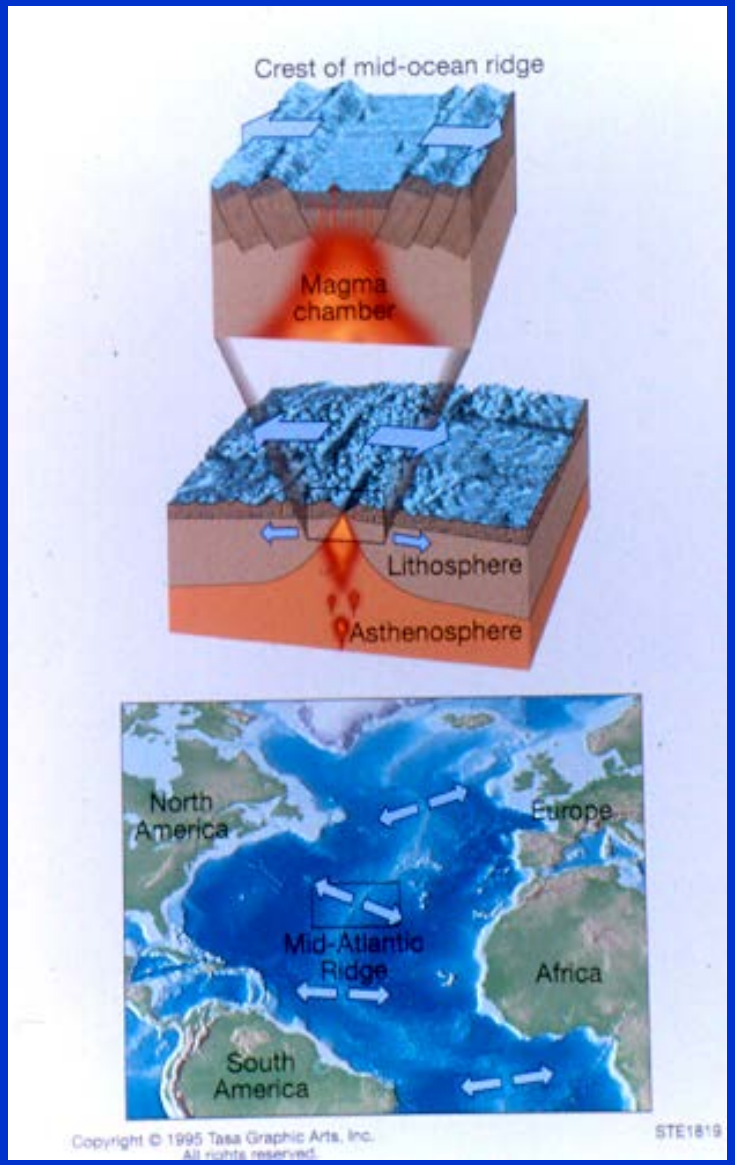
How to Access Dynamic Earth Lectures and other useful information

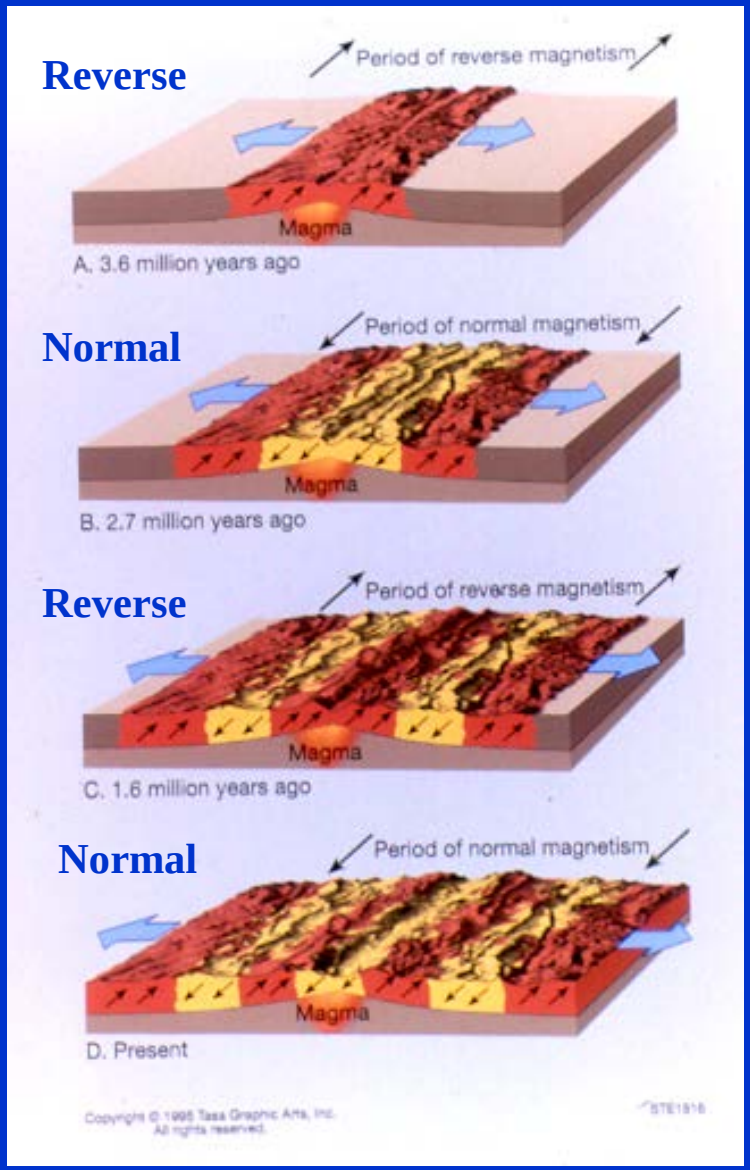
1. Go to the Geoscience website at www. geo.umass.edu.
2. Click on Courses.
3. Scroll down to Geo-105 and click on it.
4. This gets you onto the class website (as yet incomplete).
5. Click on the lecture you want to download (PDF).
6. Browse other useful information.

