Announcements!

Walking Buddies Program!

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

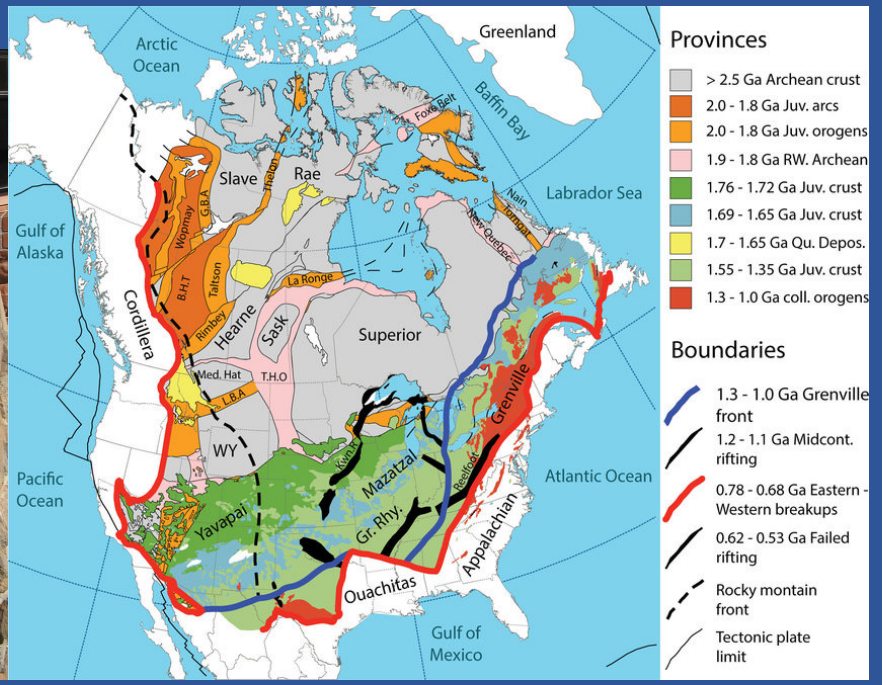
Geologic Evaluation of North America

With a Focus on the US National Parks

with Nicole Myers

Week 3: North America & the Dawn of Animal & Plant Life

https://www.appreciatingearth.com/olli



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 Parks**: prioritize public benefit & environmental protection providing protected landscapes (public engagement)
- **Field Stations**: prioritize research & knowledge generation to improve conservation (scientific communities = not open to the general public)
  - **"Living laboratories"** for outdoor-based research & education to support conservation and research endeavors and develop expertise to address environmental challenges
  - **Provide** scientific research, ecological monitoring, study human impact, develop restoration techniques, train future scientists & conservationists
- **Some field stations are located within National Parks:** Channel Islands, Yosemite, Sequoia & Kings Canyon, Capitol Reef, Grand Teton, Lassen Volcanic, Virgin Islands

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

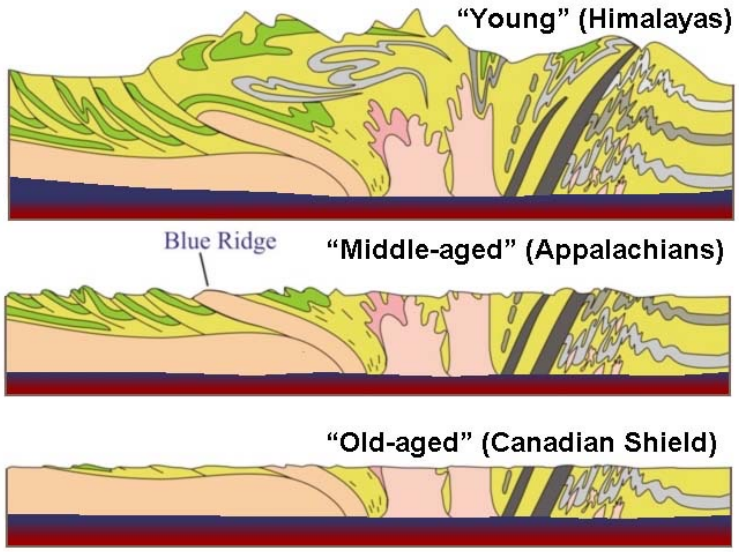
Recap

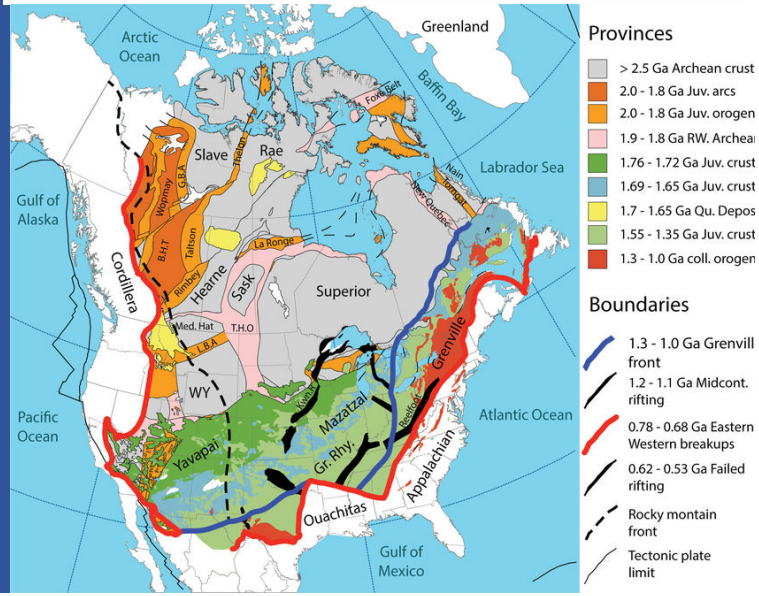
National Parks provide very high conservation protection & public access

<u>Cratons grew through successive orogenies = Precambrian convergent continental growth</u>

- **2.8-2.5Ga** Kenorland Supercontinent
- **2.4-2.2Ga** Snowball Earth
- **1.65-1.63Ga** Penokean Orogeny
- **2.0-1.4Ga** Trans-Hudson Orogeny = Columbia "SC"
- 1.8-1.6Ga Yavapai , Mazatzal & Mojave Orogenies
- 1.3-0.7Ga Grenvillian Orogenies = Rodinia "SC"

<u>National Parks So Far</u>: Voyageurs, Pipestone, Grand Teton, Yellowstone, Wind Cave, Glacier, Rocky Mountains, Black Canyon of the Gunnison, Saguaro, Joshua Tree, The Grand Canyon, Death Valley, Isle Royale, Great Smoky Mountains, Shenandoah



