

LARAMIDE OROGENY

- Major tectonic event that formed the Rocky Mountains
- Occurred 70-40 My
- Occurred in the interior of a plate
- Occurred 1,000 miles from nearest subduction zone
- Can you explain the Laramide orogeny using the paradigm of plate tectonics?

LARAMIDE CONTROVERSY

- What really caused the Laramide?
- To what extent was the subducting Farallon plate involved?
- How does intracontinental deformation on the scale of the Laramide even occur?
- How deep do Laramide reverse and thrust faults cut? Did they cut their own paths through the top of the basement, or did they follow pre-existing faults?
- The Rockies are as high as ever and still rising. How much of the cumulative Rocky Mountain uplift can the Laramide claim, and when did it occur, early or late in the orogeny?



Mountains of western US

How can the Rockies be formed by plate action?

Is the current Rio Grande Rift associated with plates?

How does the entire Basin and Range Province fit into this picture?

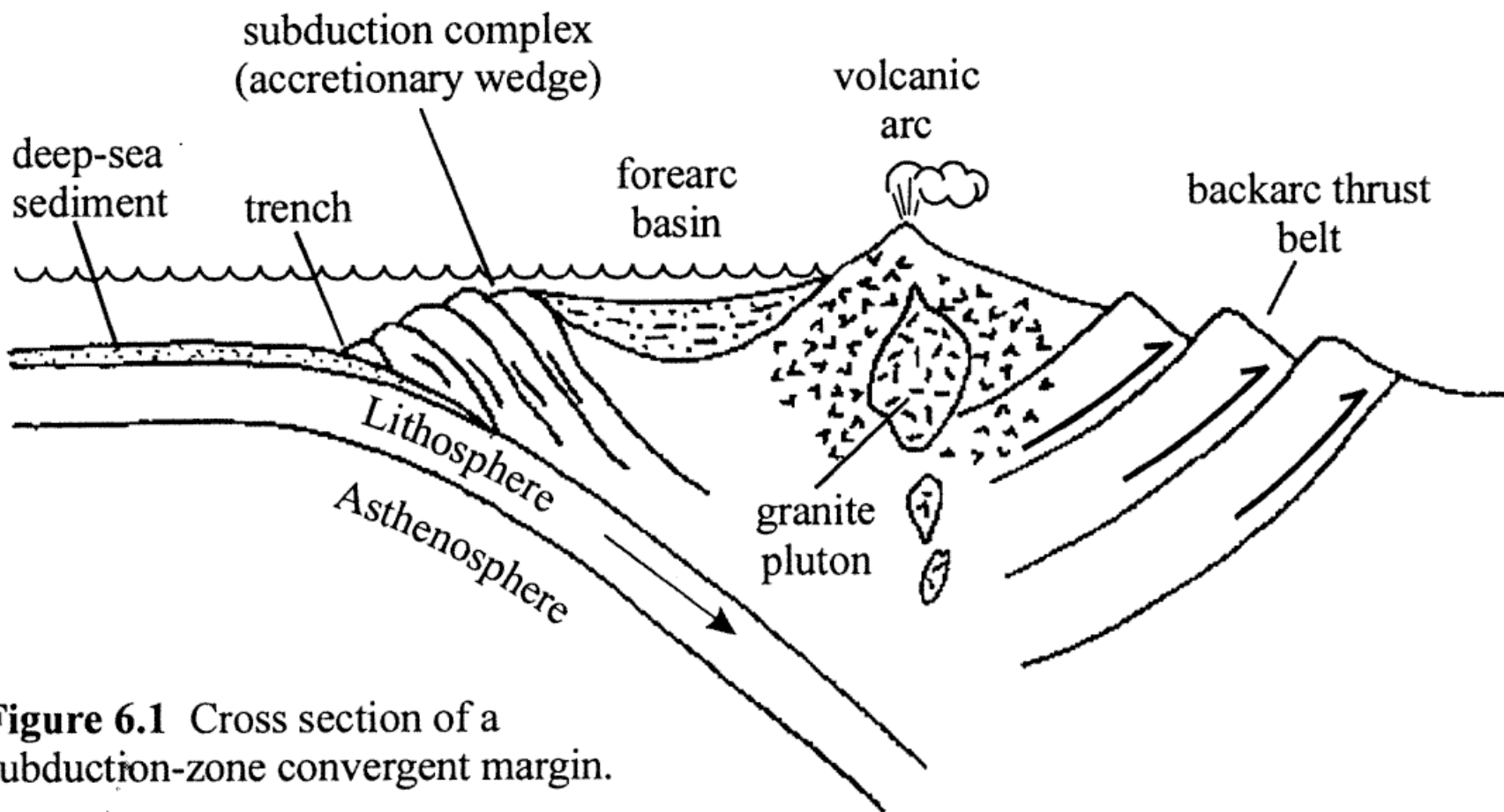
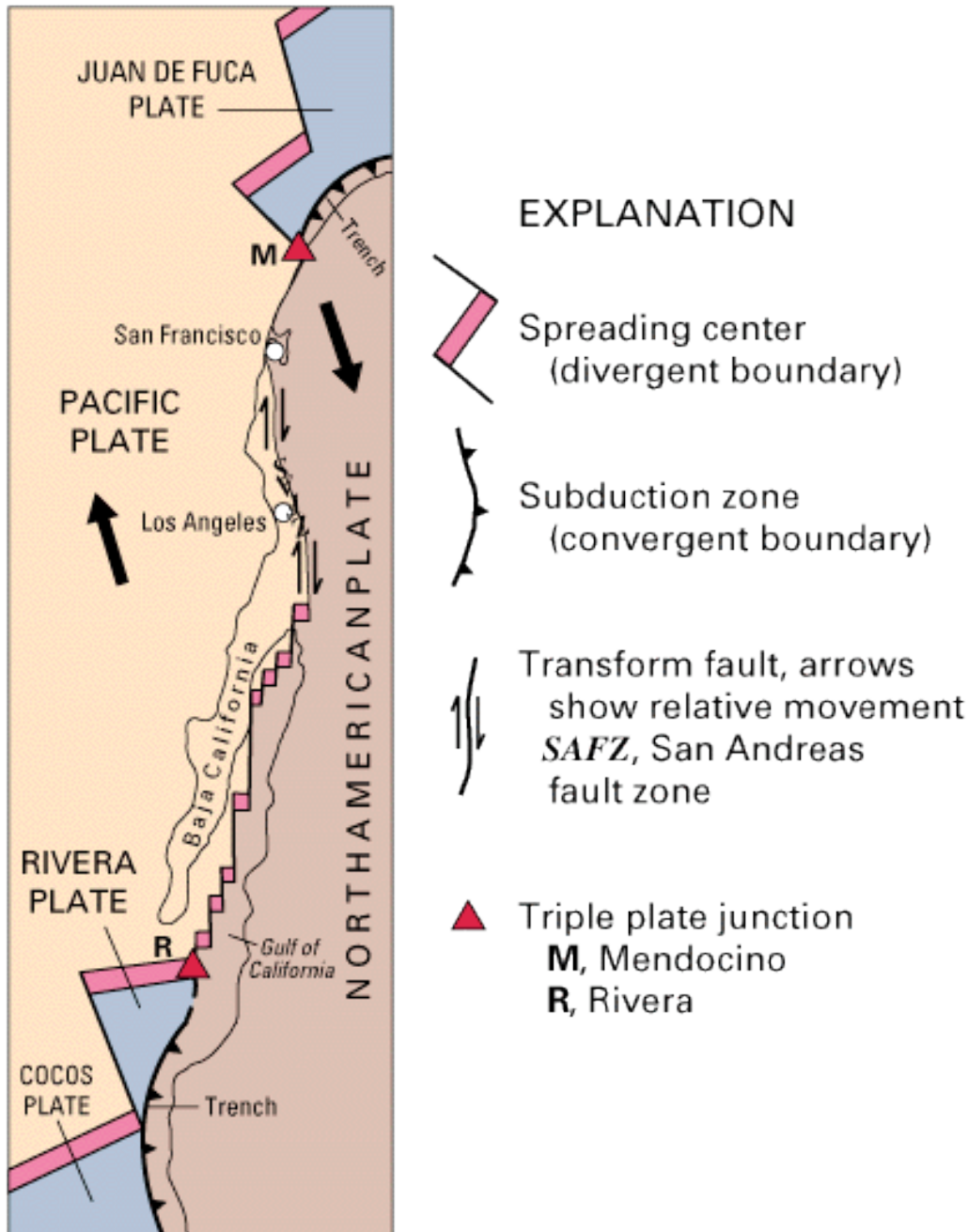


