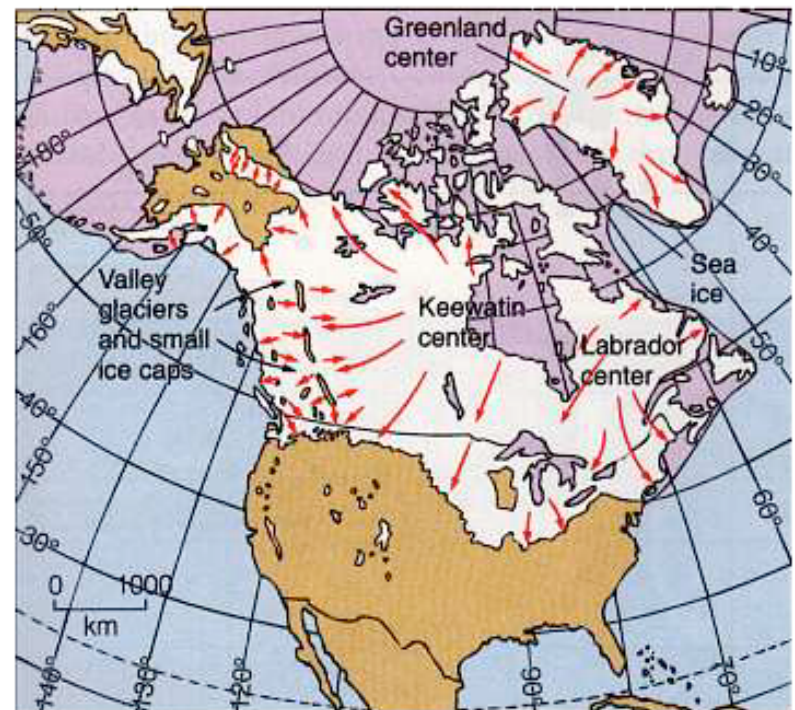
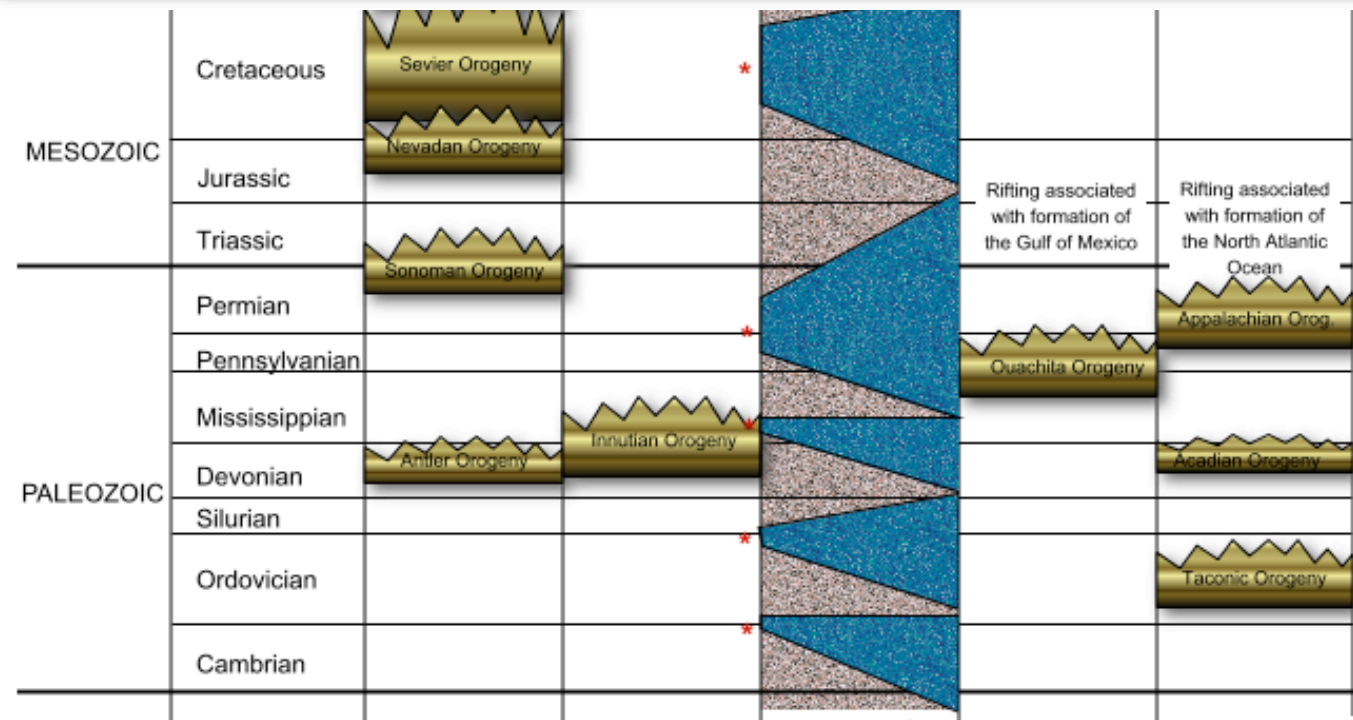
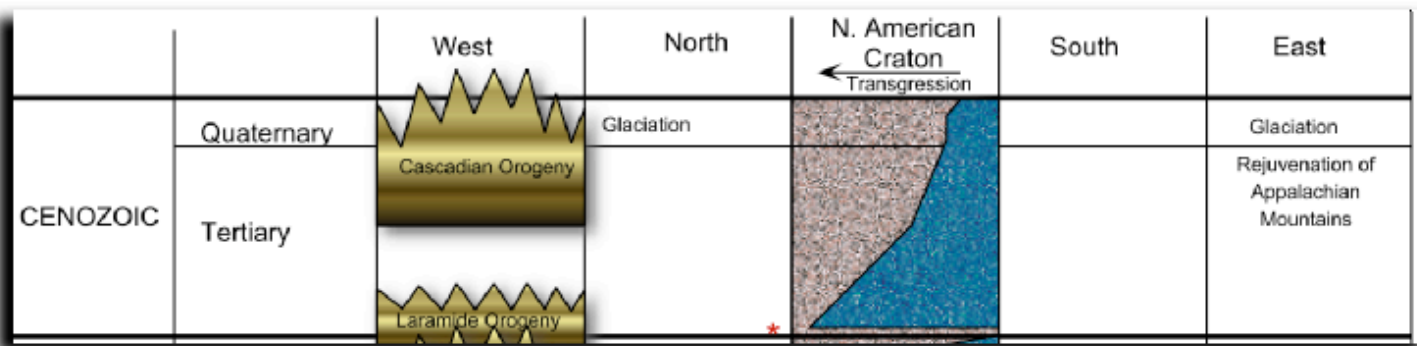




Cenozoic Rocks and Environments

Fire and Ice





* = maximum transgression

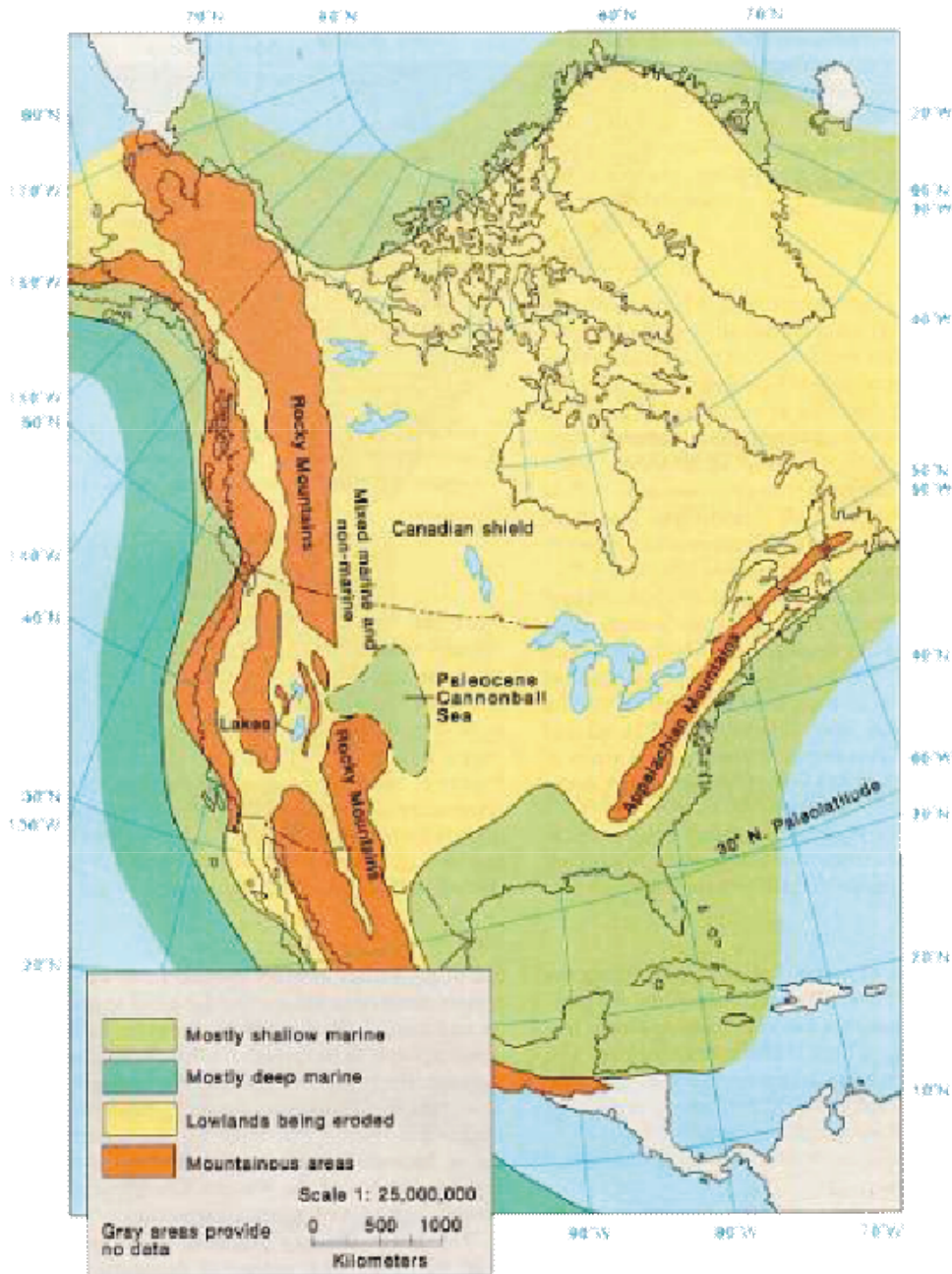
 = Marine deposits
 = Terrestrial deposits

Regression →

A.B. Busbey 1987/1995
 Based on an original idea by
 James Sprinkle, ca. 1972

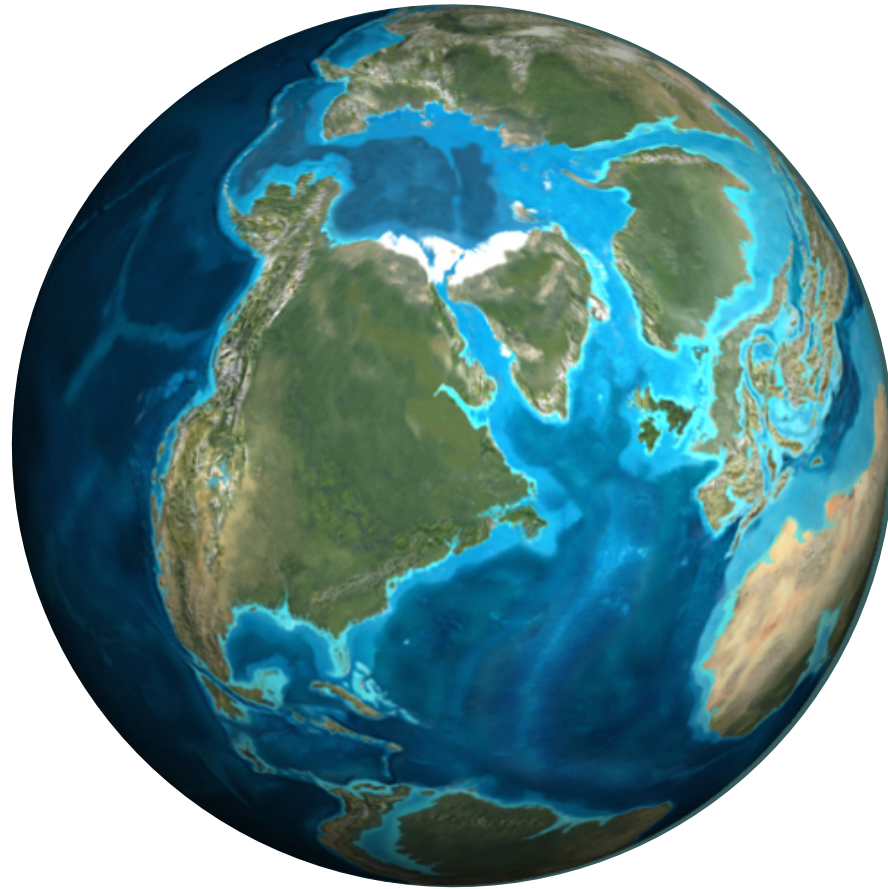
Cenozoic	Neogene	Quaternary	Recent
			Pleistocene
		Tertiary	Pliocene
	Miocene		
	Oligocene		
	Eocene		
	Paleocene		
	Paleogene		

