Chapter 7: Plate Tectonics

I. Continental-drift

A. Alfred Wegener

1. First proposed hypothesis, 1915

2. Published The Origin of Continents and Oceans

B. Wegener's continental drift hypothesis

1. Supercontinent called Pangaea began breaking apart about 200 million years ago

2. Continents "drifted" to present positions

3. Continents "broke" through the ocean crust

4. Evidence used by Wegener

a. Fit of South America and Africa

b. Fossils

c. Rock structures

Glacial Deposits

d. Ancient climates

5. Main objection to Wegener's proposal was its inability to provide a mechanism for the movement of [redacted] continents

II. Plate tectonics

A. More encompassing than continental drift

B. Associated with Earth's rigid outer shell

1940s - World War II
Harry Hess - Officer on a Navy Destroyer
Fathometer - depth gauge using sound
Long Mountain chain ran down the middle of the Atlantic Ocean - Mid Atlantic Ridge

1. Called the lithosphere

2. Consists of about 20 slabs (plates)

a. Plates are moving slowly

b. Largest plate is the Pacific plate

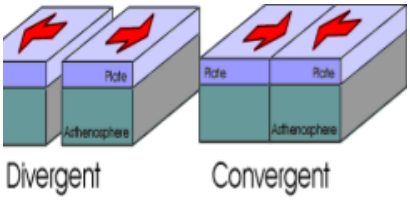
c. Plates are mostly beneath the ocean

C. Asthenosphere

1. Exists beneath the lithosphere
2. Hotter and weaker than lithosphere
3. Allows for motion of lithosphere

D. Plate boundaries

1. Associated with plate boundaries
   a. Seismic activity Earthquakes
   b. Volcanism
   c. Mountain building
2. Types of plate boundaries
   a. Divergent (spreading) boundary Mid Atlantic Ridge



1. Most exist along oceanic ridge crests
2. Seafloor spreading occurs along the boundary
   a. Forms fractures (openings) on the ridge crests
   b. Fractures fill with molten material
3. When the boundary occurs on a continent, rifts or rift valleys form Great Rift Valley - Africa

Convergent boundary

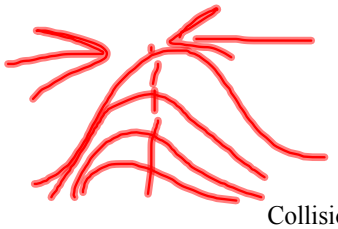
1. Lithosphere is subducted into the mantle
2. Types of convergent boundaries
   a. Oceanic-continental boundary
      1. Forms a subduction zone with a deep-ocean trench
      2. Volcanic arcs form Mountain Ranges
         a. e.g., Andes
         b. e.g., Cascades
         c. e.g., Sierra Nevada system

<u>Continental Crust</u>
Silica Rich Lower in Density
Mostly Granite
Lower Melting Temperature

<u>Oceanic Crust</u>
Fe and Mg Rich Higher Density
Mostly Basalt
Higher Melting Temp

b. Oceanic-oceanic boundary

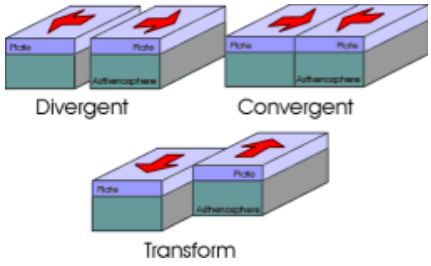
1. Often forms volcanoes on the ocean floor
2. Island arc forms as volcanoes emerge
    a. e.g., Aleutian islands
    b. e.g., Alaskan Peninsula
    c. e.g., Philippines
    d. e.g., Japan



