Late Tertiary Volcanism
Mid-Miocene to present

Reading:

DNAG volume G3, Ch. 7

Miocene to Present

High Cascade Range

Columbia River Plateau

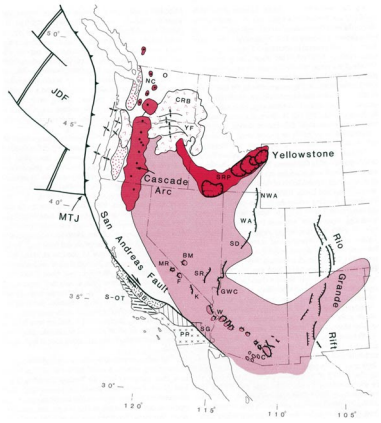
Snake River Plain

Basin and Range

Southwestern California

Sierra Madre

Trans Mexican Volcanic Belt



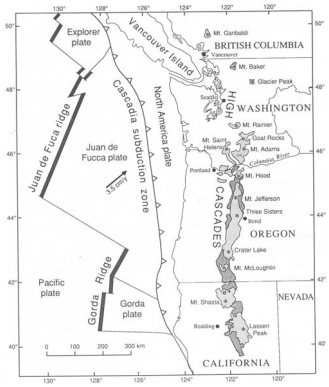
High Cascades

Volcanic centers define High Cascades

Active volcanoes extend from northern California to southern British Columbia

Distribution of volcanoes related to segmented arc

Different dips and seismicity



North Washington

Individual andesitic volcanoes and intrusive systems with regular spacing between Mt. Garibaldi, Mt. Baker, & Glacier Peak

NW trending alignment perpendicular to subduction

Between Glacier Peak and Mount St. Helens there is a nearly right angle change in direction

Southern Washington

- Subduction here is steeper
- Additional numerous short-lived volcanic systems
  - Mafic andesite and basaltic shields
- Tectonic system changes southerly
  - Uplift and contraction in the north
  - Extension within and adjacent to the arc in the south

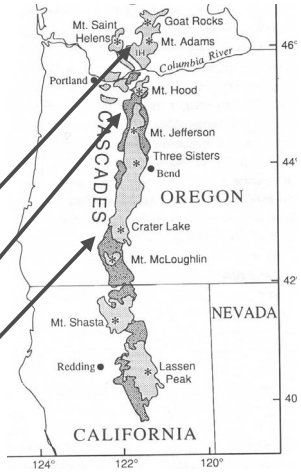
Other Andesite Volcanoes

Located at spacings of 60 to 130 km in this zone

Mount Rainier, Goat Rocks, Mount St. Helens,

Mount Adams, Mount Hood, Mount Jefferson,

Three Sisters, Crater Lake, Mount McLaughlin, Mount Shasta, Mount Lassen

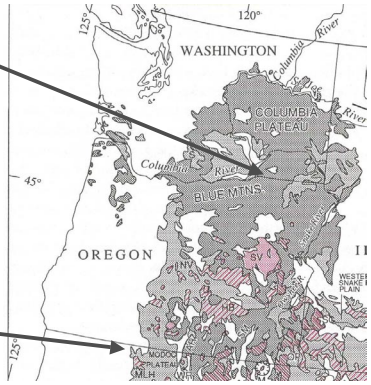


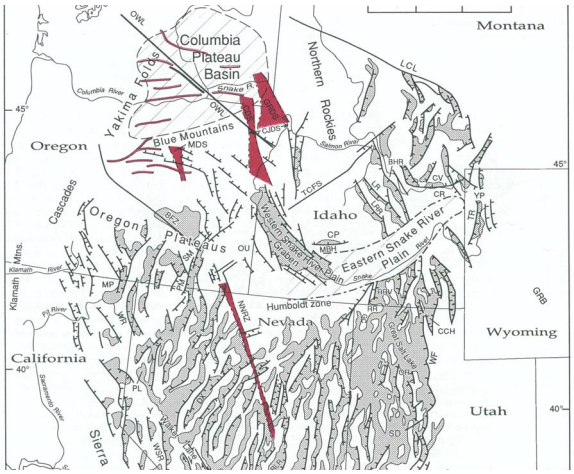
Columbia Intermontane Area

Columbia Plateau tholeiitic flood basalts

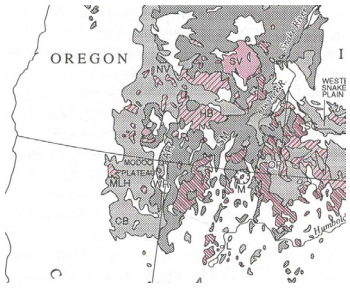
Extreme extrusion rate of 2 x 10^5 km^3 between 17 to 15 Ma