Cenozoic North America





65 Million Years



50 Million Years

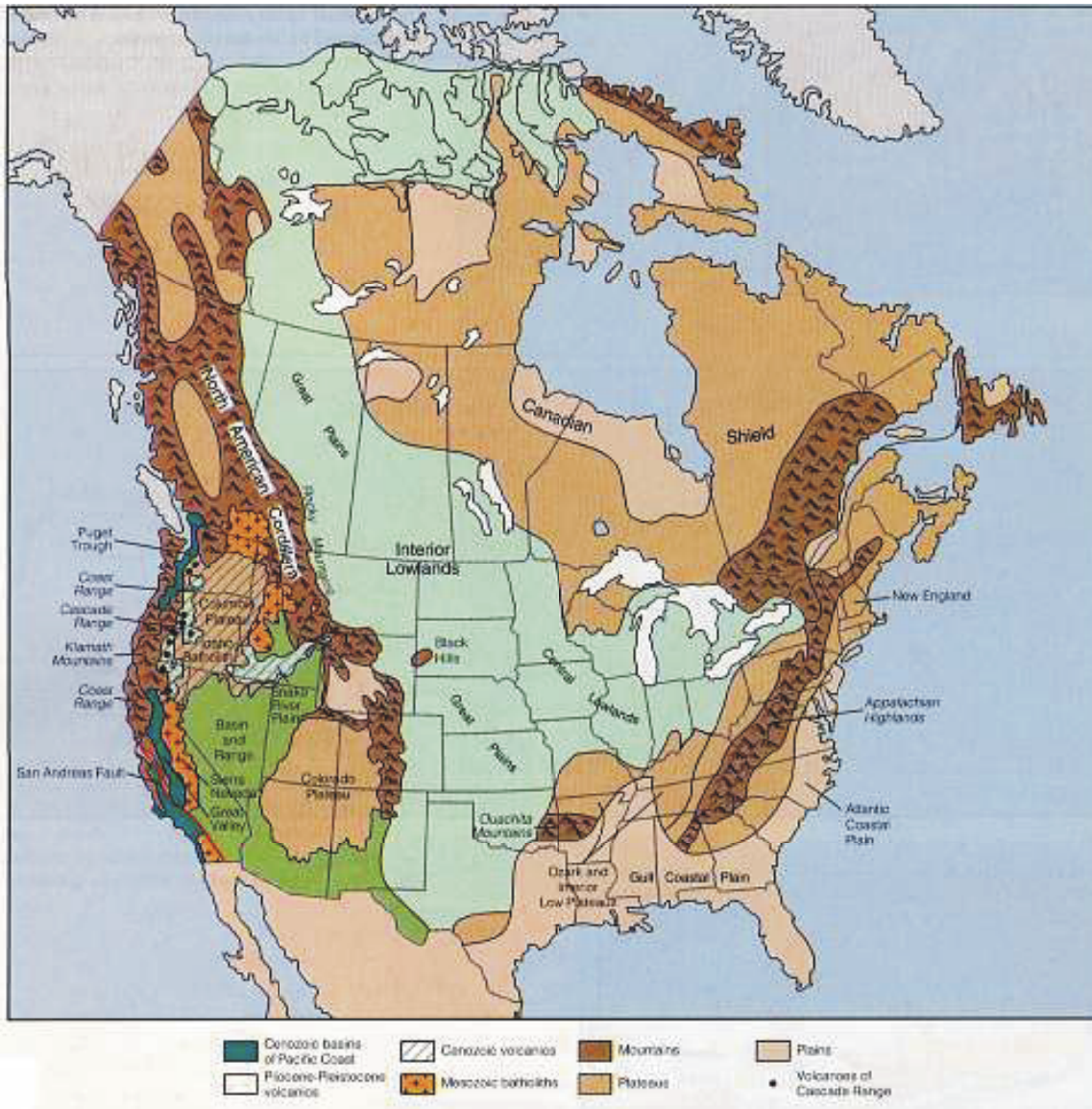


35 Million Years

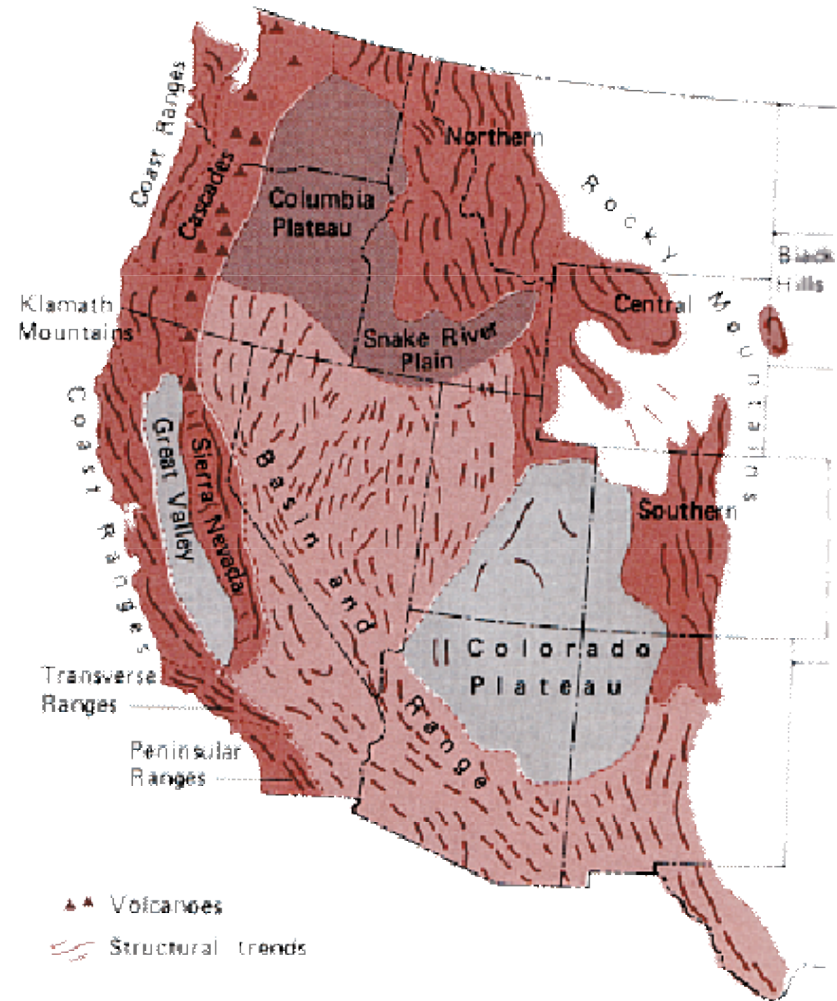


20 Million Years

Physiographic Divisions of North America

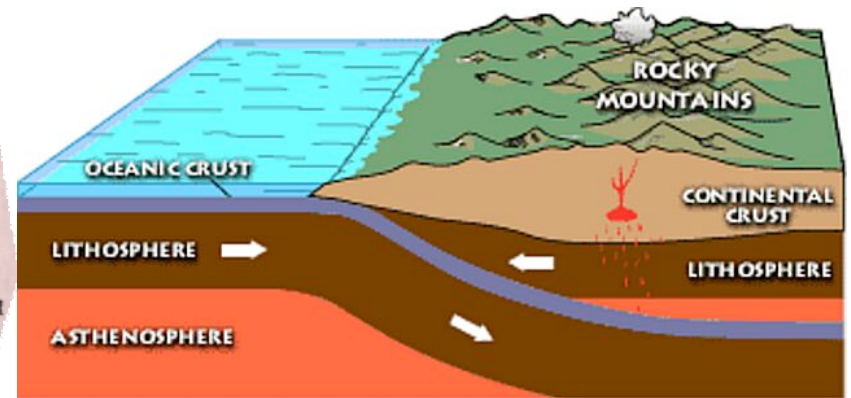
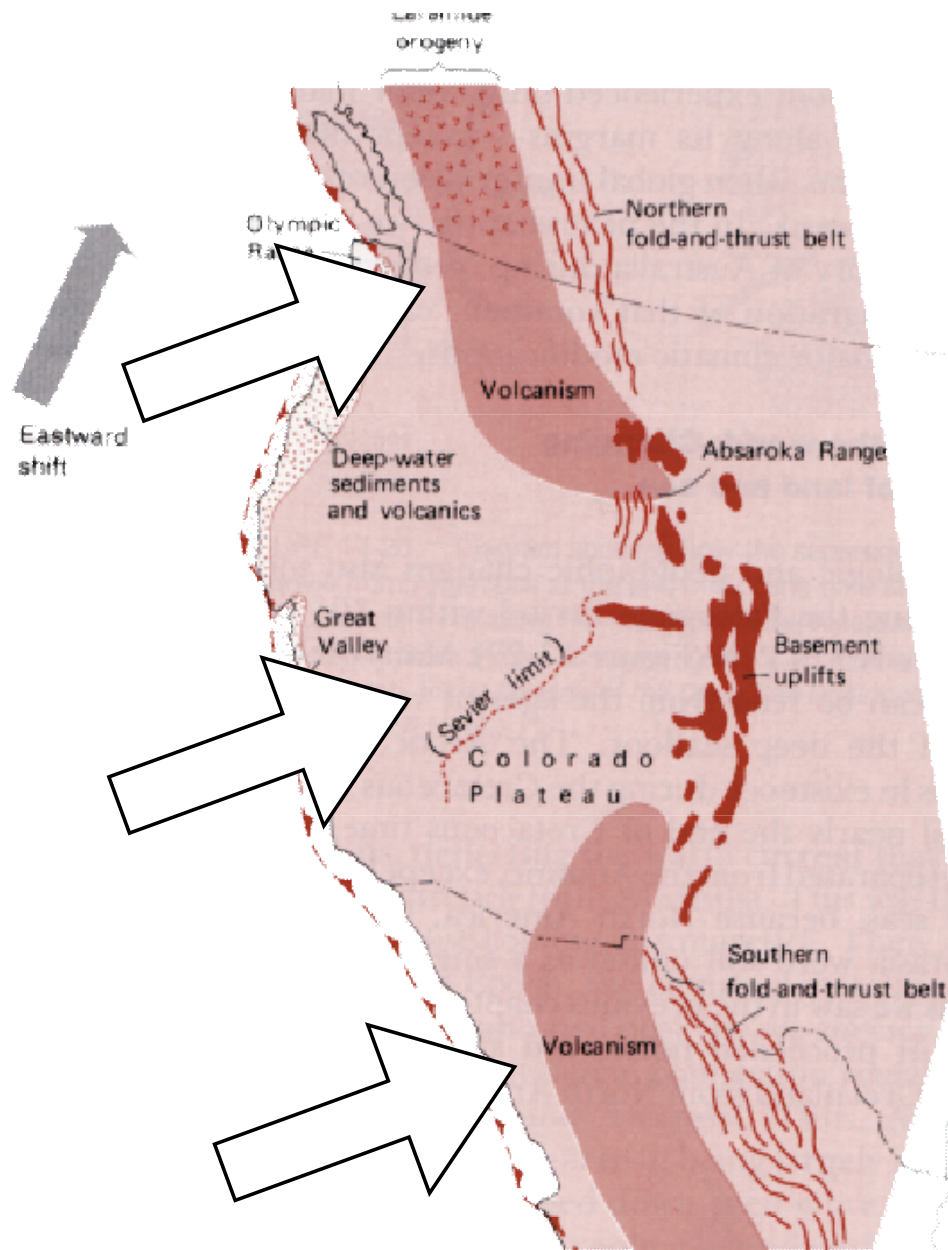