Figure 6.1 Cross section of a subduction-zone convergent margin.

Present



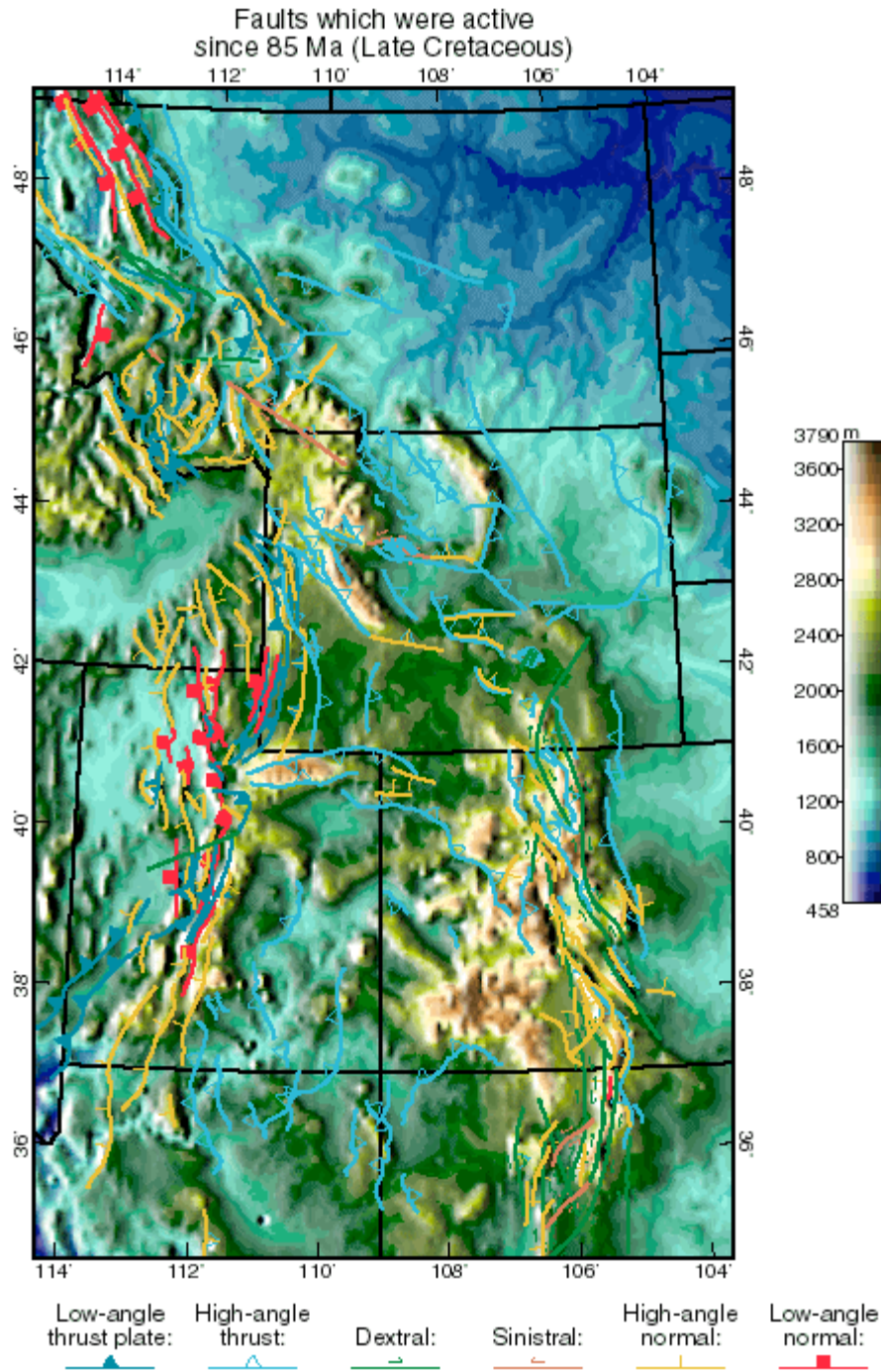
SAN ANDREAS FAULT

Intersection b/w NA plate and Pacific Plate

Note small plates: Juan de Fuca, Rivera, Cocos Plates