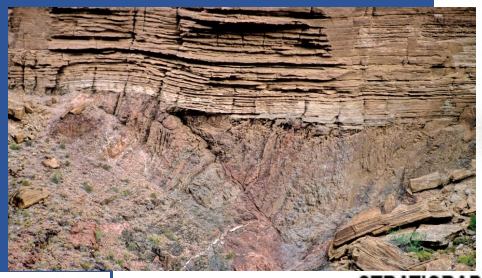


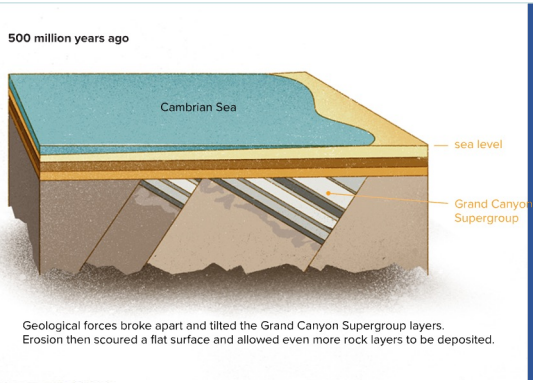
End Precambrian Unconformities

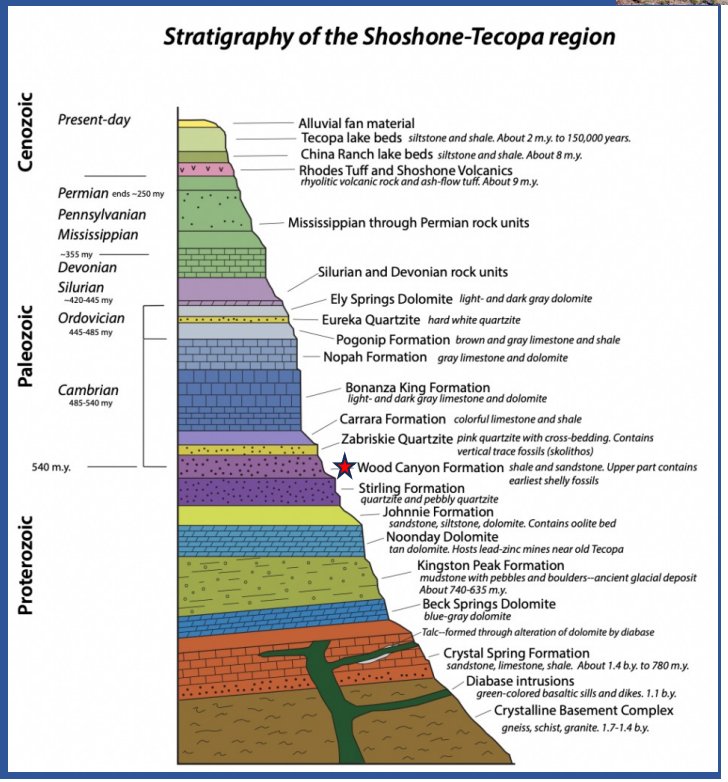
- Rodinia break-up → intense erosion & sea level rise
- Early Cambrian shallow marine deposition

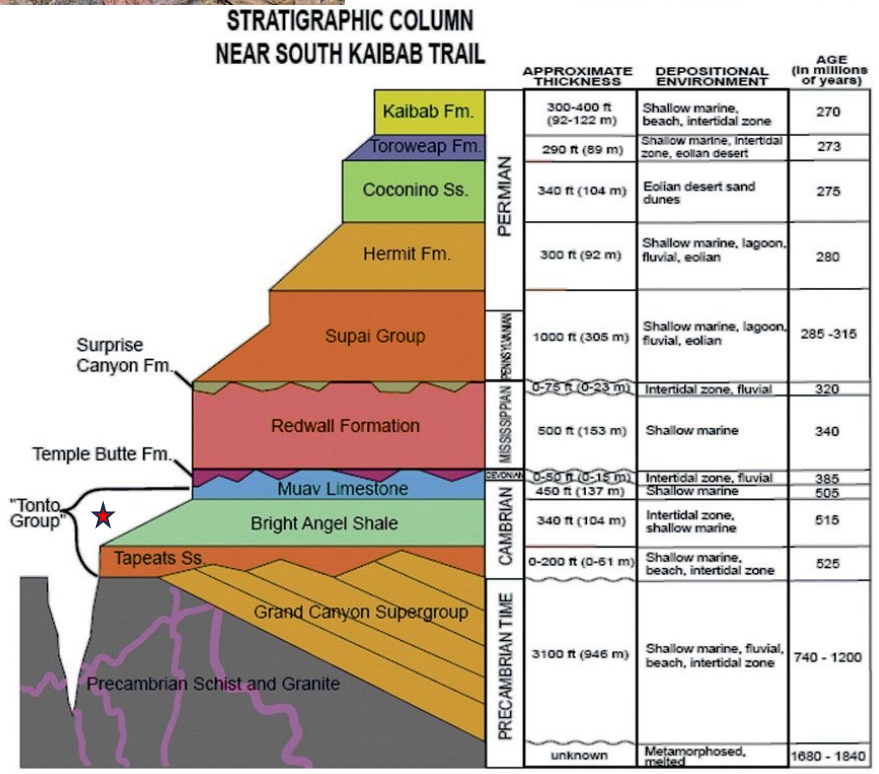
<u>Evidence of</u>:

- rapid transgression
- rising oxygen
- rising calcium (& other seawater elements)
- invertebrate fossils

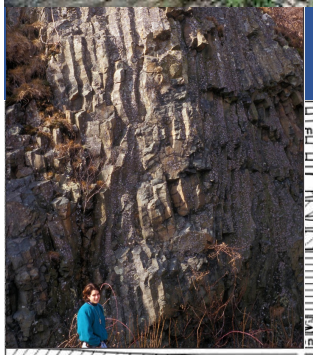








Rodinia Break-up: Iapetus Ocean



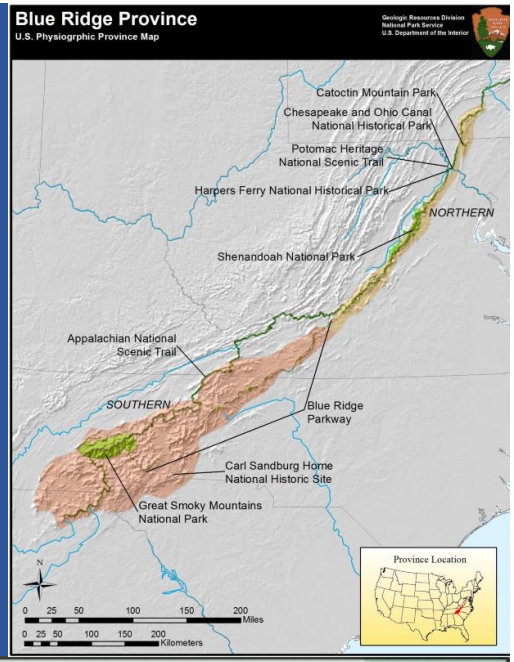
Smoky Mountains NP, TN:

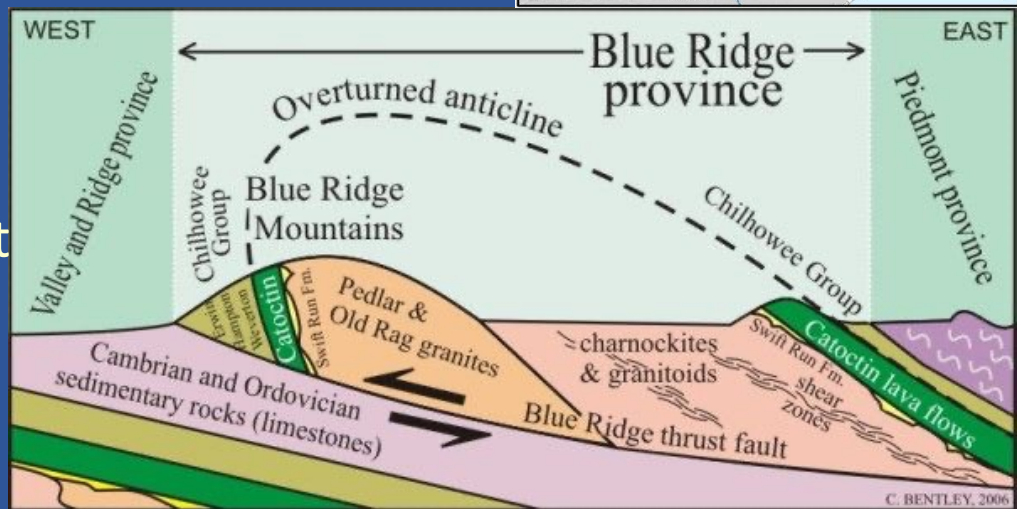
- 750-600Ma Ocoee Supergroup= sediments deposited in rift fault basins

Shenandoah NP, VA:

- 570Ma Catoctin Formation = rift flood basalts during supercontinent break-up

- Cambrian Sediments: 541-520Ma Chilhowee Group= rift → shoreline → passive margin sediments

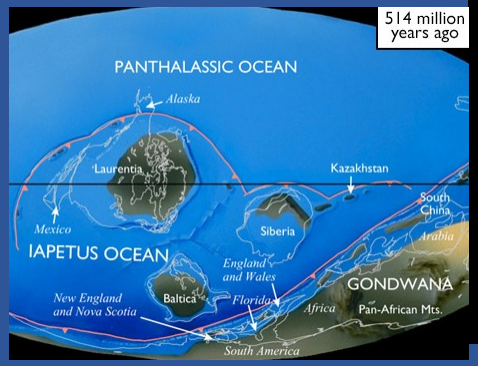




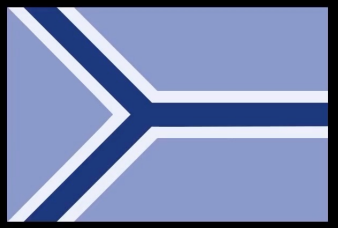
The Cryogenian: Marinoan & Sturtian Snowball Earth Glaciations

"SC" break-up → global glaciation 720-635Ma

- ↑ volcanism, shallow seas, coastlines → chemical weathering & erosion → carbon↓

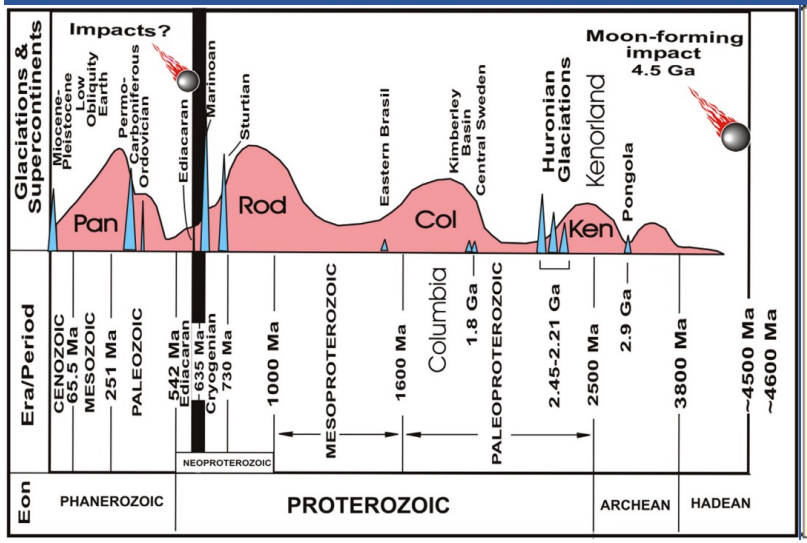


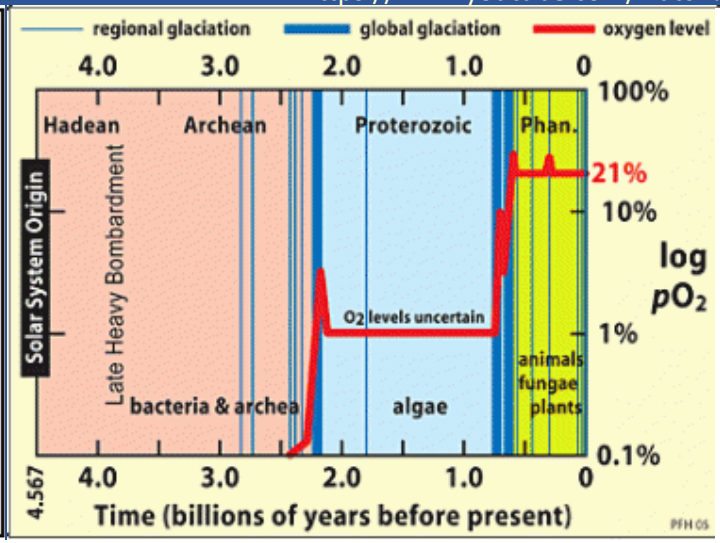
3.3 Billion Years of Continental Drift

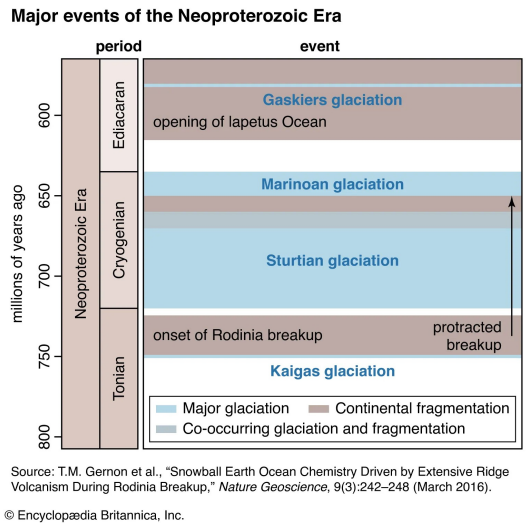


Created by: revrunnertech2772 (Algol)

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







Source: T.M. Gernon et al., "Snowball Earth Ocean Chemistry Driven by Extensive Ridge Volcanism During Rodinia Breakup," *Nature Geoscience*, 9(3):242–248 (March 2016).