Physiography of the Western US

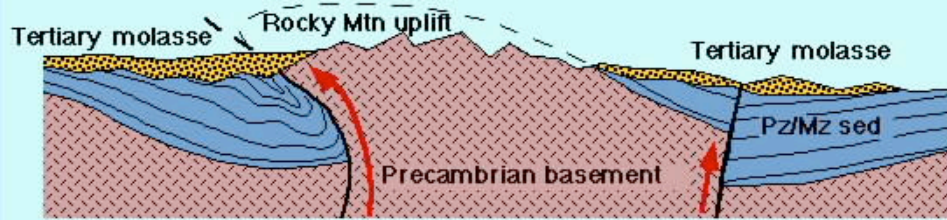


The Laramide Orogeny (compression)

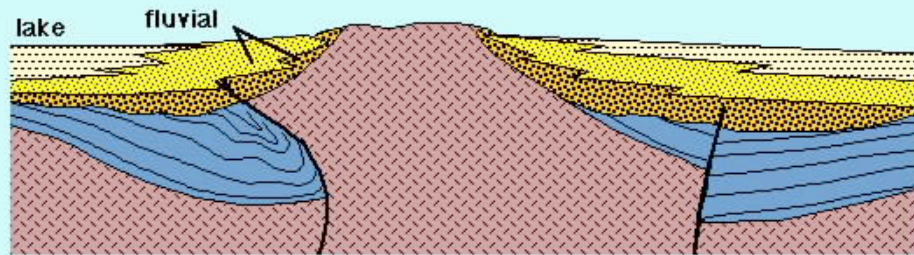
70-40 ma



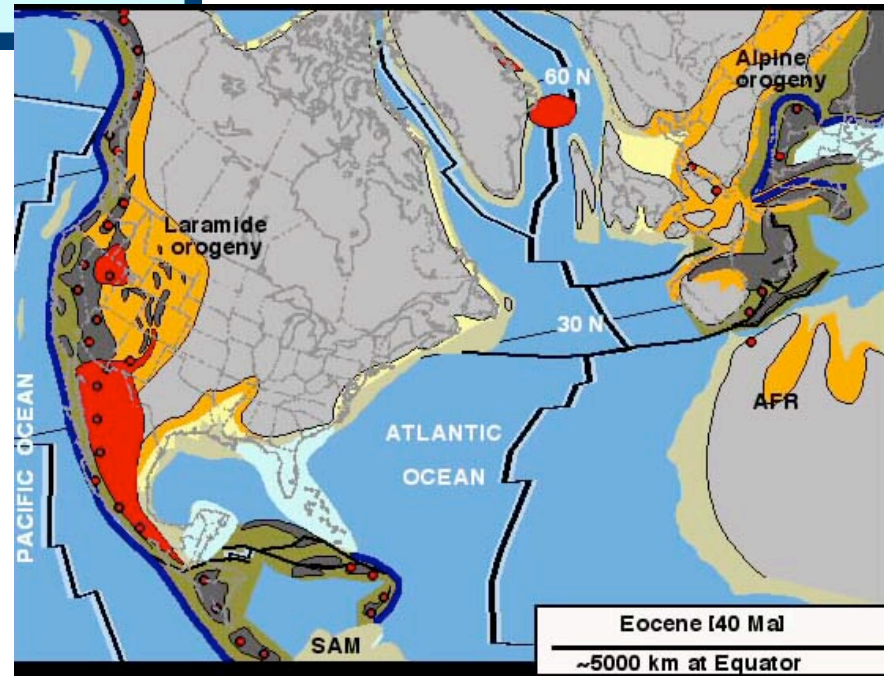
Laramide Style Uplifts

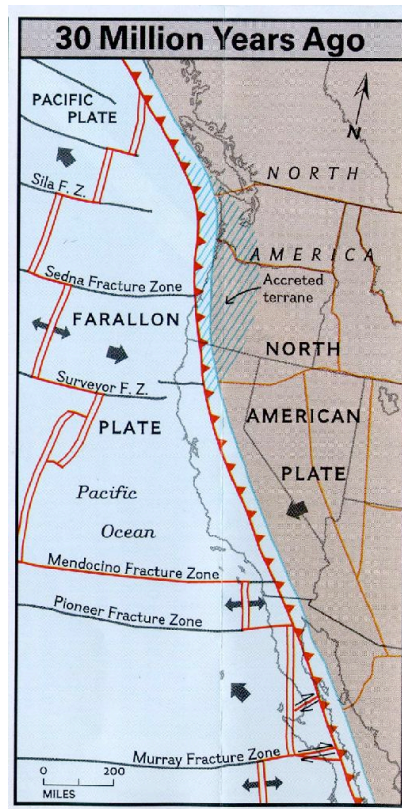
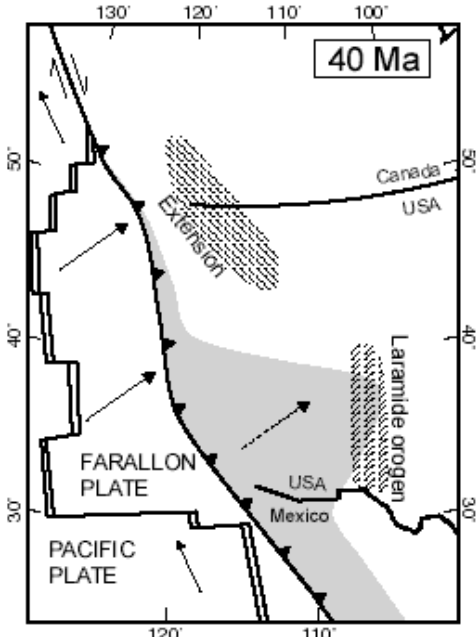
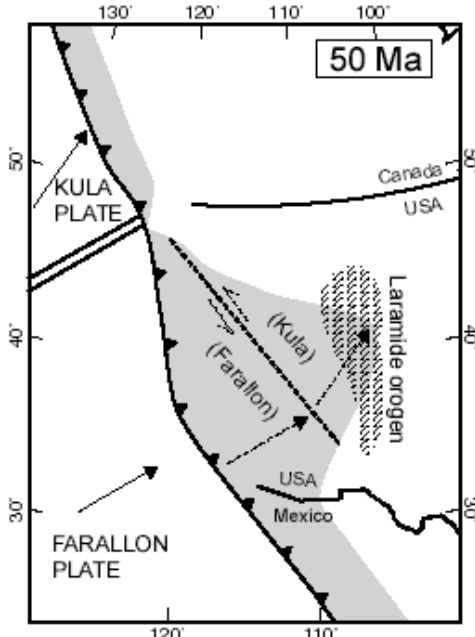
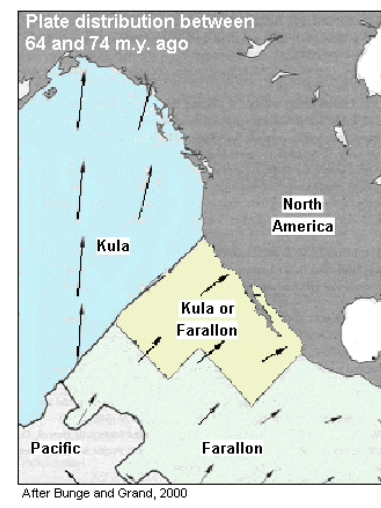
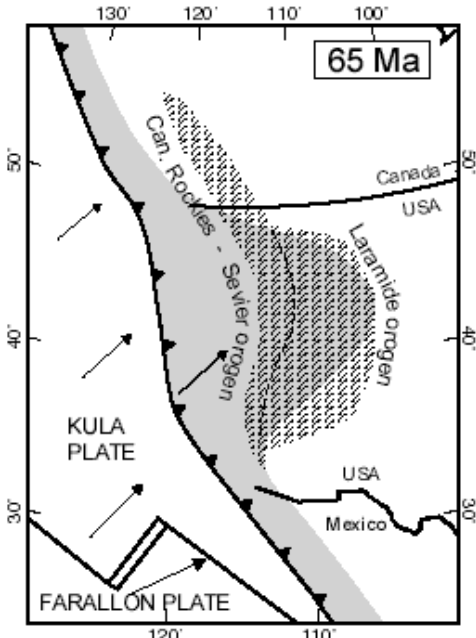
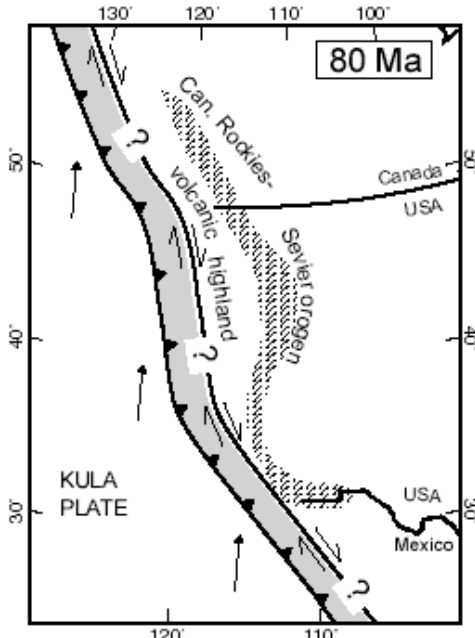


1. Paleocene - Eocene



2. Late Eocene

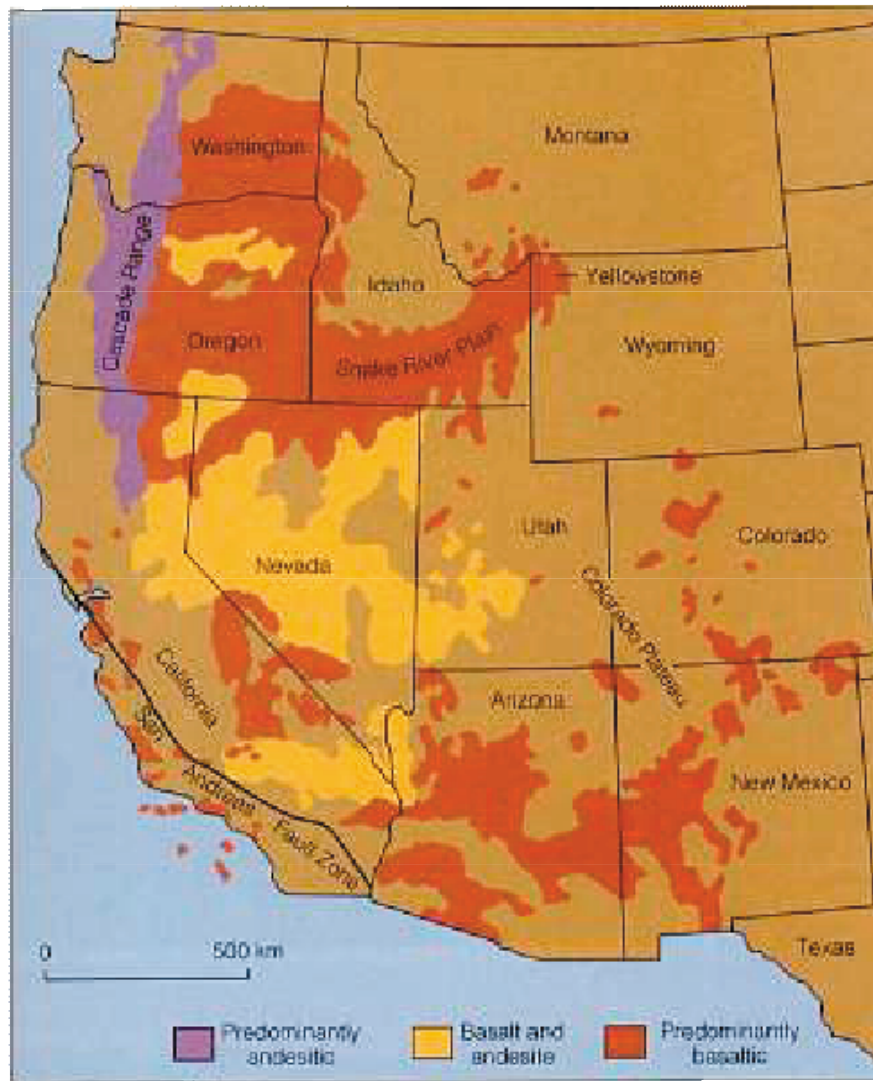




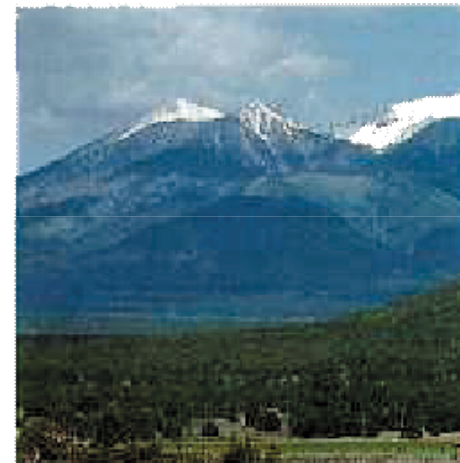


From Tarbuck, E and Lutgens, F., 1996, Earth, Prentice-Hall

Cenozoic Volcanism (Paleocene to Recent)



