

Geol 104 Lecture 18
Cordilleran Tectonics Review

I. Introduction (**Bring Silly putty to show gravitational collapse**)

- A. The next parks we will look at are Death Valley and Yosemite
- B. To understand these parks we need to review Cordilleran Tectonics: Three main events
 - 1. Sevier Orogeny 165-80 Ma
 - 2. Laramide Orogeny 80-40 Ma
 - 3. Basin and Range extension and San Andreas Faulting (25 Ma to present)

II. Tectonic Events of the Cordillera

- A. Prior to Sevier: Recall the Antler Orogeny (**Image** of subduction – accretion)
 - 1. ~380 Ma Subduction of Laurentia plate produces Antler Arc
 - 2. Reversal of subduction zone (~380 Ma)
 - a. Continental crust stops subduction, reverses ‘polarity’
 - b. Antler Arc is ‘accreted to Laurentia
 - c. New Arc – Klamath Arc begins to build on Laurentia
 - 3. Accreted Terrains (**Image**)
 - a. Klamath Arc is accreted when oceanic islands and microcontinents hit the subduction zone.
 - b. This process is repeated throughout the Paleozoic
 - c. These exotic terrains comprise much of the NA crust west of the Precambrian craton (i.e. much of the Cordillera)

- B. Sevier Orogeny (165-80 Ma) (**image of Sevier**)
 - 1. This is Andean-type subduction forming on the western boundary of North America after break-up of Pangaea
 - 2. Farallon Plate (oceanic plate of the Pacific – no longer exists) begins to subduct beneath NA.

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3. This develops a Continental Arc (e.g. Andes) with the following 'parts'
 - a. Accretionary prism
 - i. Sediment scraped from the subduction slab and eroded from the volcanic mountains
 - ii. This is now the bedrock of the California coastal ranges (**image**)
 - b. Forearc basin – this is now the Great Valley of California (**image**)
 - c. Magmatic-Volcanic Arc
 - i. All that is left is the Sierra Nevada Batholith (**image**)
 - ii. These are the plutons (magma chambers) that formed beneath the volcanoes
 - d. Sevier Fold-Thrust Belt (**image**)
 - i. These are rocks that are 'plowed' up to the east of the arc.
 - ii. These are large thrust faults and associated folds
 - iii. We saw these at Glacier National Park

C. Laramide Orogeny (80-40 Ma) (**image**)

1. Younger Farallon Slab being subducted
 - a. Forces shallow subduction Angle – young buoyant slab.
 - b. Volcanic Arc jumps further east (e.g., Absaroka WY, San Juans CO, Devils Tower)
2. Shallow subduction forces 'thick' Rocky Mountain uplifts
 - a. Re-activated Precambrian faults (were normal in PC – rifting of Rodinia, become reverse during Laramide)
 - Distinctive monocline folds caused by reverse faulting at depth and folding above the fault (**image of monocline**)
 - b. Examples of these uplifts: Rocky Mountain NP, Colorado Plateau

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D. Basin and Range Extension and San Andreas Faulting (25 Ma – present) (**image**)

1. Gravitational Collapse forces the extension
 - a. Thickened crust after Laramide
 - b. Crust spreads under it's own weight
 - i. Think soft cheese under the hot sun, or silly putty
 - ii. Deep in the crust it is hot and the rocks flow like plastic, the overlying shallow, cold, rigid crust breaks.
 - c. This forms the Basin and Range – mountains and intermountain valleys
 - i. Recall the faults on the Western boundary of Colorado Plateau (e.g., Hurricane Fault)
 - ii. Basins – for example Great Salt Lake fills one of these.
2. Form the San Andreas System – Pacific Plate moving north relative to NA plate
 - a. Cessation of Subduction when mid-ocean spreading center is subducted
 - The plate boundary changes from subduction to transform (**Image**)
 - b. Subduction continues today (**image of Western plate boundary**)
 - c. North in the Cascades where the spreading center has not subducted
 - d. South in Mexico
3. San Andreas System:
 - a. It is actually a series of parallel faults (**image of bay area**)
 - mainly in the coastal ranges, some as far east as the eastern boarder of the Sierra Nevada
 - b. displacement across the margin is ~6 cm/yr and a total of ~600 km over it's history.
 - eventually LA will be a suburb of San Francisco
 - c. Bend is the fault produce compression ('restraining bends') and extension ('releasing bends'). **Image of sketch**