
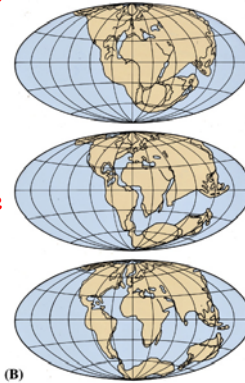


## CHAPTER 17

## PLATE TECTONICS

## Continental Drift

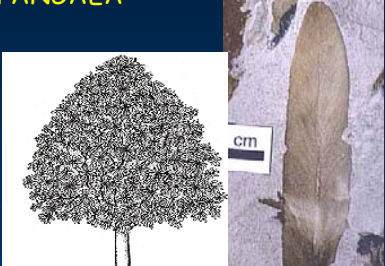
- Predecessor to plate tectonic theory
- Shape and "fit" of continents was initial evidence



### Continental Drift

Alfred Wegener (1880-1930)

- Proposed that all continents were once part of a supercontinent - PANGAEA

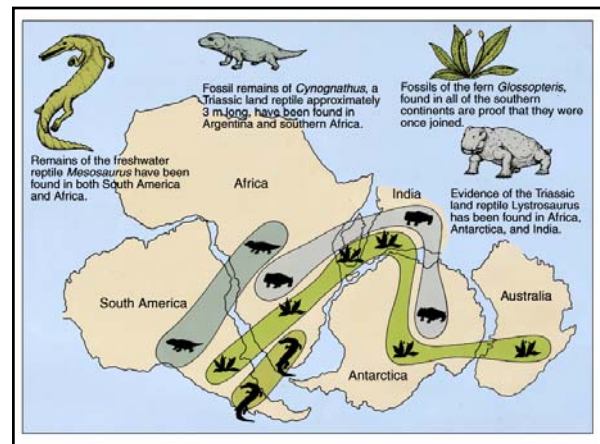


## Continental Drift

- Wegner proposed a mechanism for drift
  - Less dense continental rocks drift over more dense ocean rocks
  - Earth's rotation was driving force

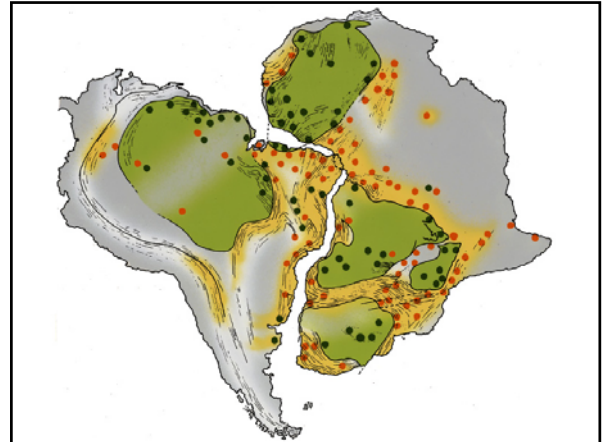
## Evidence for Continental Drift

- Paleontological
  - Similarity of fossils on opposite sides of the Atlantic Ocean



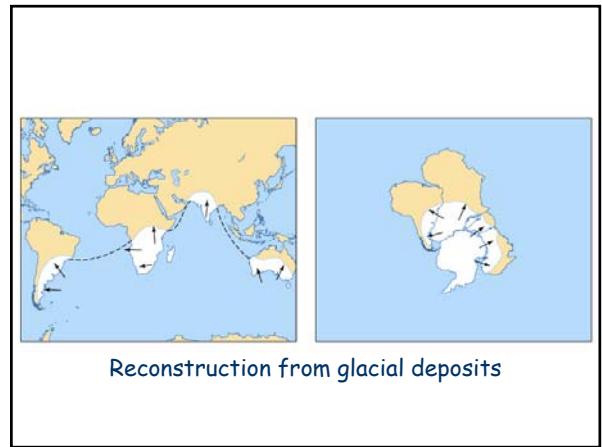
## Evidence for Continental Drift

- Distribution of Rock types
  - Distinct rock geologic structures on both sides of the Atlantic Ocean
    - Mountain fold belts seemed to match
    - Only in rocks > 145 mya



