Geologic Evaluation of North America

With a Focus on the US National Parks

with Nicole Myers

Week 4: Life & the Last Supercontinent

https://www.appreciatingearth.com/olli

Video link: https://www.youtube.com/watch?v=xaj_J_3YJMc

Reminder!
Join me next Saturday for the

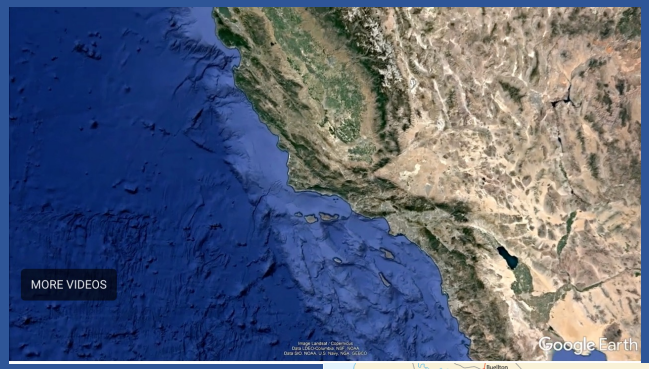
Community Planting Day in the SSU Native Plant Garden

- Join us on Saturday, February 28th 10am-2pm
- More info at https://cei.sonoma.edu/calendar-events

National Park Service

*"conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them **unimpaired for the enjoyment of future generations**." [National Park Service Organic Act of 1916]*

- **National Park Field Stations**: environmental protection through conservation research & application
  - **Channel Islands Field Station**



The Virtual Field:
https://thevirtualfield.org/video/santa-rosa-island-torrey-pines/ &

Video Link
https://www.youtube.com/watch?v=bFJDZOgfySQ

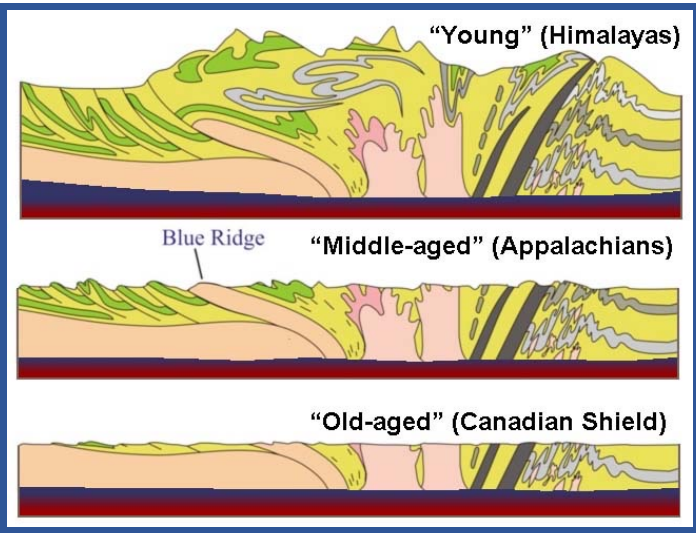
Recap

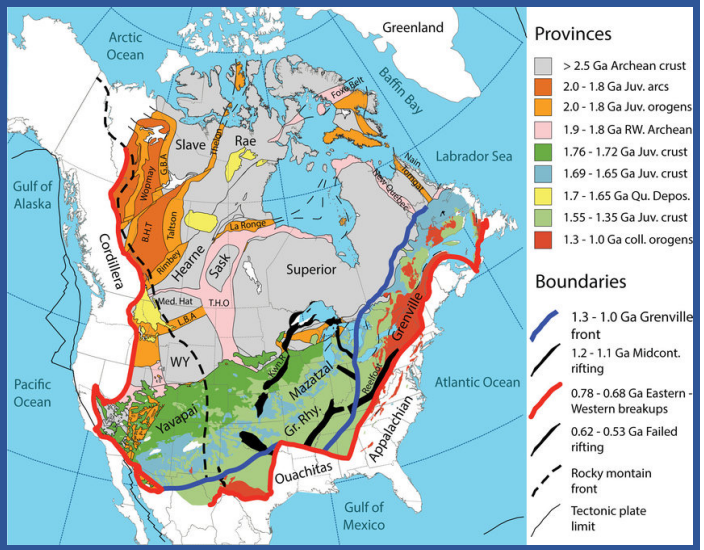
***National Parks provide very high conservation protection & research** opportunities*

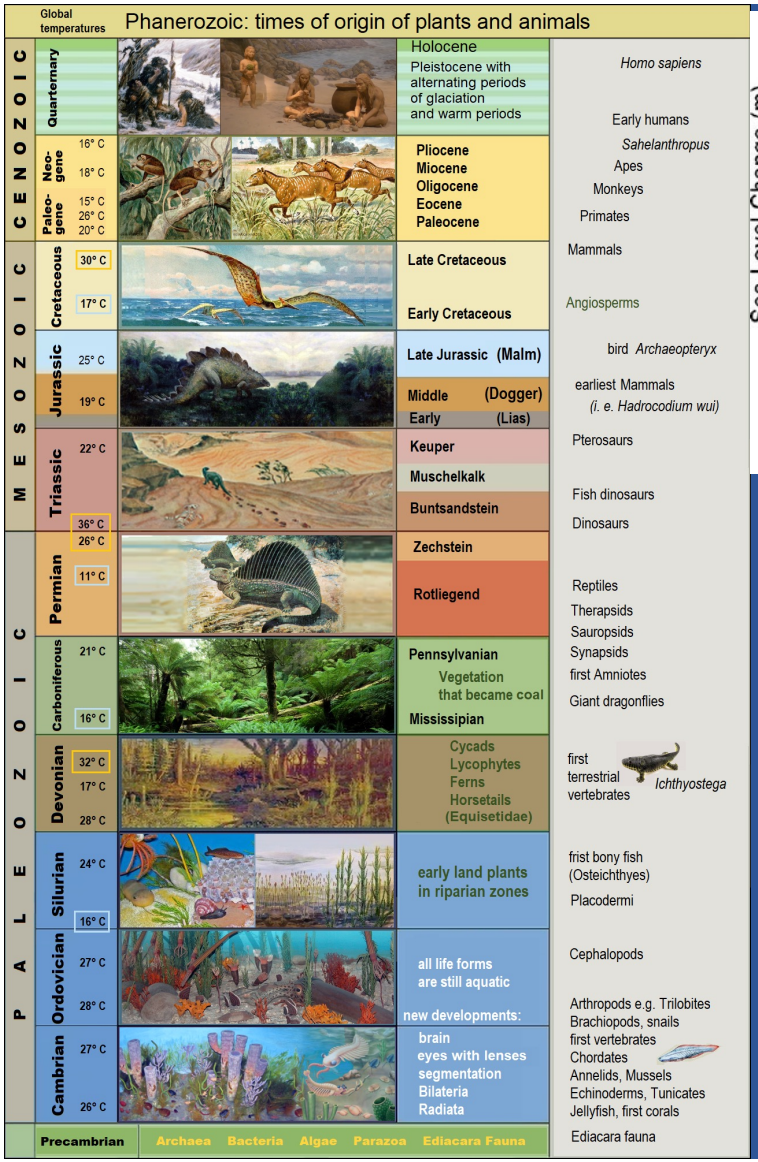
Precambrian craton

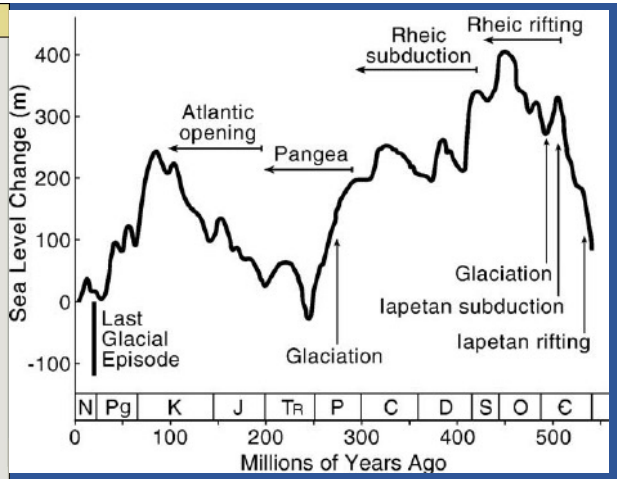
- 2800-2500Ma Kenorland Supercontinent
- 2400-2200Ma Snowball Earth
- 1650-1630Ma Penokean Orogeny
- 2000-1400Ma Trans-Hudson Orogeny/Columbia “SC”
- 1800-1600Ma Yavapai , Mazatzal, Mojave Orogenies
- 1300 - 700Ma Grenvillian Orogenies = Rodinia “SC”
- 720 - 635Ma Final Snowball Earth
- 541 - 530Ma Cambrian Explosion

