

# Plate Tectonics – historic approach

## “Continental Drift”

Alfred Wegener (1880-1930) meteorologist

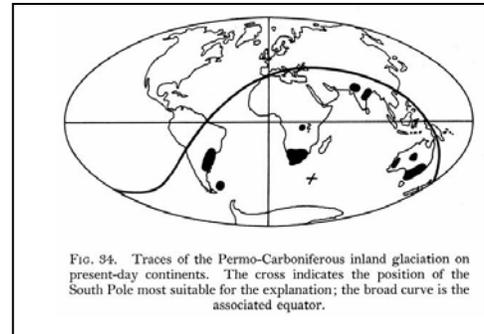
1915 published “The Origin of Continents and Oceans”  
 Eng. Trans. 1924

Idea: continents “drifted” apart from ancient supercontinent **Pangaea** (=all lands) 200 million years ago

### Evidence

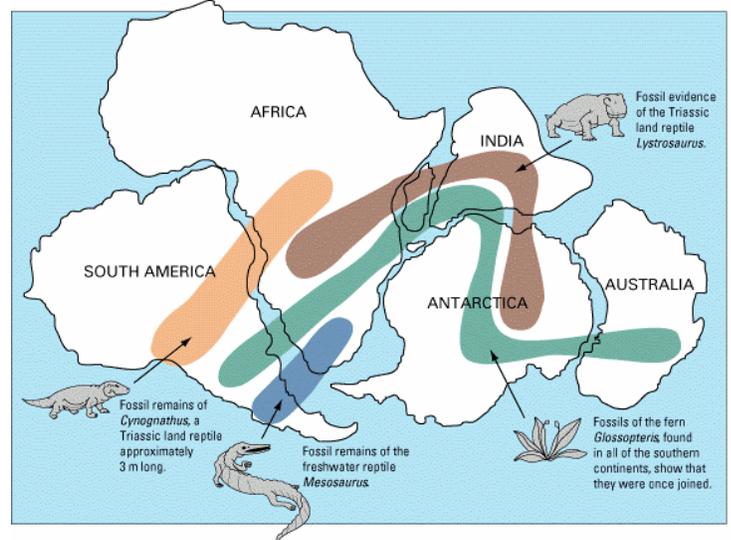
1) Fit of Atlantic coast lines, noted since reliable maps were made.

- 2) Distribution of ice sheets (paleoclimate ~300 my)
  - a) would be huge in southern hemisphere but not north
  - b) direction of glacial striations



- 3) Fossils
  - a) Mesosaurus (fresh water), Lystrosaurus, Glossopteris, etc.

- \* Couldn't swim across ocean
- \* ecosystems are different on each continent now
- \* tropical life in Antarctica?



- 4) Geologic structures
- 5) Locations of quakes around Pacific rim



## Objections:

- 1) Too radical
- 2) No driving force
- 3) Granitic continents can't "plow" through basaltic seafloor

Arthur Holms – mantle convection

## **New evidence from the WWII technology**

### Echo sounding

- 1) German ship *Meteor* 1920's
- 2) Mid-ocean ridge system

### *Harry Hess*

- 1) Princeton geol. Professor & Naval Captain in WWII.
- 2) Collected echo-sounding records in Pacific
- 3) Why oceans weren't filled by sediments? (too young)
- 4) 1962 proposed mobile seafloor ("seafloor spreading" from Dietz)