A Mechanism for Sea-Floor Spreading



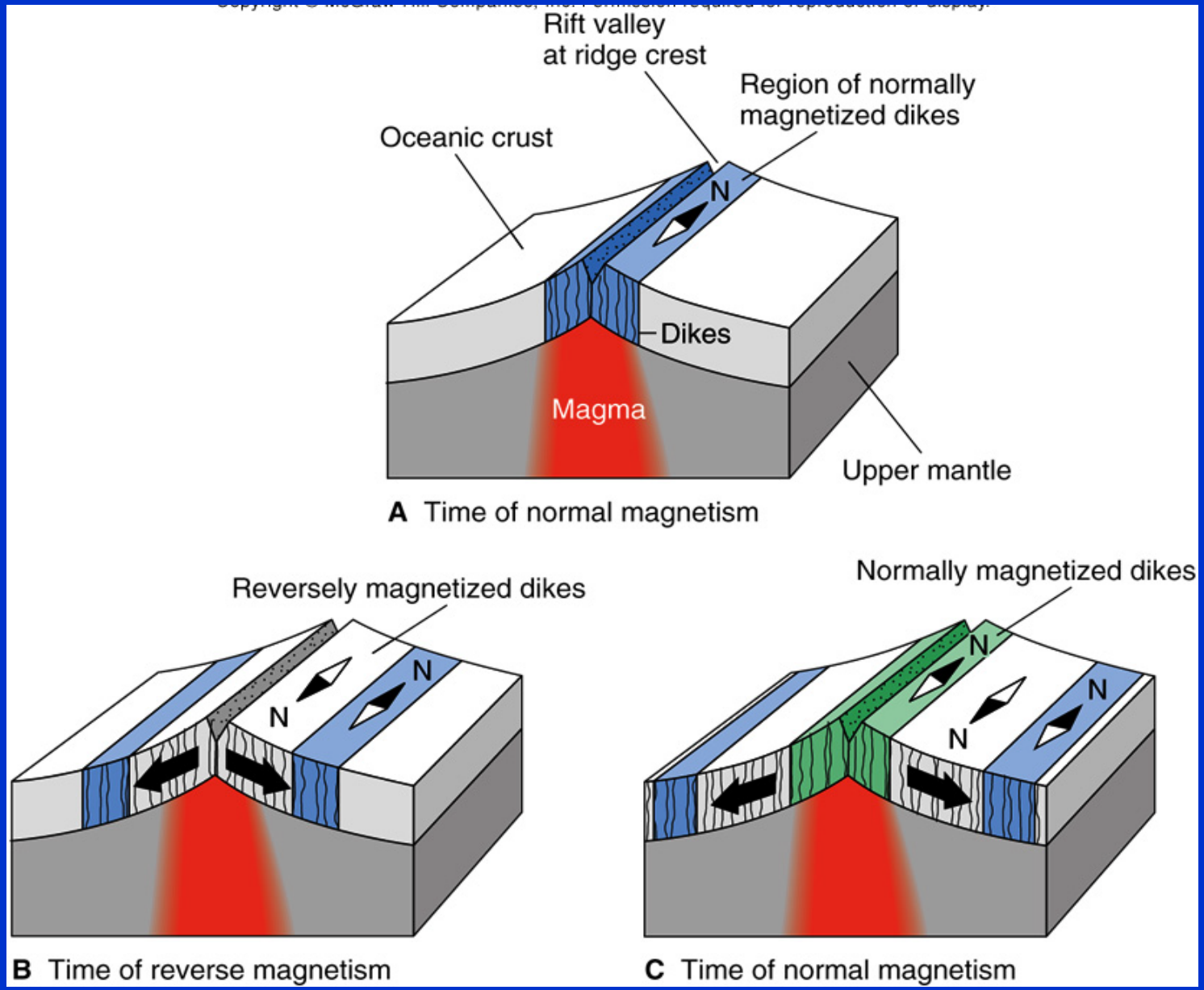
- New oceanic crust is created through volcanic activity at ridge crests.
- This material then moves away from the ridge crest as additional new material is constantly added.