Only ~25% of National Parks have Precambrian rock outcrops: Voyageurs, Pipestone, Grand Teton, Yellowstone, Wind Cave, Glacier, Black Canyon of the Gunnison, Rocky Mountains, Joshua Tree, Grand Canyon, Death Valley, Saguaro, Isle Royale, Great Smoky Mountains, Shenandoah, Great Basin









Paleozoic Accretion

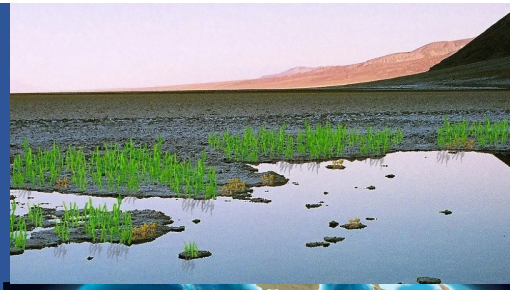
Orogenies: Appalachian (Taconic, Acadian & Alleghenian) + Antler & Sonoma

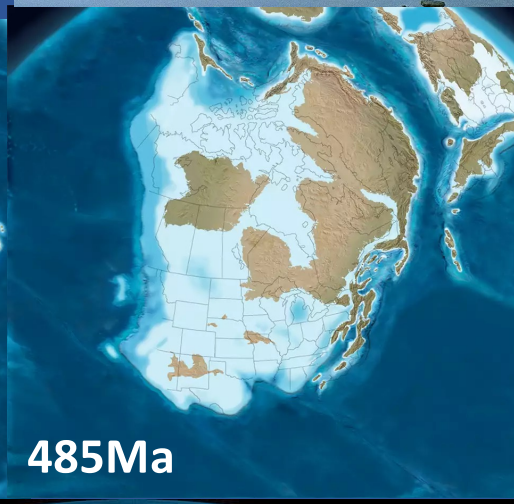
Video link:
https://www.youtube.com/watch?v=g_iEWvtKcuQ

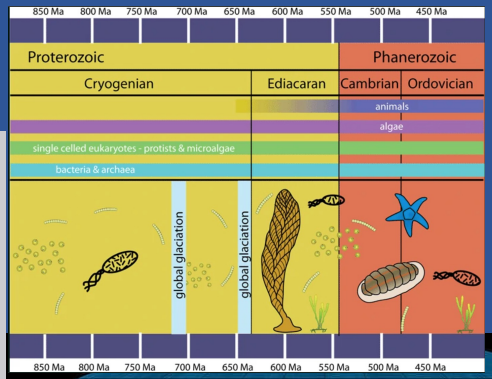
Cambrian-Ordovician Shallow Seas

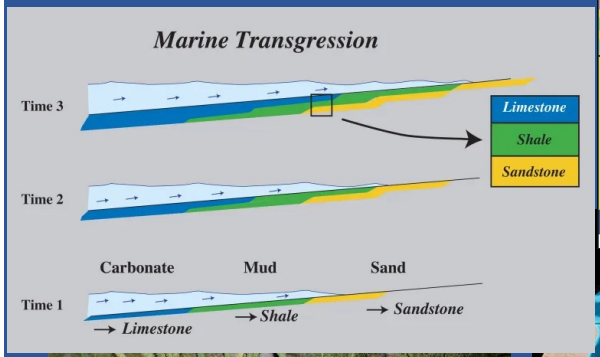
541-443Ma Drowned Tropical North America

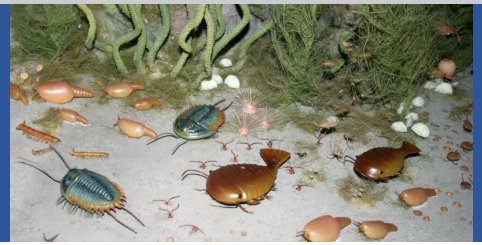
- Evolution of animals, fungi, plants
- Global warming
- Sea level: transgression→ice age regression
- Oxygenated seas & biodiversification
- Taconic Orogeny
- 85% extinction

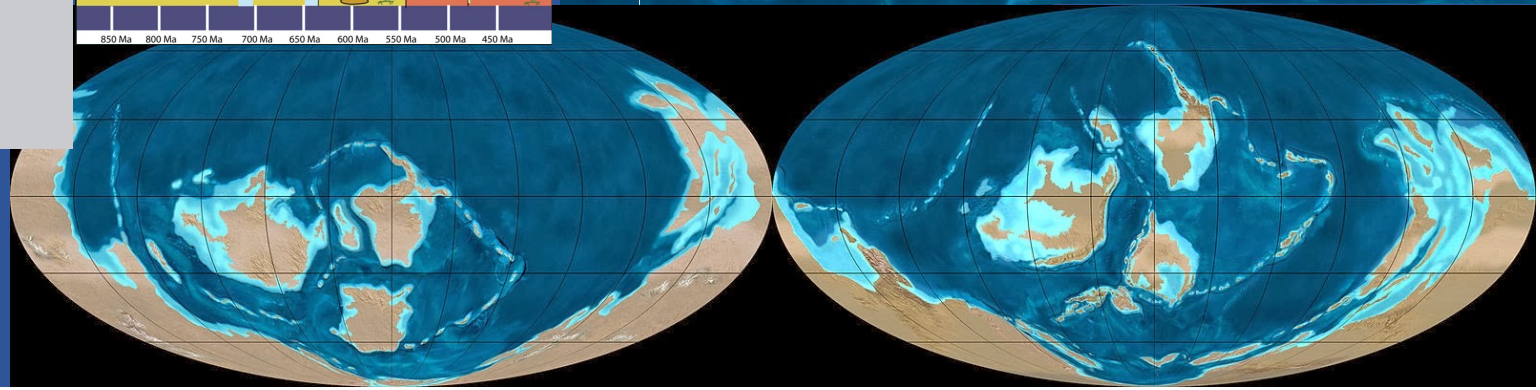












Cambrian-Ordovician Alaska

Submerged & Fragmented

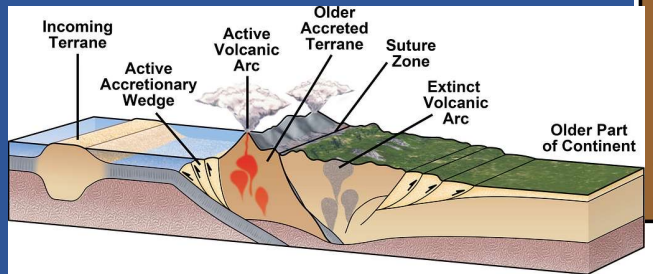
Equatorial: submerged passive margin continental shelf, continental slope, & deep basins + distant offshore volcanic arcs & microcontinent(s)