These small plates are remnants of the much larger Farallon Plate

Gulf of California is a spreading center

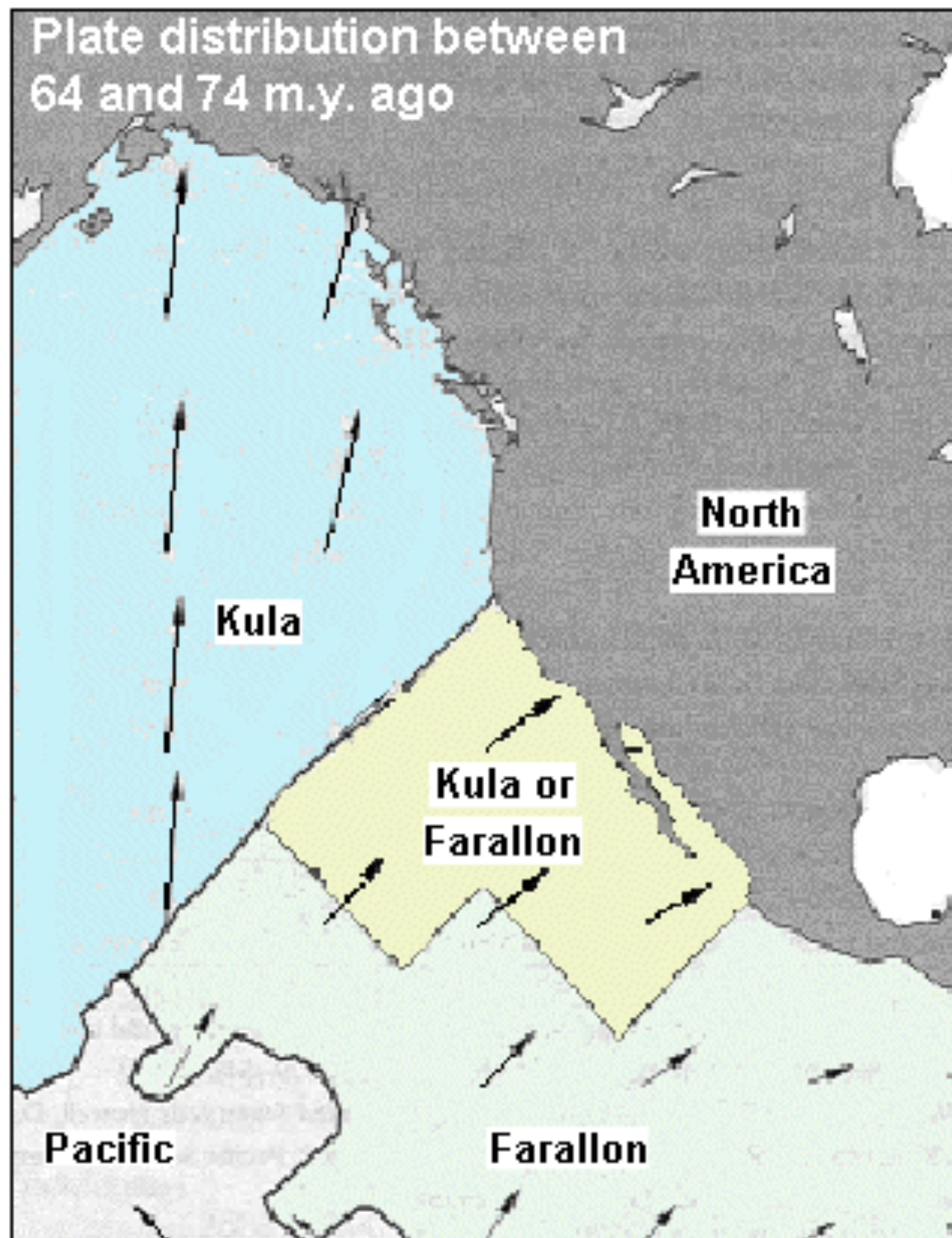


Active faults prior to the Laramide Orogeny