## Evidence for Continental Drift

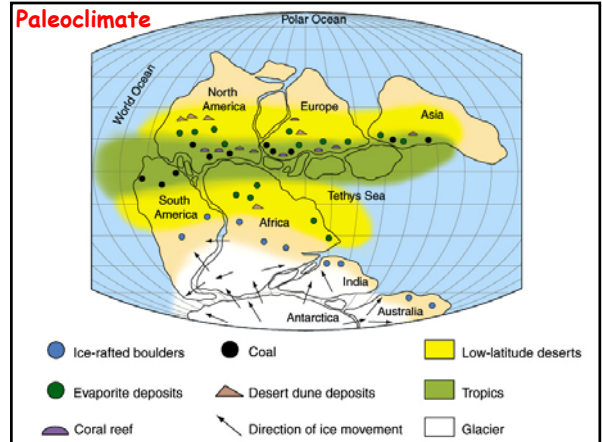
- Glaciation
  - Late Paleozoic rocks
    - Distinct glacial deposits (Till)
    - Glacial striations (direction of movement)



Reconstruction from glacial deposits


## Evidence for Continental Drift

- Paleoclimate belts
  - Evidence of extreme changes in climate as compared to the present
    - Coal deposits
    - evaporite deposits, eolian deposits & coral reefs
    - Paleoclimate reconstruction in modern continental configuration doesn't make sense



## Plate Tectonic Theory

- Technological advances in the 1950's and 1960's
- Investigation of the sea floor



## Topography of Ocean Floor

- Ocean basins divided by large, continuous ridge system

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

## Topography of Ocean Floor

- Central rift valley within the ridge

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

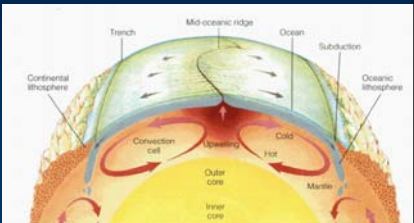
## Ocean Floor

- Composed of basalt
- Young and thin
- No ductile deformation

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

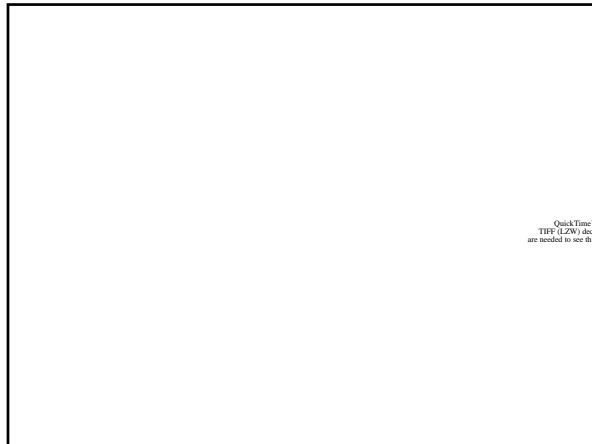
## Seafloor spreading (1960)

- Proposed mechanisms:
  - Mantle convection
  - Rifting along ridge system
  - Continents pushed by spreading seafloor
  - Recycling of oceanic crust by subduction



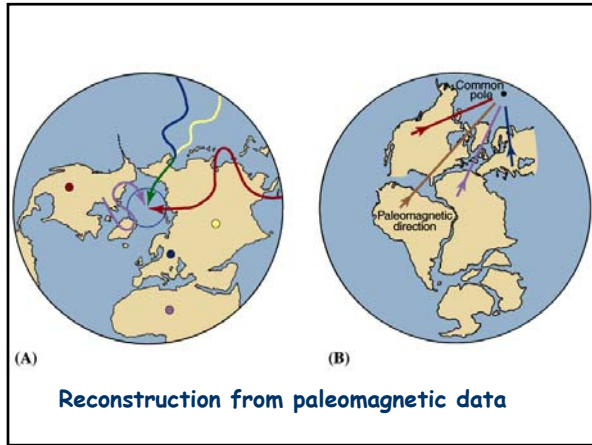
## Geology of the Ocean Floor

- Paleomagnetism
  - Fe-rich minerals magnetized by Earth's magnetic field
  - Orientation preserved in mineral
  - orientation varies on Earth's surface