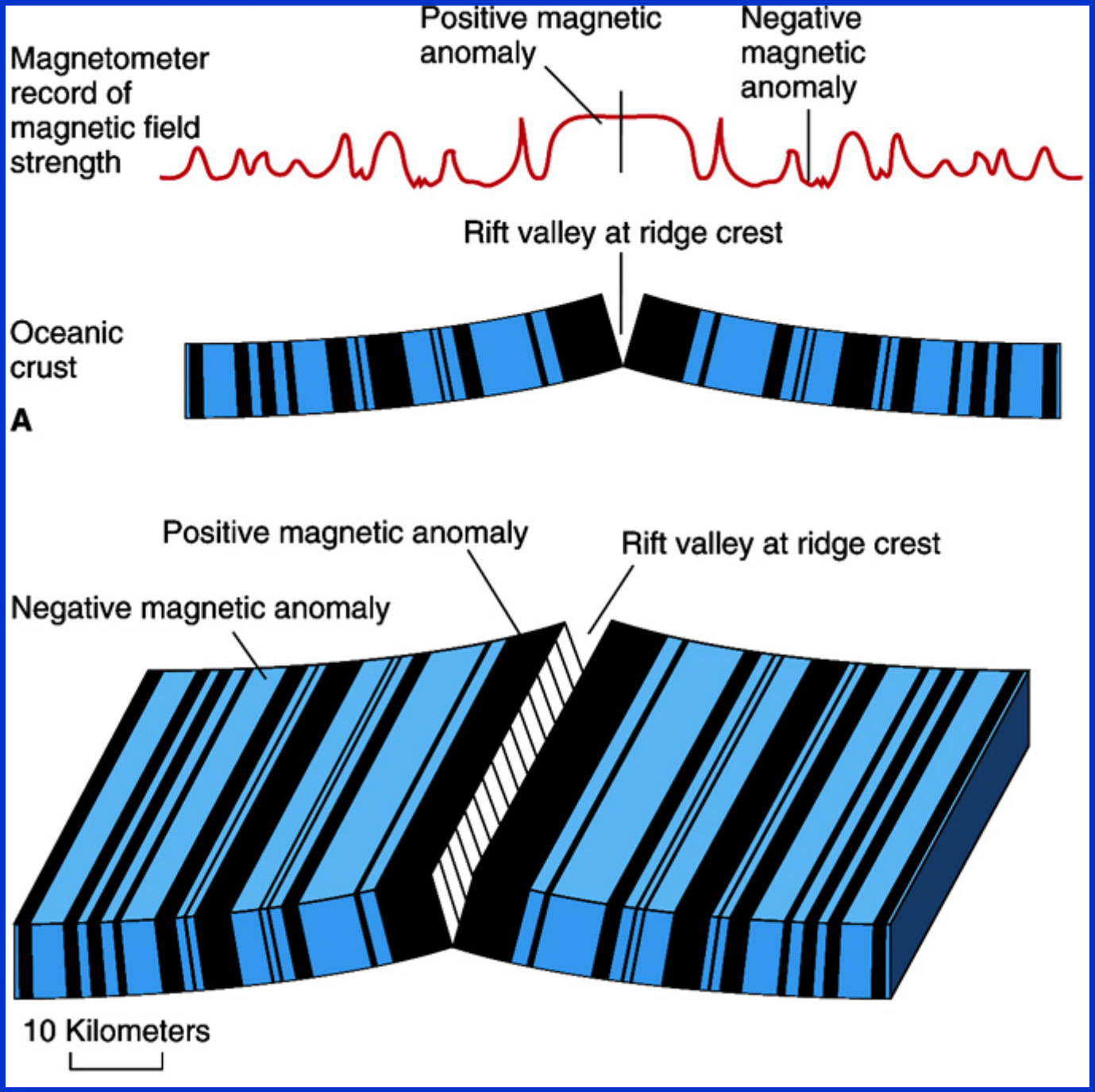
Magnetic Anomalies



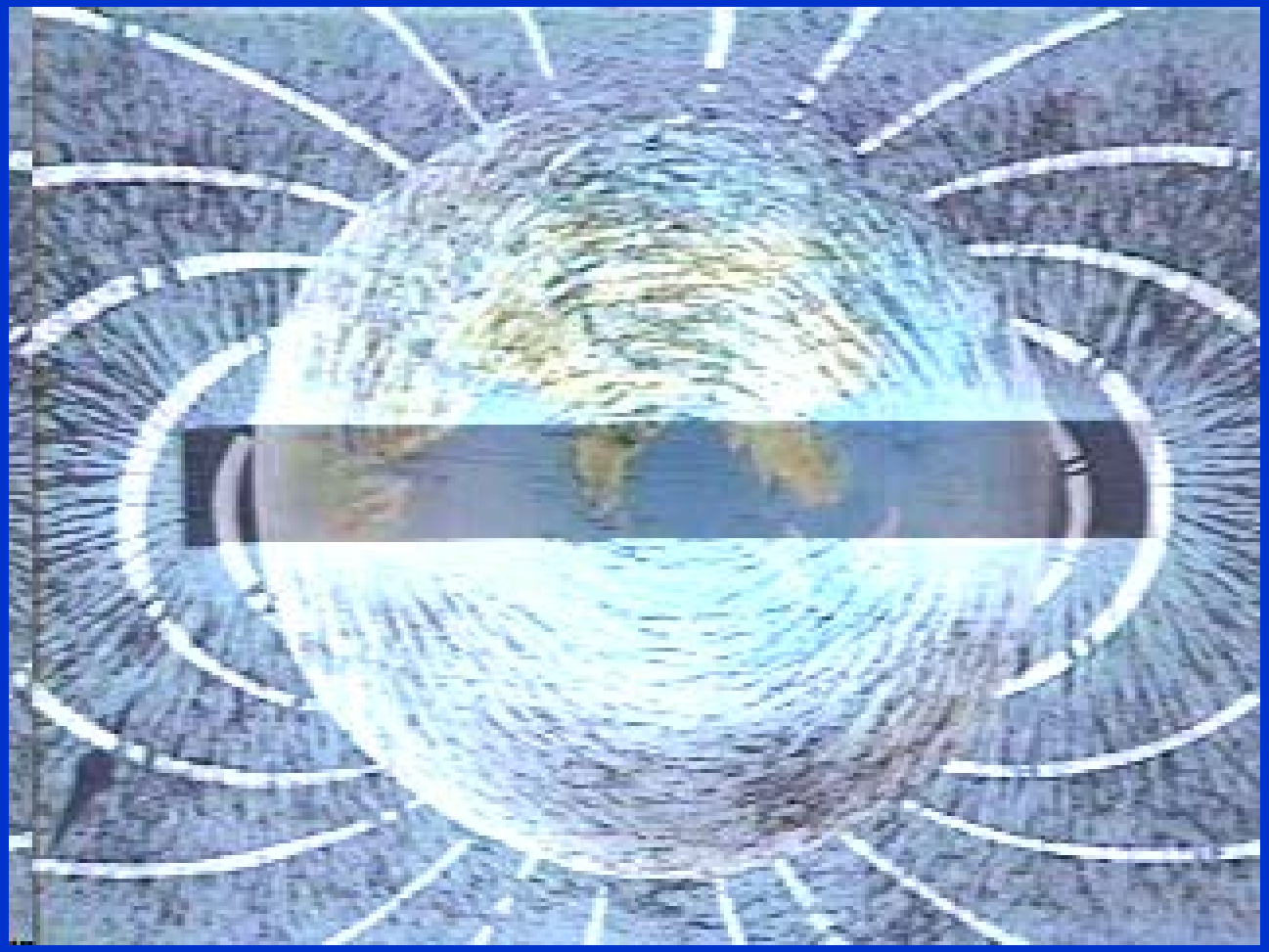
- The crust retains the magnetic signature (normal or reversed) that was in effect at the time of its formation

Another diagram just to make it clearer!




Positive magnetic anomaly
Negative magnetic anomaly
Magnetometer record of magnetic field strength
Rift valley at ridge crest
Oceanic crust
A
Positive magnetic anomaly
Rift valley at ridge crest
Negative magnetic anomaly
10 Kilometers

A Review of Magnetic Evidence for Sea-floor Spreading



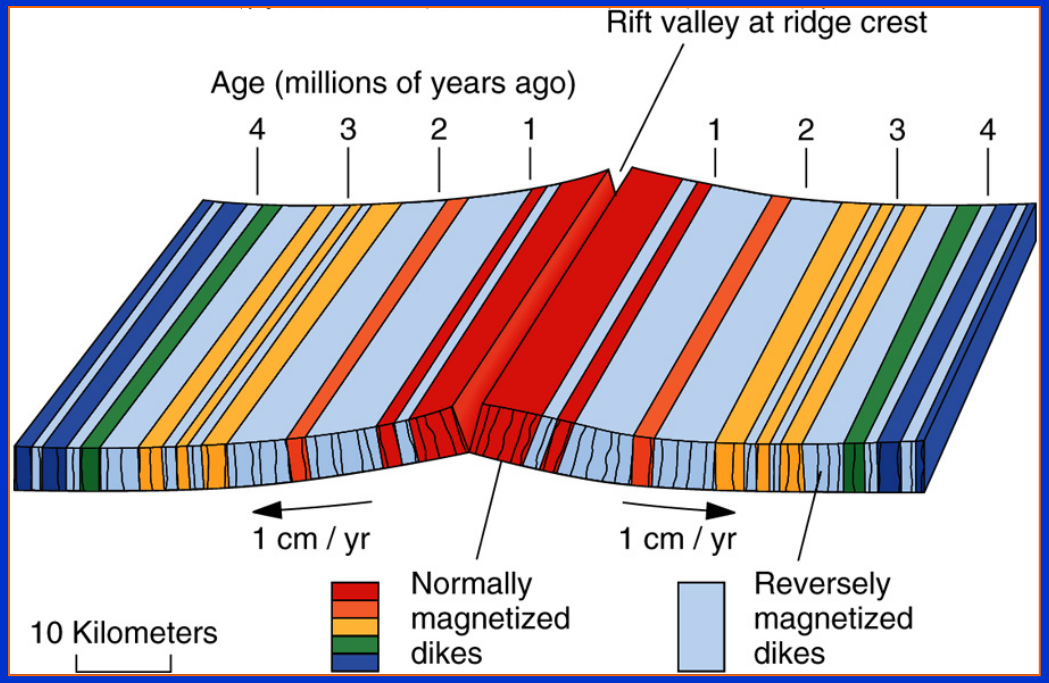
Spreading Rates

- The linear magnetic anomalies provide an estimate of the age of the oceanic crust (like tree rings).