Isolated small volcanic fields e.g. Modoc Plateau





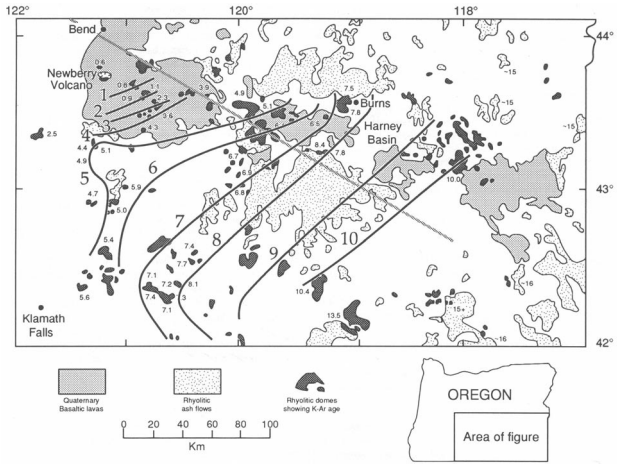
Southwest Oregon



Eastward decreasing ages

Bimodal (basalt-rhyolite) compositions

Domes and lavas



South Rocky Mountains, Rio Grande, Mojave

Mainly basaltic magmatism

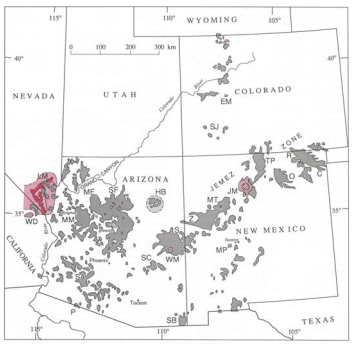
Scoria cones and lava flows

Central volcanoes

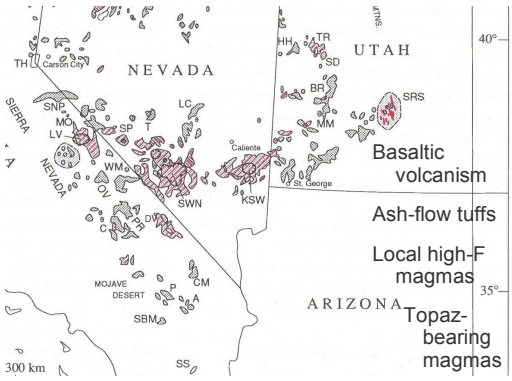
San Francisco Peaks, White Mountains, Mount Taylor

Calderas - Valles Caldera

Diatremes - Hopi Buttes

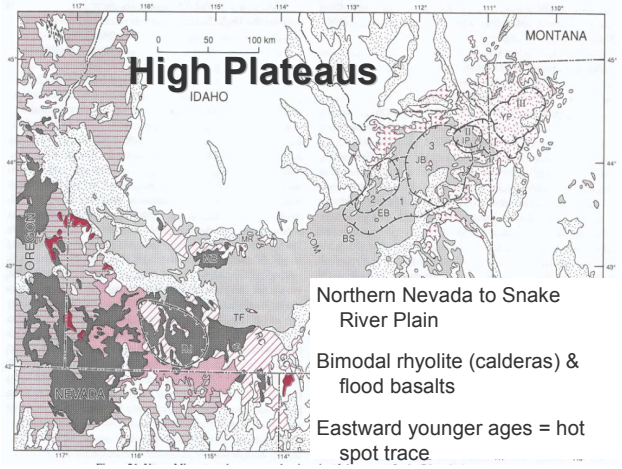


Sierra to Wasatch Range



Drastic Change in Tectonic Pattern

- Occurred in mid-Miocene (18 to 10 Ma)
- Earlier extension related to degrading of Laramide highlands
- Formed depositional or volcanic plains
- Later extension related to regional linear block faulting
- Features are manifest in present day morphology

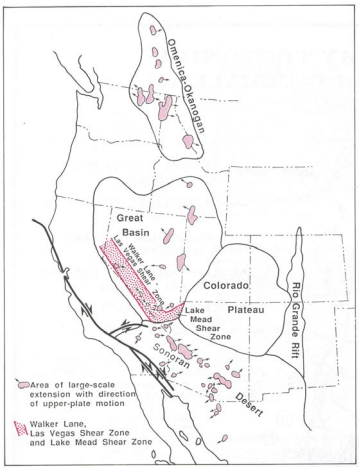


Late Cenozoic Extension and Uplift

- **Southern Rocky Mountains and Rio Grande-Mojave region**
- **Salton Trough**
- **Sierra-Wasatch high plateaus region**
- **Columbia intermontane region and northern Rocky Mountains**
  - **Mid-Miocene Columbia volcanic episode**
  - **Later Miocene to Quaternary volcanism of the Columbia and Oregon Plateaus**