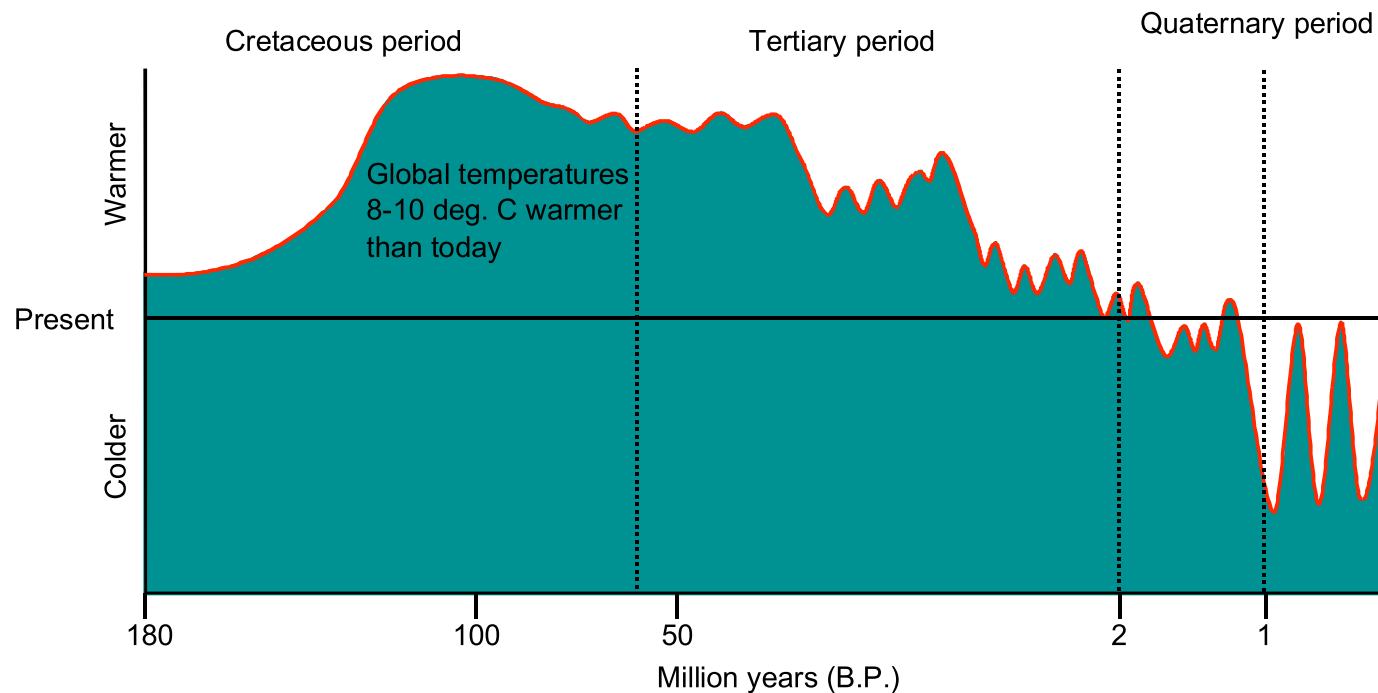
(b)



(c)

Major Climatic Events

- ◆ Temperature seasonality end of Eocene
- ◆ Increase in volcanism
- ◆ General drying and cooling during Cenozoic
- ◆ Pleistocene Glacial cycles





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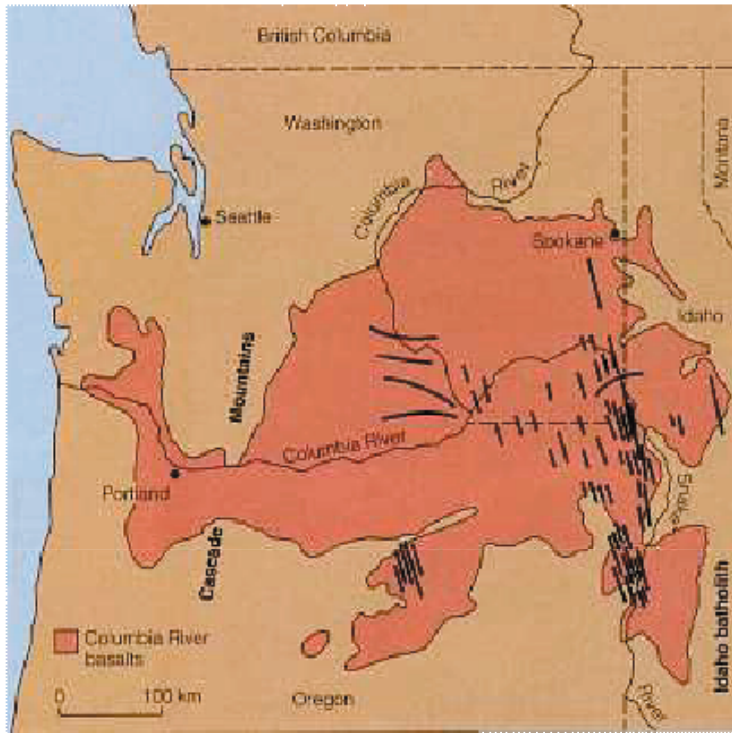


193



193

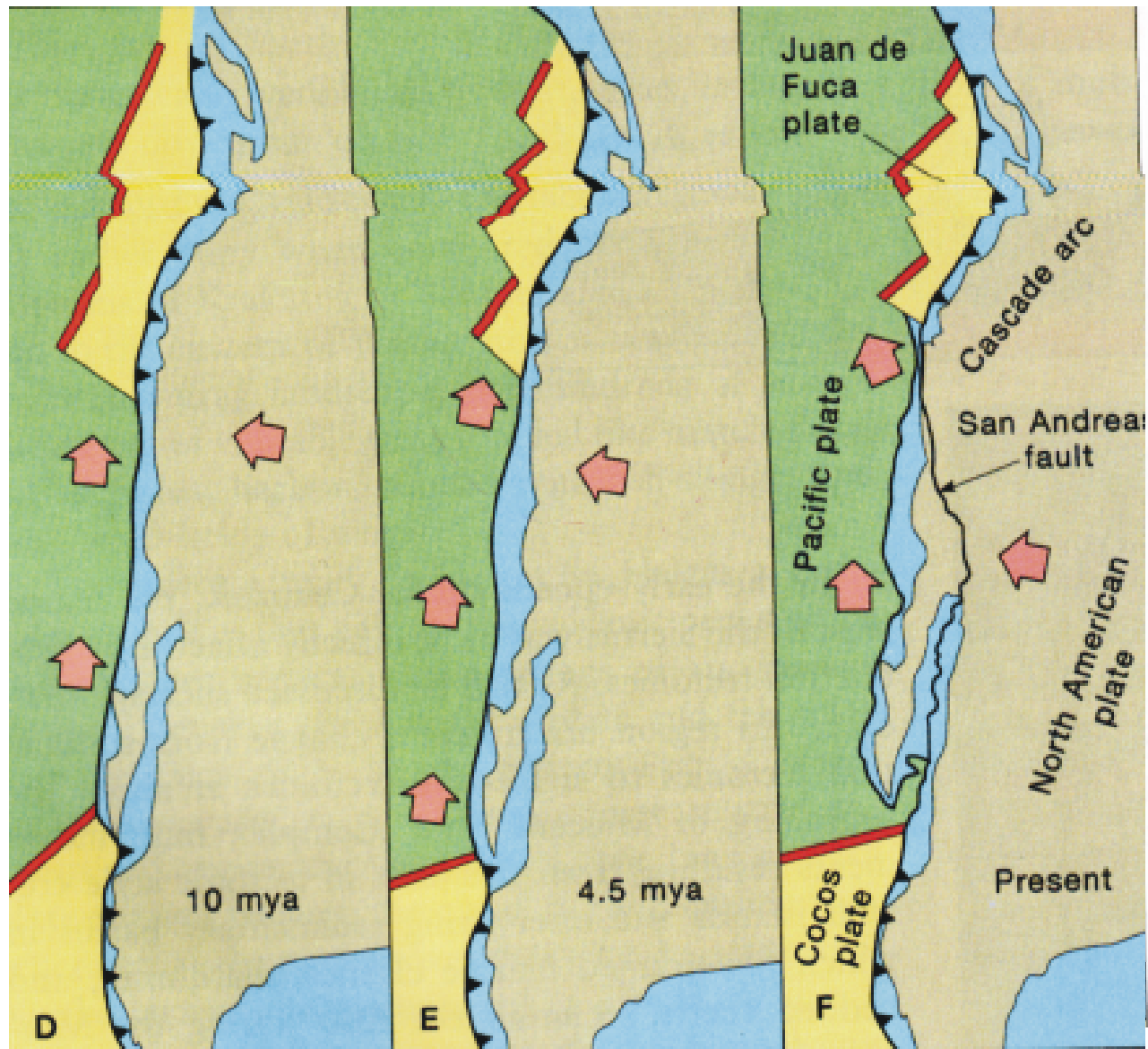
Cascade Eruptions

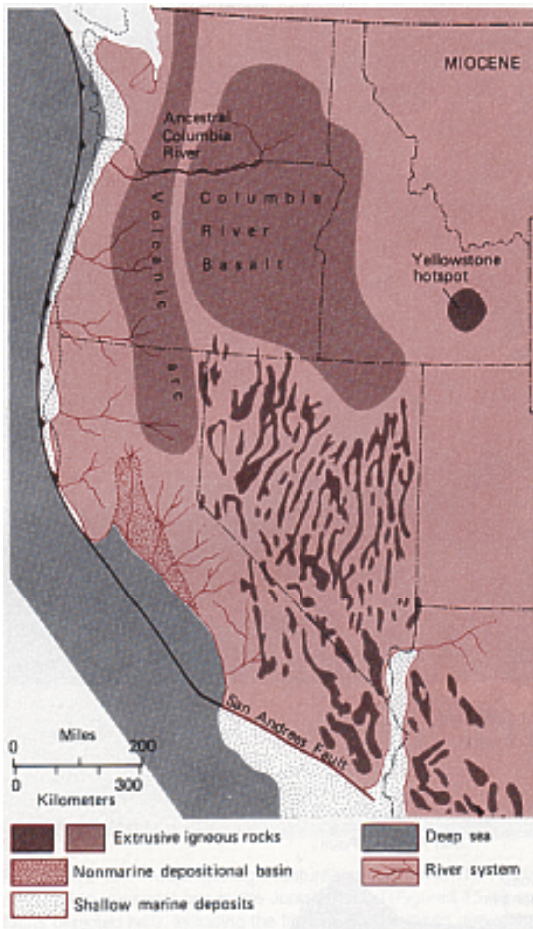
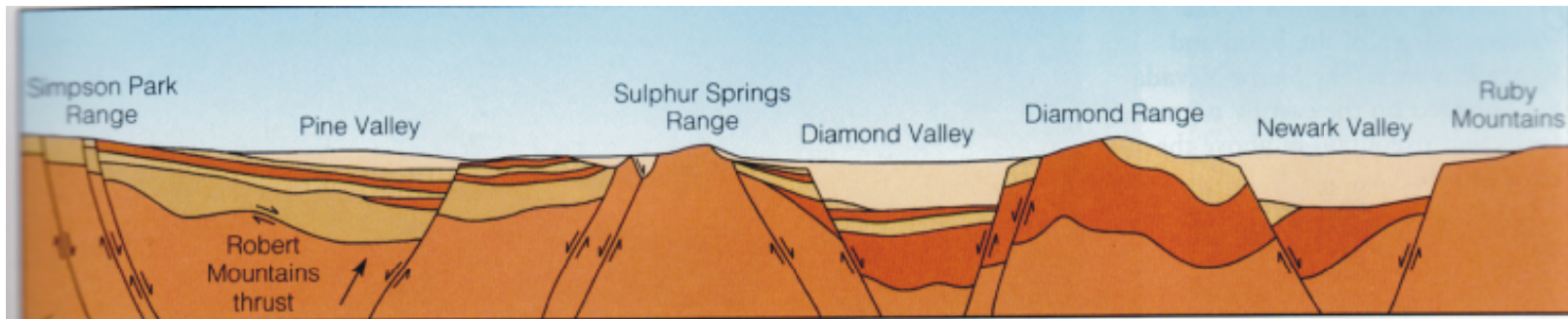


Columbia River Basalts (Miocene)



