Outline 19: The Cenozoic World

Mountain Building
Cenozoic Epochs

- Recent (Holocene)
- Pleistocene
- Pliocene
- Miocene
- Oligocene
- Eocene
- Paleocene

People Eat Only Mario's Pan Pizza, Right?
Cenozoic Mountain Building

Two great orogenies:

1. **Alpine-Himalayan Orogeny**: extends from Europe to Asia, caused by the collisions of Africa and India with Europe and Asia. This closed off the Mesozoic Tethys Seaway. The Mediterranean and Black seas are remnants of the Tethys.
Major Cenozoic orogenic belts
The Alpine orogen
The Alps, Switzerland
The Himalayas: Mt. Everest in the center
The Himalayas: Mt. Everest in the center
Mt. Everest, view from Tibet
Reconstruction of the Himalayan orogeny

(a) Paleocene

(b) Late Eocene
Reconstruction of the Himalayan orogeny
Cenozoic Tectonics or Mountain Building

2. **Laramide Orogeny** of North America: caused by the collision between the Pacific plate and North America. Formed the **Rocky Mountains** and many other features of western North America.
The Tetons of Wyoming. Block Uplift Mountains of the Laramide Orogeny.
My own shot of the Tetons
Orientation of Teton Fault Zone
Physiographic features of the western U.S.
The Grand Canyon of the Colorado River in Arizona: cuts through the Colorado Plateau.
The Grand Canyon of the Colorado River in Arizona: cuts through the Colorado Plateau.
Laramide Orogeny

- The Rocky Mountains are not near the edge of the continent. How did they form from plate collisions? Very rapid subduction of the Pacific Plate caused deformation far to the east underneath North America.
Angle of Subduction affects the extent of orogeny inland.
Figure 12.7a
Creation of Tensional Features

• About 25 MY ago North America overrode the East Pacific Rise. This created tension underneath North America and stretched the crust. This formed the Great Basin and the San Andreas Fault System.
Formation of the San Andreas transform fault
Miocene
Geology of western US

Figure 12.3a
Modified from Cole, Mark R. and John N. Armentrout, “Neogene Paleogeography of the Western United States.” In Cenozoic Paleography of the Western United States, SEPM Pacific Coast Section, Third Paleography Symposium,
Cross-section of the Basin and Range province
Simplified and schematic geologic cross-section of the Basin and Range

Before extension to make the basins and ranges:
- Normal Faults
- Precambrian to Mesozoic Rocks
- Rock lost to erosion

After
- Death Valley
- Great Basin
- Great Salt Lake
- Wasatch & Uinta Mtns
Beneath Yellowstone Park a monstrous plume of hot rock is causing the earth to heave and tremble. Past volcanoes have erupted with a thousand times the power of Mount St. Helens. The future is anybody's guess.
Yellowstone National Park

Sleeping Giant

Below Yellowstone, a hellish column of superheated rock—mostly solid, some viscous, some molten—rises from hundreds of miles within the Earth. Current stirrings may be remnants of a past eruption, or early harbingers of a still far-distant cataclysm.
Yellowstone National Park

Cubic miles of erupted ash and rock

How Far? Some events spread ash thousands of miles. After the biggest eruption, wind carried dust around the globe, and ash piled up in drifts across the western half of the U.S. Near the caldera, lava and debris hardened into layers hundreds of feet thick. For years pollutants chilled the climate, devastating ecosystems.

Area covered by erupted ash and rock

How Big? Monumental. The combined material from the three events would fill the Grand Canyon. The largest ejected enough rock, lava, and ash to bury an area the size of California under more than 20 feet of debris. Even the smallest was 280 times more voluminous than the 1980 eruption of Mount St. Helens.

Comparative Volume of Eruptions

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
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<tbody>
<tr>
<td>1980</td>
<td>67 cubic mi</td>
</tr>
<tr>
<td>1.3 million years ago</td>
<td>240 cubic mi</td>
</tr>
<tr>
<td>640,000 years ago</td>
<td>600 cubic mi</td>
</tr>
<tr>
<td>2.1 million years ago</td>
<td>0.24 cubic mi</td>
</tr>
</tbody>
</table>

0.24 mi in height, 8.43 mi in base, width - 0.24 mi in height, 8.43 mi in base, width
Migration of the Yellowstone Hot Spot
Migrating Hotspot as North America moves over a Mantle Plume

18 to 13.8 million years ago
As the edge of one tectonic plate grinds under another, the plume breaks through, causing eruptions that form vast calderas on the surface.

12.5 to 6.65 million years ago
Plate drift continues, with new blasts occurring northeast of earlier sites. Ashfall causes massive wildlife die-offs hundreds of miles away.

2.1 million years ago to today
The plume drives three huge eruptions, then settles into a calmer phase, powering Yellowstone’s geysers, mud pots, and hot springs.
Key points about Yellowstone Supervolcano

- Giant eruptions at 2.1 MY, 1.3 MY, and 0.64 MY
- That’s about every 650,000 years. So next eruption is about due, perhaps within 10,000 years.
- Could be the largest eruption in recorded human history.
- Would kill millions in USA. Devastate North American ecosystems.