## Geology of the Ocean Floor

- Polar wandering
  - Earth's north magnetic pole appeared to move through time
  - Wandering paths varied by continent
  - Multiple poles are not possible



## Geology of the Ocean Floor

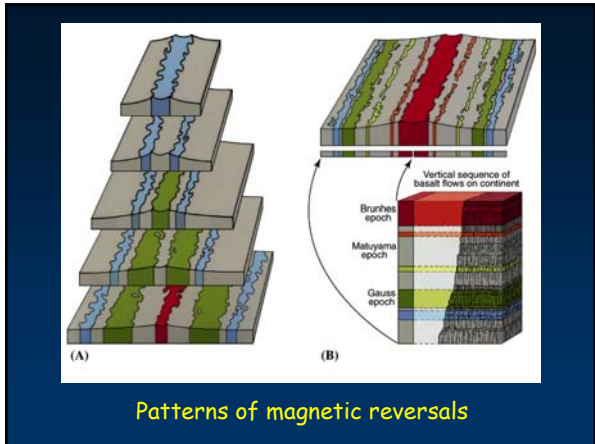
- Magnetic reversals
  - magnetic field polarity can "flip-flop"

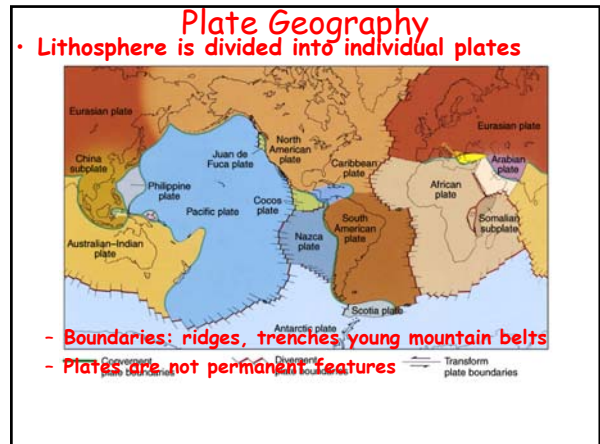
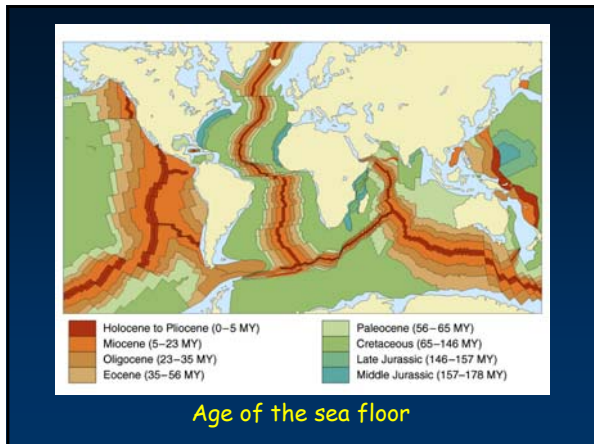
  
  

- Normal polarity -  $N_{\text{magnetic}} = N_{\text{geographic}}$
- Reversed polarity -  $N_{\text{magnetic}} = S_{\text{geographic}}$

