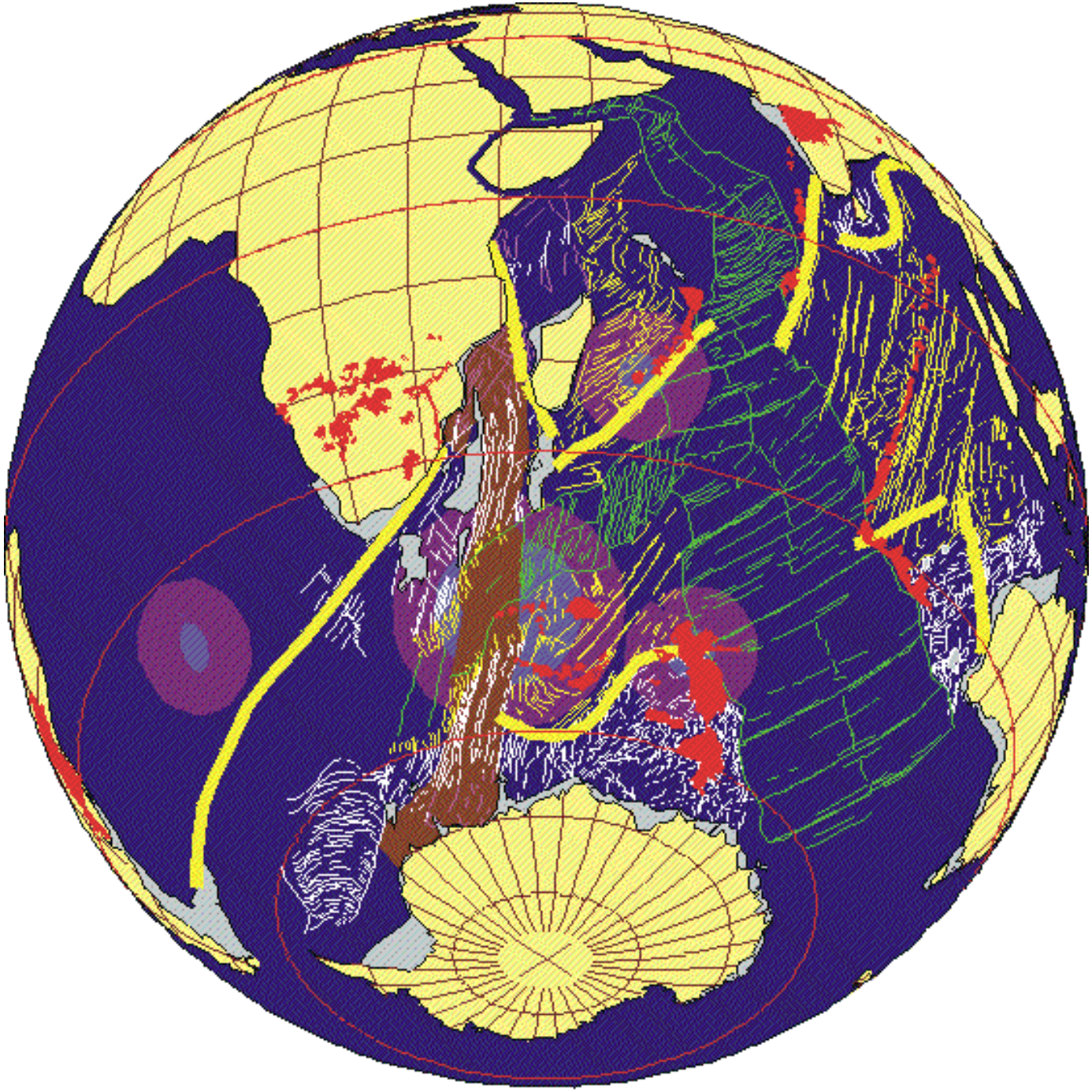
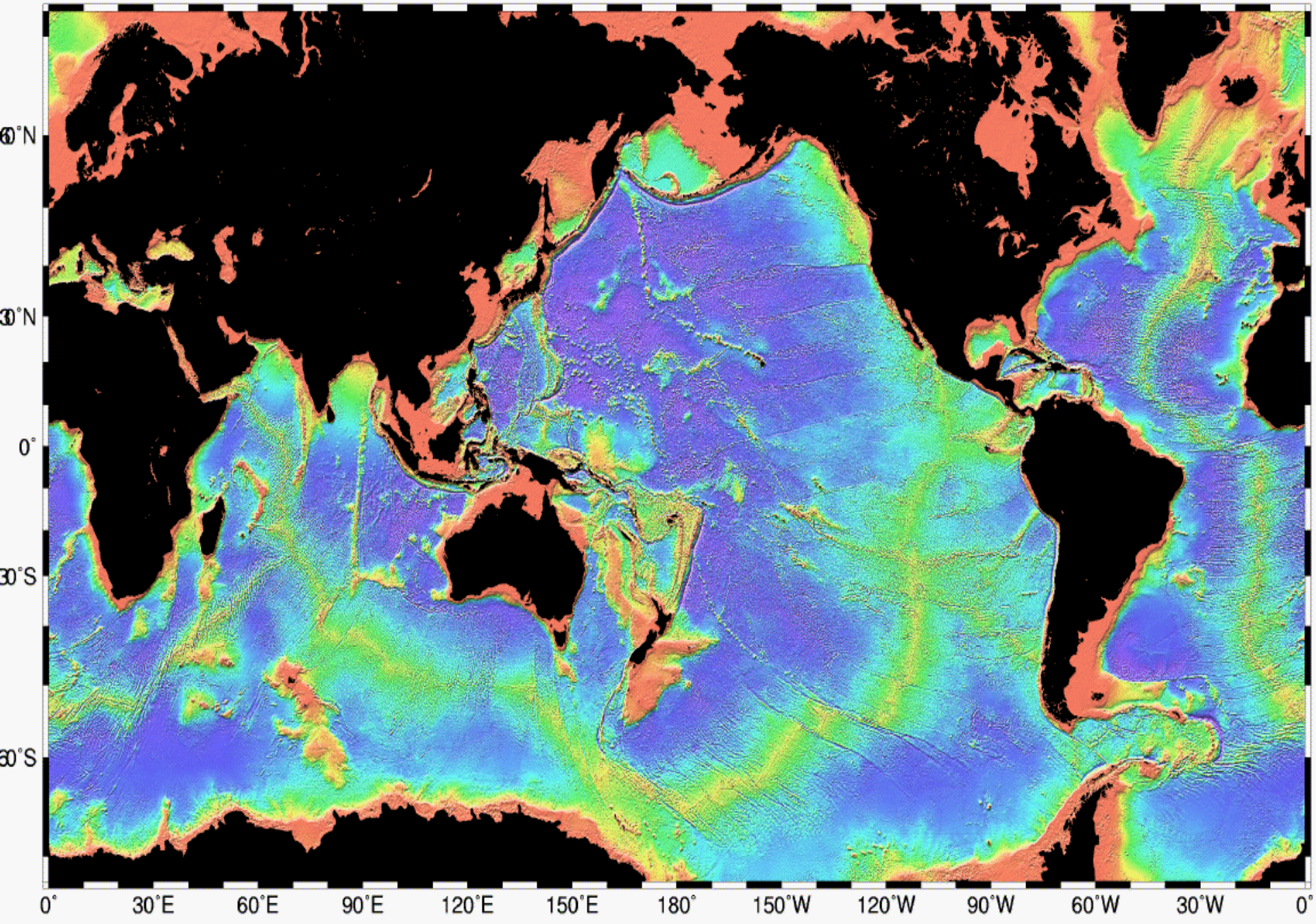


SHAPING THE EARTH – FROM PANGEA…AND POSSIBLY BACK AGAIN!