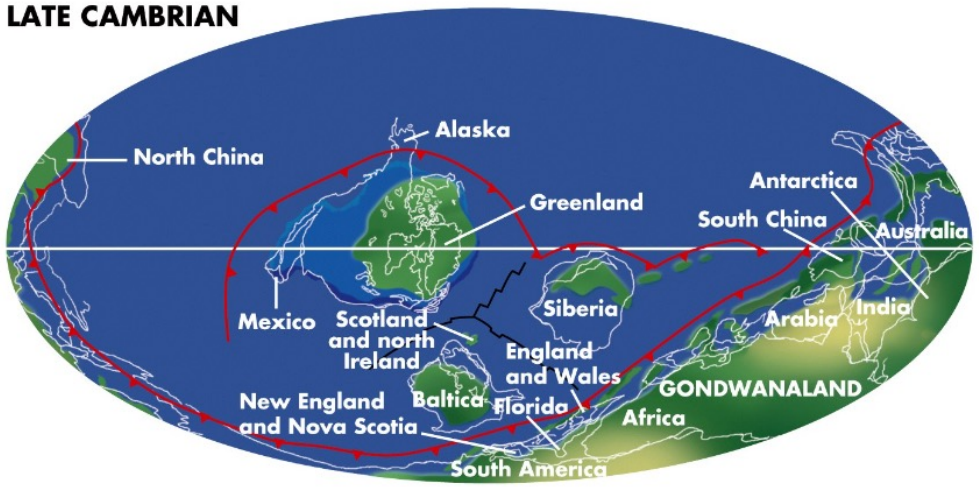
Shallow continental shelf

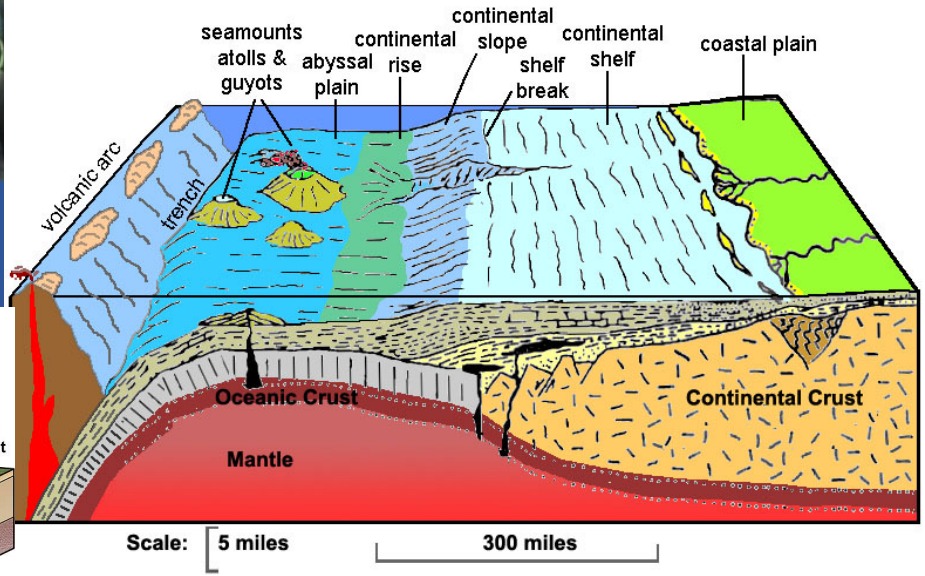
- Denali
- Gates of the Arctic
- Kobuk Valley

Continental shelf → deep marine along a distant microcontinent

- Wrangell-St. Elias



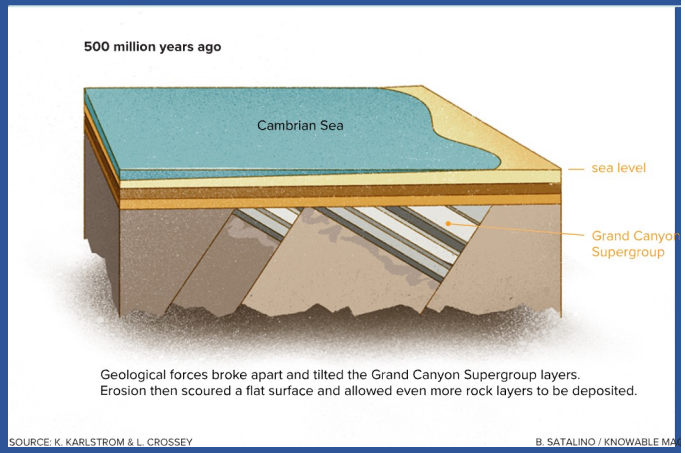


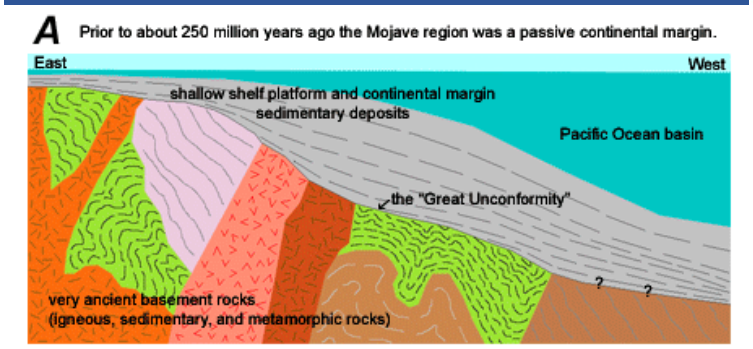


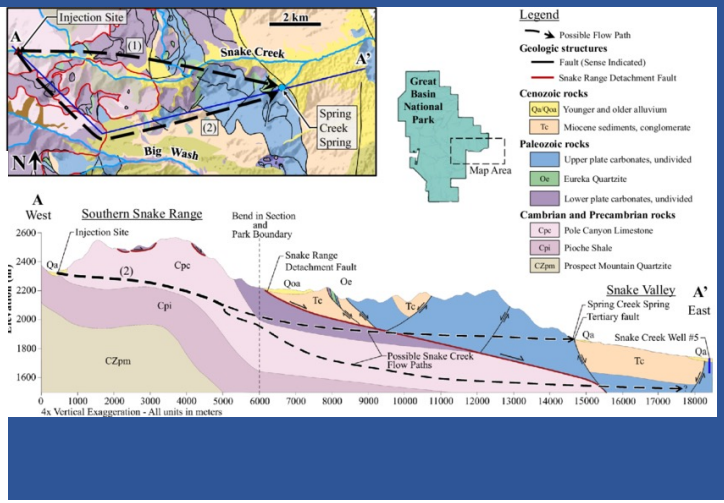
Panthalassa Coast Cambrian-Ordovician Rocks

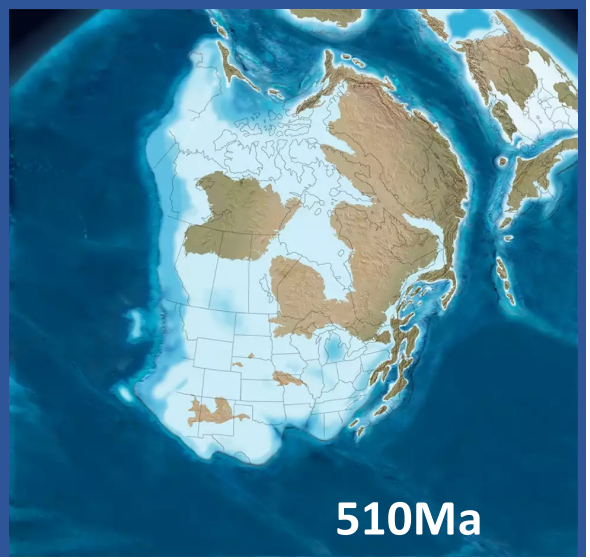
Equatorial: submerged passive margin continental shelf, continental slope & deep basin

- Wyoming/Montana/Idaho: Yellowstone, Grand Teton, Glacier
- California: Sequoia, Kings Canyon, Yosemite, Death Valley, Joshua Tree
- Nevada: Great Basin
- Arizona: Grand Canyon (Cambrian limestone & shale → *Ordovician unconformity*)









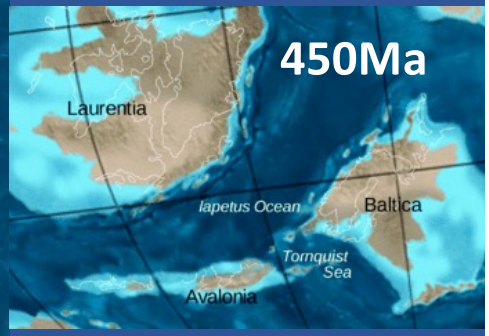
Iapetus Coast Cambrian-Ordovician Rocks

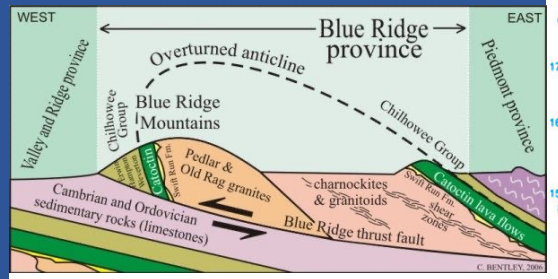
- **Cambrian passive margin → Ordovician active margin with offshore volcanic arcs**

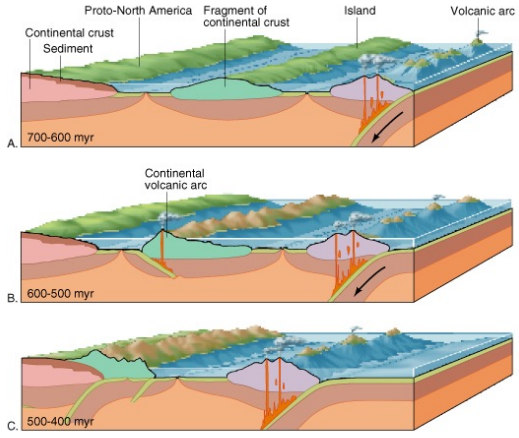
Equatorial: coastline to submerged continental shelf, slope & deep basin