Death of the Farallon Plate

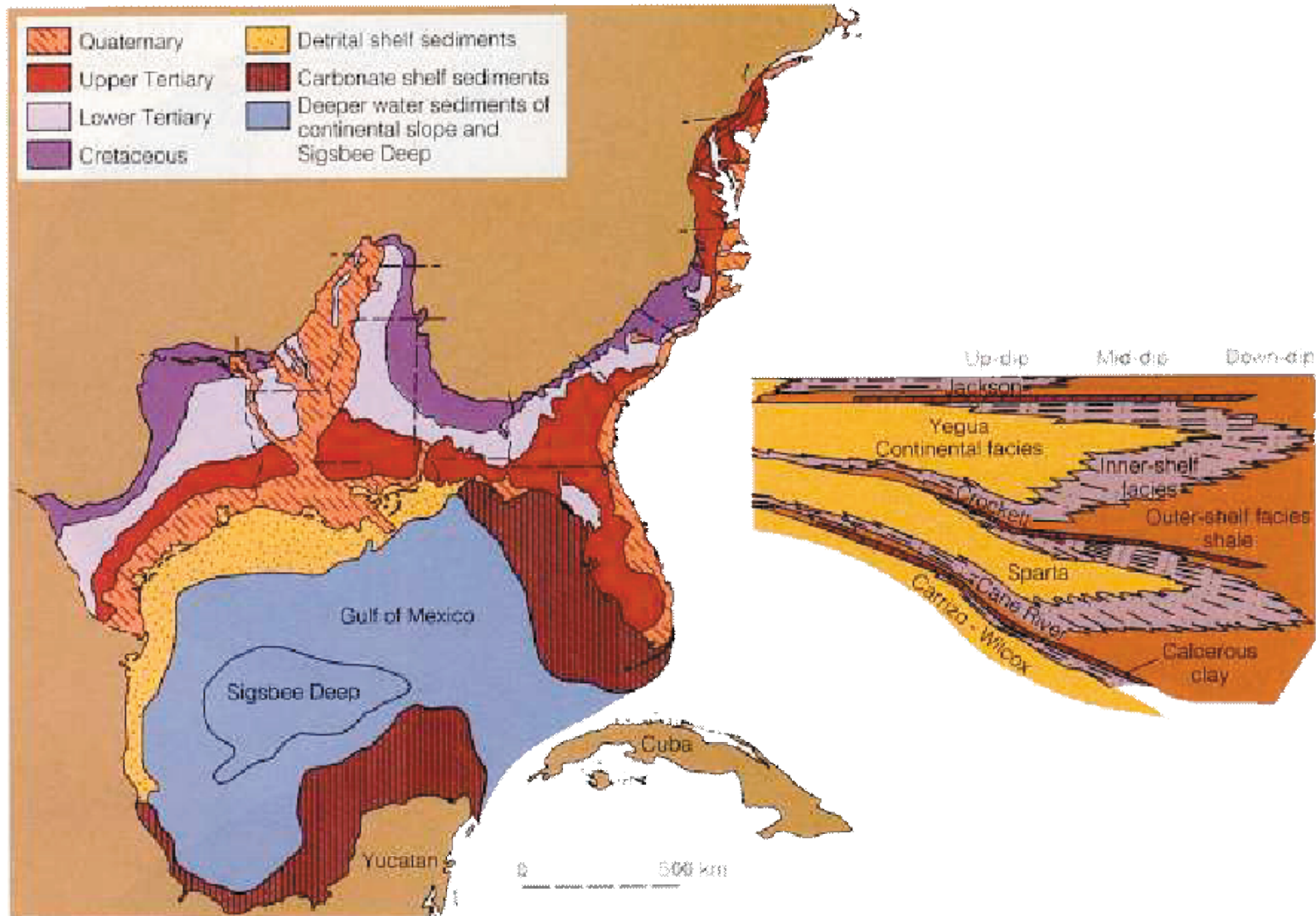




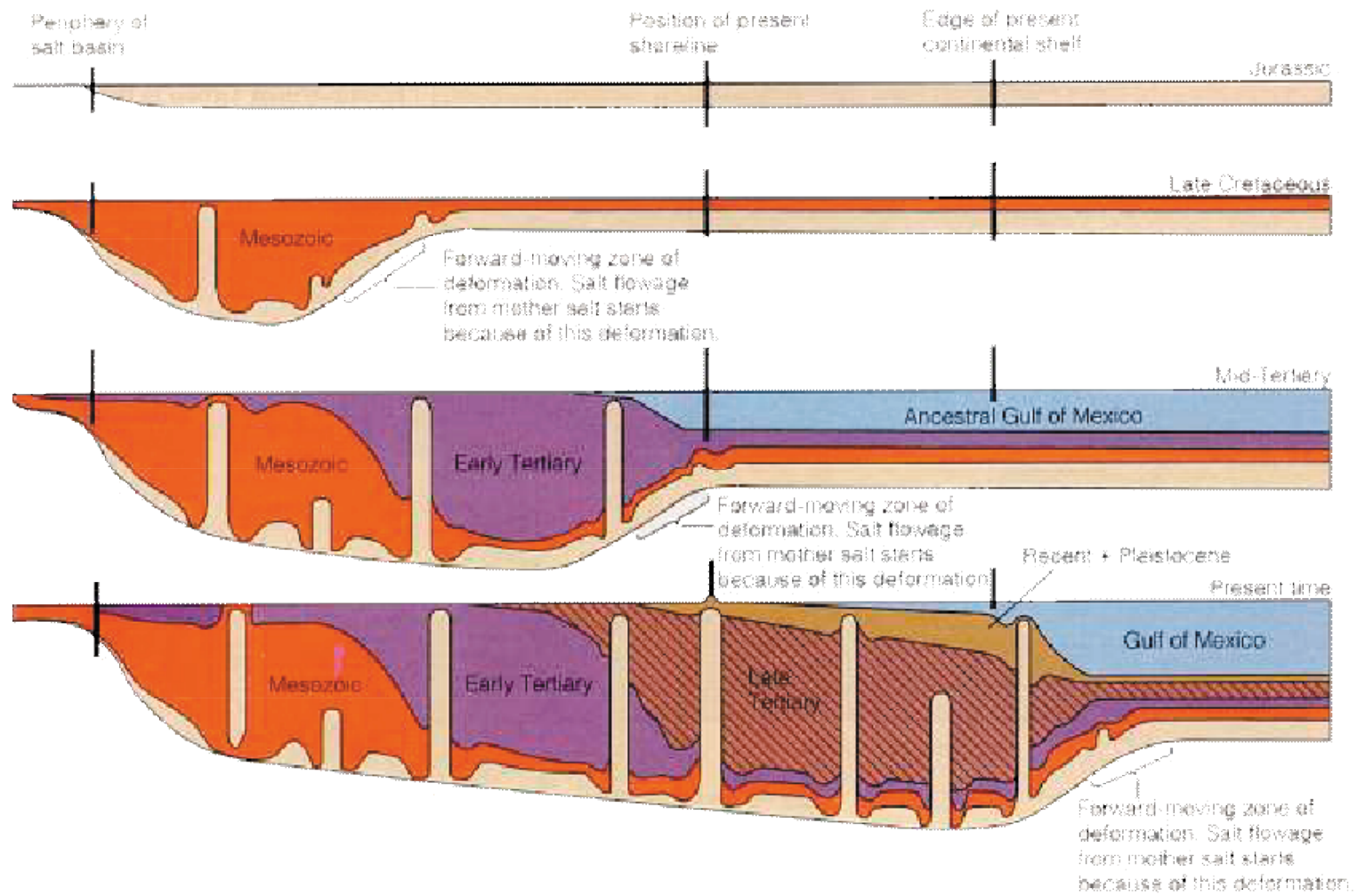
The Basin and Range Province (Miocene)

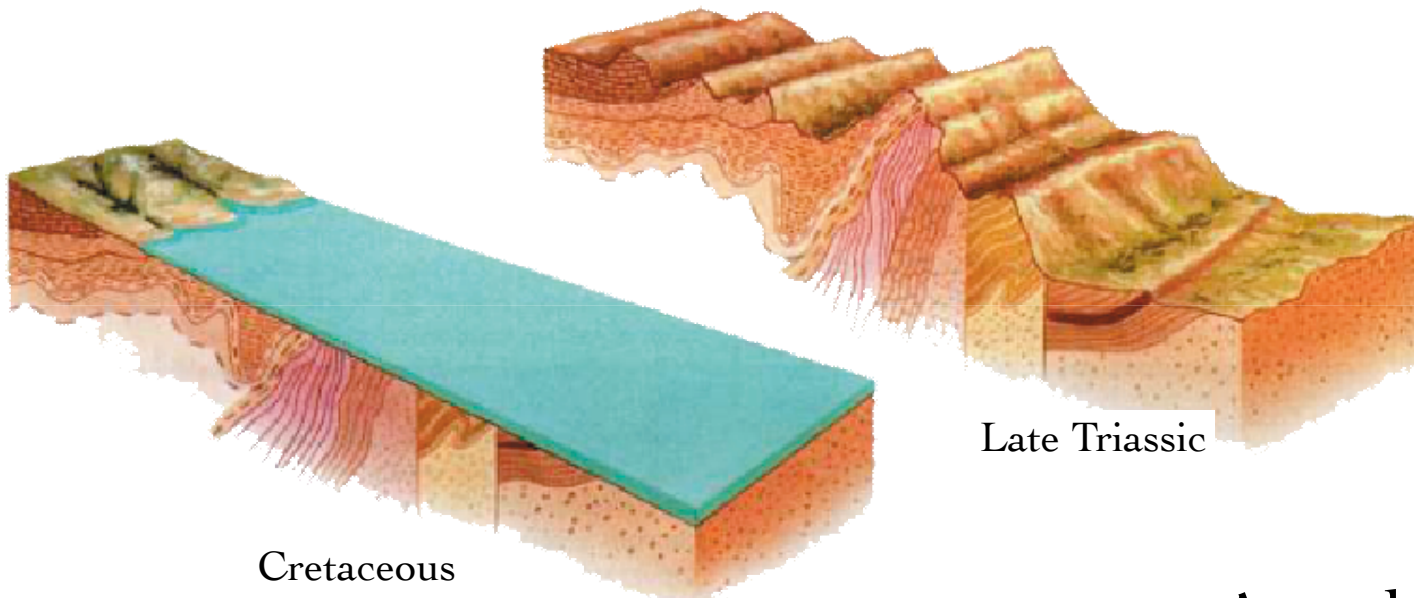
Shift from compression to tension in western US at ca. 25 ma.