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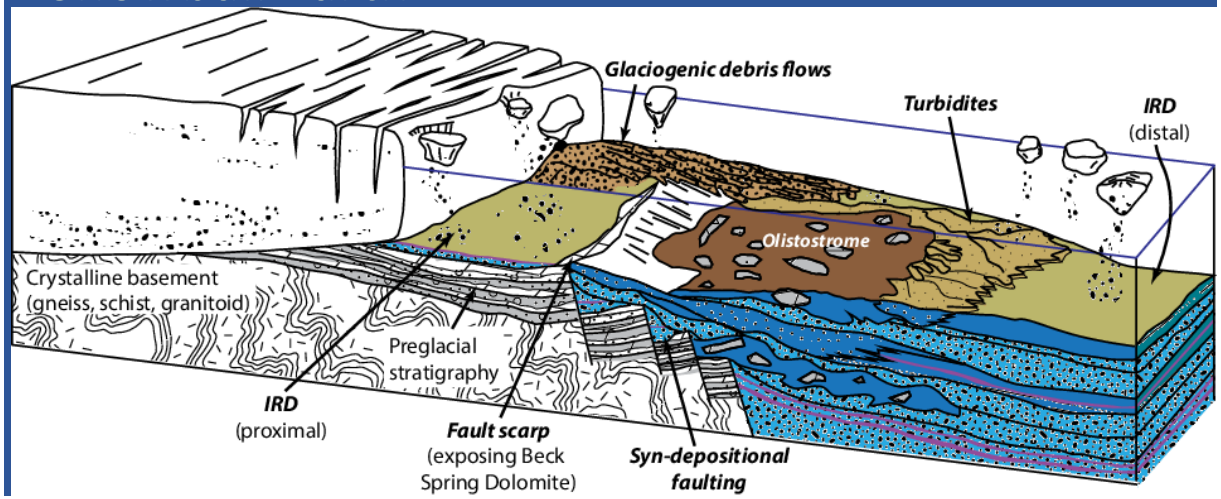
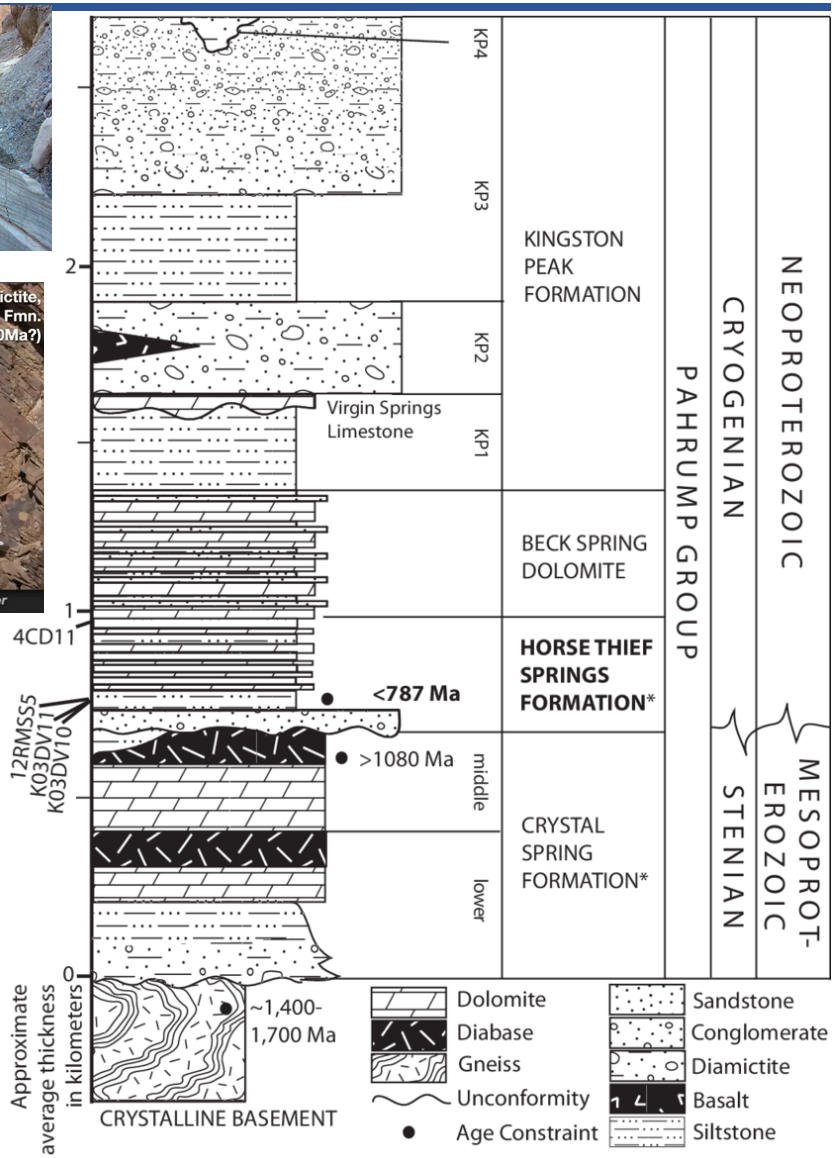
Equatorial Glaciations

Death Valley National Park

- Pahrump Group = Rodinia rifting
  - ~800Ma Kingston Peak Formation = diamictite from Snowball Earth
  - faulting & tilting
- ~635Ma Noonday Dolomite "cap carbonate" = global warming after Snowball Earth