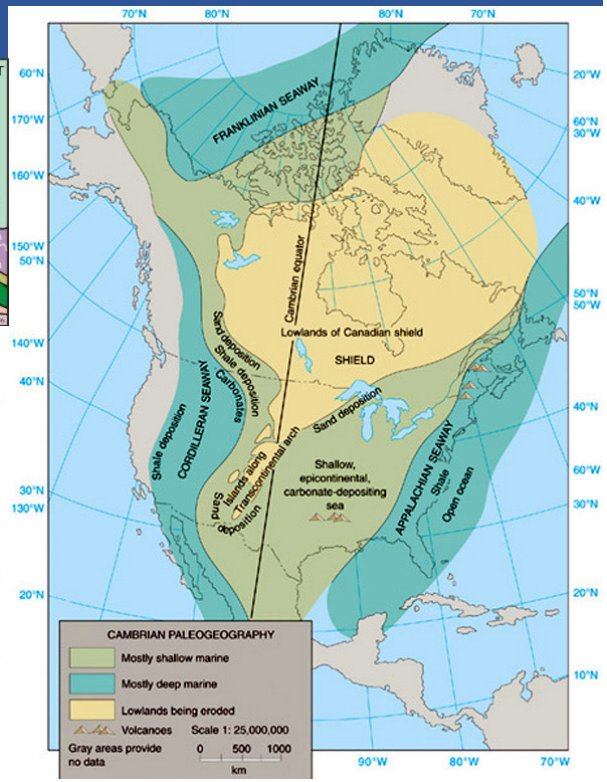
- Virginia: Shenandoah
- West Virginia: New River Gorge
- Tennessee: Great Smoky Mountains
- Arkansas: Hot Springs

- **Maine**: Acadia = offshore Avalon Microcontinent island-arc
- **Florida**: Everglades, Biscayne, Dry Tortugas = African Gondwana granite basement





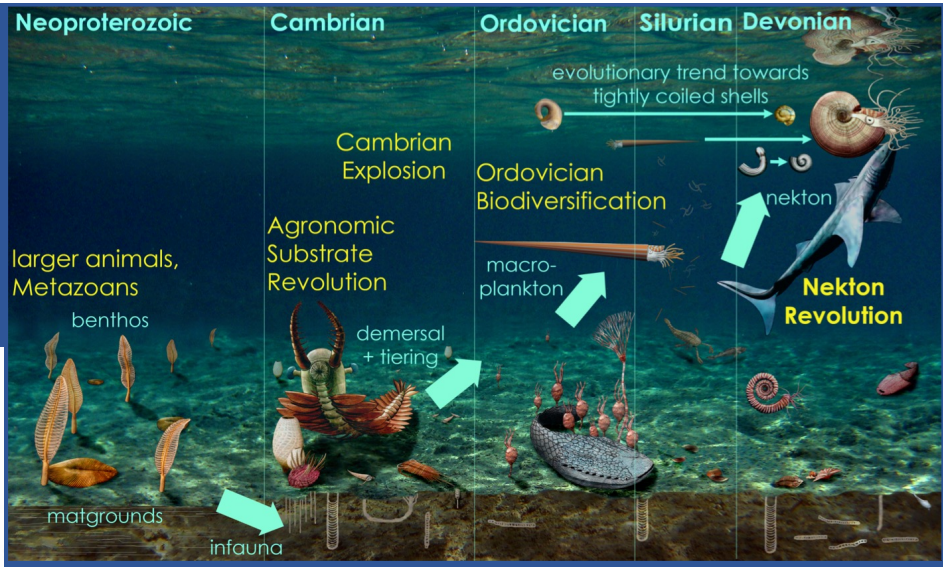


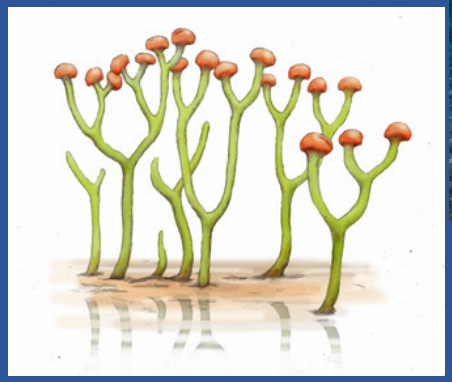


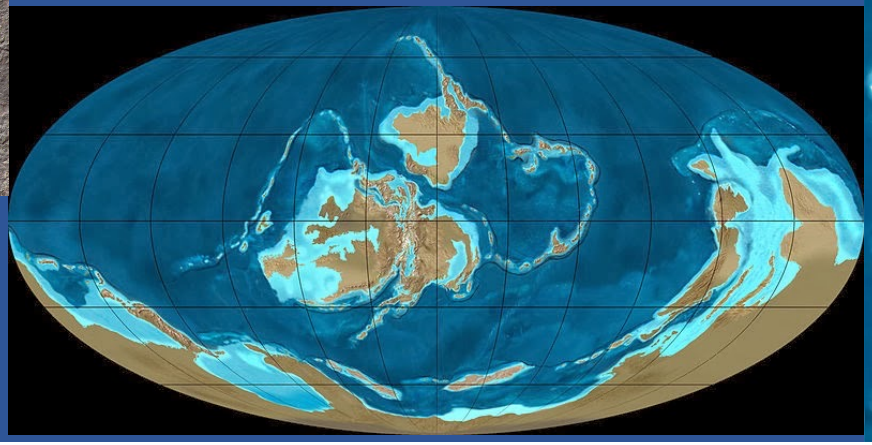
Silurian Active Margins

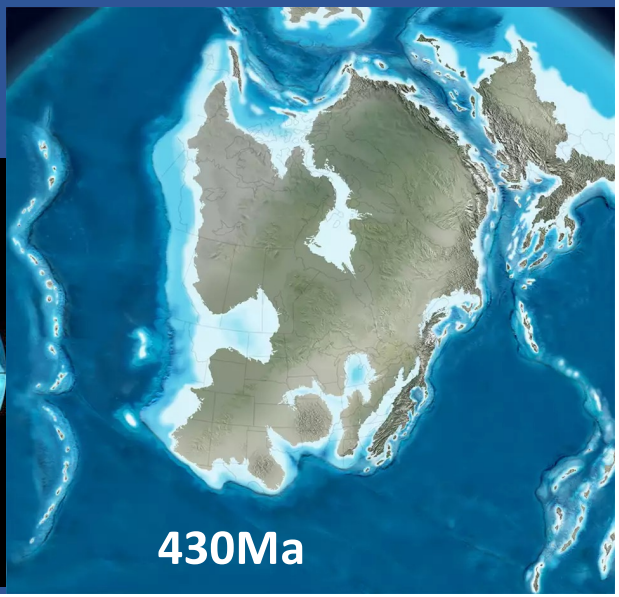
443-419Ma Equatorial North America

- First coral reefs
- Oldest terrestrial fungi
- First cartilaginous fish
- First vascular plants
- Oldest insect (milliped)
- Sea level drop







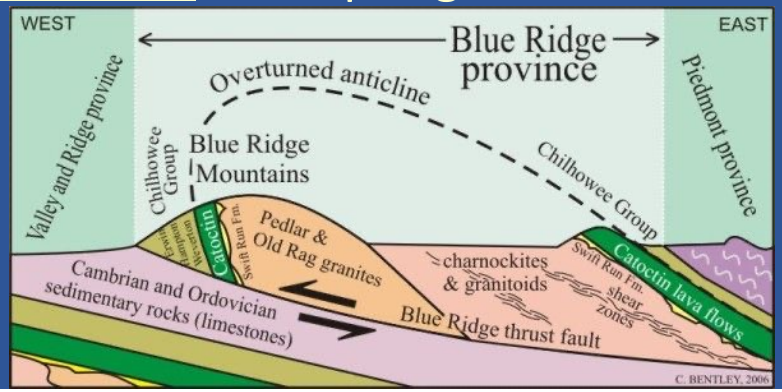


Iapetus Coast Silurian Rocks

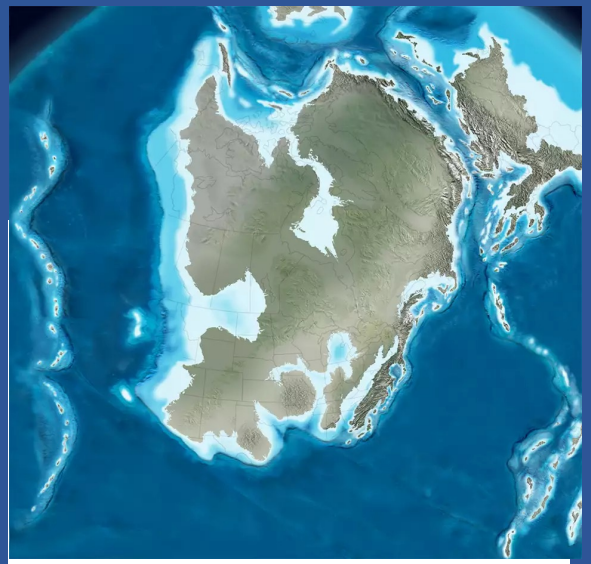
- **Active margin: volcanic island arcs & nearing microcontinents**