Tectonic Extension

- Entire region broadly uplifted in mid-Miocene
- Colorado Plateau
- Great Basin



Rocky Mountains and Great Plains Uplifted

- Late Cenozoic uplift of Rocky Mountains
- Fixed position of present continental divide
- Much of earlier basin deposits removed and redeposited
  - Ogallala Fm of great plains of eastern Colorado
- Northern Rockies
  - Continuous with Canadian Rockies
    - Undergone little late Cenozoic tectonism

Rocky Mountains and Great Plains Uplifted

- Middle and southern Rockies
  - Undergone Basin and Range faulting
  - Deeper erosion
- Highest elevations are in the southern Rockies
- Epeirogenic uplift

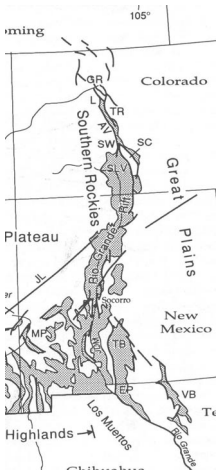
Rio Grande Rift System

Early rift system

- **Developed in late Oligocene (30 Ma)**
- **Followed zone of Laramide uplifts**
- **Reflects Basin and Range extension**

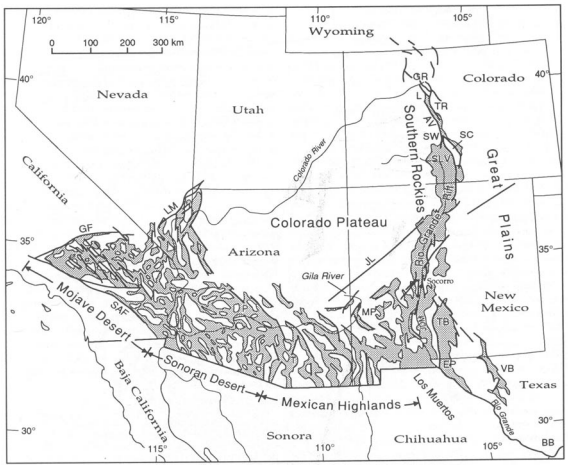
Later faulting

- **Along zone of grabens and half grabens**
- **Related to regional uplift**
- **Broad integrated system of widely distributed extension**



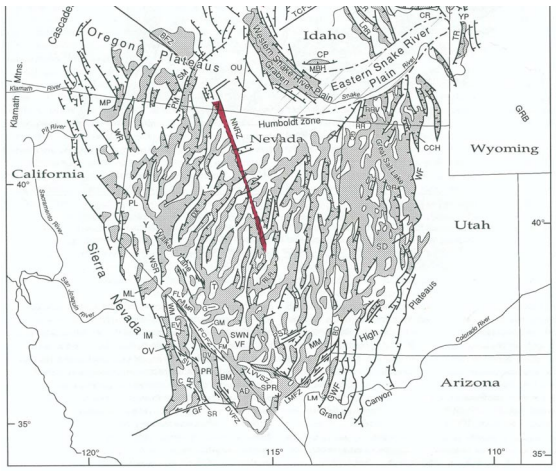
Gila-Sonora-Mojave

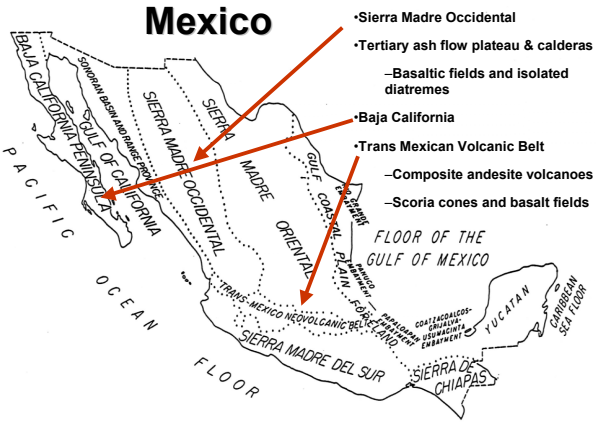
- Southern Basin and Range & Mogollon Plateau
- Regional Basin and Range extension and block faulting (12 Ma to present)
- Widespread extension and basin formation
- Mafic to intermediate calc-alkaline volcanism



Sierra-Wasatch

- Mid-Miocene was a period of transition (21 to 14 Ma)
- Widespread welded ash-flow sheets
  - Broken by late Miocene and younger faults
- Distributed extension
  - Broad subsiding basins
  - Some rotational fault blocks
- Local mafic to intermediate volcanism
- Parallel linear fault block ranges
  - Began to form 14 to 10 Ma





Summary:

- Laramide paleogeography and physiography
- Post-Laramide, Eocene to mid-Miocene (55 to 21 Ma)
- Mid-Miocene to Quaternary (14 to 0 Ma)