- Since we know how far an anomaly is from the spreading ridge axis we can estimate the **spreading rate**.

- **Velocity (Spreading Rate) = Distance/Time**

Calculating Spreading Rate



Distance of the 7th normal stripe (green) is about 40 km from the ridge crest. The age is about 4 million years.

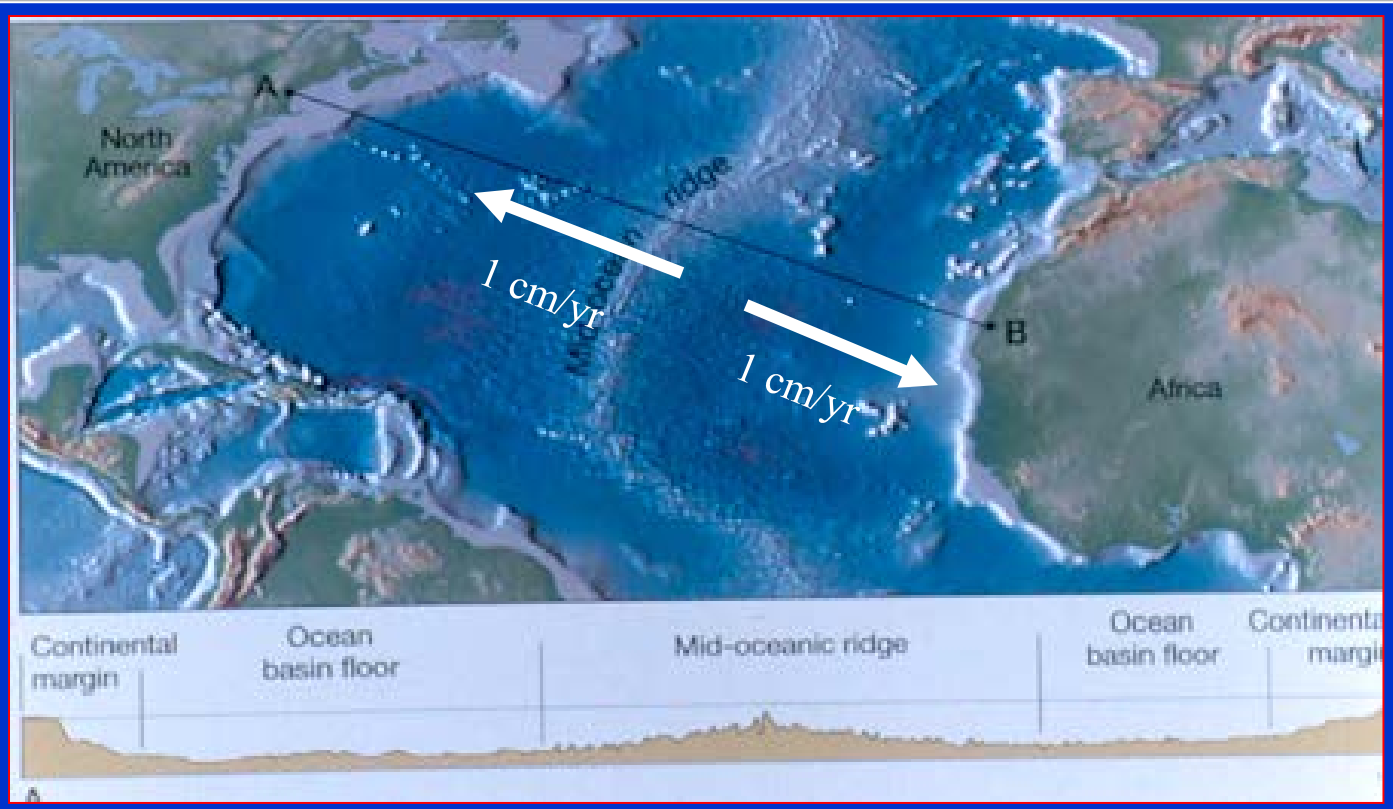
Spreading Rate = Distance (cm)/Age (years)

Spreading Rate = $(40 \times 10^5)/(4 \times 10^6)$

Spreading Rate = 1 cm/yr

Typical spreading rates range from 1 – 10 cm/yr

CAUTION If each side of a mid-ocean ridge is moving from the ridge axis at about 1 cm/year, then continents on either side of the ocean will be spreading apart at twice that rate, that is at about 2 cm/year. Therefore spreading calculated from magnetic anomalies on one side of the ridge is often referred to as the half spreading rate.