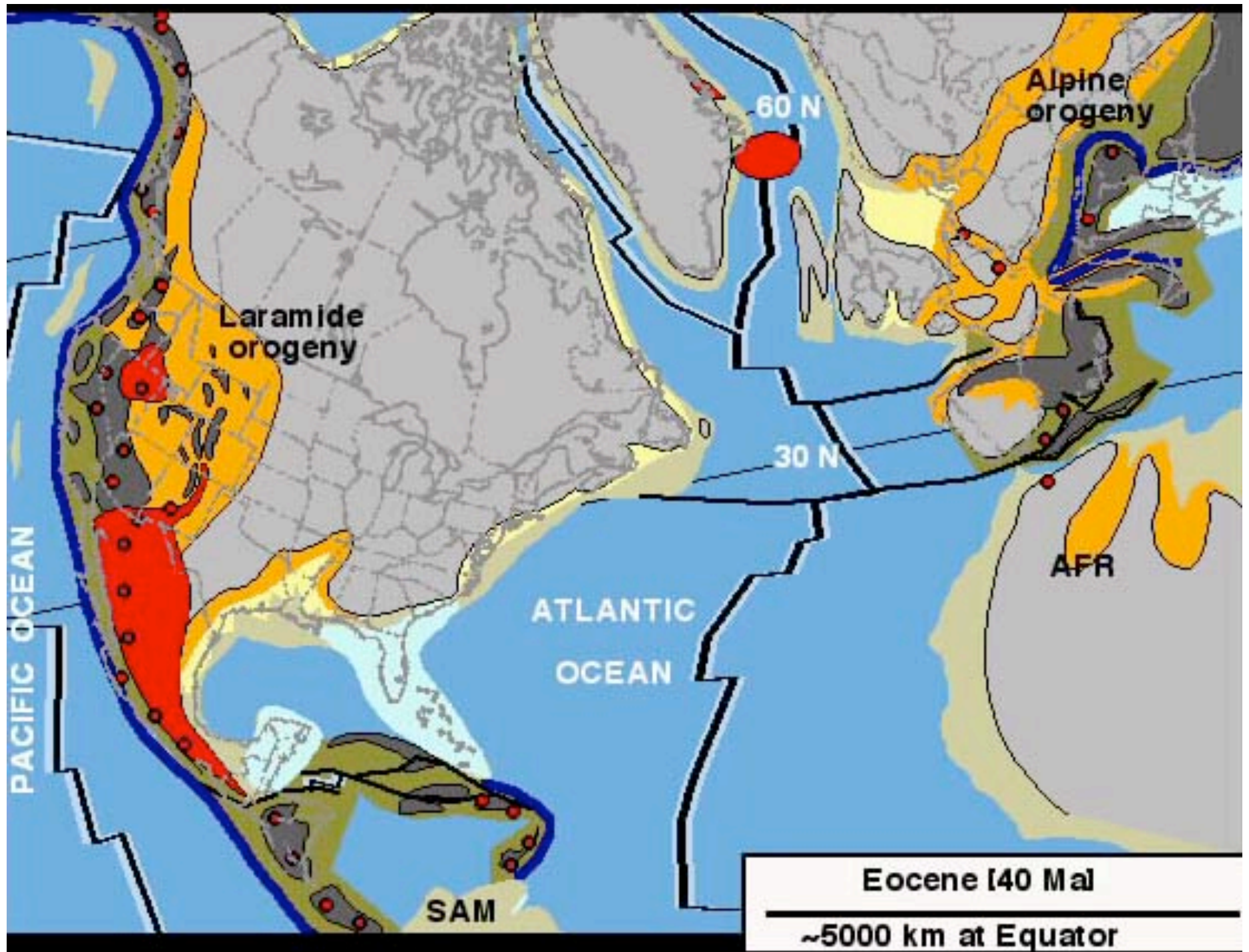
Note that they fit the present day Rockies quite well

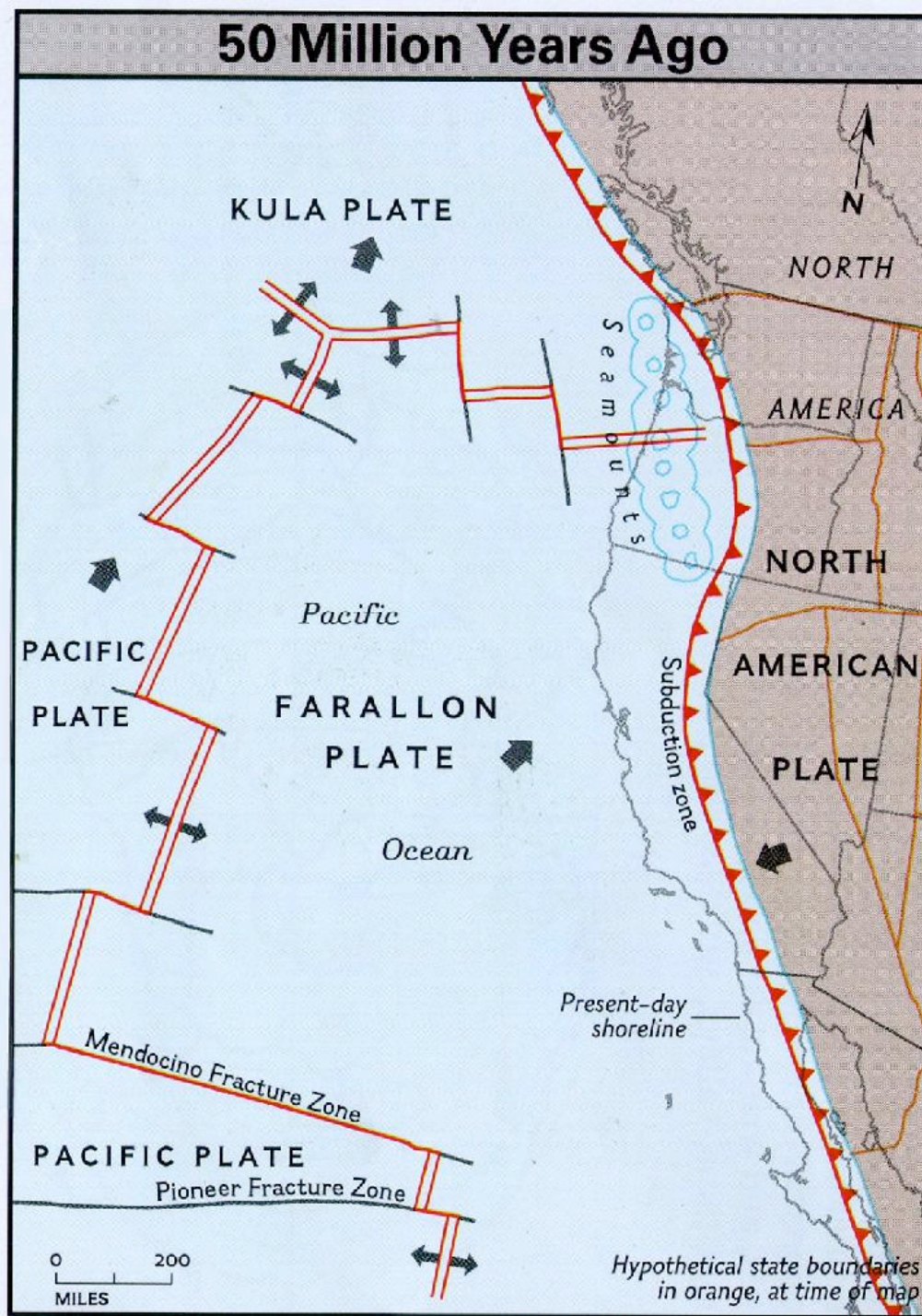
Faults developed as part of the Frontrangia Orogeny 330 My