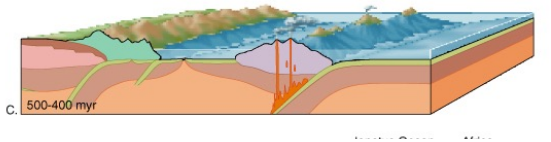
Equatorial: submerged continental shelf, continental slope & deep basin with far offshore volcanic arcs

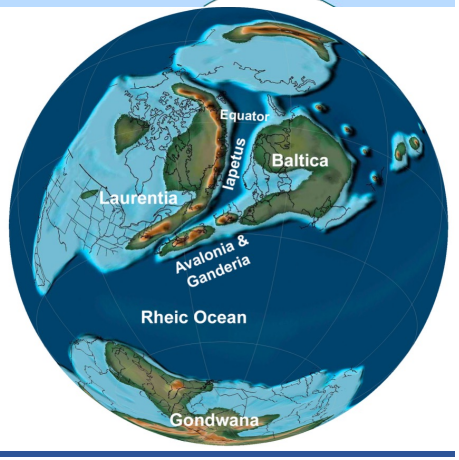
- Virginia: Shenandoah
- West Virginia: New River Gorge
- South Carolina: Congaree
- Tennessee: Great Smoky Mountains
- Arkansas: Hot Springs



- **Maine**: Acadia = subduction zone of Acadian Orogeny & accretion of Avalonia
- **Florida**: Everglades, Biscayne, Dry Tortugas = African Gondwana cover sediments



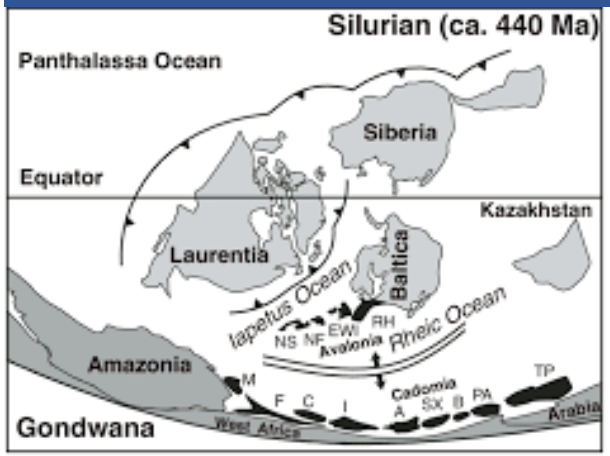


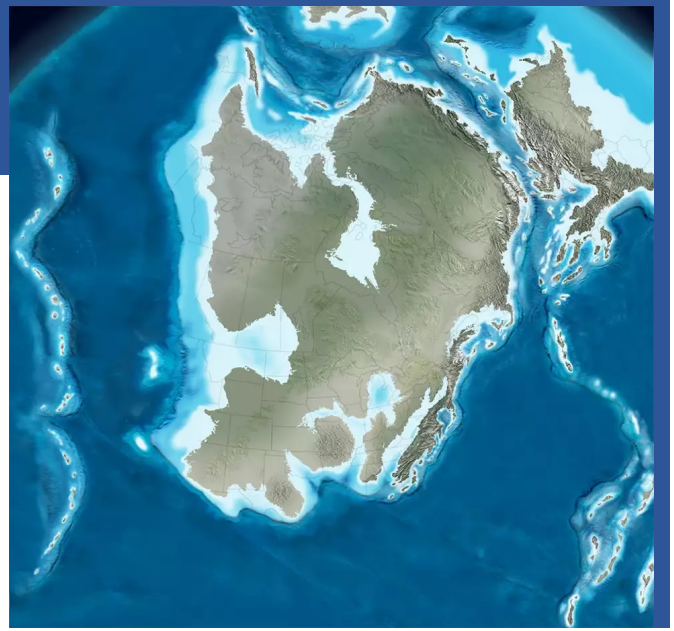


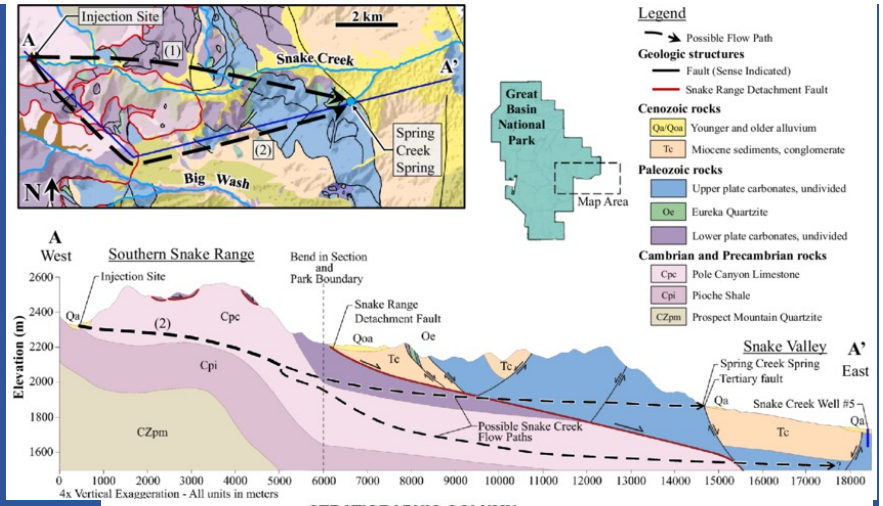
Panthalassa Coast Silurian Rocks

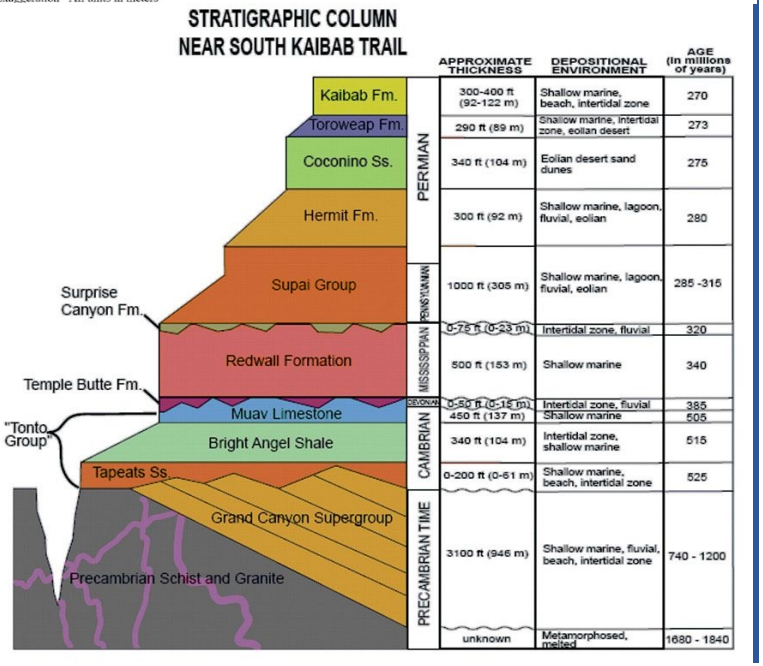
Equatorial: submerged passive margin continental shelf, continental slope & deep basin

- California: Pinnacles, Sequoia & Kings Canyon, Yosemite, Death Valley, Joshua Tree
- Nevada: Great Basin
- *Colorado Plateau: unconformity (erosion)*