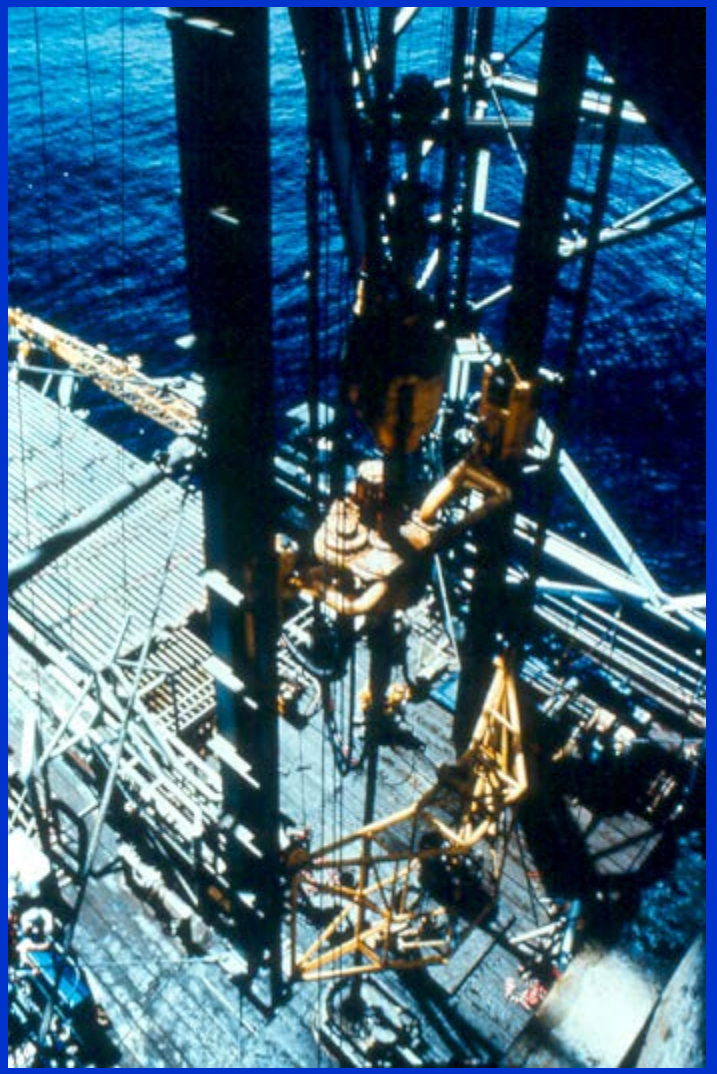
Testing the sea-floor spreading hypothesis with the Glomar Challenger drilling ship

If we drill a series of holes in the ocean floor that are progressively further away from an ocean ridge, we should find the following:-

1. The sediment thickness should increase with increasing distance from the ocean ridge.
2. Beneath the sediment there should be volcanic “pillow lavas” exactly like those found on mid-ocean ridges.
3. The age at the base of the sediments should get progressively older with increasing distance from the ridge (so should the age of the lavas beneath the sediments).
4. We should get similar results in all the oceans.

The Glomar Challenger

Glomar Challenger



View of the drill rig

More Glomar Challenger

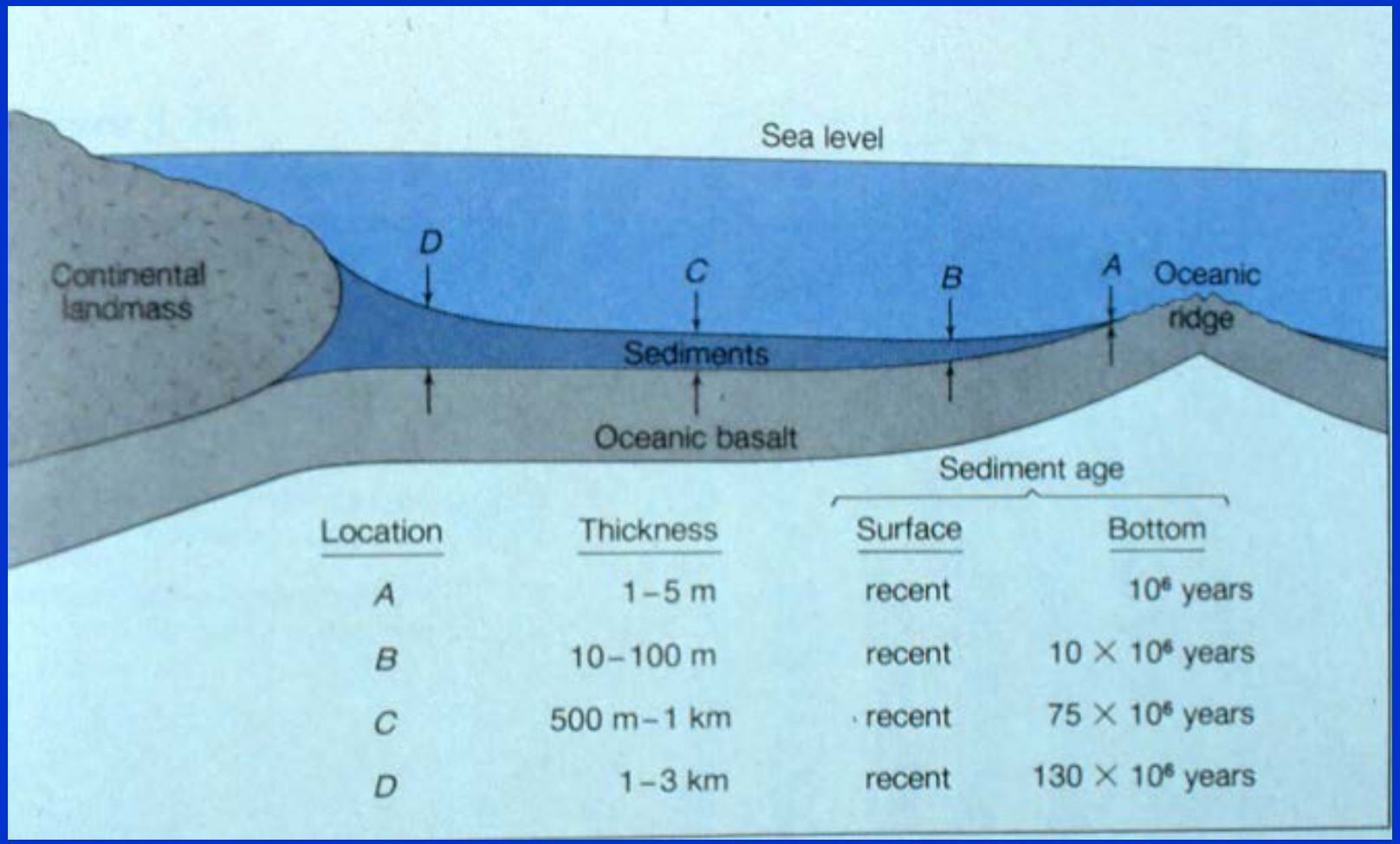
View from rig

Drill core

Guess who!

