Grand Canyon National Park, AZ

Physical Geography

- The Great Shapers
  - –Plate Tectonics ("continental drift")
  - – Uplift and erosion
  - –The Ice Ages
- A Recap on Climate
- A Primer on Soil

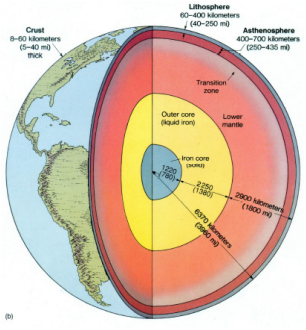
Big Ideas

- A contested continent
- Population growth and movements, old and new
- Increasing human diversity
- Technological innovation
- Urban growth and sprawl
- Resource use and misuse
- Industrialization and de-industrialization
- Movers & shapers: Plate tectonics & the Ice Ages
- Water for movement and well-being
- Lots of latitude – the Tropics to the Arctic
- A physical environment under assault.

Alfred Wegener (1880-1930)

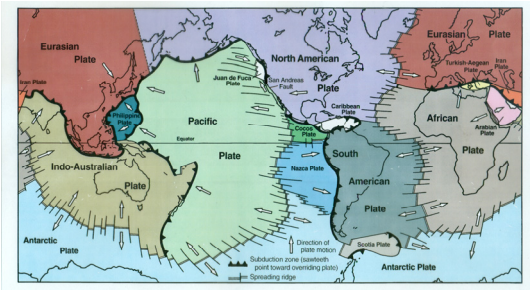
A German physical scientist

- Interested in locations of continents over time.
- Wrote (1912) *"Die Verschiebung der Kontinente"*
- *Verschriebung* = shift, displacement.
- Mistranslated as "Continental Drift"



Earth's interior is extremely hot and exerts great pressure on the lithosphere, causing it to crack and break up into large units called *plates*.

Locations of the Earth's Plates
and their directions of movement



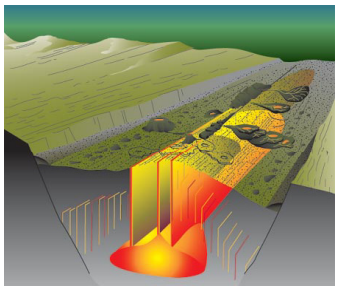
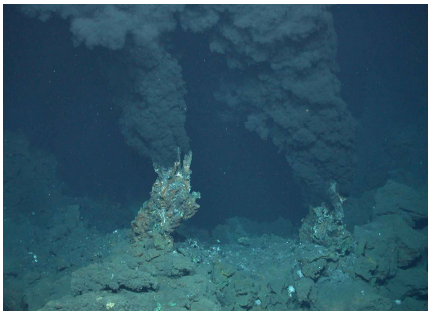


Diagram of *magma* (molten rock) extruding onto the ocean floor at the Mid Atlantic Ridge, causing the ocean to widen.

Actual photos of magma vents on the Mid-Atlantic Ridge



<u>Plate tectonics</u> is the theory that the Earth's outer hardened lithosphere is broken into very large units called *plates*, which move relative to each other, resulting in mountain building, earthquakes, and volcanoes.

["Tectonics" comes from the Greek word *tektonikos,* roughly meaning "of a builder."]

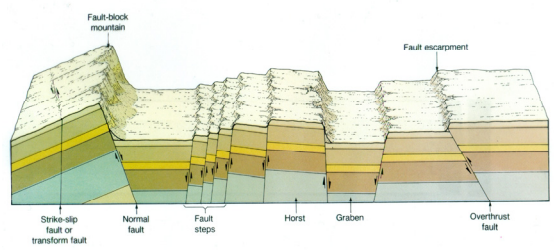
Mountains are built in three ways:
Faulting
Folding
Volcanism

The North American plate is moving toward the west. As a result . . .

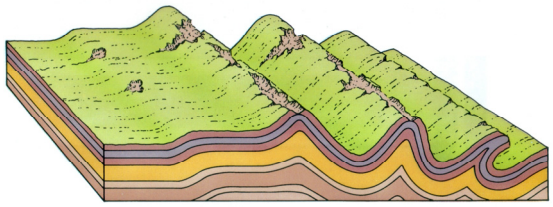
- Western North America is younger and more "built up." The East is older and more worn down.
- Earthquakes are much more common in the west.
- Volcanoes are exclusively western phenomena.
- The western coast has little or no coastal plain. The eastern coast has extensive coastal plain.
- The western coast exhibits relatively few coastal marshes, swamps and barrier islands, while the eastern coast has a good supply of each.
- The western coast has fewer inlets and estuaries (safe, natural anchorages) than the eastern coast.
- [But that's now. Things were different farther back in time, as suggested by the Appalachians.]