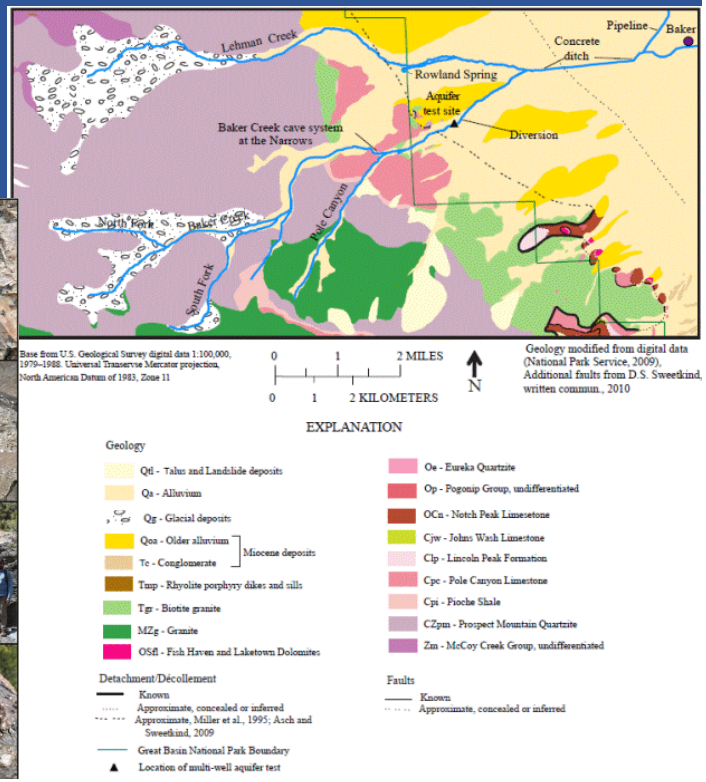


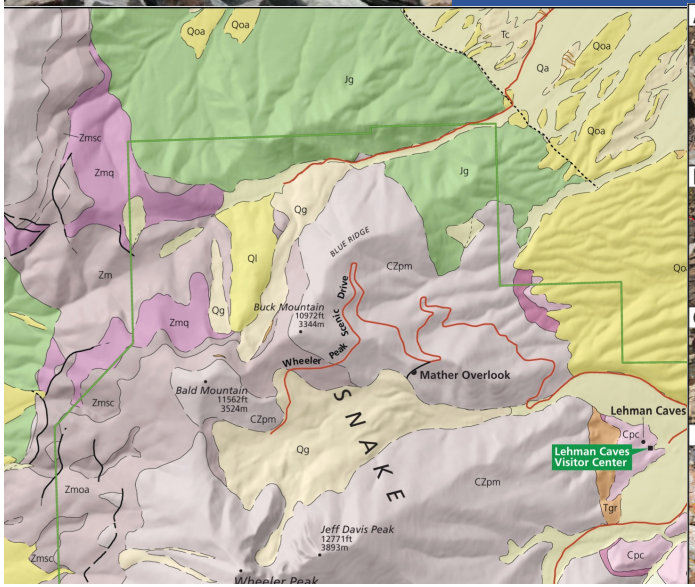
Rodinia Break-up: Panthalassic Ocean

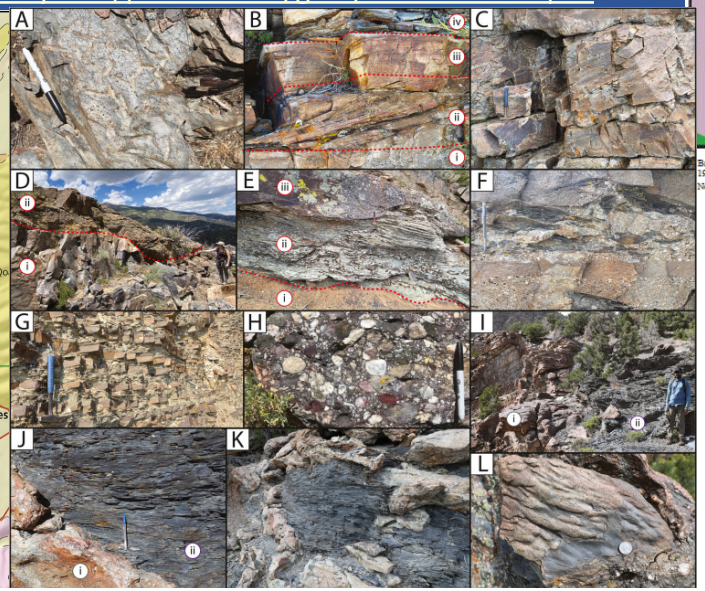
Great Basin NP, NV (*unconformity vs. comformable*)

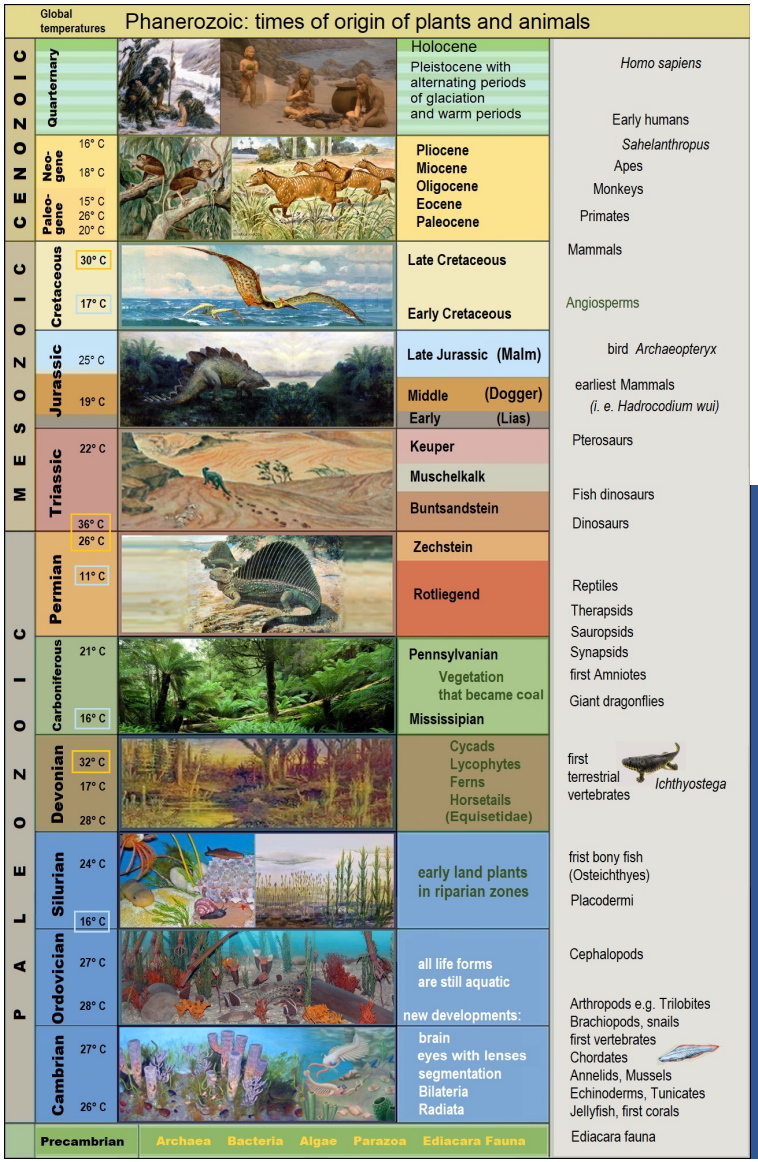
- Continental margin deposition
- **Above**: ~575-550Ma Prospect Mountain Quartzite - marine transgressive sandstone (cratonic source)
- **Basement**: ~650-575Ma McCoy Creek shallow marine + diamictite

Hyper detailed geologic map:
https://npshistory.com/publications/grba/nrr-2014-762.pdf









	Eon	Era	Period	Epoch	
Younger	Phanerozoic	Cenozoic	Quaternary	Holocene	Today
				Pleistocene	11.8 Ka
			Neogene	Pliocene	1.8 Ma
				Miocene	5.3 Ma
			Paleogene	Oligocene	23 Ma
				Eocene	34 Ma
				Paleocene	56 Ma
		Mesozoic	Cretaceous	~	66 Ma
			Jurassic	~	100 Ma
			Triassic	~	201 Ma
		Paleozoic	Permian	~	252 Ma
			Carboniferous: Pennsylvanian	~	299 Ma
			Carboniferous: Mississippian	~	323 Ma
			Devonian	~	359 Ma
			Silurian	~	419 Ma
			Ordovician	~	443 Ma
			Cambrian	~	485 Ma
Older	Proterozoic	~	~	~	541 Ma
	Archean	~	~	~	2.5 Ga
	Hadean	~	~	~	4.0 Ga
					4.56 Ga