Evolution of the Gulf Coast



Filling of the Gulf Coast

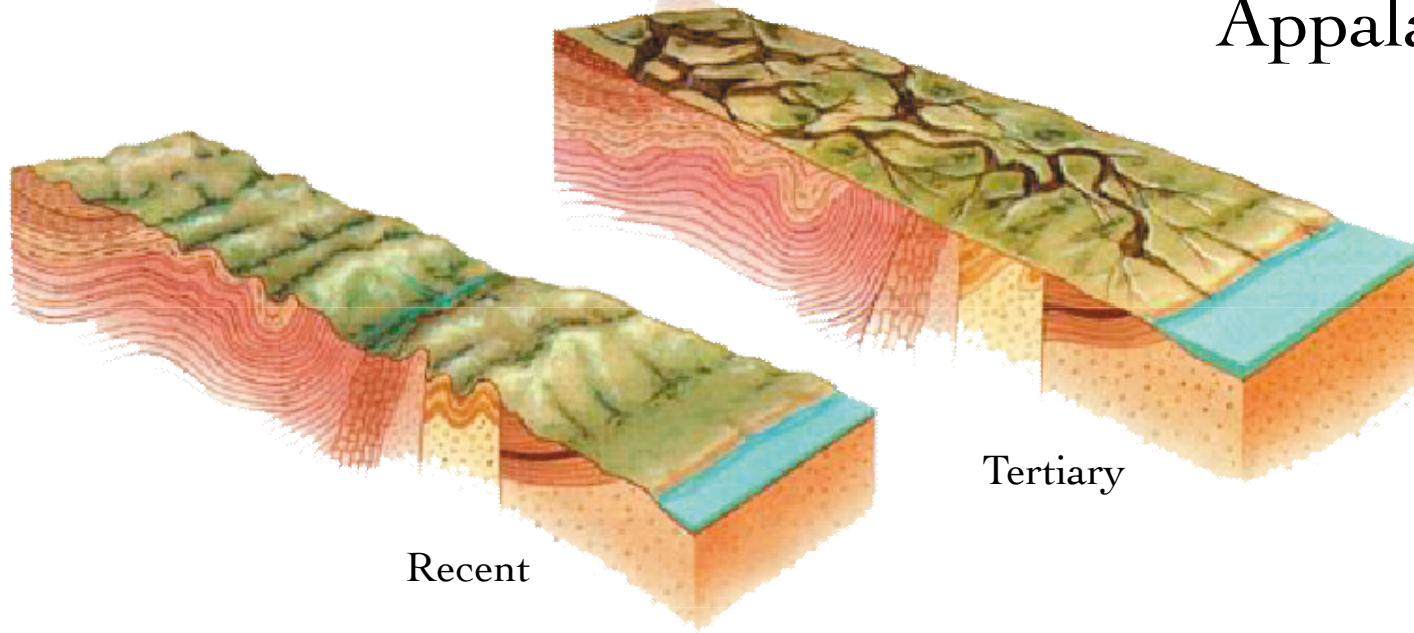




Late Triassic

Cretaceous

Appalachians

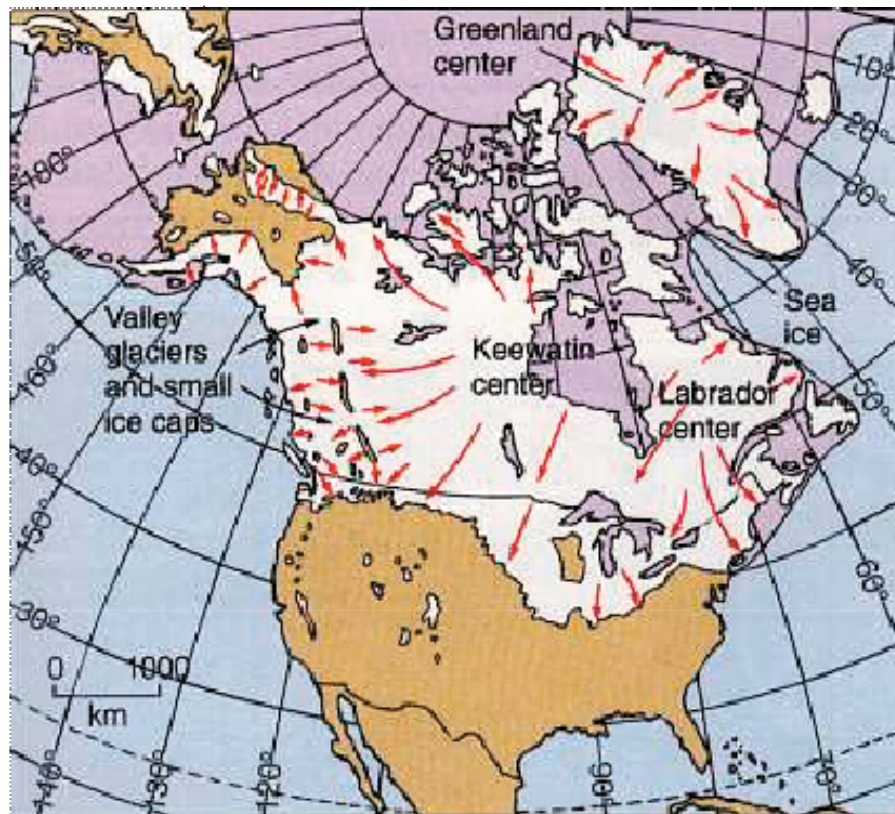


Tertiary

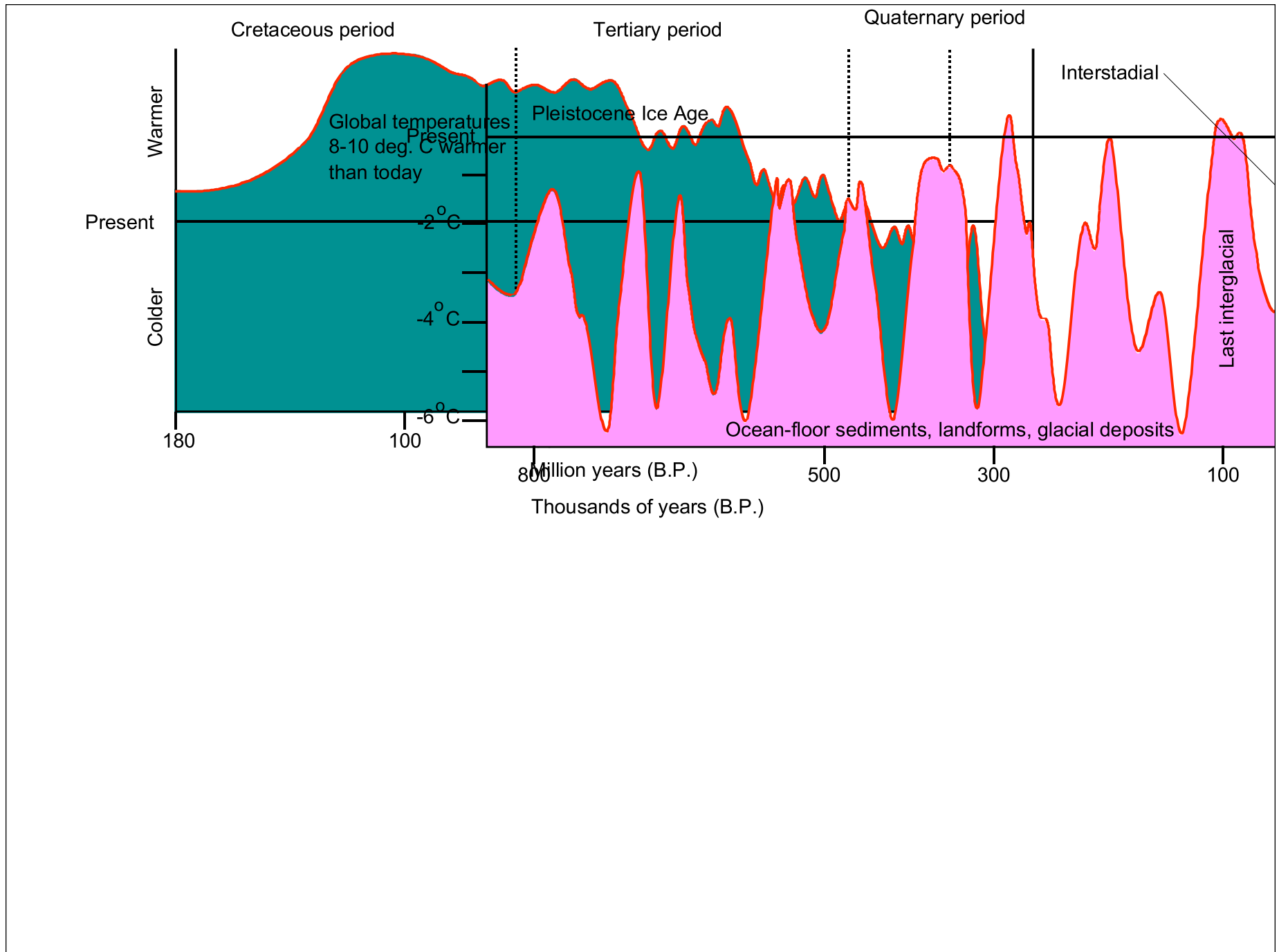
Recent



The Pleistocene "Icebox"

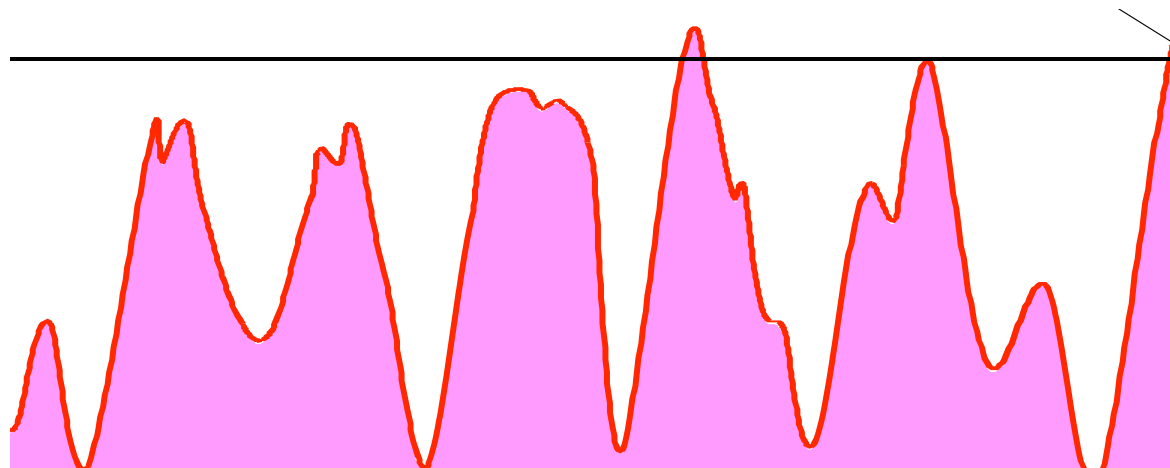


We used to think there were 4 major glacials and interglacials during the Pleistocene. More detailed analytical techniques now tell us there are more than 40 cycles of glacial expansion and retreat.



Glacial Cycles

- ◆ Glaciation
- ◆ Deglaciation
- ◆ Interglacials



Glacial Cycle Events

- **During glacials** (or glacial maxima):
 - Continental glaciers advance equatorward; alpine glaciers advance downslope
 - Large scale scouring and erosion due to advance
 - Eustatic regression (sea water trapped in glaciers), up to 100 m, out to the edge of the continental slope
 - In response, rivers carve deep channels along edge of continents
 - Land surface is depressed under up to 3 km depth of ice
 - Migration of animal and plant species
 - In tropical regions and many higher latitudes: climate dries even more, deserts expand, forests and rainforests contract
 - In western North America and a few other locations, deflected weather patterns actually make things WETTER - huge Pluvial lakes
 - Episodes last for 5-20 ka

- **During deglaciations**

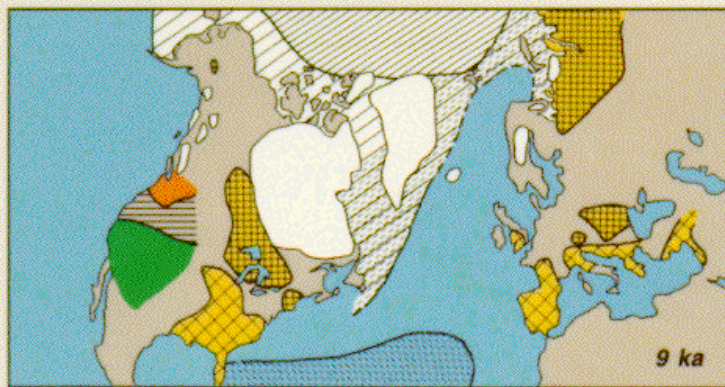
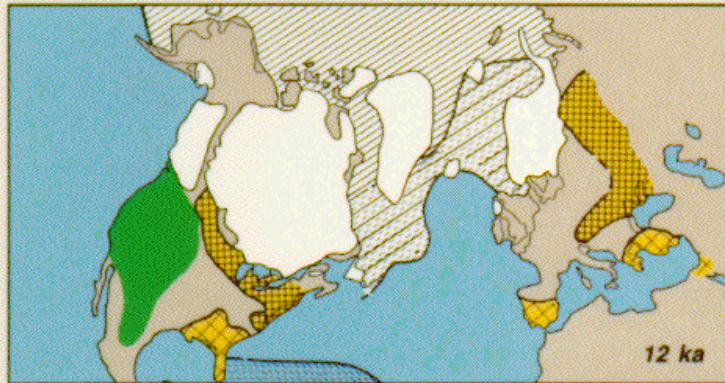
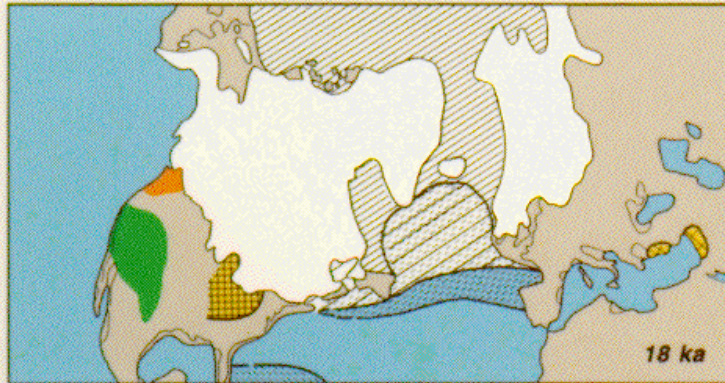
- Heinrich events : massive discharge of icebergs releasing sediment into the sea