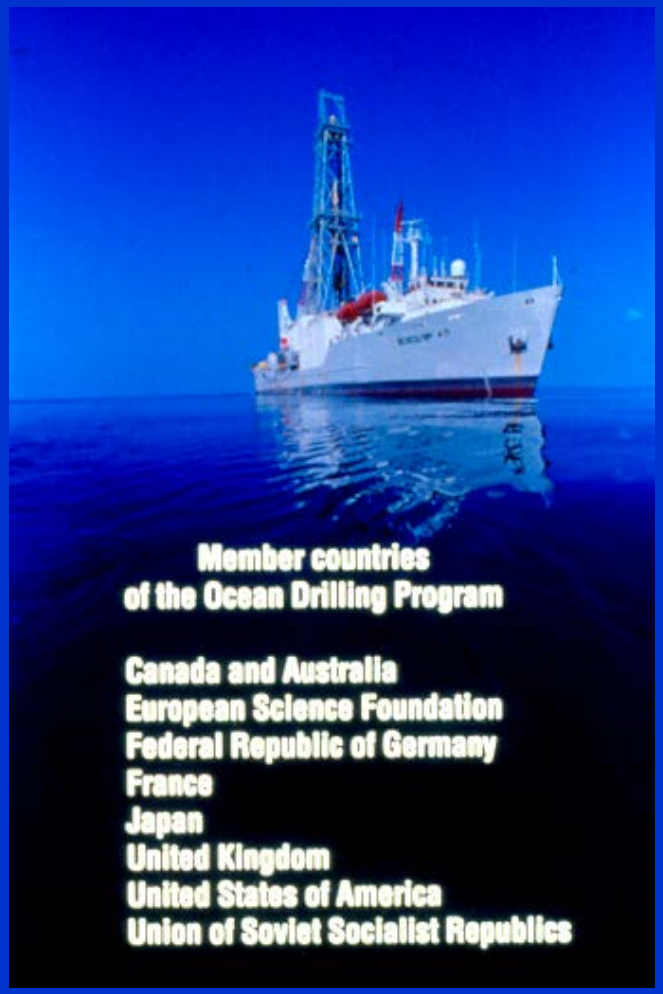
Drill bits

Testing the Sea-Floor Spreading Hypothesis with the Glomar Challenger



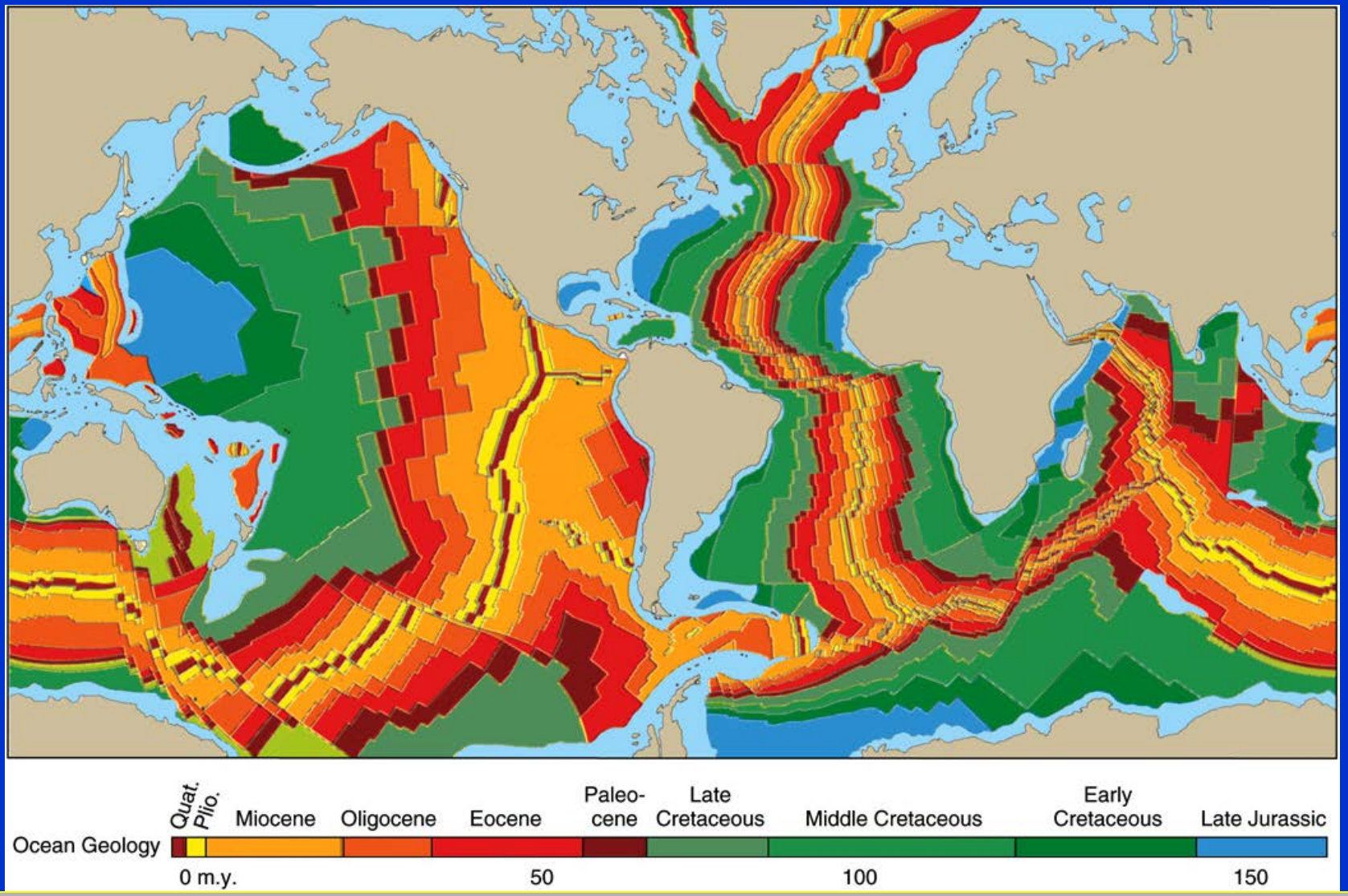
Location	Thickness	Sediment age: Surface	Sediment age: Bottom
A	1–5 m	recent	10^6 years
B	10–100 m	recent	10×10^6 years
C	500 m–1 km	recent	75×10^6 years
D	1–3 km	recent	130×10^6 years