Collision

c. Continental-continental boundary

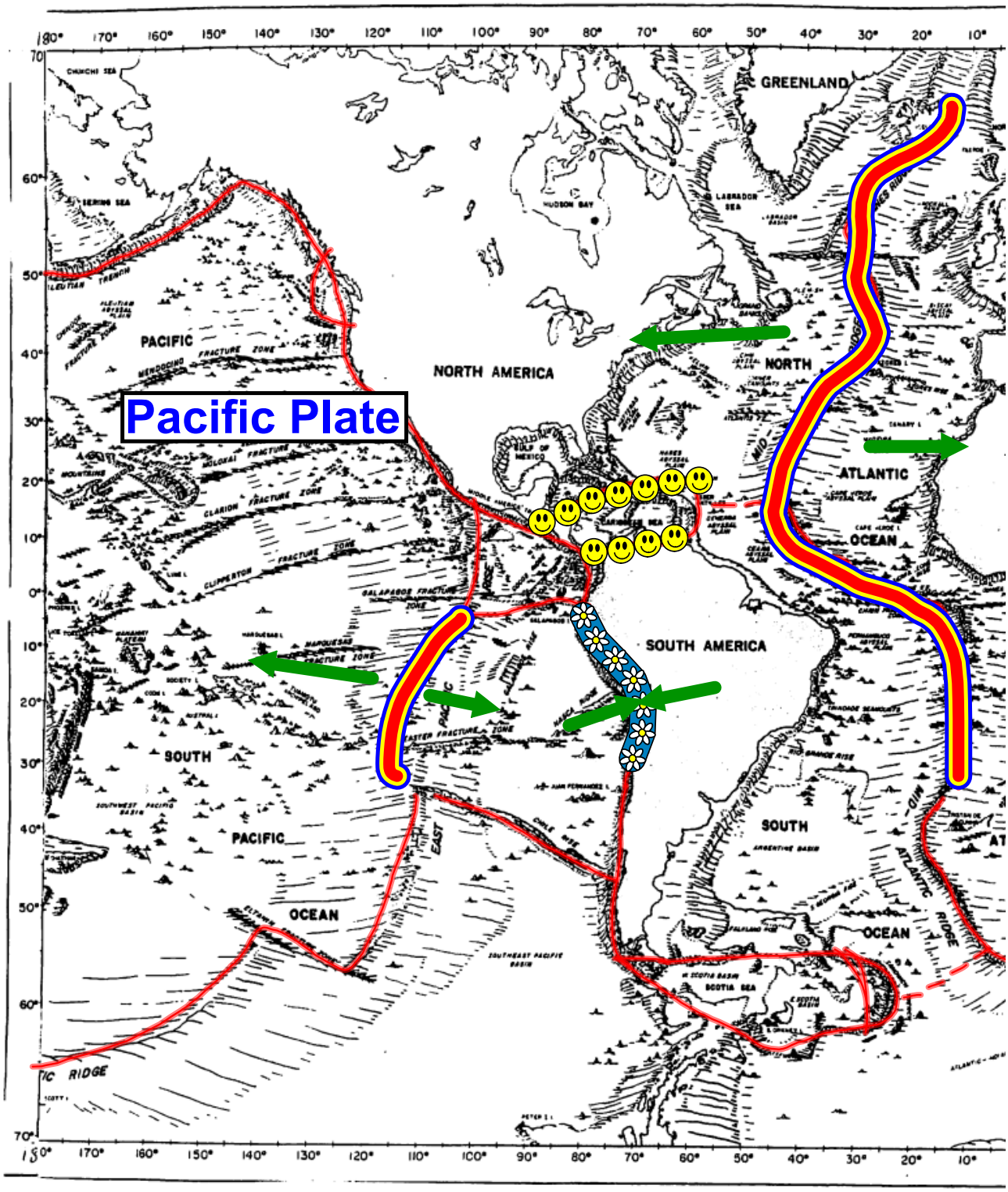
1. Neither plate will subduct
2. Can produce mountains
    a. e.g., Himalayas
    b. Other possibilities
        1. Alps
        2. Appalachians
        3. Urals



c. Transform boundary

1. Plates slide past one another
    a. No new crust is created
    b. No crust is destroyed
2. Transform faults
    a. Most are in oceanic crust
    b. Parallel the direction of plate movement
    c. Aids in movement of crust material

Strike-Slip / Faulting


Pacific Plate
GREENLAND
NORTH AMERICA
PACIFIC
OCEAN
ATLANTIC
SOUTH AMERICA
SOUTH
PACIFIC
OCEAN
SOUTH
ATLANTIC
OCEAN

E. Evidence that supports plate tectonics

1. Paleomagnetism

   a. Probably the most persuasive evidence

   b. Ancient magnetism preserved in rocks

   c. Paleomagnetic records show

      1. Polar wandering (evidence that continents moved)

      2. Earth's magnetic field reversals

         a. Recorded in the sea floor

         b. Confirms seafloor spreadng

2. Earthquake patterns

   a. Associated with plate boundaries

   b. Deep-focus earthquakes along trenches provide a method for tracking the plate's descent