- Glacial lakes form along edges of continental glaciers. These and other large lakes often overflowed (burst through ice dams, etc.), leaving large outwash plains. Extreme example is the Channeled Scablands

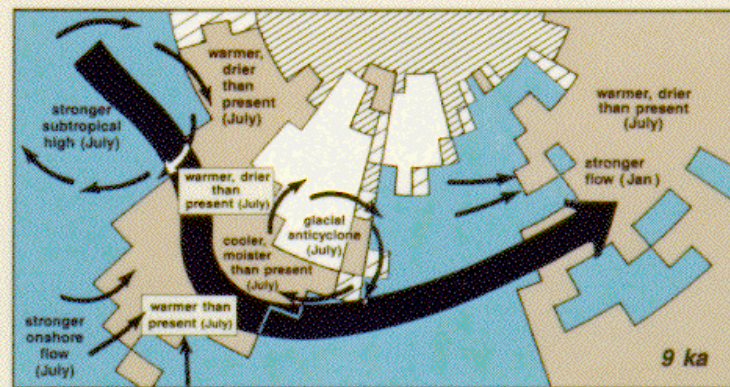
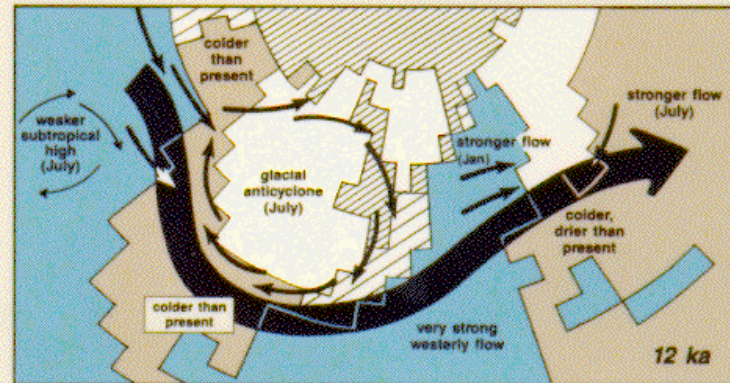
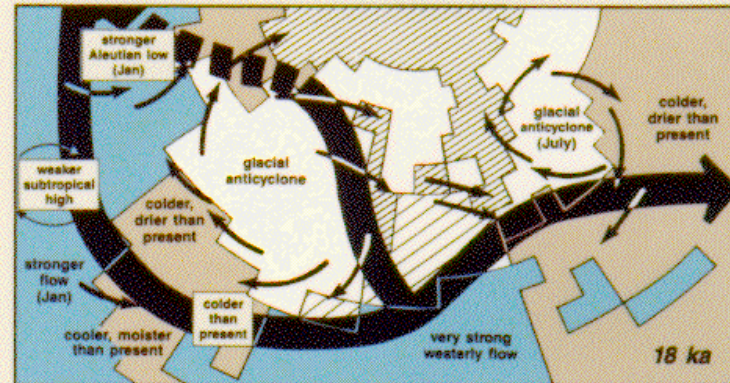
- Deglaciations are now known to be VERY rapid : several degrees rise in less than 10 years!

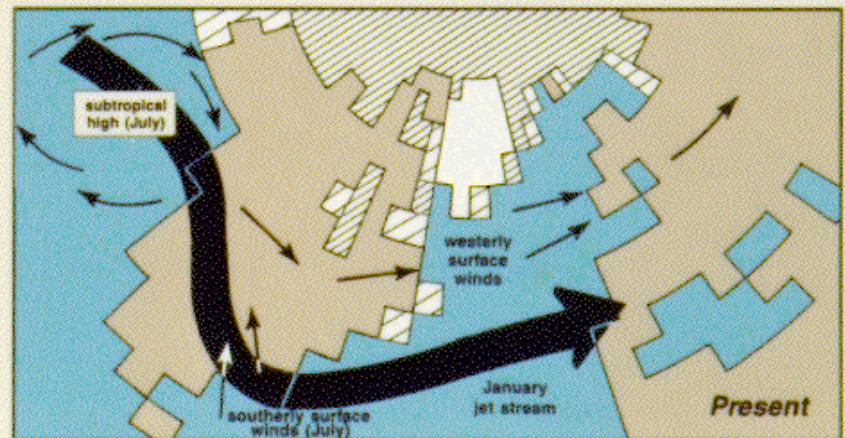
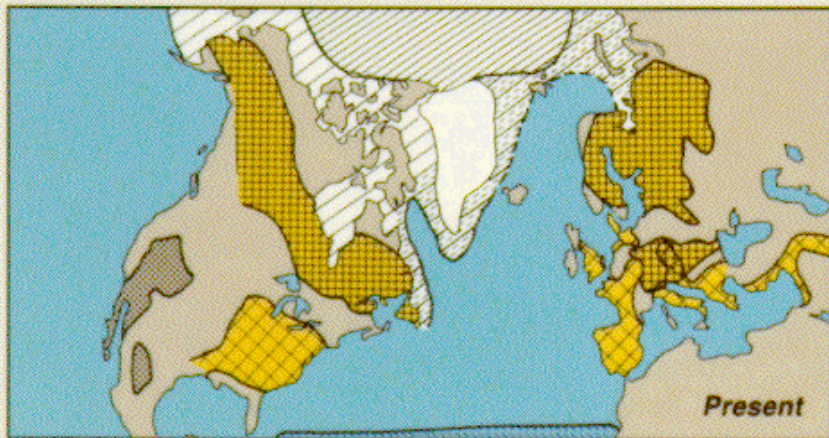
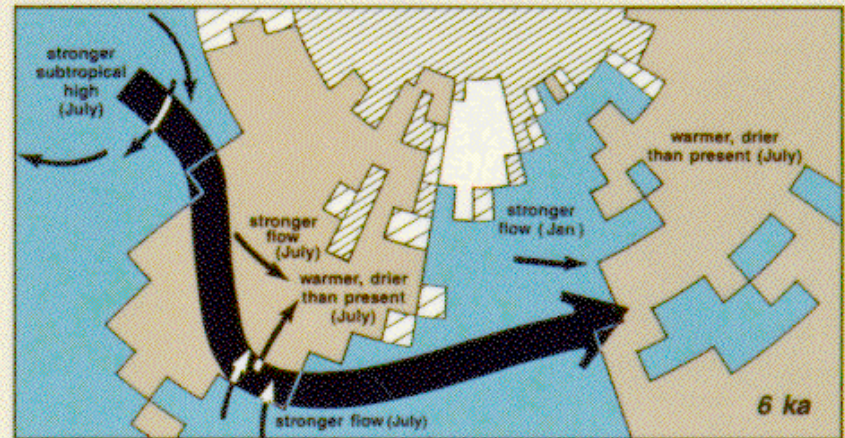
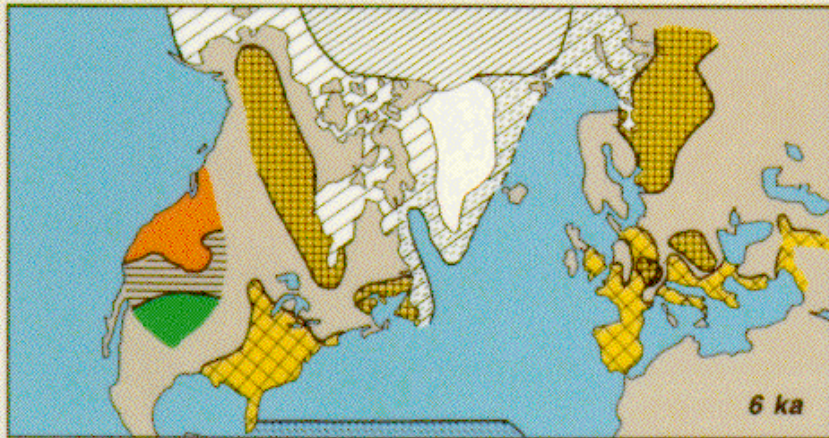
- During interglacials (or glacial minima):
 - Glaciers retreat
 - Isostatic rebound in continental regions
 - Sea level rise, up to 30 m higher than present at maximum
 - Coastal river valleys flood to form estuaries
 - Animal and plant migrations poleward
 - Last for 5-20 ka