Grand Teton National Park, Wyoming

Block mountains and Associated Faults



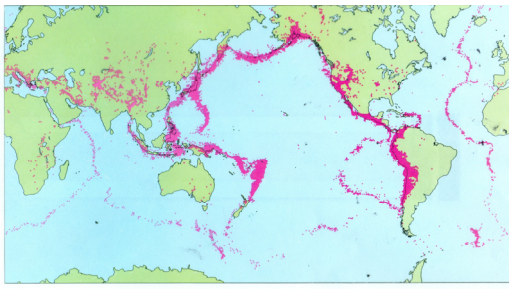
In folding, lateral tectonic forces cause the outer layers of the lithosphere to compress and form a wave-like surface ("folded mountains).



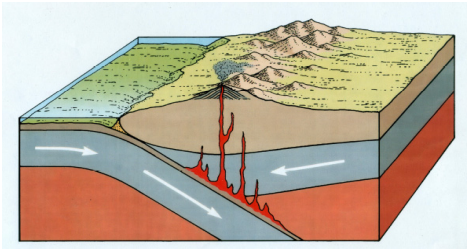
Fall in the Southern Appalachians

Geography of Earthquakes

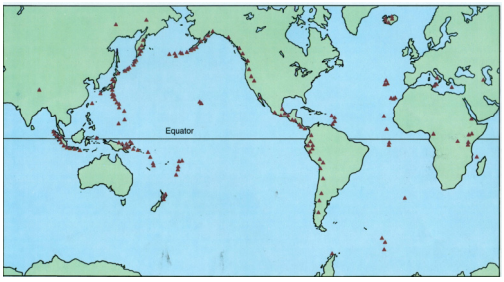
(Purple dots shows epicenters of major quakes.)



Subduction: a tectonic process in which one plate is overridden by another



Locations of historically recent volcanic activity



Mt. Saint Helens, WA (1980)

Mt. Shasta, northern CA

Crater Lake National Park, OR

Coastline of Northeastern U.S.

Port of Charleston, SC

Texas

Houston, Texas

SAN DIEGO

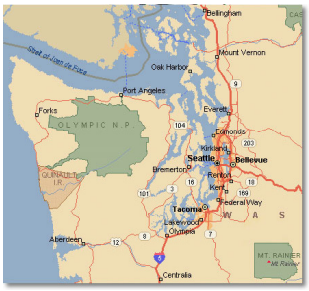
Port Of Los Angeles/Long Beach

Site of San Francisco, CA

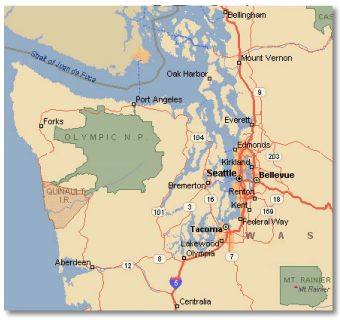
Golden Gate Bridge, San Francisco

Portland, Oregon
Port facilities

Reconstruction of a large Dutch Sailing vessel from the time of the American Colonial period



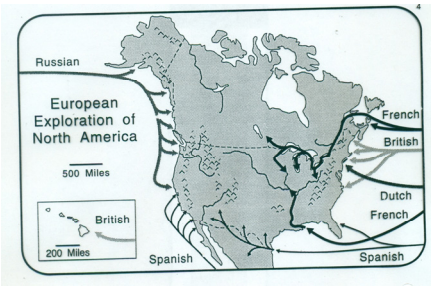
Puget Sound and Greater Seattle



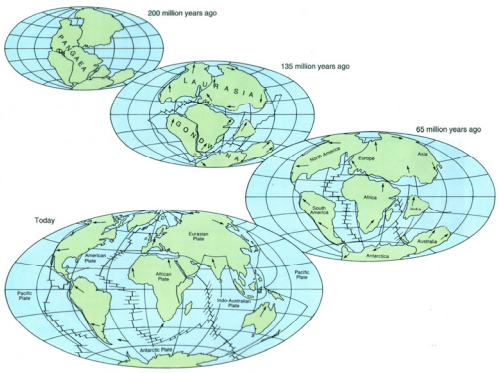
Port of Seattle

Big Sur coastline, California

- A rugged, mountain-fringed coastal area south of Monterrey.
- Called "El pais grande del sur" by the Spanish. ("The big land to the south" – of Monterrey.)
- Anglicized as Big Sur.