## Magnetic Polarity Reversals

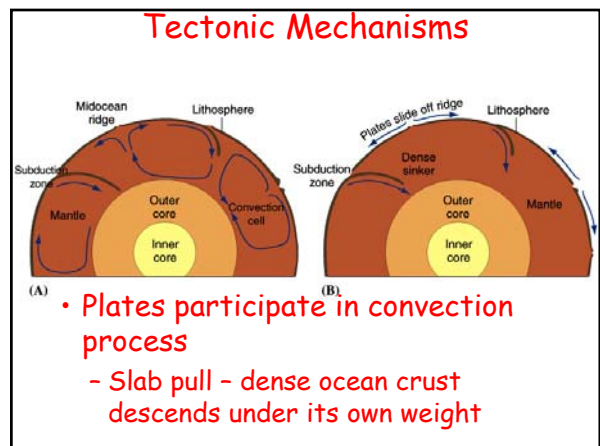
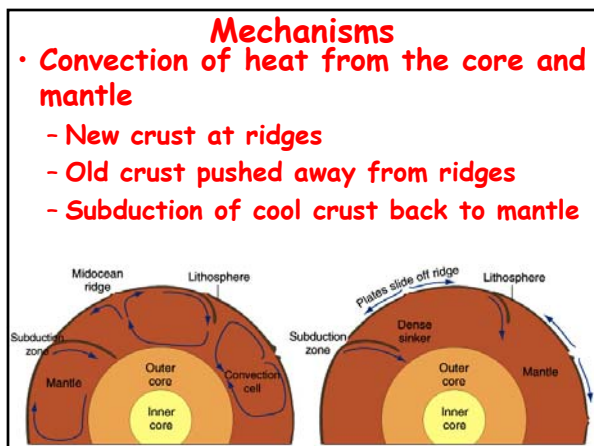
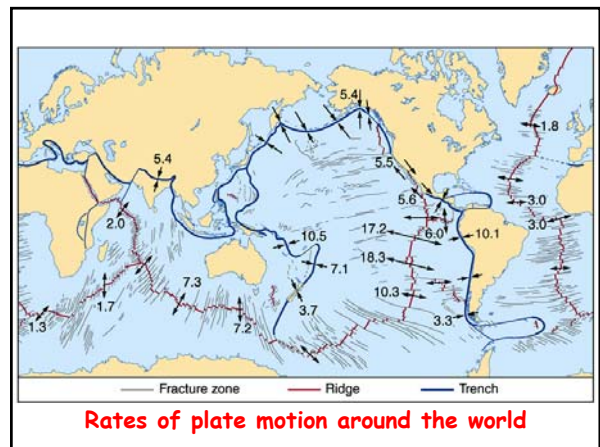
- recorded in ocean floor basalt
- polarity reversals parallel ridges
- Polarity "chrons" give age of seafloor
  - Older away from ridge
  - Rates of plate motion may be calculated
- Youngest sediment rests on basalt near ridge
- Sediment above basalt is older away from ridge



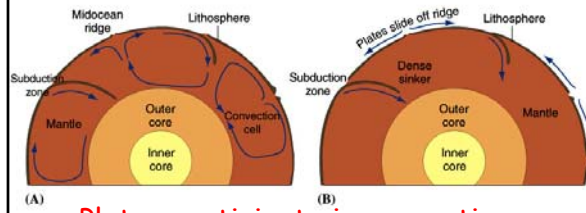


### Plate Motion

- Tectonic plates are rigid curved plates
  - Velocities vary within a plate
  - Rates vary from 1 to 20 cm/yr

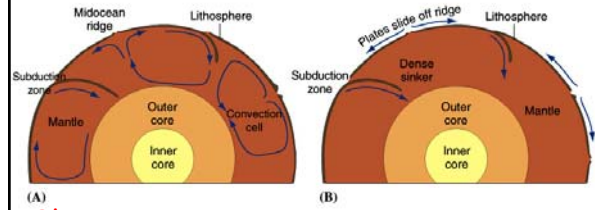


## Tectonic Mechanisms



- Plates participate in convection process
  - Ridge push - gravity pulls lithosphere down & away from ridge

## Tectonic Mechanisms



- Plates participate in convection process
  - Friction - resistance to movement from various sources