Replacement for the Glomar Challenger

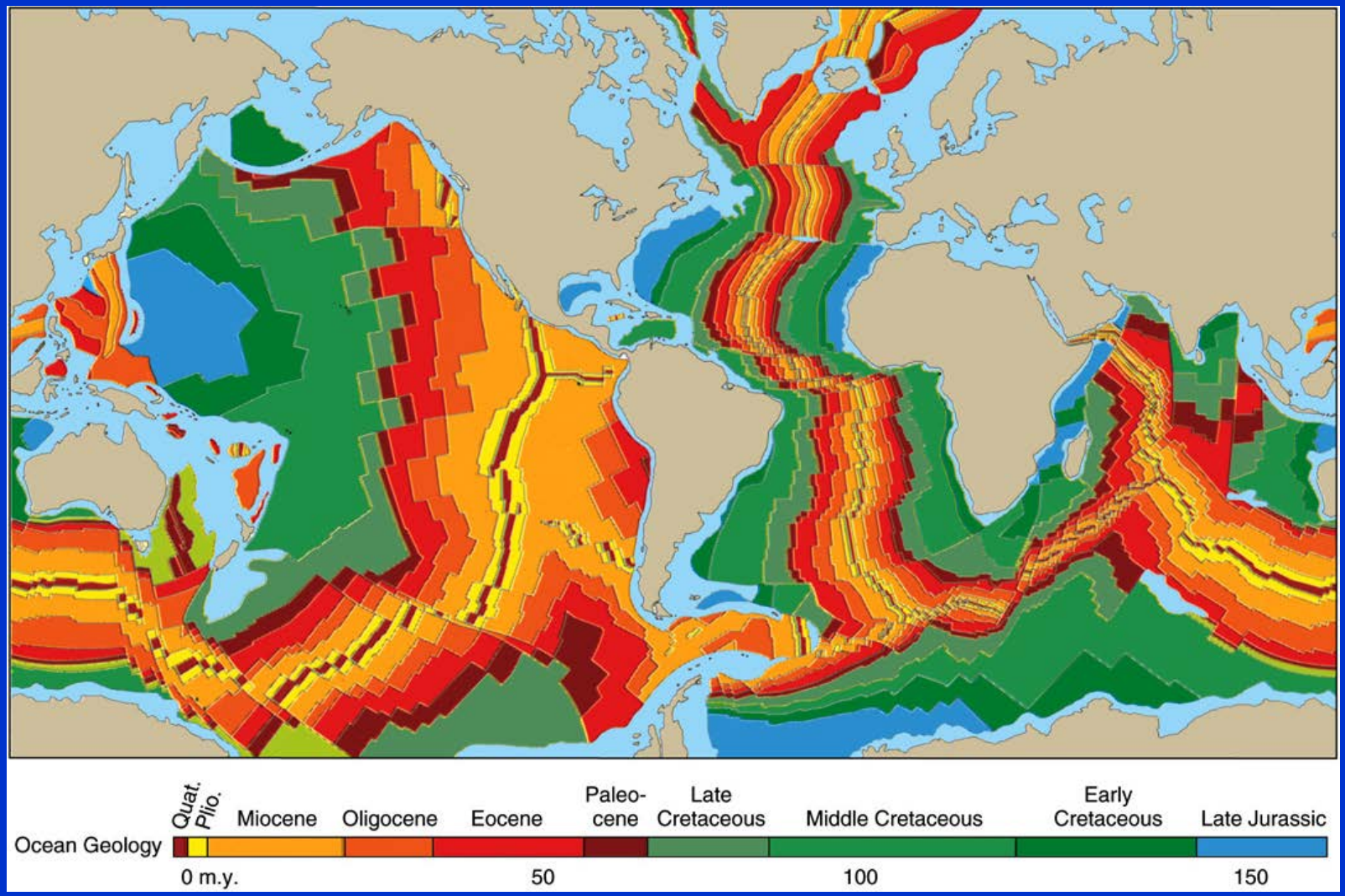


The Joides Resolution

Age of the Sea-Floor



The age of the sea-floor estimated from magnetic anomalies and drilling (note that there is no sea floor much older than 200 myrs).



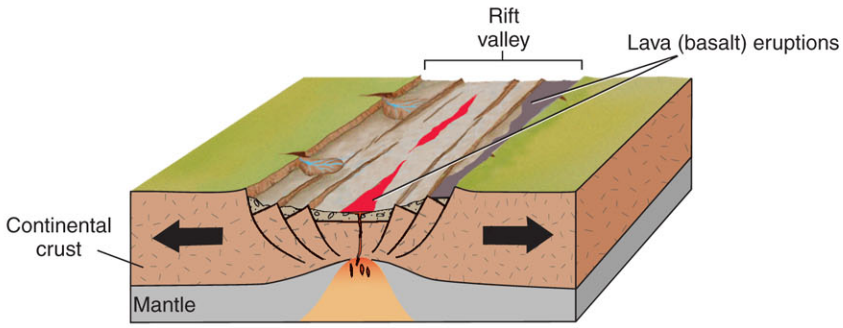
Why are the colored stripes thinner in the Atlantic Ocean than in the Pacific Ocean?

Another Test

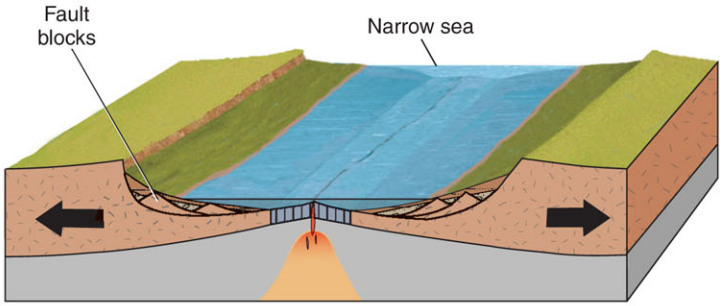
If continents once split apart to form new ocean basins:-

- Is it happening anywhere today?
- What will it look like?

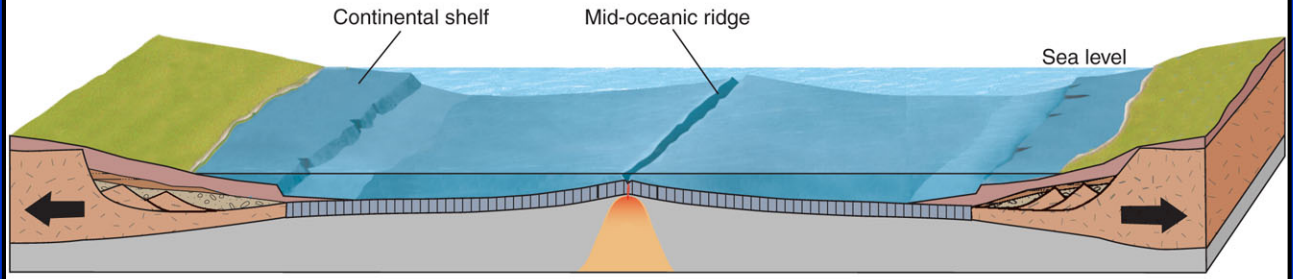
What we might expect



A Continent undergoes extension. The crust is thinned and a rift valley forms.



B Continent tears in two. Continent edges are faulted and uplifted. Basalt eruptions form oceanic crust.



C Continental sediments blanket the subsiding margins to form continental shelves. The ocean widens and a mid-oceanic ridge develops, as in the Atlantic Ocean.