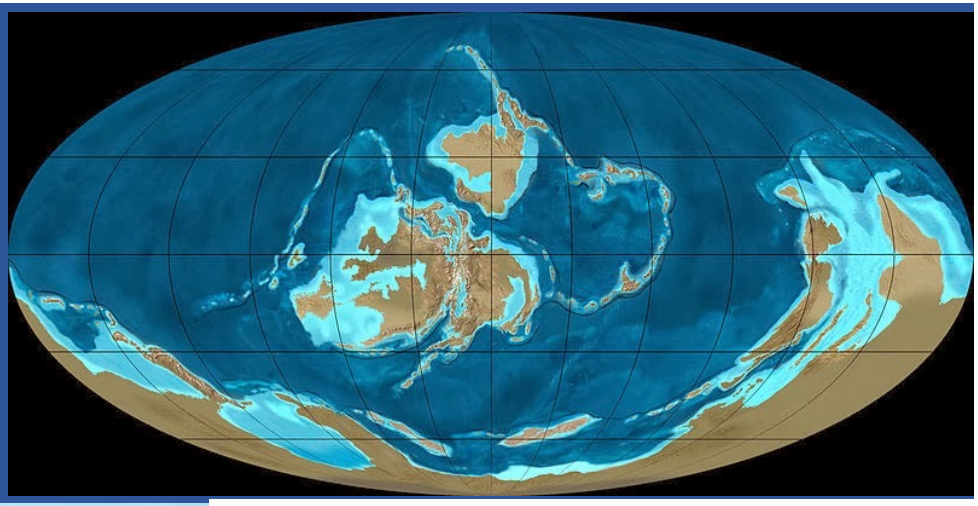




Alaskan Silurian Tropical Islands

- **Active margin: volcanic island arcs & offshore microcontinents**

Equatorial: submerged continental shelf, continental slope, & deep basins



Deep Marine

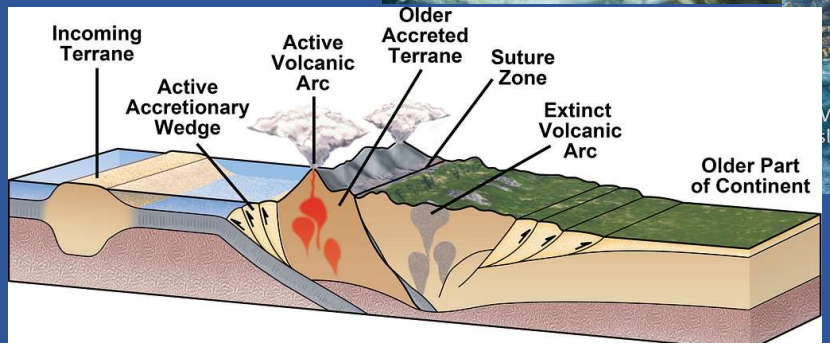
- Denali

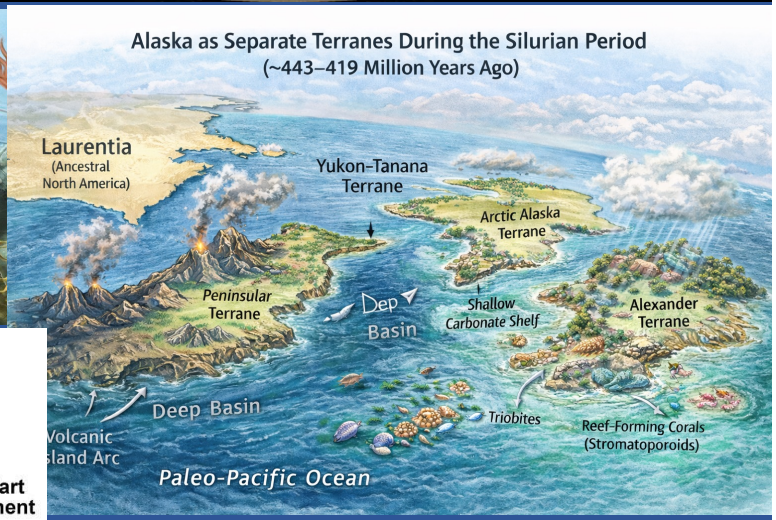
Volcanic Island Arc + Shallow Marine

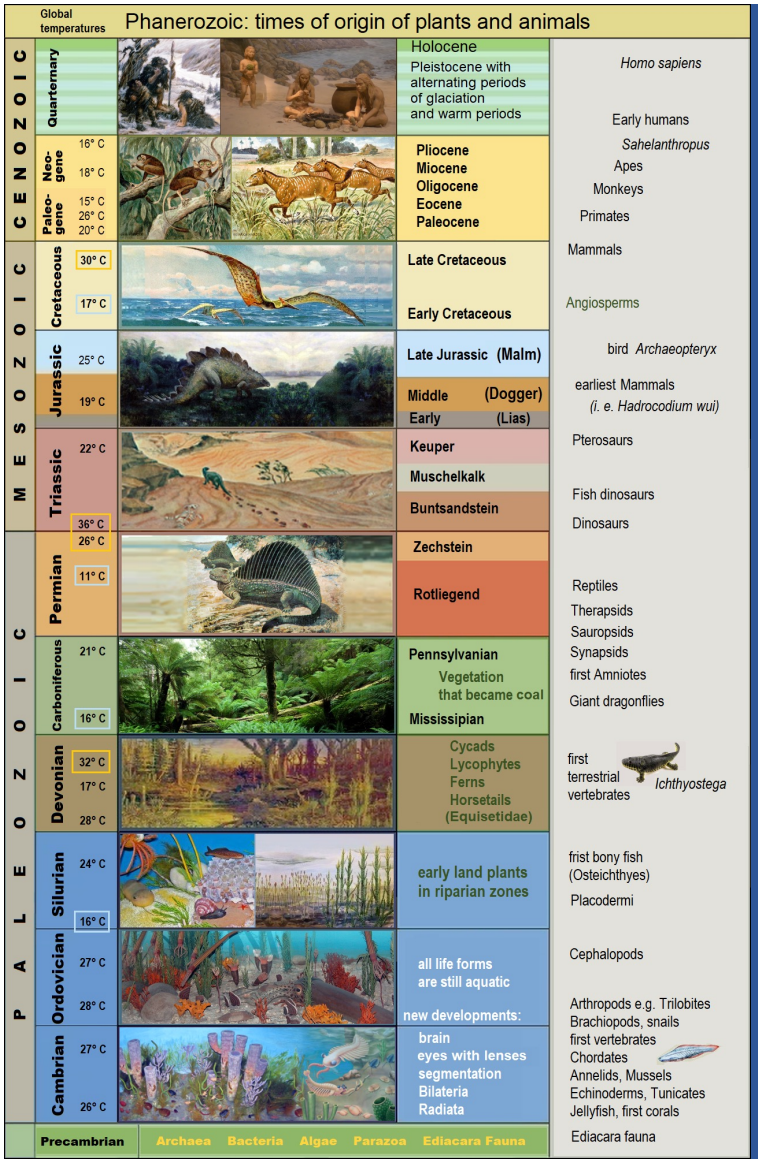
- Wrangell-St. Elias
- Katmai & Lake Clark

Shallow Marine

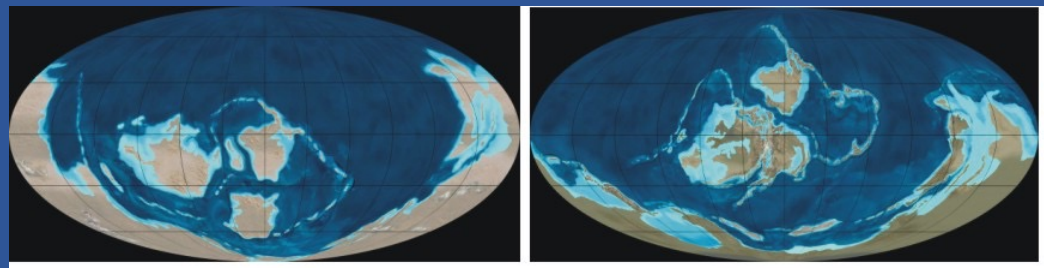
- Gates of the Arctic
- Kobuk Valley
- Glacier Bay



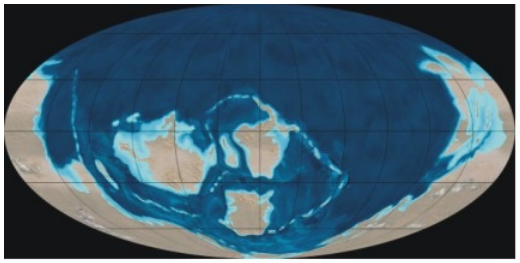




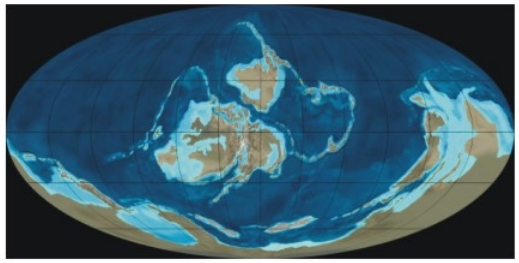
10 Minute Break!