3. Ocean drilling

   a. Deep Sea Drilling Project (ship: Glomar Challenger)

   b. Age of deepest sediments

      1. Youngest are near the ridges

      2. Older are at a distance from the ridge

   c. Ocean basins are geologically young

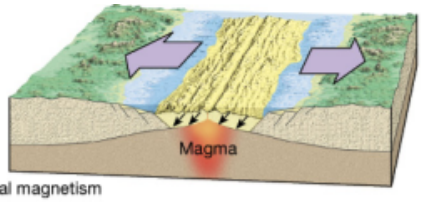
4. Hot spots

   a. Rising plumes of mantle material

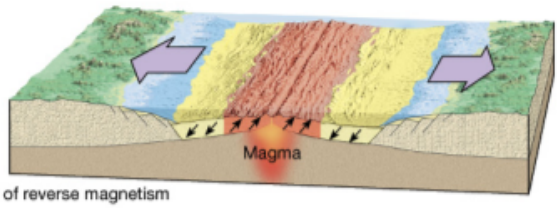
   b. Volcanoes can form over them

      1. e.g., Hawaiian Island chain

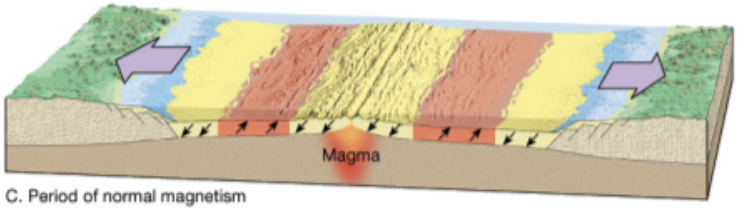
      2. Chains of volcanoes mark plate movement



A. Period of normal magnetism



B. Period of reverse magnetism



C. Period of normal magnetism

150-135 M.Y.A.
Northern Continent - Laurasia
Southern Continent - Gondwanaland

F. Breakup of Pangaea

1. Migrations of continents over the past 500 million years has been determined Terranes - parts of old continents

2. Breakup begins about 200 million years ago

   a. North America and Africa began separating between 200 and 165 million years ago

   b. Africa and South America begin splitting apart about 135 million years ago

3.. Landmasses also had fragmented prior to the formation of Pangaea

4. Fragments that formed Pangaea began collecting between 500 and 225 million years ago

G. Driving mechanism of plate tectonics

1. No one model explains all plate motions

2. Earth's heat is the driving force

3. Several models have been proposed

   a. Convection currents in mantle Whole Mantle Convection Boundary Layer Model

   b. Slab-pull and slab-push model

      1. Descending oceanic crust pulls the plate

      2. Elevated ridge system pushes the plate

   c. Deep Layer Model

      1. Extend from mantle-core boundary

      2. Spread laterally under lithosphere

Plate Tectonics Map Activity

1) Trace the edges of all the plates (using the map on pages 200-201 and the laminated map) (Lightly trace in pencil)

(Look for features: trenches, rises, rifts, ridges, mountains)

2) Label the plates with their proper names (1st page of the notes) 20 total

3) Identify the plate boundary type

A) Spreading / Divergent

Create a key

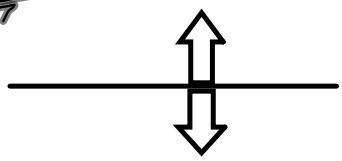
Convergent

B) Collision (Continental / Continental)

C) Subduction (Continental / Oceanic)

D) Subduction (Ocean / Ocean)

E) Faulting / Transform / Strike-Slip



4) Draw arrows of Movement

Plate Names

North American	Caribbean	Mariana
South American	Scotia	Cocos
Pacific	Sandwich	Nazca
African	Arabian	Juan de Fuca
Eurasian	Philippine	Soloman
Indo-Australian	Bismarck	Somolia
Antarctic	Caroline	

Attachments

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