### Global Seismic Network -- Nuclear Test detection

- 1) Showed shallow events at mid-Ocean ridges
- 2) Deep quakes around Pacific

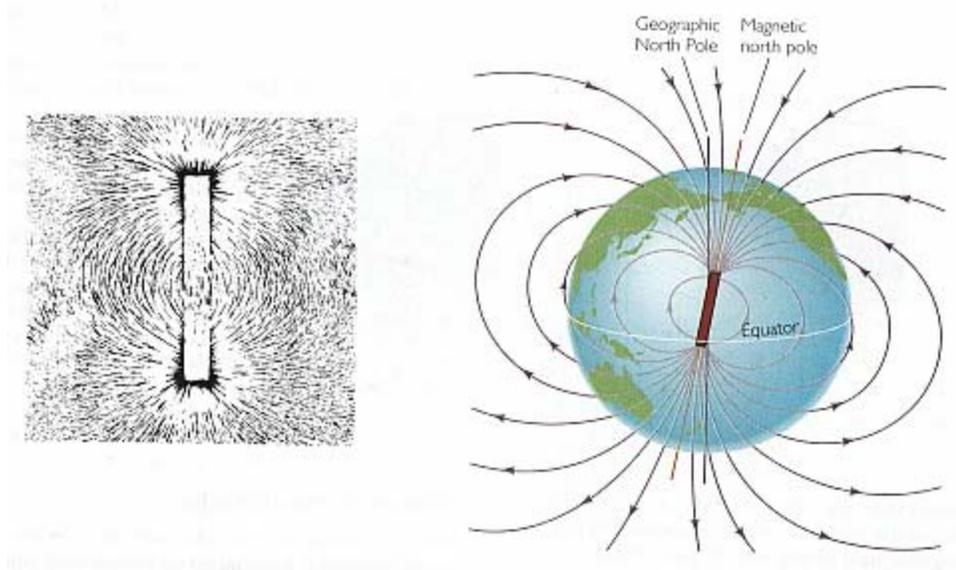
### Radiometric dating of ocean basalts

### Magnetometers

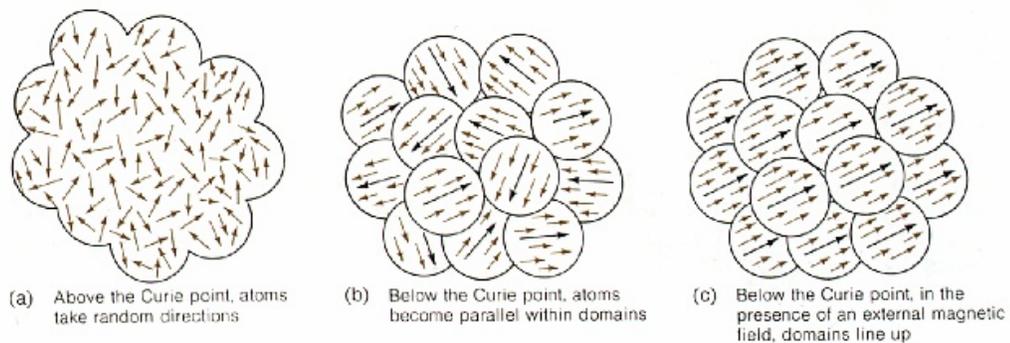
## **Paleomagnetism**

- 1) Earth has a magnetic field

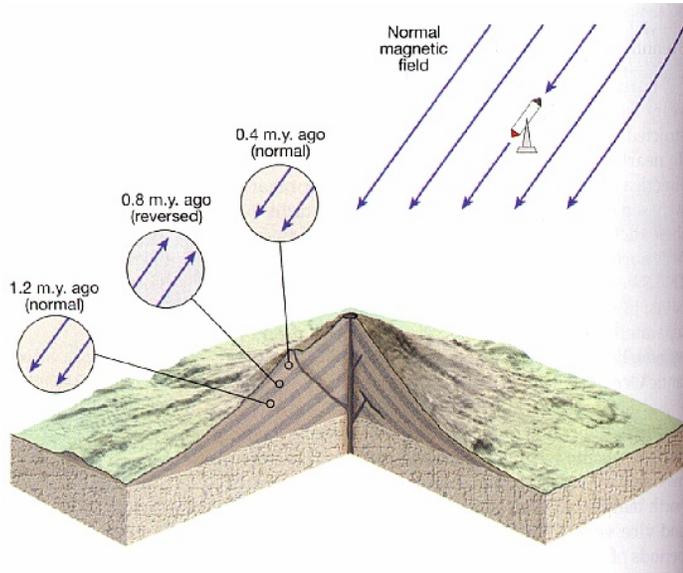
- a) Probably caused by rotation of solid Inner Core in liquid Outer Core (both mostly Fe) (“Magneto effect”)



- 2) *Remanent magnetization (thermoremanent)* -- Many rocks have magnetic minerals that align with the earth’s magnetic field as they cool past the Curie point ( $580^{\circ}\text{C}$ )
- 3) Rocks retain “memory” of magnetic field when they cool.



- 4) **Polar Reversals** - Different aged rocks show that the polarity of the magnetic pole has reversed many times in the past.



Frequency of flips: ten thousand to tens of millions  
 Last polarity reversal was 690,000 years ago

5)

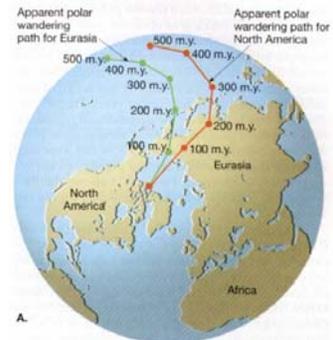
6) Polar wandering curves

a) Earth's magnetic pole moves over time.  
 Path is called a "polar wander curve"

b) Different continents show different curves

further proof continents have moved

(back to plate tectonics...)



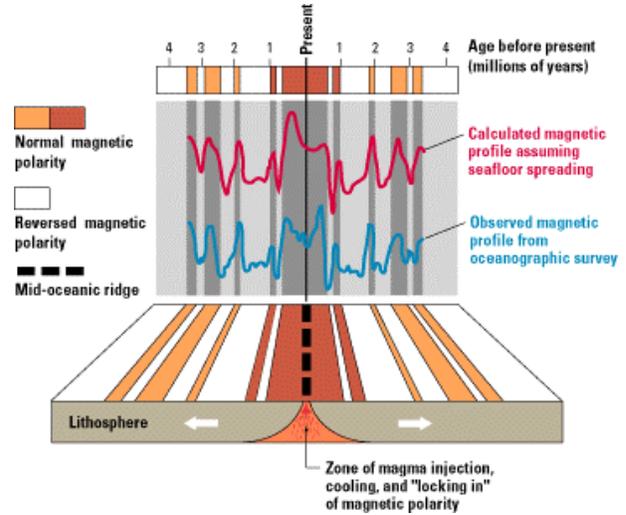
## Magnetization of the sea floor (detected with magnetometers)

### 1) Sea floor basalt magnetometer readings

### 2) magnetic stripes

a) parallel to mid-ocean ridges

b) symmetrical



### 3) *Vine & Matthews – 1963* (Cambridge University) explained by seafloor spreading

