#### **Continental Drift**

• Alfred Wegener, 1912 • continents like jigsaw puzzle • fossil records match across oceans • geologic units match across oceans • apparent polar wander curves don't match



Fig 4.2

### Continental Drift



#### Continental Drift

#### How do we know that plates move sideways?



#### Earth's Magnetic Field

• magnetic north 2000 at: 81.0°N, 109.6°W



Shape: like that of bar magnet (dipole)

Observables: strength, declination, inclination

Origin: currents in metallic liquid outer core -> magnetic dynamo

Time Evolution: changing field; reversals

Fig 4.5

#### Recording Earth's Magnetic Field

Fig 4.7



Image: S. Marshak "Earth, Portrait of a Planet"

Curie Temperature (~ 500°C) above: domains align with mag. field below: domains frozen

rock freezing from magma record current field
Earth's field/rock position change over time (record of magn. field)



Source: Wikipedia

#### Watch That Magnetic Pole when Hiking!

# • magnetic north 2000 at: 81.0°N, 109.6°W







#### Apparent Polar Wander Curves

MA

**\* - \*** 300

400

600

500 🛲

200

#### Fig 4.8



Image: S. Marshak "Earth, Portrait of a Planet"

- freezing rock conserve current magnetic field
- measure inclination and declination in layers of geol. profile
- determine age of layers (fossils, radioactive dating)
- for one location, construct polar wander curve

#### **Apparent Polar Wander Curves**



construct polar wander curves for different continents
 different curves but only 1 pole -> continents move w resp each other

• move curves to try to match them

• rest is true polar wander and continents were once together



### What Makes Continents Drift?

Fig 4.10

continental drift (Alfred Wegener 1915)

sea floor observations (Harry Hess 1950s)

- sea floor deepens away from mid-ocean ridges (MORs)
  sediments thicken away from MORs
- heat flow is greater at MORs than elsewhere
- dredging (ocean rock different from continental rocks)
- earthquakes along MORs -> seafloor cracking

## **Sea Floor Spreading Hypothesis**

map by Heezen and Tharp



#### Seafloor Spreading

#### • mapping of magnetic anomalies (1960s)



#### How fast does the Magnetic Field Reverse?

field direction maintained on the order of millions of years



SIO Professor Cathy Constable (Photo: La Jolla Light)



anywhere between 100 and > 20,000 yrs most say a few 1000 yrs

not related to mass extinctions!