Plate distribution between
64 and 74 m.y. ago



After Bunge and Grand, 2000





East Pacific Rise analogous to today's Atlantic Rise

Farallon Plate moving to NE

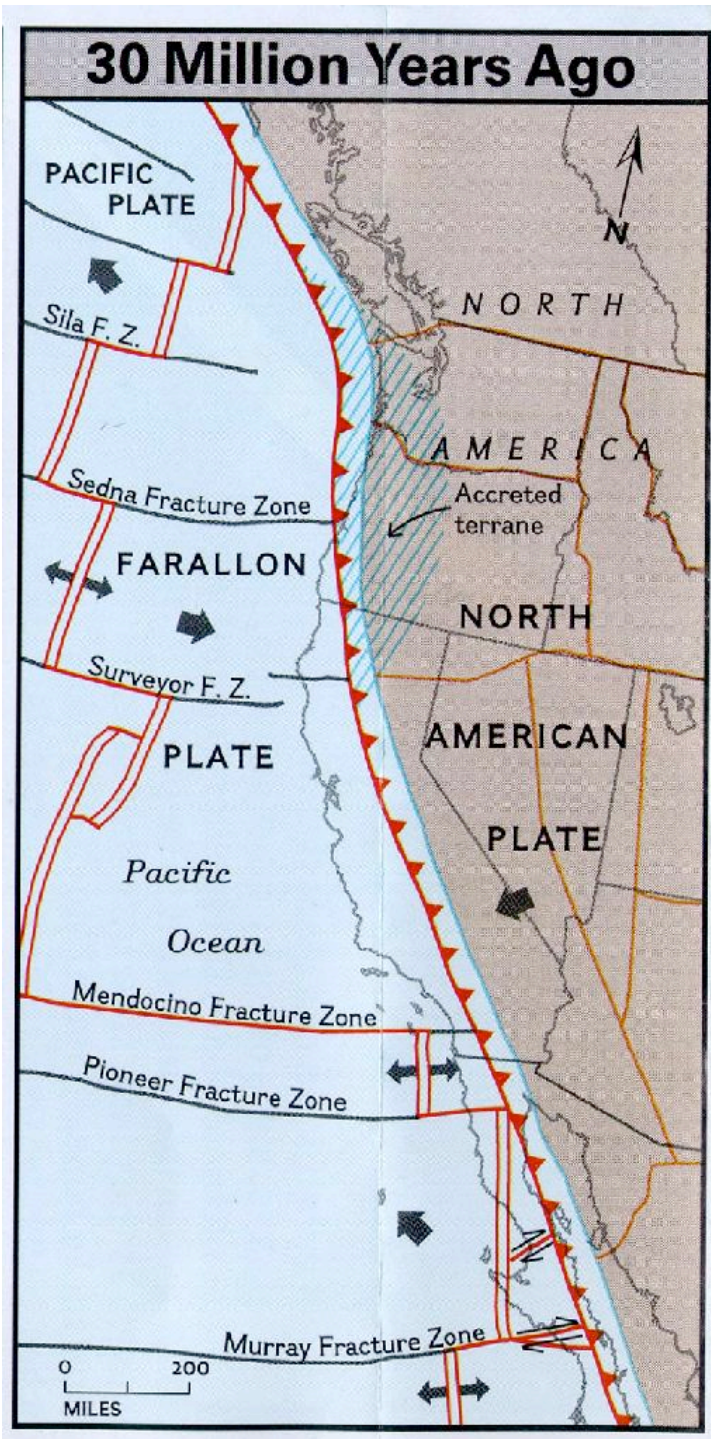
Collision with the North American Plate

Subduction zone off of present day California, similar to the Andes today

Hot, new plate material moving underneath North America

Floats near the crust to Colorado

Cools and dips in Colorado



East Pacific Spreading Center comes closer to the North American Plate

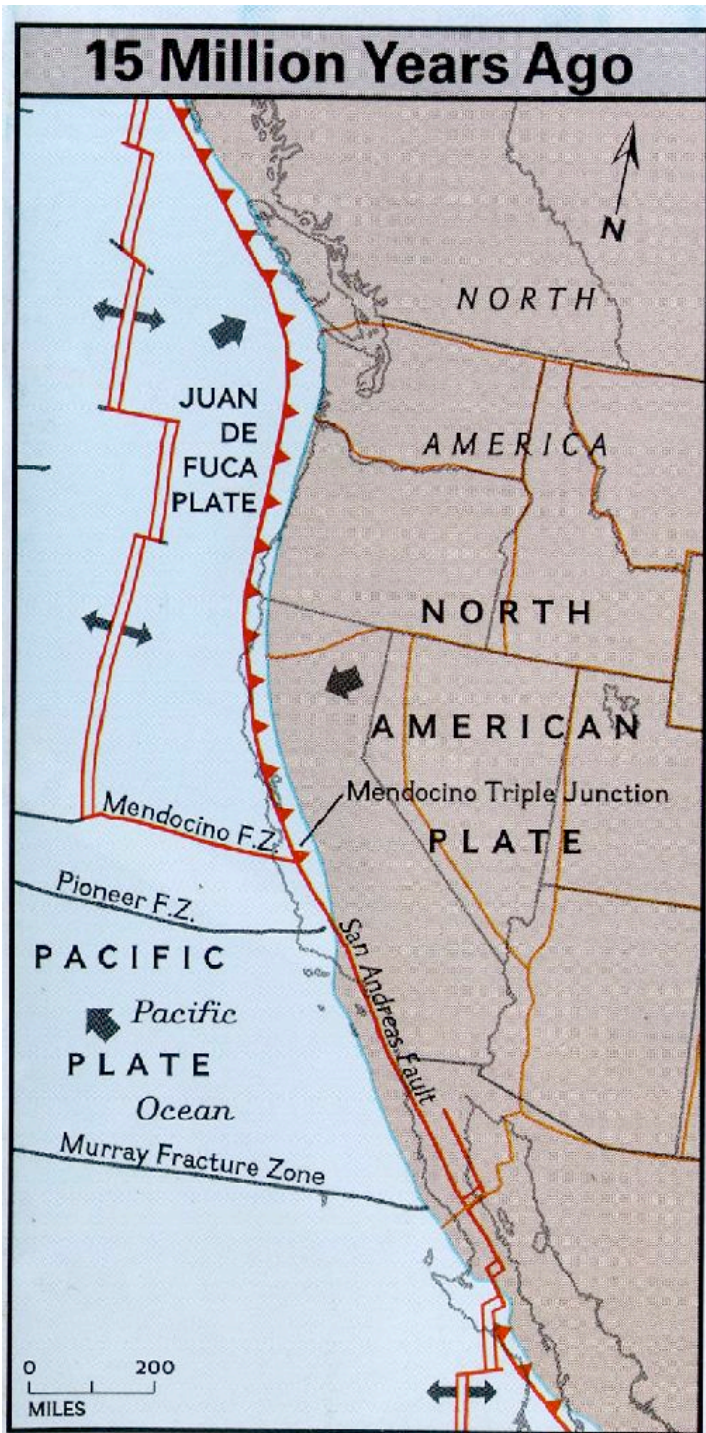
The Farallon Plate becomes much smaller, broken into smaller plates

Little new plate material produced

Laramide Orogeny shut off

Farallon plate begins to sink into the mantle due to cold slab pull (denser, thicker plate).