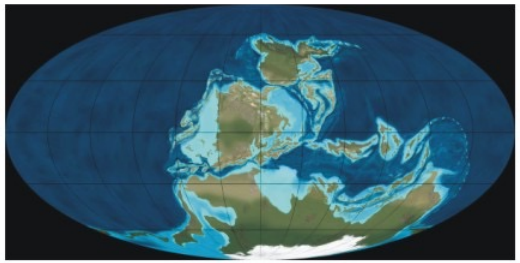
Video link:
https://www.youtube.com/watch?v=g_iEWvtKcuQ



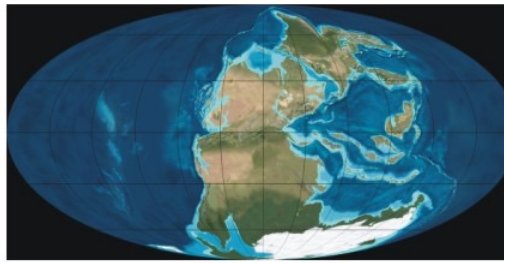
500 mya



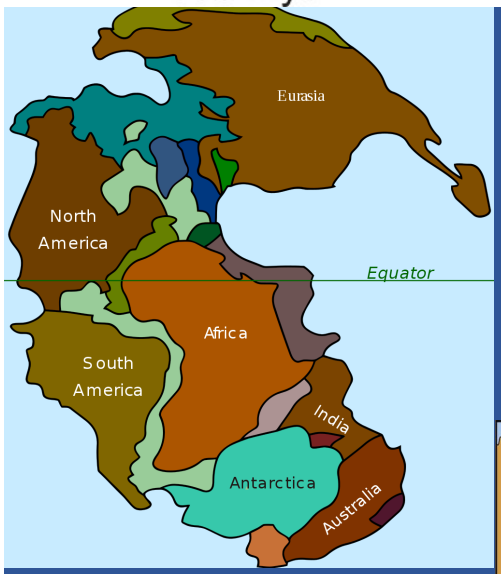
430 mya



340 mya



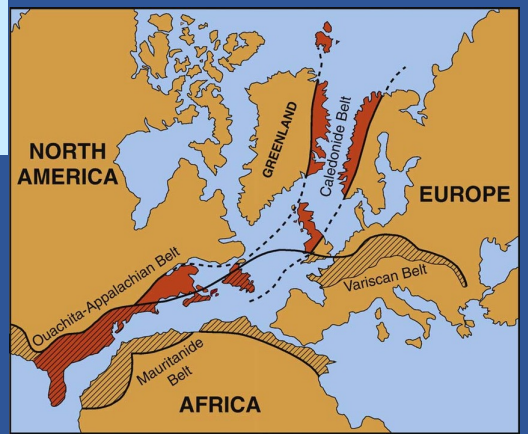
260 mya

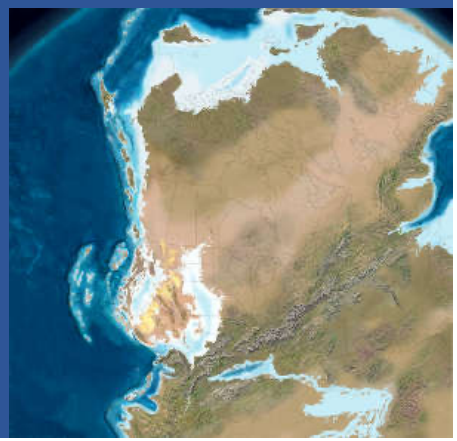


Assembly of Pangaea Supercontinent

480-260Ma East coast active margin

- Taconic Orogenies: volcanic arcs
- Acadian Orogeny: Avalonia microcontinent
- Alleghanian Orogenies: Europe, Africa, NA, SA

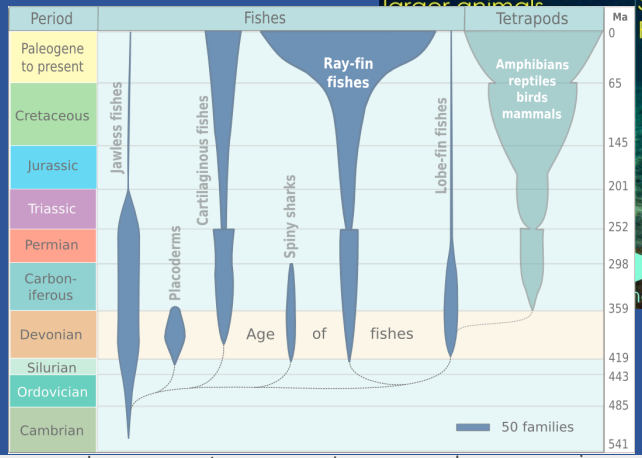


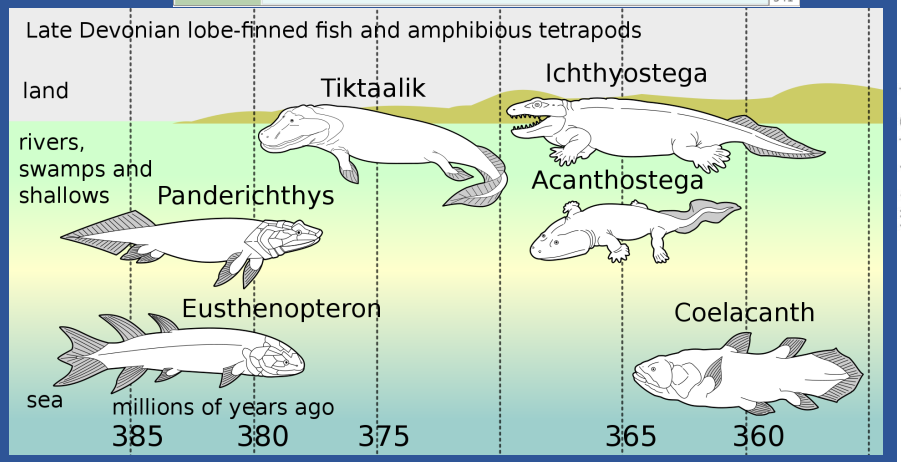


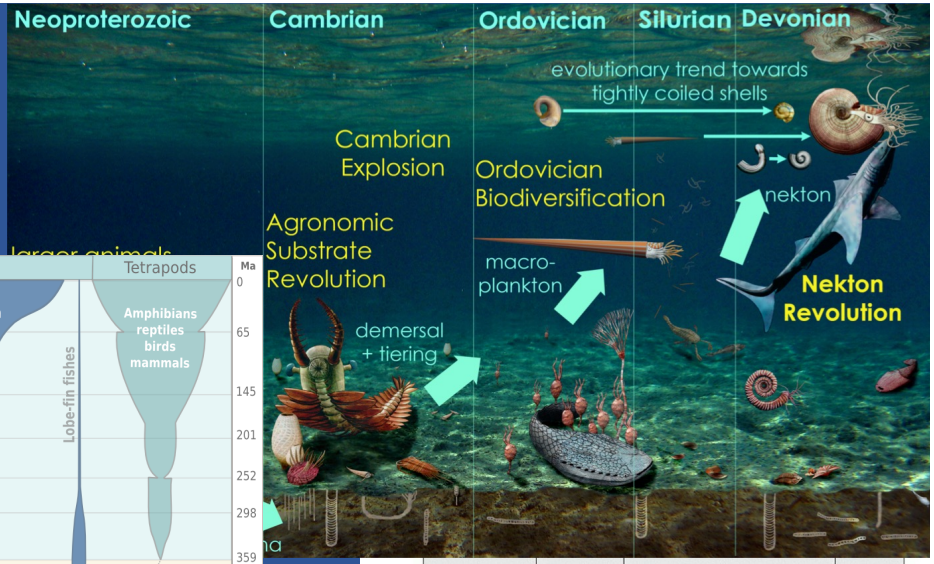
Devonian Active Margins

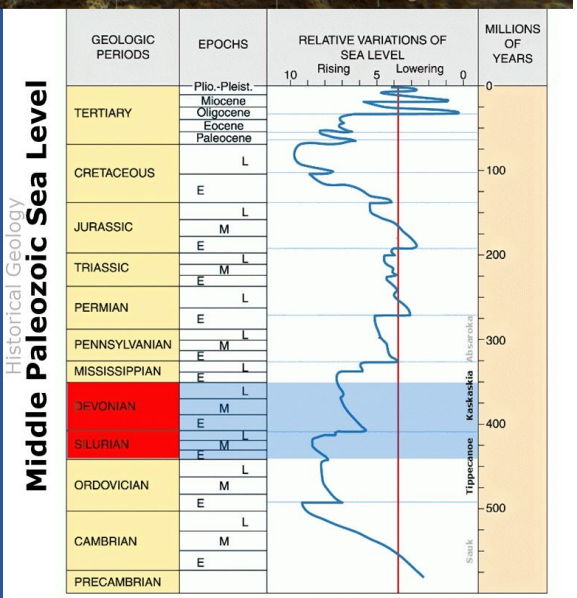
419-359Ma Equatorial North America

- First tetrapod track & amphibian fossils
- Oldest trees/forests (lignin)
- Terrestrial insects
- Land-water transition
- Lobe-finned fish
- LIP & 75+% extinction