10 Minute Break!

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

PLATE TECTONICS, PALEOGEOGRAPHY, and ICE AGES (Modern World - 540 Ma)

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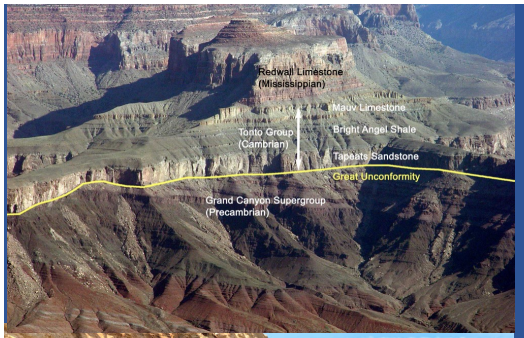
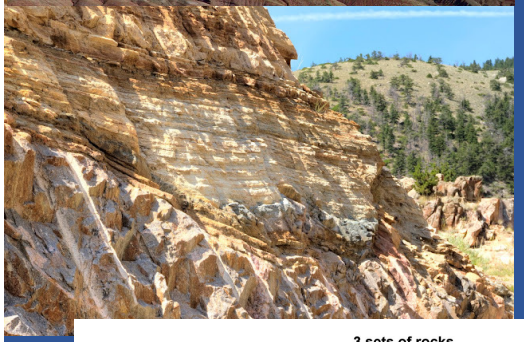




The Great Unconformity

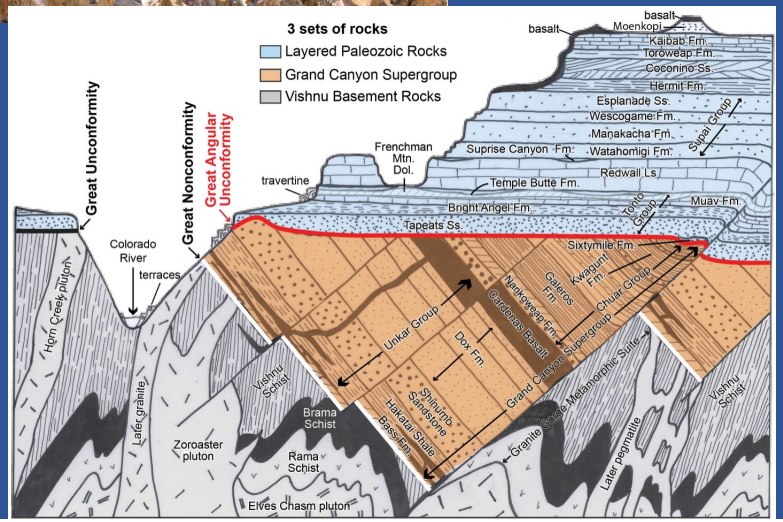
A Continent-Scale Surface of Cambrian Cover Rocks

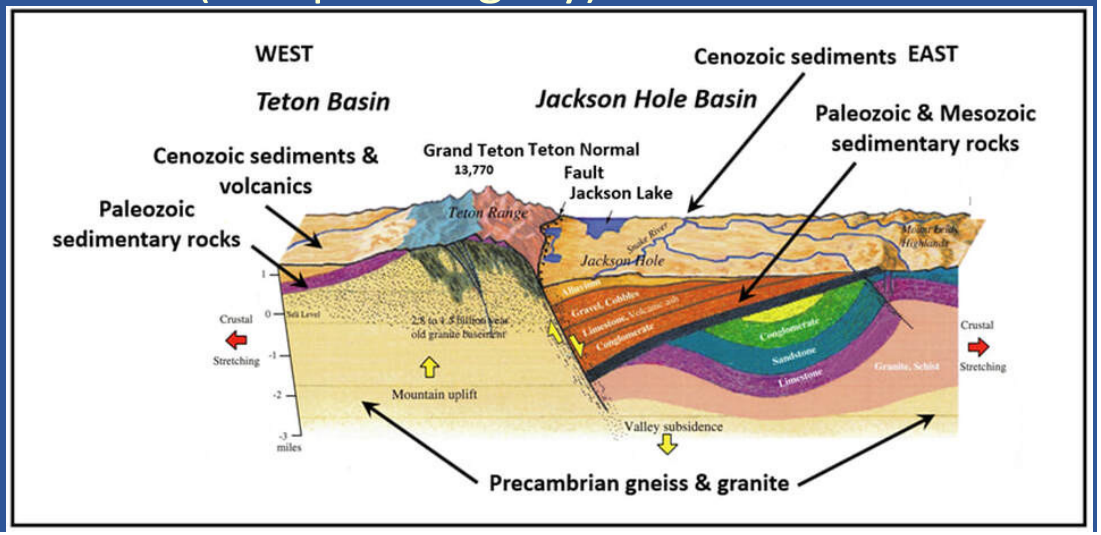
Grand Teton & Yellowstone NP, WY

- **Cover** = 530-520Ma Flathead Sandstone: marine transgression
- **Basement** = Archean gneiss & granite (Wyoming Craton)

Grand Canyon NP, AZ

- **Cover** = 508-497Ma Tonto Group: marine transgression
- **Basement** = Vishnu Schist (Yavapai Orogeny)





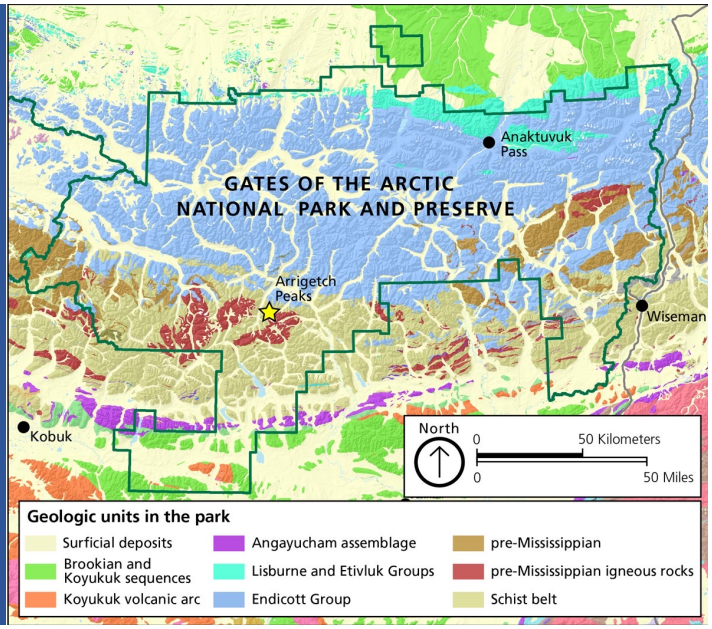
End of Rodinia & the Precambrian

Precambrian Rocks of Alaska

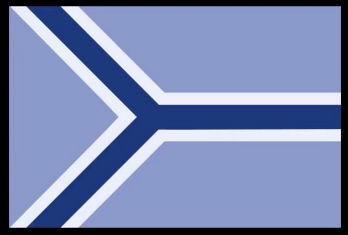
- Rare outcrops & dates largely undetermined
- Scant evidence of Rodinia formation and break-up in Gates of the Arctic NP