Asthenosphere rises towards surface, causing San Juan volcanics



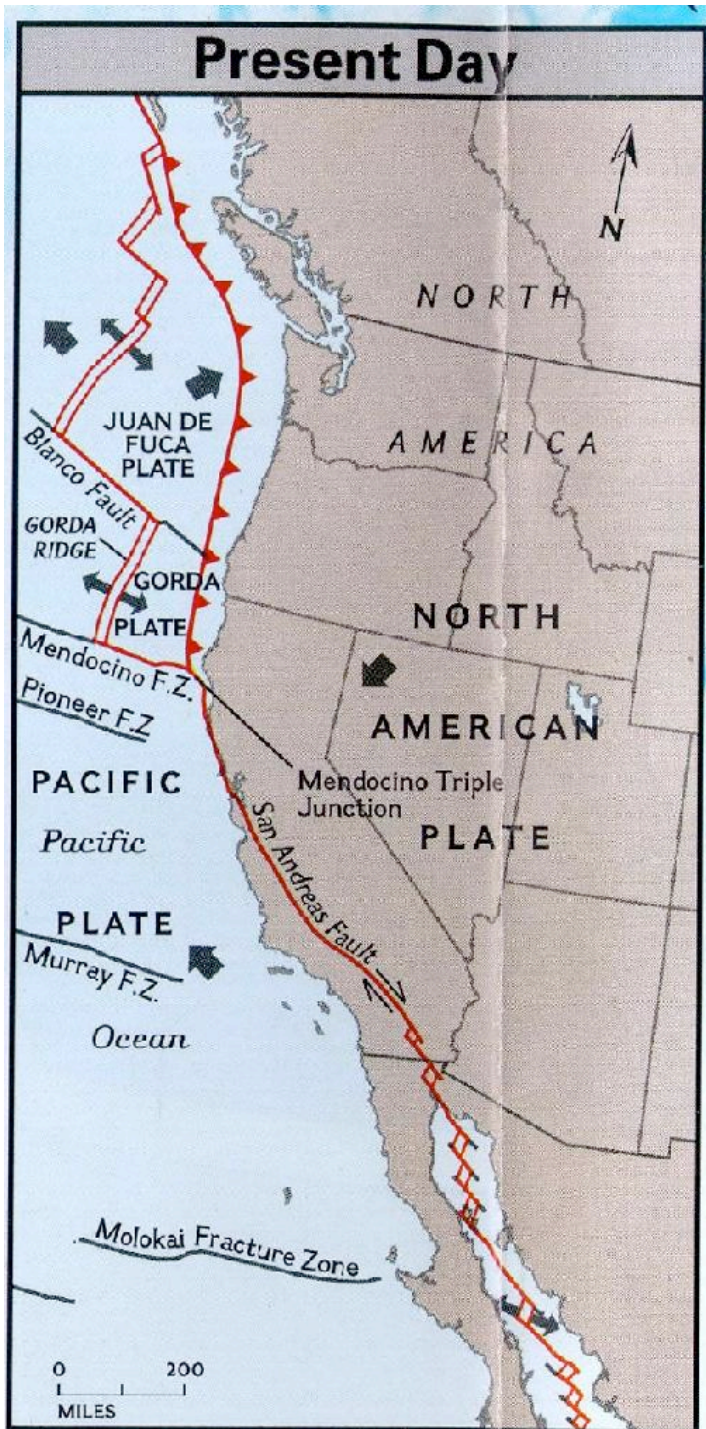
East Pacific Rise almost completely overrun by the North American Plate

The East Pacific Spreading Center becomes the San Andreas Fault around present-day California

The Gulf of California begins to form

The Farallon plate underneath western North American continues to subduct due to cold slab pull, leaving a “thin” spot underneath the Basin and Range province.

Asthenosphere continues to rise to fill void, causing epeirogenic uplift. Doming takes place.



Still a “thin” spot under continental crust of the Basin and Range province caused by subduction of Farallon Plate during Laramide Orogeny