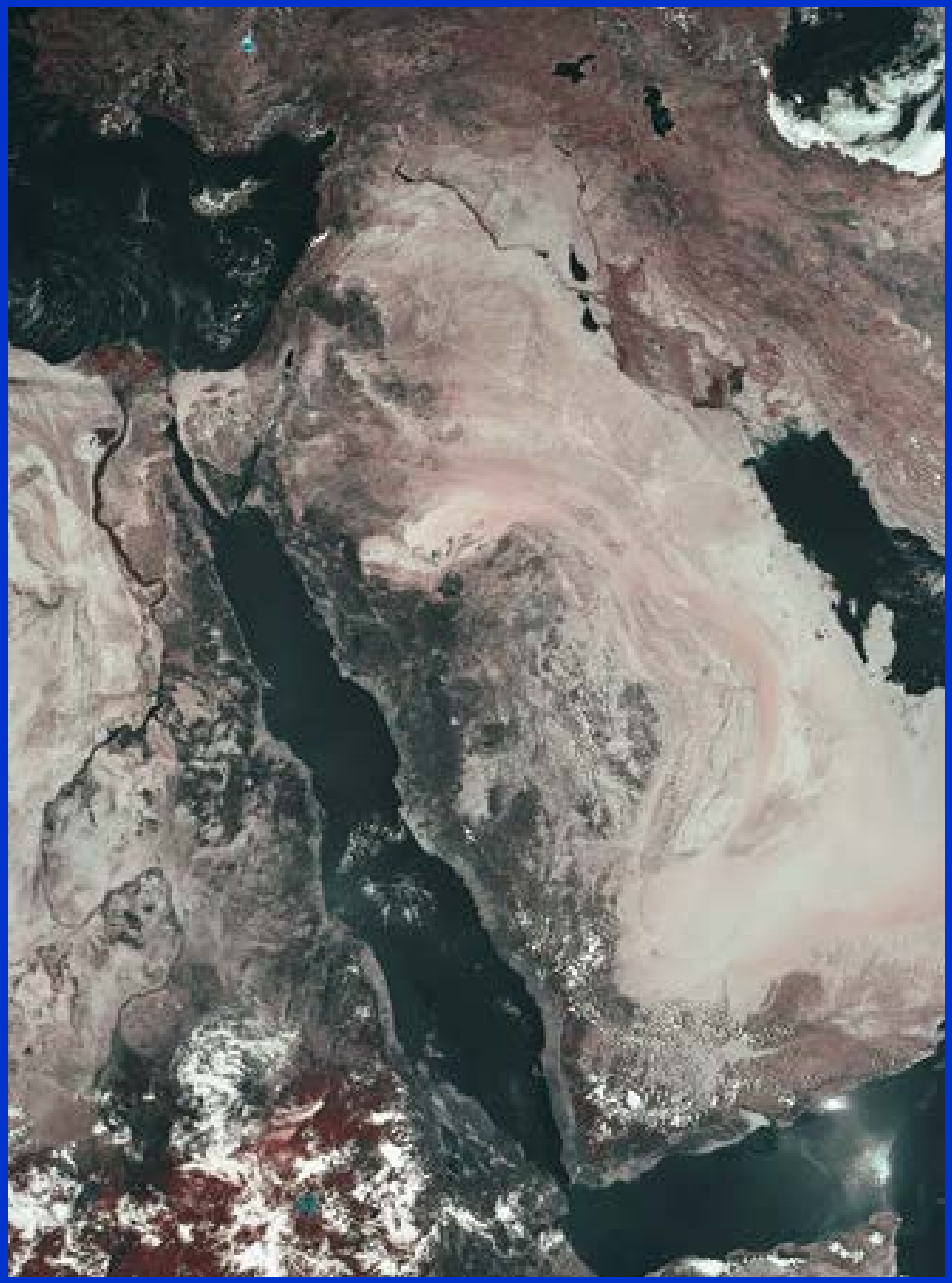
Rift valley with volcanoes

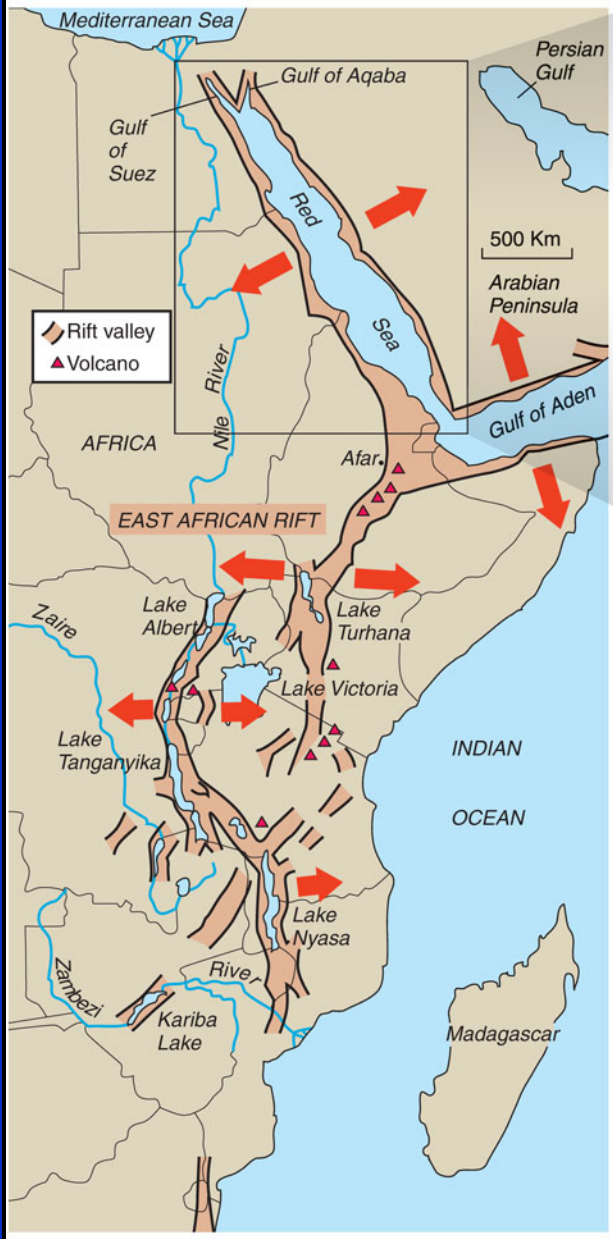
Linear sea (e.g Red Sea)

Ocean

The East African Rift Valleys and the Red Sea

Another example is the Gulf of California





A

B

C

A more detailed look at spreading along the Red Sea and East African Rift Valley (arrows show the spreading directions)

b: Image by Jeff Schmaltz, MODIS Rapid Response Team, NASA/GSFC (http://visibleearth.nasa.gov/); c: Photograph by Anthony R. Philpotts