Alaskan Devonian Tropical Islands

- **380-320Ma Ellesmerian/Innuitian Orogeny: accretion of distant offshore volcanic arcs**

Equatorial: submerged continental shelf & deep basins

Volcanic Island Arc & Marine Basin

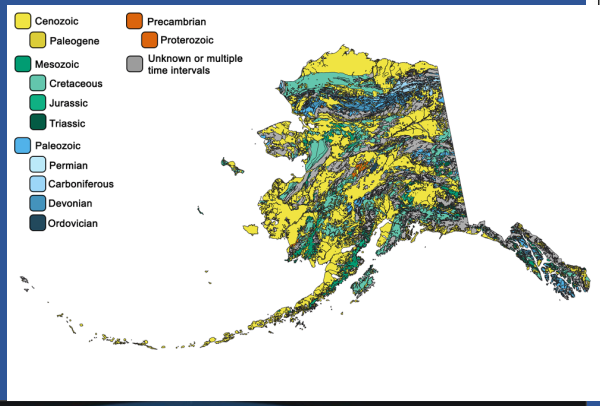
- Denali
- Katmai
- Lake Clark

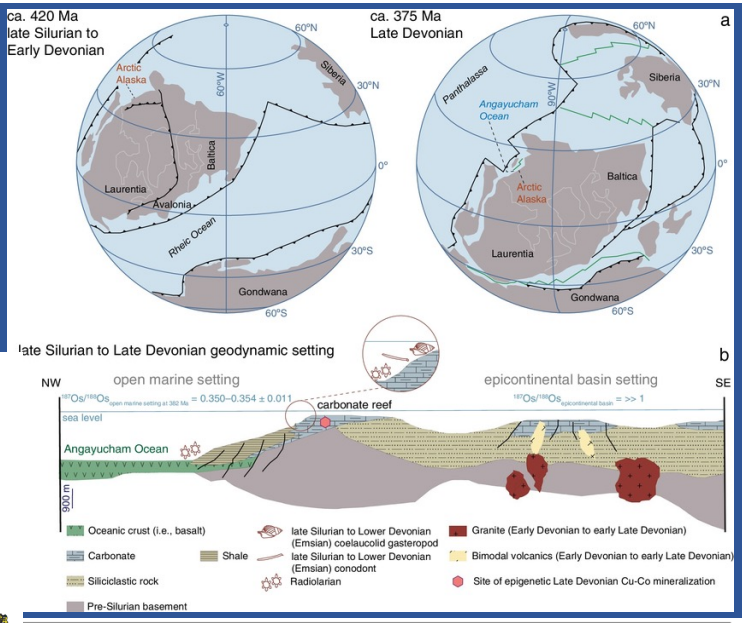
Volcanic Island Arc & Shallow Marine

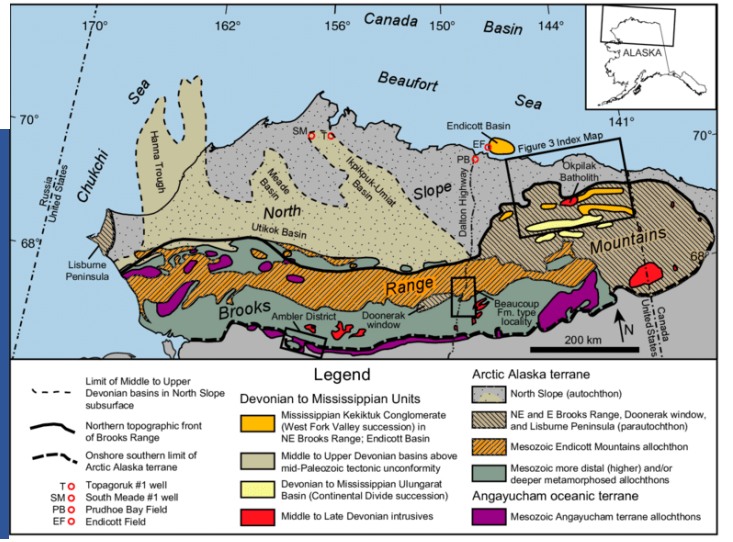
- Glacier Bay
- Wrangell-St. Elias

Continental Shelf

- Gates of the Arctic
- Kobuk Valley



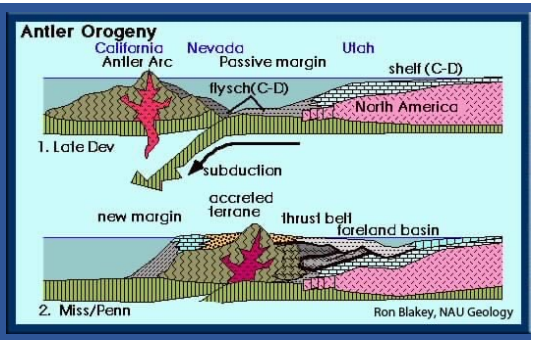




Panthalassa Coast Devonian Rocks

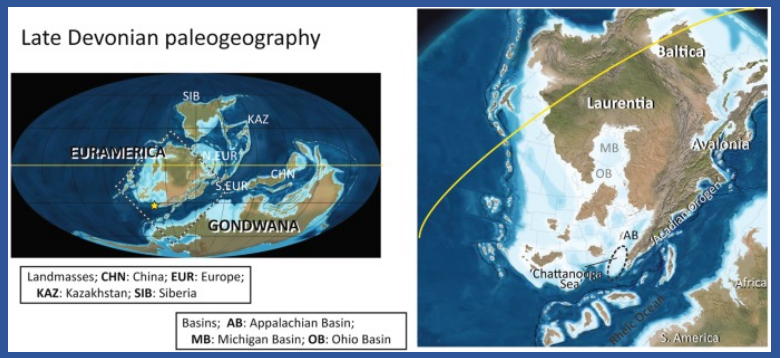
- **375-320Ma Antler Orogeny: accretion of distant offshore volcanic arcs**

Equatorial: submerged continental shelf & subduction trench



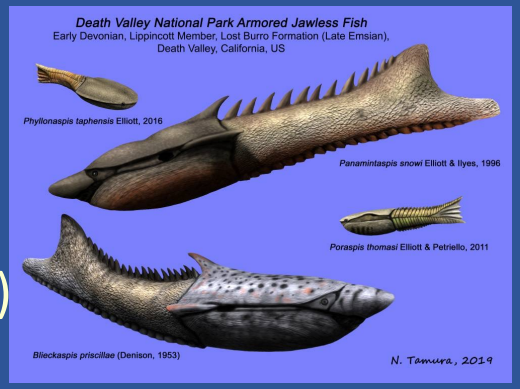
Volcanic Island Arc, Deep & Shallow Marine Basins

- California: Channel Islands, Sequoia & Kings Canyon, Yosemite
- Washington: North Cascades



Continental Carbonate Shelf

- California: Death Valley (fish!)
- Nevada: Great Basin
- MT/WY/ID: Yellowstone, Grand Teton



Video link:
https://www.youtube.com/watch?v=xaj_J_3YJMc

Nearshore Continental Shelf (nearby rivers)

- Arizona: Grand Canyon (fish!)

Rheic Coast Devonian Rocks

- **410-360Ma Acadian Orogeny: accretion of Avalonia microcontinent**

Tropical: shallow continental shelf

- Indiana: Indiana Dunes
- Kentucky: Mammoth Cave

Regression to Coastal Delta

- Ohio: Cuyahoga Valley
- West Virginia: New River Gorge
- Virginia: Shenandoah

- **Maine**: Acadia = Avalon Microcontinent island-arc accretes on to North America
- **Florida**: African Gondwana approaching