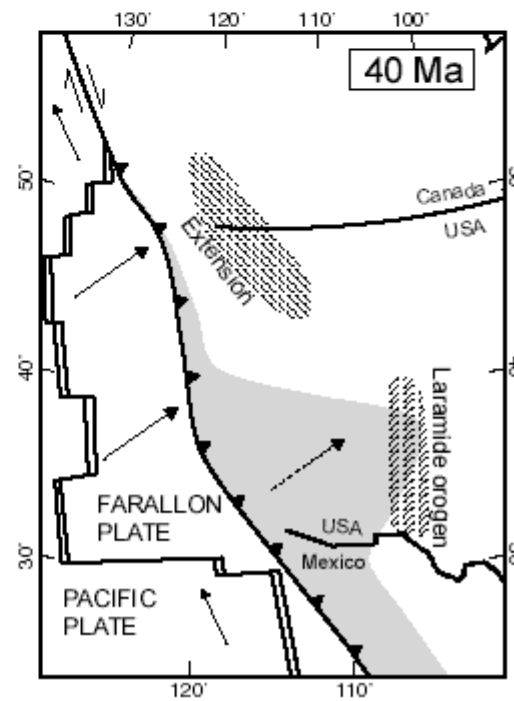
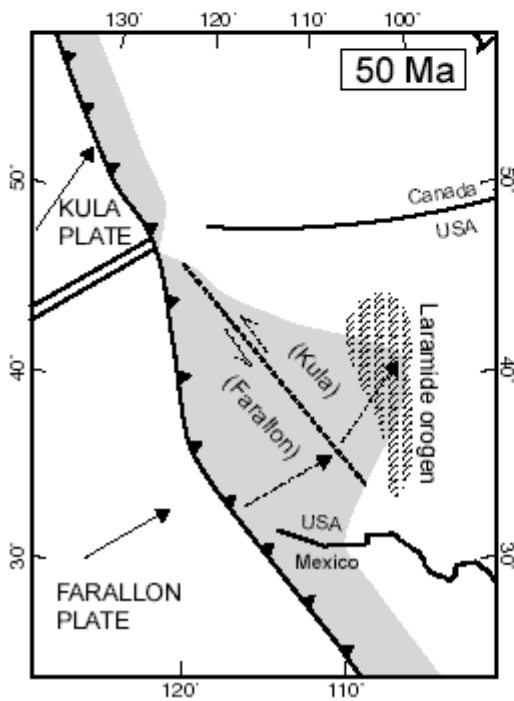
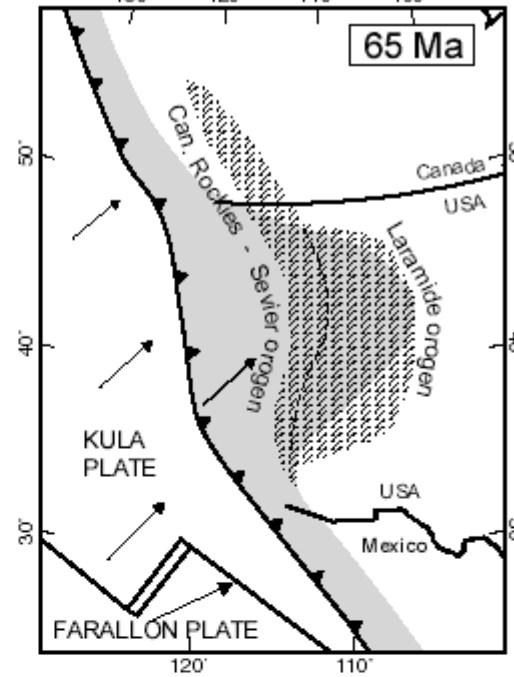
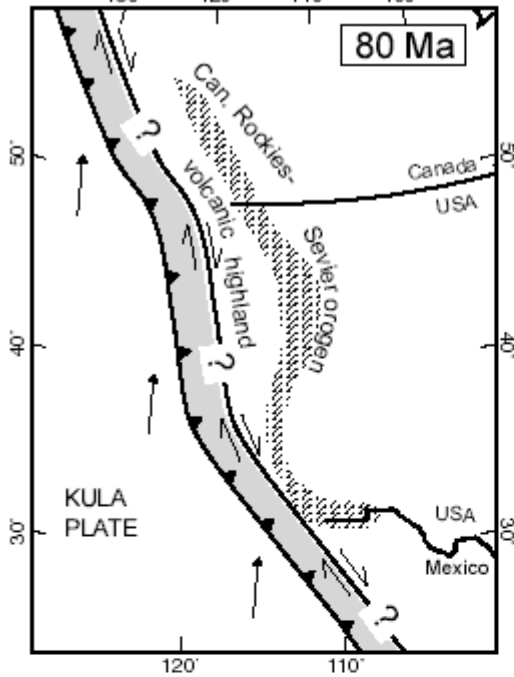
Asthenosphere still rises towards surface to fill that “thin” spot

“Big Dome” in Colorado still growing; Rockies getting taller today

Explains hot springs in Basin and Range

Explains Rio Grande Rift

Gulf of California may “unzip” California



Review of plate movements during Laramide Orogeny

80 Ma: normal high-angle (50 degrees) plate subduction causing Sevier Orogeny

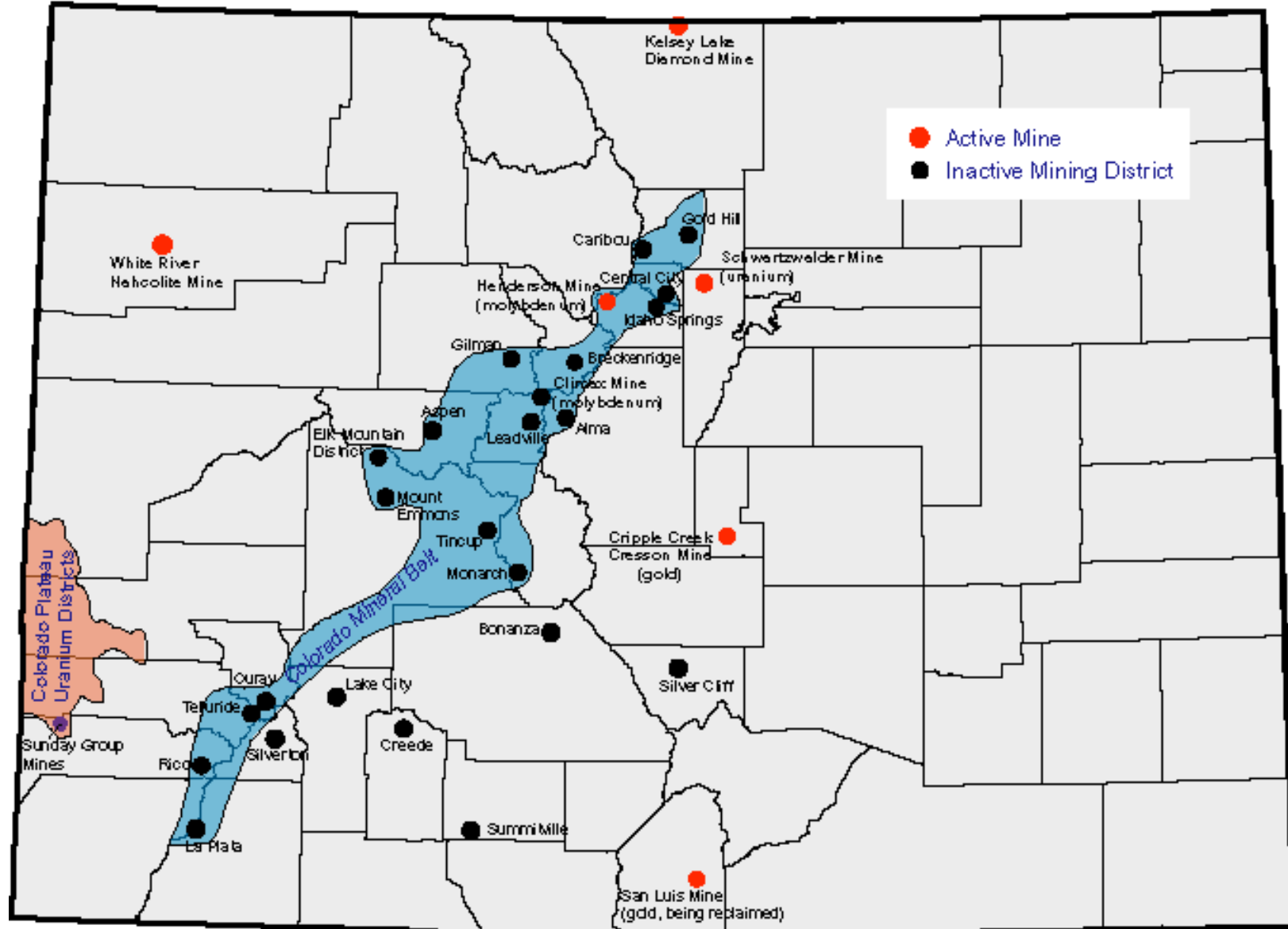
65 Ma: Farallon/Kula plate formed near NA plate, subduction angle decreases. Farallon plate moves horizontally to Colorado