Laurentia “west” coast becomes a passive margin

Focus on the green shapes & watch North America slowly form



3.3 Billion Years of Continental Drift



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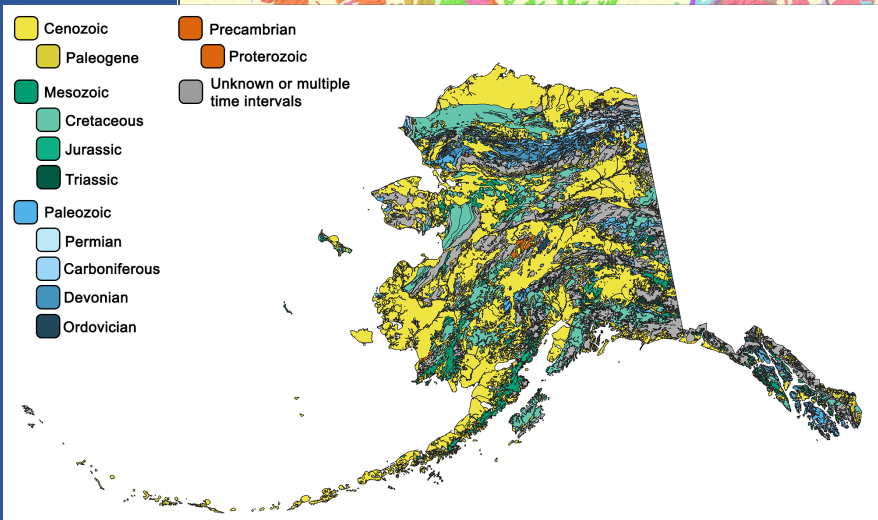
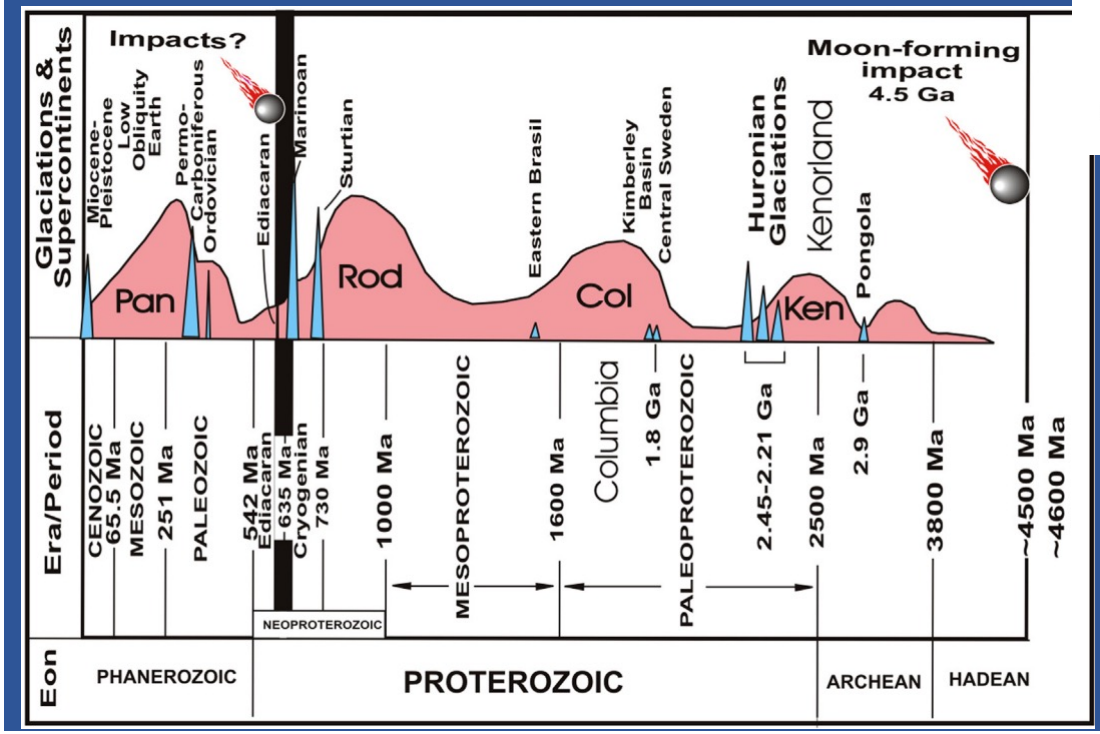
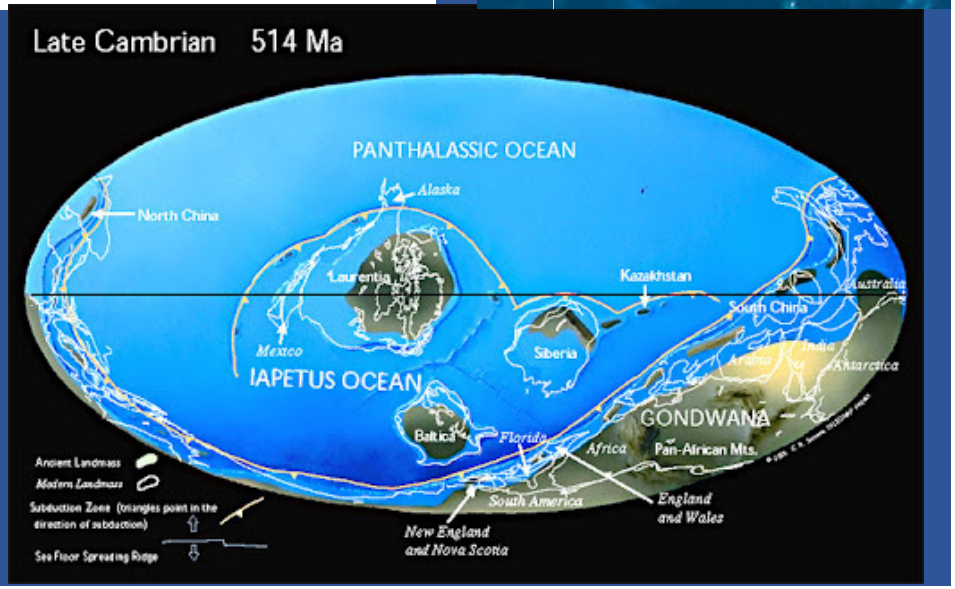


Phanerozoic Eon: Laurentia & Gondwana

- Cambrian Explosion: end of Snowball Earth → first animals with hard parts



550 Ma



The Cambrian ~~Explosion~~ Diversification

~541-530Ma

Grand Canyon NP

- Tonto Group: trilobites & brachiopods

Death Valley NP

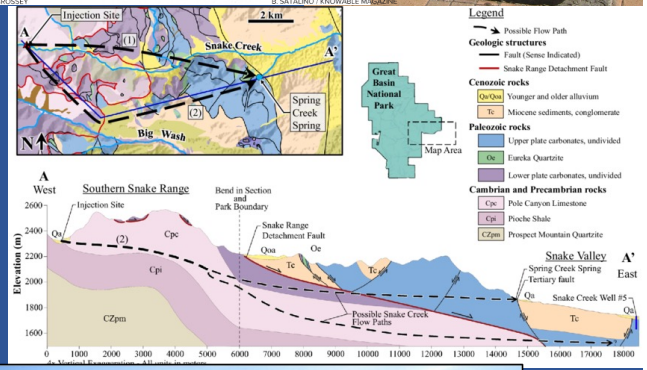
- Wood Canyon Formation: trilobites, archaeocyathid sponges