(Cartography by Phil Gersmehl)



Ice age **refers to periods in the past when large portions of Earth's surface were covered by continental glaciers.**

Recent research suggests ice ages come and go in intervals of about 100,00 years.

But what is a glacier? And what causes an ice age to occur?

A GLACIER is a large naturally occurring mass of ice on land that moves in response to gravity. There are two types:

Alpine glaciers originate on mountainsides and flow downhill. They tend to be relatively small.

Continental glaciers originate on fairly flat expanses and tend to be comparatively large. (Indeed, they aren't called *continental* for nothing!)

Medial moraine
indicated by red arrows

Moraine is an accumulation of earth (soil) and stones that is eroded, carried, and finally deposited by a glacier.

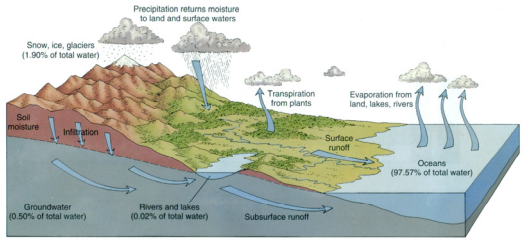
Extent of Continental Ice Sheet in North America about 18,000 years ago

A portion of the Greenland Ice Sheet

How to build a glacier

- **More snow falls in winter than melts in summer.**
- **This repeats for several years, creating an ever-increasing surplus of snow.**
- **Eventually, the snow will compact under its own weight and form ice.**
- **The longer the above continues, the thicker the ice becomes.**
- **Once the ice starts to move in response to gravity it officially becomes a glacier.**
- **[All of this has much to do with "the water cycle."]**

The Water Cycle

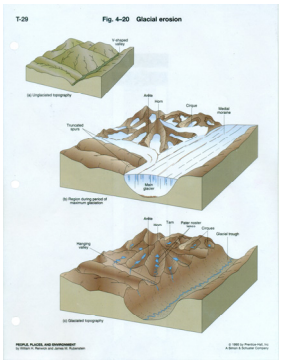


The Hydrological Cycle

- **The continuous cyclical movement of water in all its forms (liquid, vapor, solid) on, above and below Earth's surface.**
- **Key stages of the cycle include evaporation, condensation, precipitation, infiltration and runoff.**
- **Sea level rise and fall over time is inversely related to the amount of ice on Earth's surface.**
- **That is, the greater the amount of ice on land, the lower the sea level, and vice versa.**

How can glaciers transform a landscape?

- By crushing rock and making soil.
- By moving the soil somewhere else.
- By creating landforms that are products of erosion (removal of earth and rock material).
- By creating landforms that are products of deposition (the laying down/accumulation of earth and rock material that was previously eroded elsewhere.



A Glacially Carved U-shaped Valley

Glacial grooves in Central Park

The Finger Lakes, Upstate New York

Half Dome, Yosemite National Park, CA

- A granitic structure that towers above Yosemite Valley
- A glacier sheered away half of the dome during the last Ice, creating a north-facing cliff (“face”)
- The North Face logo

Half Dome, Yosemite Nat’l. Park, CA

A fjord is a narrow inlet of the sea between cliffs or steep slopes created by glacial erosion.

A fjorded coast is a coastal area characterized by numerous fjords, making overland travel along the length of the coast tedious or impossible. Examples in North America:

- The Alaskan panhandle
- The coast of British Columbia
- The western coast of Vancouver Island
- Newfoundland and Labrador

The nature of fjorded coasts explains the lack of roads only the coasts on the previous list, and why Juneau, Alaska, is the only U.S. state capital that cannot be reached by car.

Similar fjorded coasts are found in:

- Norway
- Greenland
- Iceland
- New Zealand
- Chile
- And elsewhere

Alaskan fjord

Glacial Outwash Landscape