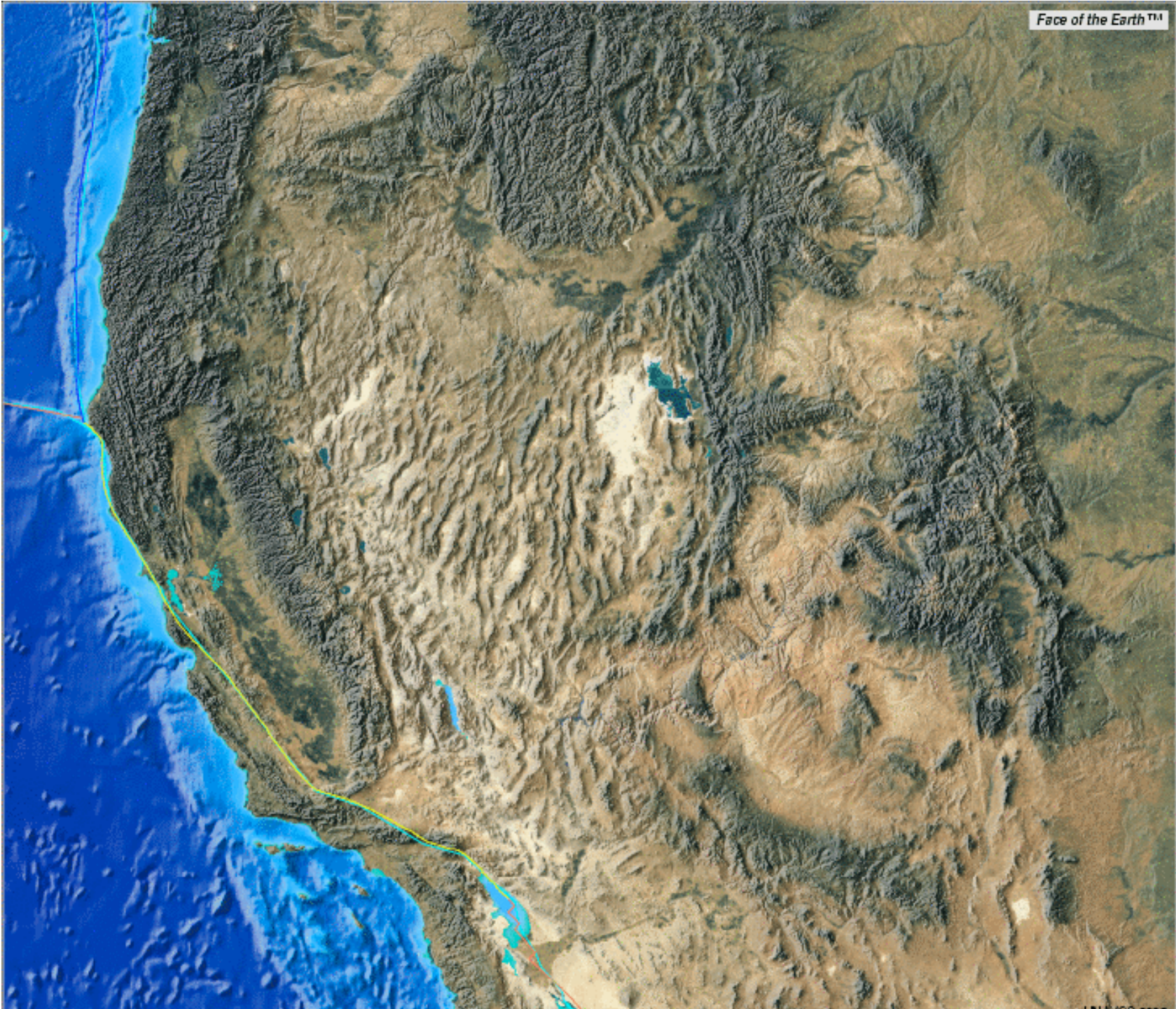
40 Ma: Farallon plate dies

Major Mining Districts of Colorado

(Does not include coal or construction material mines)

Click on location for a description of mining district





- Deformation occurred inland from the plate margin
- Crustal deformation resulting in uplift, arched domes, basins, and large anticlines
- Believed to be the result of subduction of the Farallon Plate beneath North America
- Subduction along entire west coast
Subduction at an angle of ~ 50 degrees
- Volcanic activity 150-200 km from trench
- Angle of subduction decreased, resulting in Farallon Plate moving nearly horizontal beneath
- Plate cools enough to subduct in Colorado, forming the Rocky Mountains