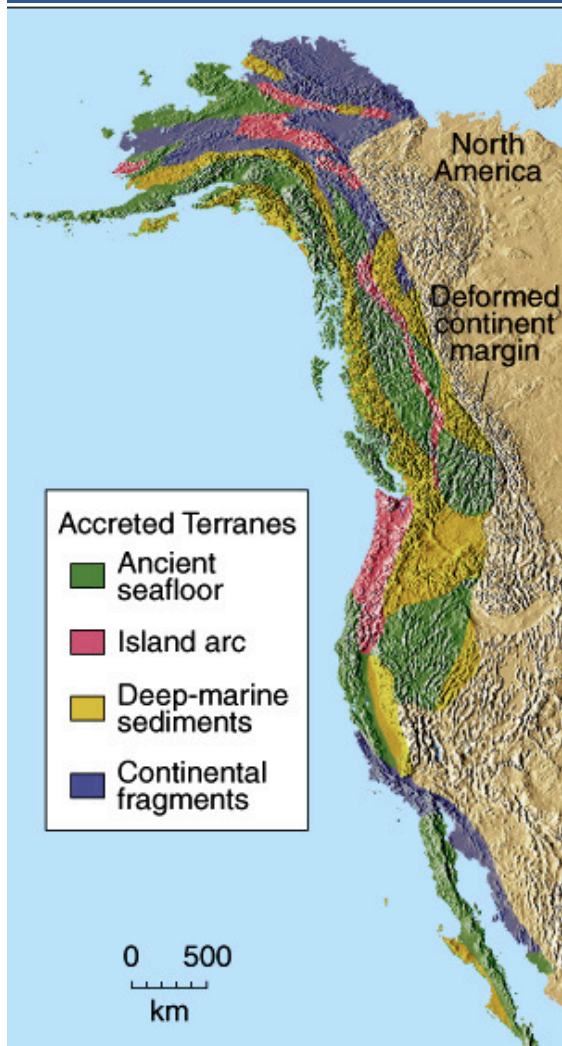
Precambrian Exposures in the United States



Video Link:

<https://www.youtube.com/watch?v=UwWWuttntio&t=32s>

Weeks 5 & 6: Cordillera Belt ← Week 2: Appalachians



Next week... The Appalachians & Pangaea Supercontinent

