Chapter 20: Mountain Belts and the Continental Crust
Major Mountain Belts:
*Composed of Mountain Ranges
*North America: Cordillera, Appalachian

Cordillera (Orogeny) Mountain Ranges in CA:
1. Transverse Ranges
2. Coast Ranges
3. Sierra Nevada
4. Cascades (extend into WA, OR)

World Mountain Belts: Alps, Andes, Caledonia, Himalayas, Urals

Ages of Mountain Belts vs Continents
Mountain Belts ----> Stable Platform ----> Craton
(young) (old-contain basement rock)

Basement Rock Exposed in the US:
1. Grand Canyon - AZ
2. Ozark Dome- Missouri
3. Black Hills - South Dakota
4. Several Ranges in the Rockies
5. Adirondacks - NY

The basement rock is the oldest exposed on a continent.

Craton - Structurally stable (core of the continent)
*most of the craton is covered by a third blanket of sediment
>Portion that's not: Precambrian Shield - crystallize rock, very old root of oldest mountains.
>Most of the craton is over a billion years old.

Characteristics of Mountain Belts
1. Thickness and Characteristics of Rock Layers

Craton	vs	Mountain Belt
Thin sediment cover seds may show no deformation (Domes/Basins)		Think sediment sequences Intense deformation with folds and faults. Seds are of marine origin usually, also have volcanics and other igneous

2. Patterns of folding and faulting associated with mountains.
Overturned
Tighter folds indicate greater stress
Recumbent

3. Fold and Thrust Belt-reverse faults (compressional) at a low angle
Detachment Fault-lowermost in fault
*Common in mountain belts, and suggest crustal shortening and crustal thickening
(Alps originally over 500 km, now 200 km)

4. Other Characteristics

a. Metamorphism and Plutonism-and mix (migmatites)
b. Normal Faulting-from extension (stretching)
c. Thickness and Density of Rocks
d. Other Features and Active Mountain Ranges
(Earthquakes and Volcanoes)

Evolution of a Mountain Belt
Three Stages:
1. Accumulation
2. Orogenic
3. Uplift / Block Fault

<u>The Accumulation Stage</u>
* Includes the accumulation of a great thickness of sediment (source for sediment must be a nearby landmass)

a. Accumulation in an opening ocean basin
(Passive Continental Margin) - Like the Eastern US
* Accumulation of Shales, Limestones and Qtz sandstones
(from continental shelf, slope and abyssal plain)

b. Accumulation along a Convergent Boundary - Active Margin, like here
* Volcanic Rocks and Sedimentary rocks: Shales, Sandstones

Sandstones are graywackes - dirty, include volcanic rock fragments
* Source is thus a magmatic arc - all rock types weather
* If an island arc, may have deposition on either side of the arc

The Orogenic Stage

* Follows or is contemporaneous with the accumulation stage

Orogeny - episode of intense deformation of the rocks in a region, usually accompanied by metamorphism and igneous activity

* Reverse faulting is common, Normal Faulting, more rare
* Magma migration - intrusive and extrusive results
* Regional Metamorphism

Orogenies and Ocean-Continental Convergence (magmatic arc)

Gravitational Collapse and Spreading Take Place

* Central part of the mountain becomes too high and gravitationally unstable.

Explains:

1. Fold + Thrust Belts
2. Simultaneous Normal Faulting
3. How once deep-seated Metamorphic Rocks rise to an upper level in a mountain belt.

Arc-Continent Convergence

* Eventually the arc collides with the continent
* Arc is too buoyant to be subducted
* Subduction zone will change direction

(Flipping Subduction Zones)

Continent-Continent Convergence

* Mountain belts found within continents (with cratons on either side)

Examples: Urals, Himalayas

Himalayas - began 45 MYA

Tibetan Plateau has normal faults: gravitational collapse

Appalachian Mountain History

1. starts with Arc-Continent
2. Continent-Continent Convergence
3. Divergence

Cycle of Splitting of a Supercontinent,opening of an ocean basin followed by closing of the basin and collision of continent is known as the Wilson cycle.

Wilson cycle have occurred before and will continue to occurs.

Why would Appalachian actually split in its center,near the suture zone?

The Uplift and Block Faulting Stage

*After plate convergence stops and the compressive force of the orogeny is relaxed, there is a long period of uplift accompanied by erosion.

*Appalachians are in this stage-eventually will be eroded down and become part of the craton.

Significant Attributes of Uplift and Block Faulting

1) Isostacy - contributes most recent uplift
(called isostatic adjustment)
The craton is in equilibrium, but the mountains float higher. As material is eroded off the mountain, the crust (of that mountain adjusts. The adjustment is not instantaneous-there is a time lag.
Relationship between crustal thickness and altitude above sealevel:
Tibetan Plateau: 75 km thick
Kansas: 44 km
Denver: 50 km

Discrepancies are attributed to density differences in the mantle. LESS DENSE-RIDE HIGHER

2) Normal Faulting
*implies horizontal extension, or regional pulling apart of the crust
Results in Fault Block Mountains - Sierra Nevada, Teton Range
*Isolated volcanic activity may be associated with this stage. (Cinder cores of Sierra Area)

Taking Place on most of the western US - Great Basin, NV Utah, AZ, NM, Idaho, CA

3. Delamination or Lithosphere Delamination - The detachment of part of the mantle portion of the lithosphere beneath a mountain belt.
* Great Basin was 3km higher than present (from fossils)
* Helps explain why PANGEA broke up
* Hypothesis that builds on the theory of Tectonics

The Growth of Continents

* If we Isotopically date rocks starting from the shield working east and west, we should find the rocks to be progressively younger.
However, there are exceptions: Suspect and Exotic Terranes

Terrane or Tectonostratigraphic Terrane - regions within which there is geologic continuity.
*geology from one terrane is very different from another
*Boundaries are usually faults

Suspect Terranes - did not form at its present location

1. Accreted Terrane - did not form at its present location, traveled a short distance

2. Exotic Terrane - traveled a great distance to get accreted.

*These types of terranes typically contain rocks and fossils not common, or unusual for their new location.
*Wrangellia Terrane
*Paleomagnetism data helps plot its course

Microcontinents - like New Zealand - old Island arc that may be accreted onto a continent.

<u>Our Pal, the SAF</u>
If SAF remains active:
20 MY near S.F., 25 MY will pass
100 MY will be accreted onto Alaska

Not all geologists agree on the nature of terranes
Sometimes, a very complicated history is involved:
*Alaska - many exotic terranes

Science present builds on science past.
(The Principle of Uniformity)