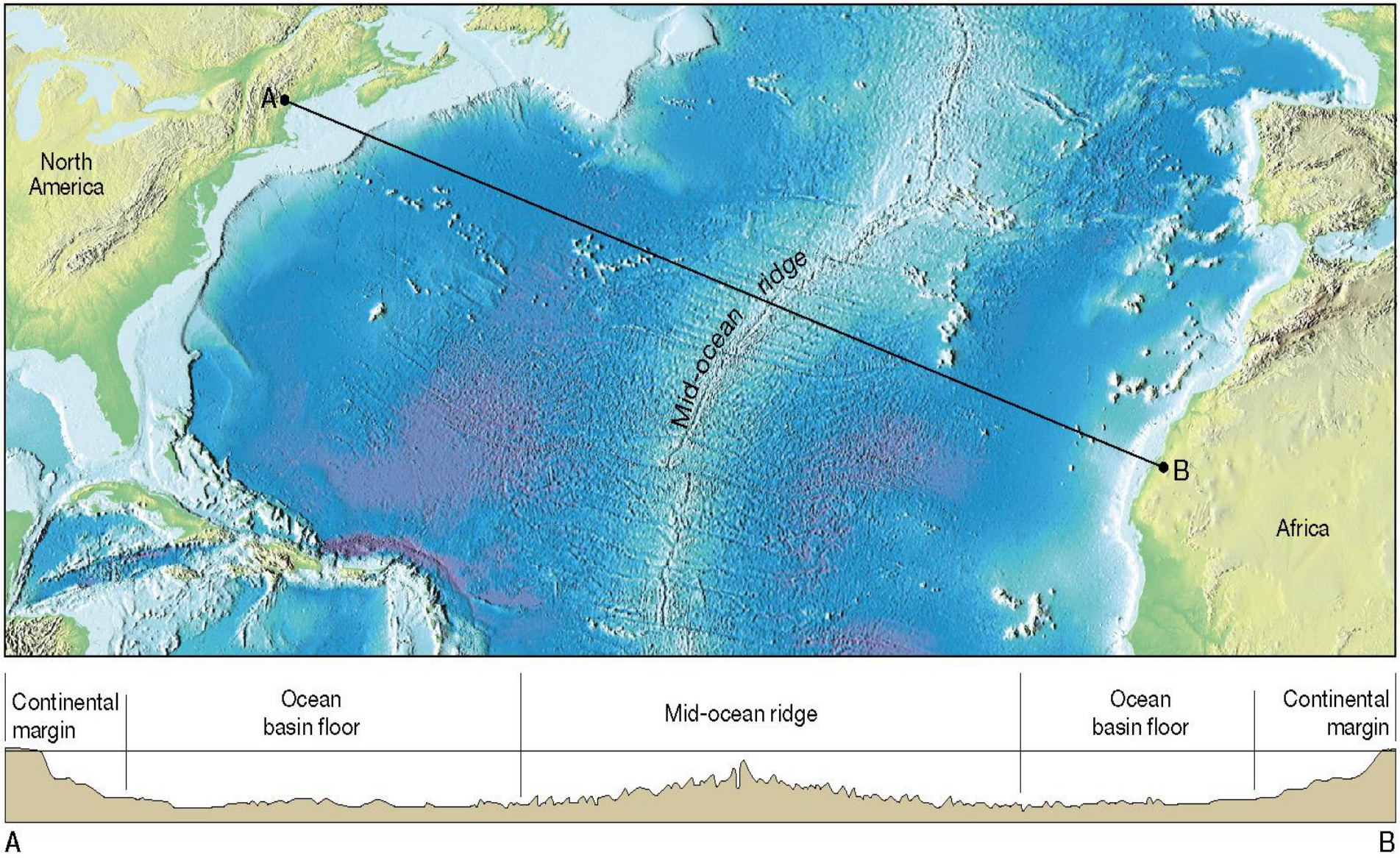
- The ocean floor
- Shape of the ocean basins
- How are we able to date the oceans?
- Looking into the future – where