Great Basin NP

- Pioche Shale & Pole Canyon Limestone: trilobites, archaeocyathid sponges

Yellowstone & Grand Teton NP

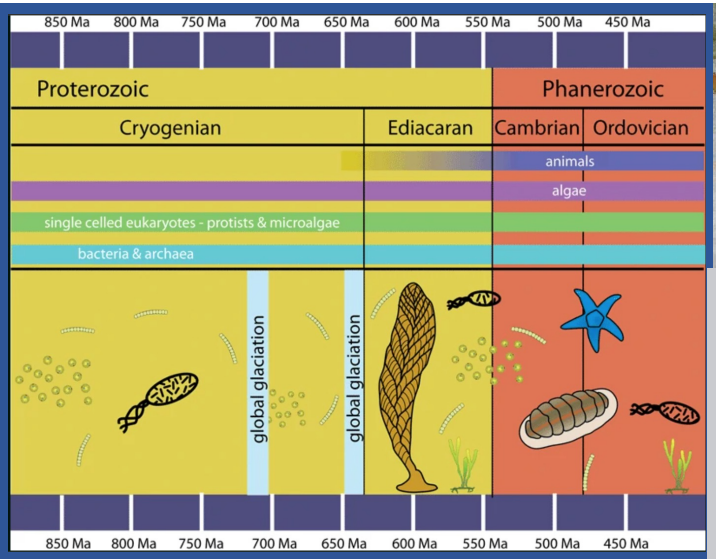
- Flathead Sandstone & Pilgrim Limestone: trilobites, brachiopods, stromatolites

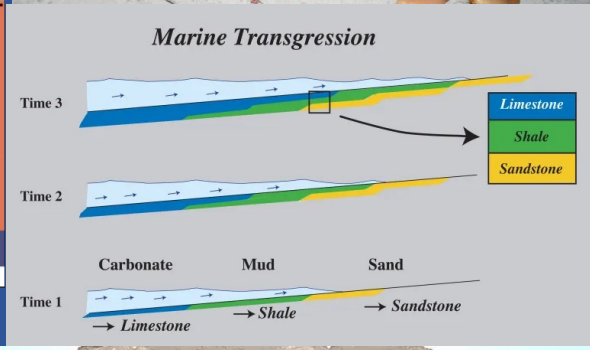


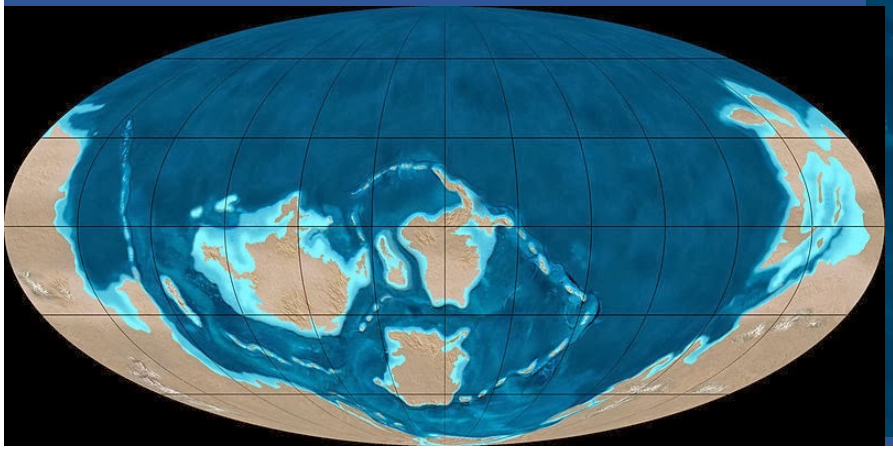
Cambrian Shallow Seas

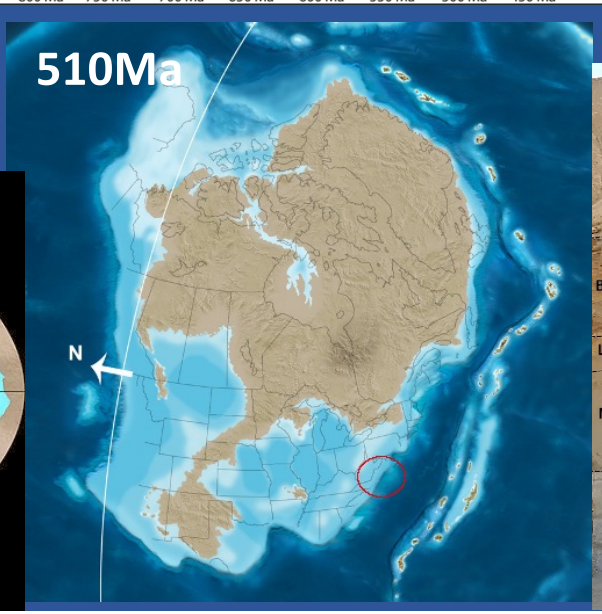
<u>541-485Ma Equatorial NA</u>

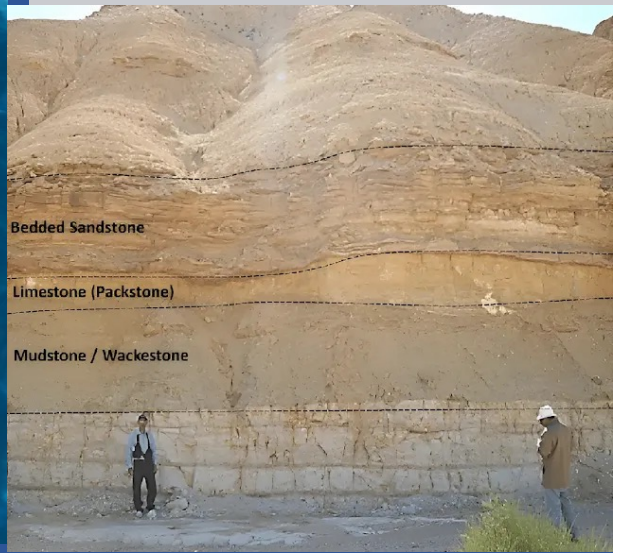
- Oldest shells & skeletons
- First apex predator
- First aquatic plants
- First chordates
- Global warming
- Rising sea levels = transgression
- Oxygenated seas











Ordovician Drowned Continent

485-443Ma Equatorial North America

- GOBE = The Great Ordovician Biodiversity Event
- First animals with jaws
- First terrestrial plants
- Ice Age
- Taconic Orogeny
- LIP
- 85% extinction