Laramide Orogeny:
Late Cretaceous to Early Eocene

Reading:
GSA DNAG volume 3, Ch. 6

Topics
• Late Cretaceous to early Eocene
• New patterns developed
• 5 main regions
• Tectonic interpretations
• Post-Laramide events

Prior Andean Style
Continental Margin
• Eastern fold and thrust belt
  – Adjacent foreland basin
• Central magmatic arc system
  – Flanking fore-arc and back-arc basins
• Accretionary complexes
  – Shifting terrains along the coast

Pre-Laramide Configuration
• Fold and thrust belt
• Magmatic arc
• Accretionary complexes

New Laramide Patterns
• Uplifted thrust-blocks on craton
  – Localized sedimentation
  – Thick sedimentary accumulation
• Local thin-skinned foreland thrusting to the west
• Prior zones of magmatism in the central region cooled
  – Uplift and erosion

Laramide Elements
Rocky Mountain foreland
Fold and thrust belt
Magmatic arc
Pacific margin
Changing Zones of Magmatism

- Magmatism spread eastward
- To the south:
  - Southern California and Arizona
- To the north:
  - Idaho and Montana

Main Regions

- Rocky Mountain foreland
- Cordilleran fold & thrust belt
- Sonoran and Mojave Deserts
- Magmatic arc
- Pacific margin

Rocky Mountain Foreland

- Thick-skinned deformation
- Basin sedimentation
- Local magmatism

Changing Magmatic Patterns

- Idaho/Montana
- Mohave/Arizona
- Colorado
- Mineral Belt

Thick-Skinned Deformation

- East of miogeoclinal wedge and hinge line
- Thin sedimentary cover
- Pre-fractured anisotropic cratonic basement
- Deformation localized along zones of prior weakness
- Deep-seated thrust faults
**Thick-skinned Deformation**

- Basins bounded by medium-angle reverse faults
- Uplifts ramped
- Sedimentary decollement features
- Bounded by conjugate thrust faults opposite uplift
- Floating basement wedges

**Other Features**

- East-west faults imply oblique or strike-slip component
- Uinta Mts, Utah (11)

**Thick-skinned Mechanism**

- Basement cored uplift is due to middle or lower crust decoupling
- Mantle is not deformed beneath uplifts
- Laramide anticlines are probably located above similar deep uplifts
- Anticlines of the Williston Basin, edge of Black Hills

**Cordilleran Fold and Thrust Belt**

- Frontal thrust belt on the east
  - Thin-skinned thrusts
  - Localized by hinge line between miogeocline and craton
- Hinterland on the west
  - Thrust faults located deep in miogeoclinal sediments
  - Also in craton

**Cordilleran Fold and Thrust Belt**

- Cooling of western metamorphic belt during late Cretaceous
- Widespread Eocene volcanism accompanied deformation
  - Challis volcanics
  - Sanpoil volcanics

**Magmatic Arc**

- Central section weakly magmatic
- Main zones shifted
  - South into California and Arizona
  - North into Idaho and Montana
Local Magmatism

- SW Montana/NW Wyoming
  - Pioneer Batholith
  - Elkhorn and Adel Volcanic Fields
- Colorado Mineral Belt
  - Hypabyssal rocks
  - Monzonite to syenite
- SE Arizona and SW New Mexico
  - Calc-alkaline plutons and volcanics

Core of the Cascade Range

- Granitoid plutons (75-60 Ma)
- Tonalite to Granodiorite
- Some foliated to orthogneiss
- Dextral slip

Central Zone Volcanism

- Andesite volcanoes
- Older group (70-60 Ma)
- Younger group (54-44 Ma), similar to Eocene volcanism of the Challis and Absaraka volcanics to the north

Colorado Mineral Belt

- Hypabyssal intrusions (70-50 Ma)
- Monzonite, granodiorite, syenite
- Associated ore deposits
  - Mo, Sn, W, U, Th, (Au, Ag)

Sonoran and Mojave Desert Regions

- Plutonism and metamorphism
- Calc-Alkaline composition
- Biotite and two-mica granitoids
- Porphyry copper deposits
  - Cu, Pb, Zn, (Au, Ag)
- Ductile flexure of crustal blocks
**Tectonic Interpretations**

- Relatively rapid convergence
- Shallow angle of subduction
- Buoyancy of near horizontal slab
  - Caused upward forces

**Tectonic Pattern**

- Andean type continental margin
- Magmatic arc system
- Continuous subduction of the Farralon Plate
Local zones of metamorphism within the fold and thrust belt.

Pacific Plate Margin
- Fore-arc basins
- Strike-slip sedimentary basins
- Accretionary tectonic slices

Late Cretaceous Margin
- Basins
- Allochthonous terranes
- Magmatic Arcs
- Metamorphic terranes

Paleocene-Eocene Basins
- Puget Sound
- Olympic Mountains
- North Cascades
- Blue Mountains
- Klamath Mountains
- Franciscan Fm.
- Great Valley
- Southern California
Paleogeography
Late Cretaceous
- Okanogan Highlands
- Klamath uplands
- Franciscan Terrane
- Great Valley Foreland
- Salinian Terrane
- Transverse Ranges
- Peninsular Ranges

Paleogeography
Paleocene-Eocene
- Extinct magmatic arc
- Olympic Peninsula
- Clarno Basin
- Tyee forearc basin
- Salinian Terrane
- Sur-Obispo Terrane
- Transverse Ranges
- California Borderland

Post-Laramide Events
- Major zones of extension
- Normal faulting overprint
- Thick calc-alkaline volcanic sections
- Localized sedimentary basins
- Major strike-slip faulting