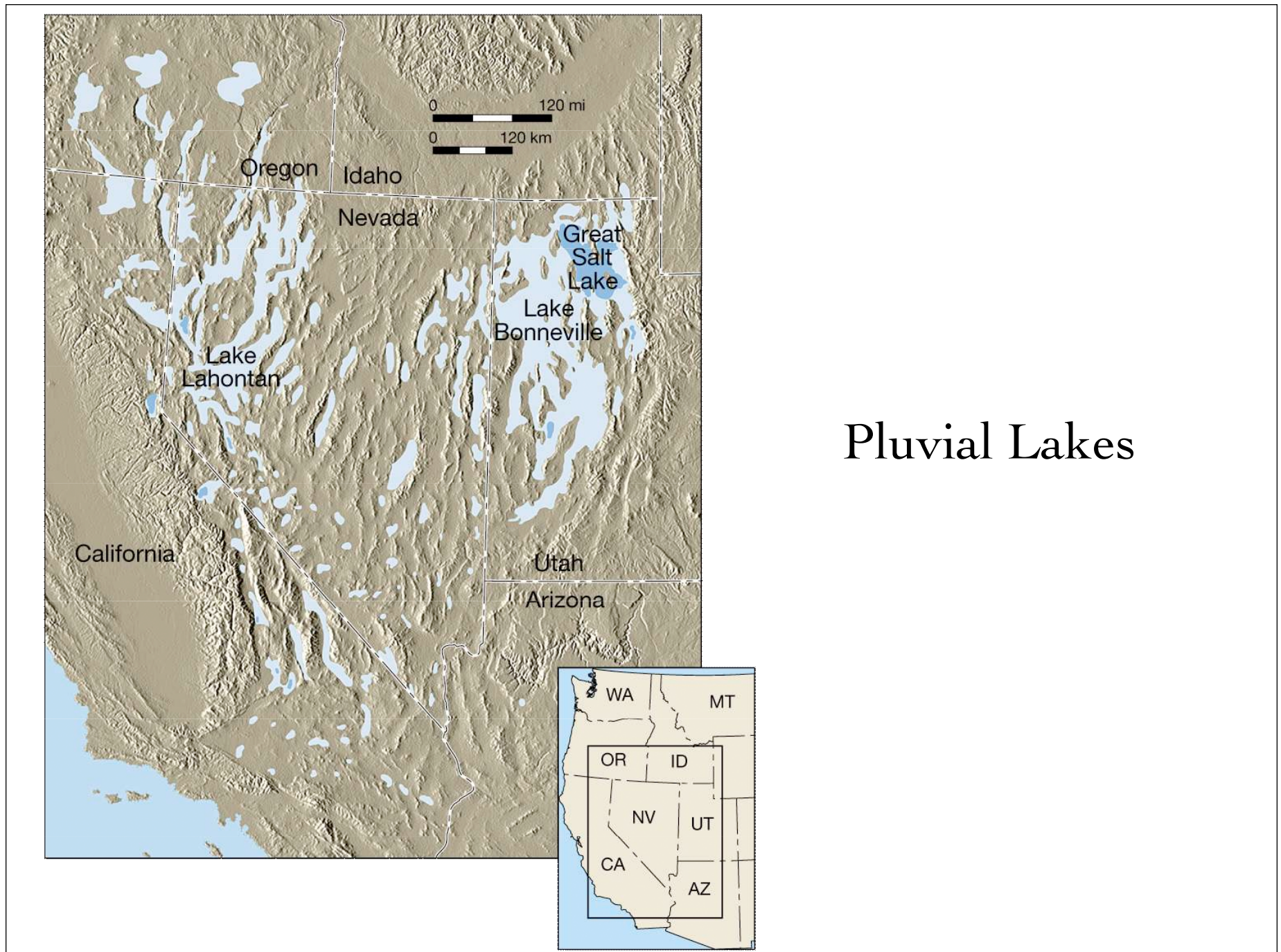
DATA



MODEL

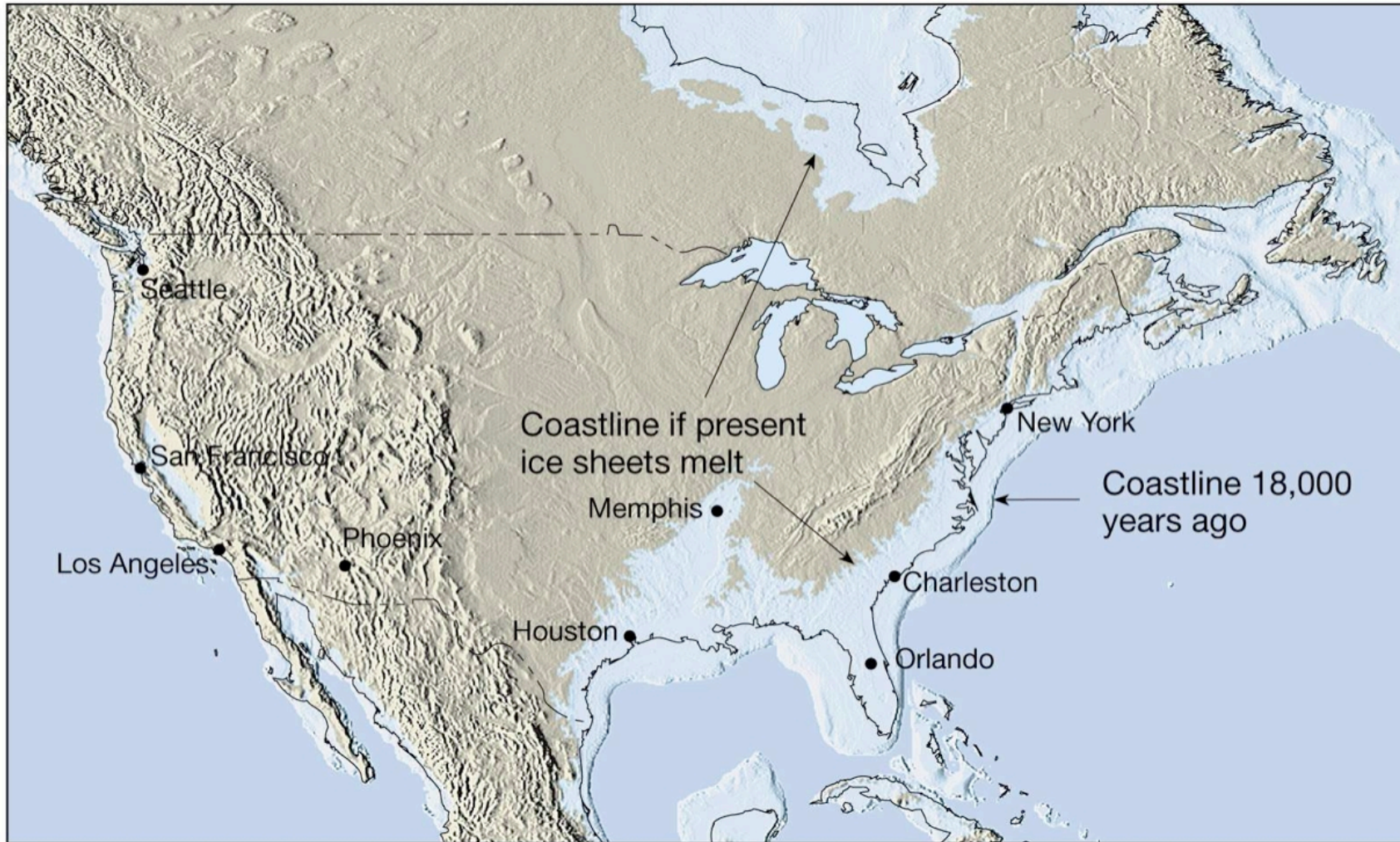






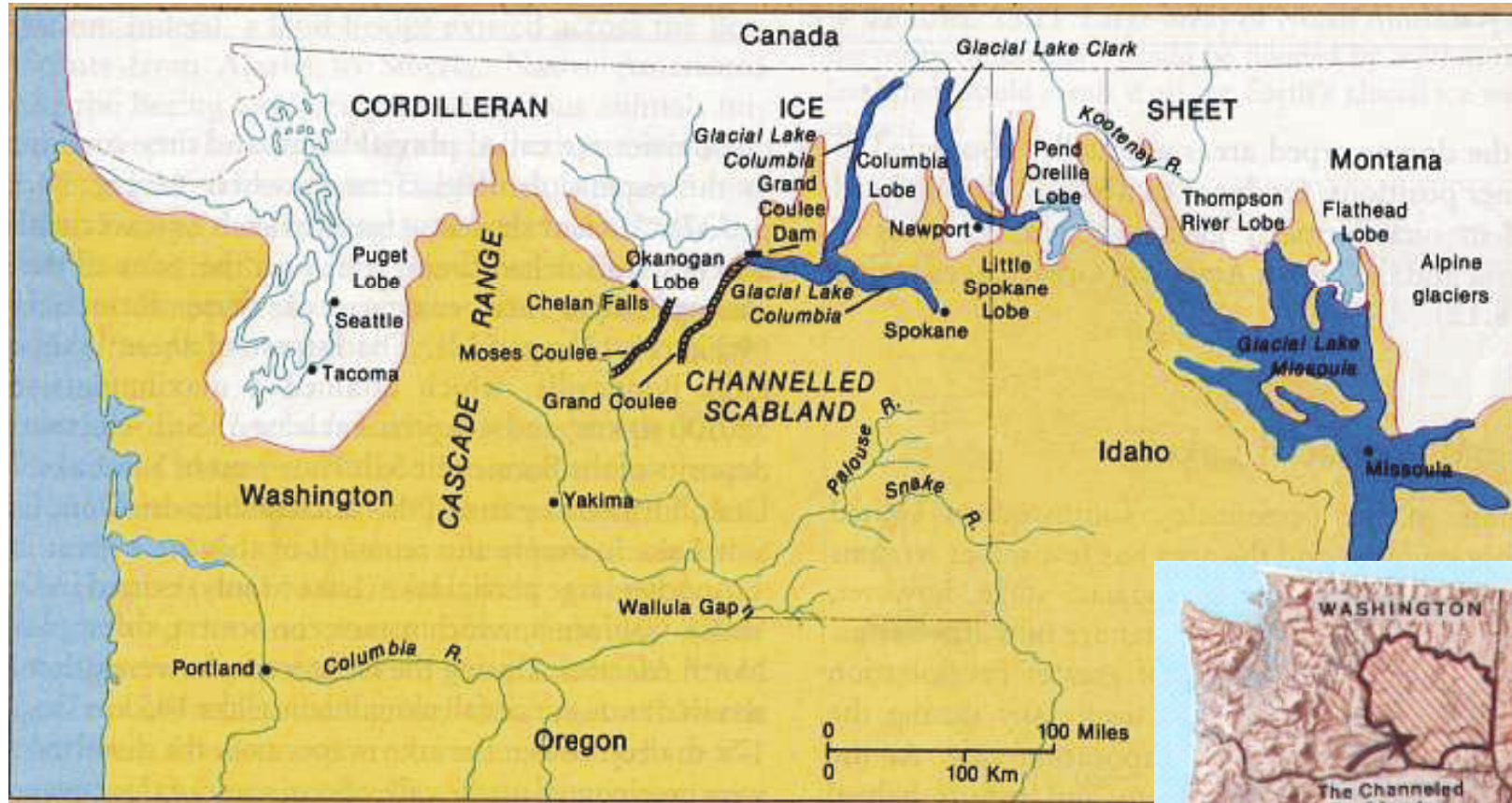
Pluvial Lakes

Sea Level Changes

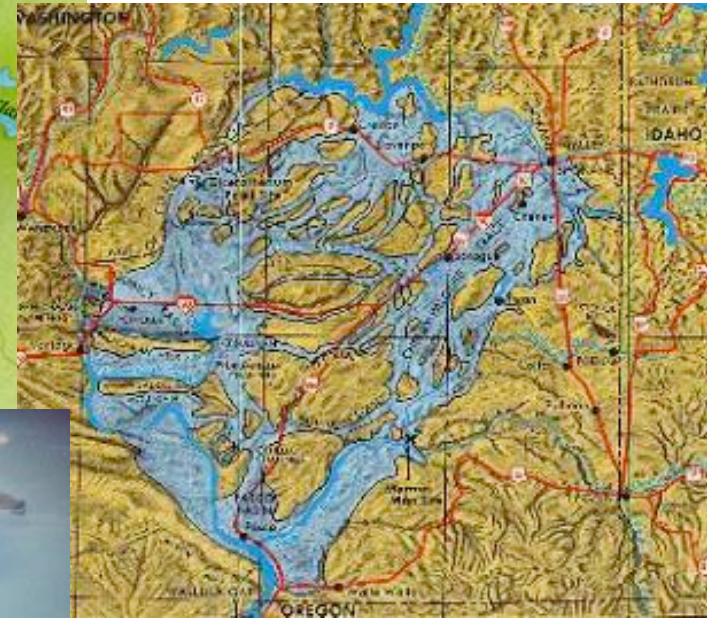


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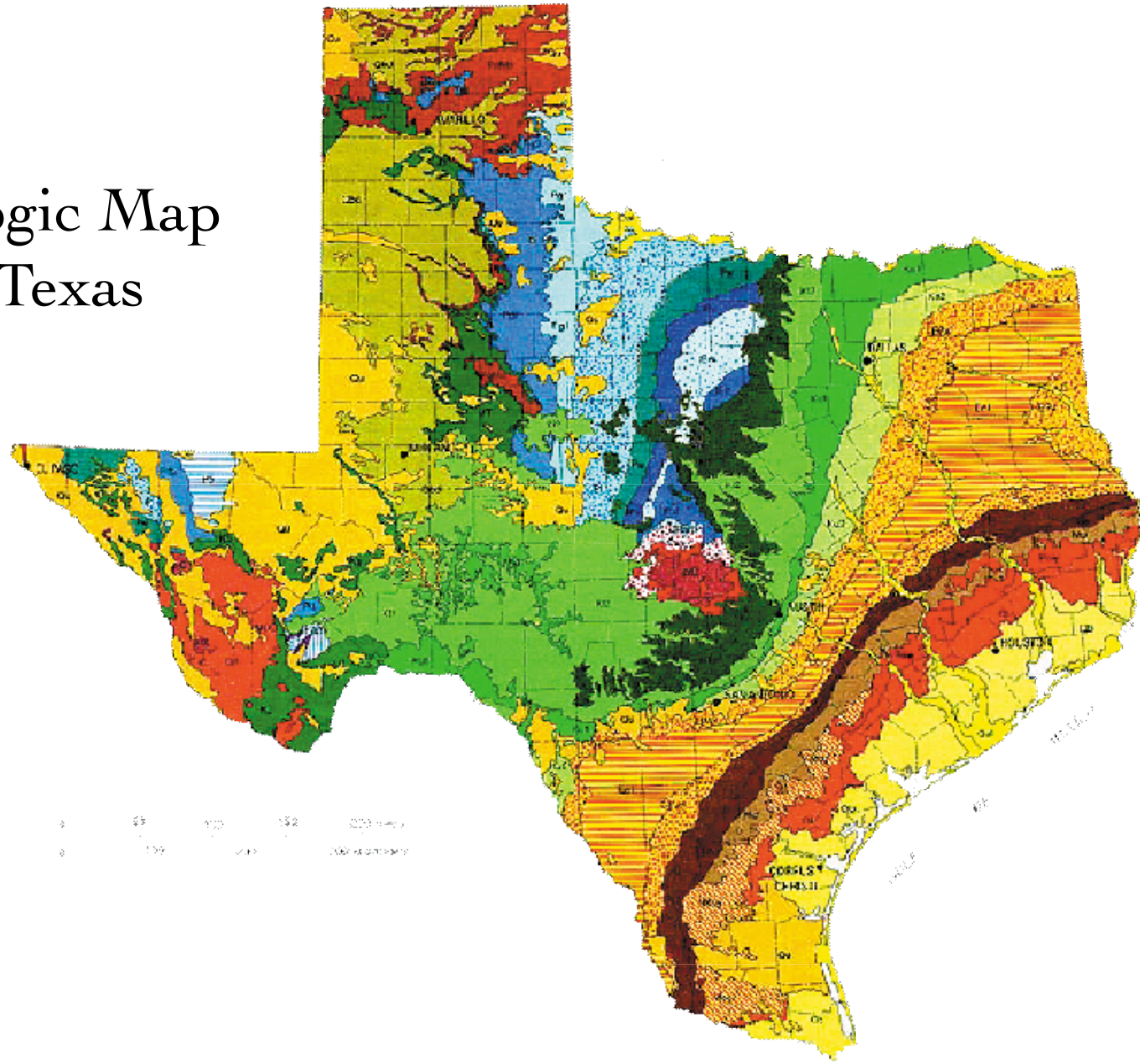
The Channeled Scablands



The Channeled Scablands



Geologic Map of Texas



Floral zones 14 ka vs. today