will we be in millions of years time?

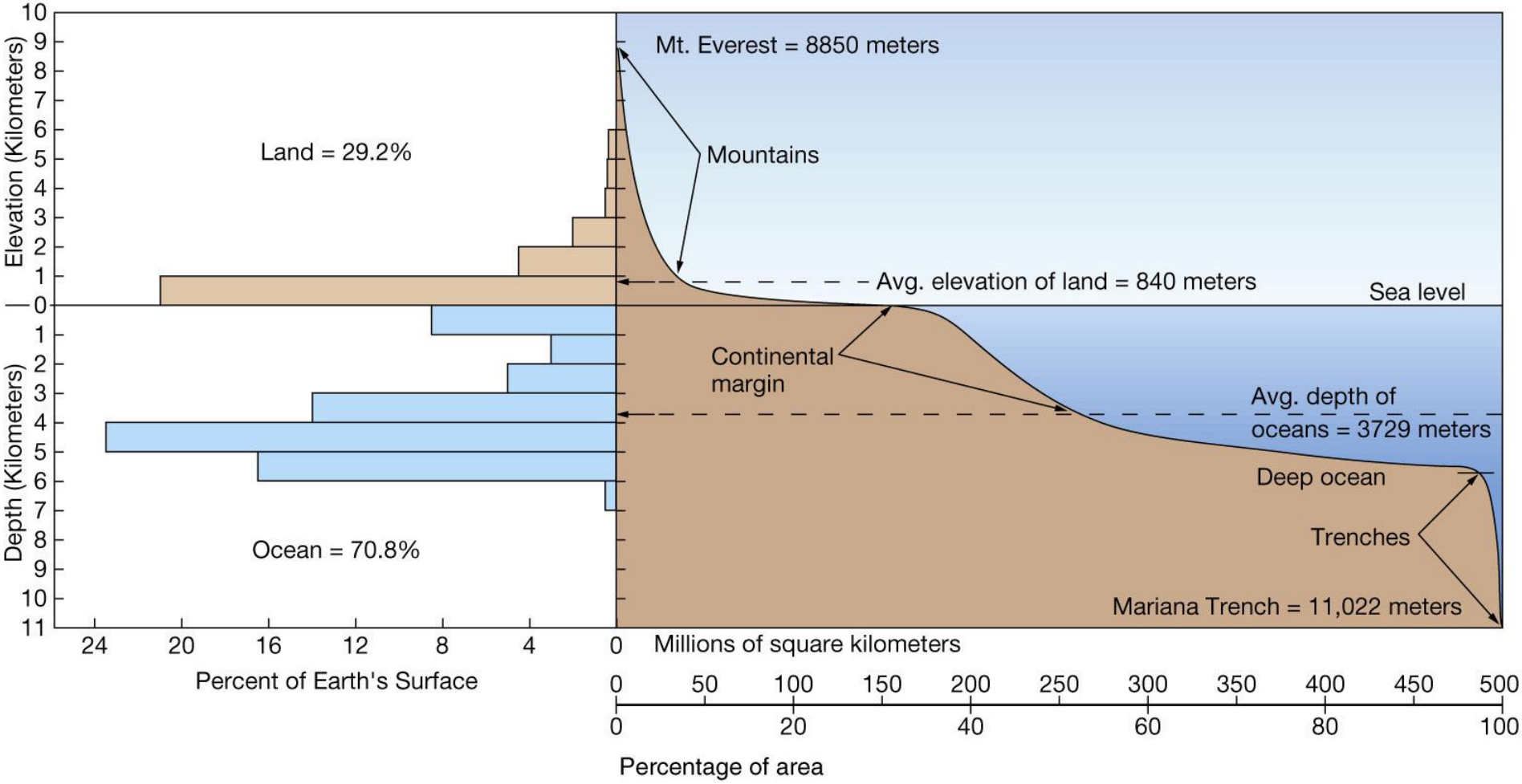
Evidence that Brexit is here to stay!

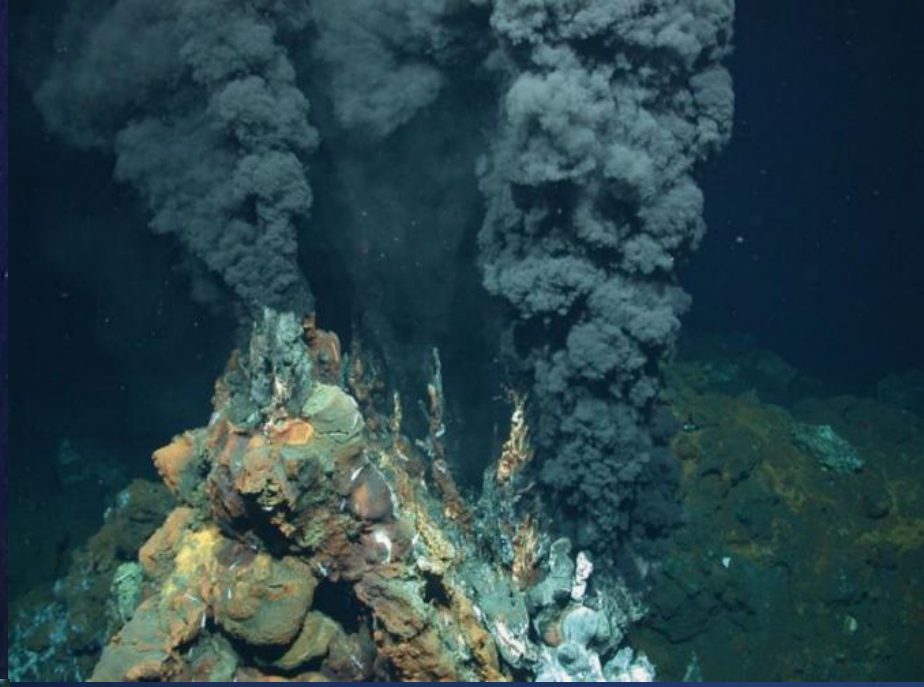


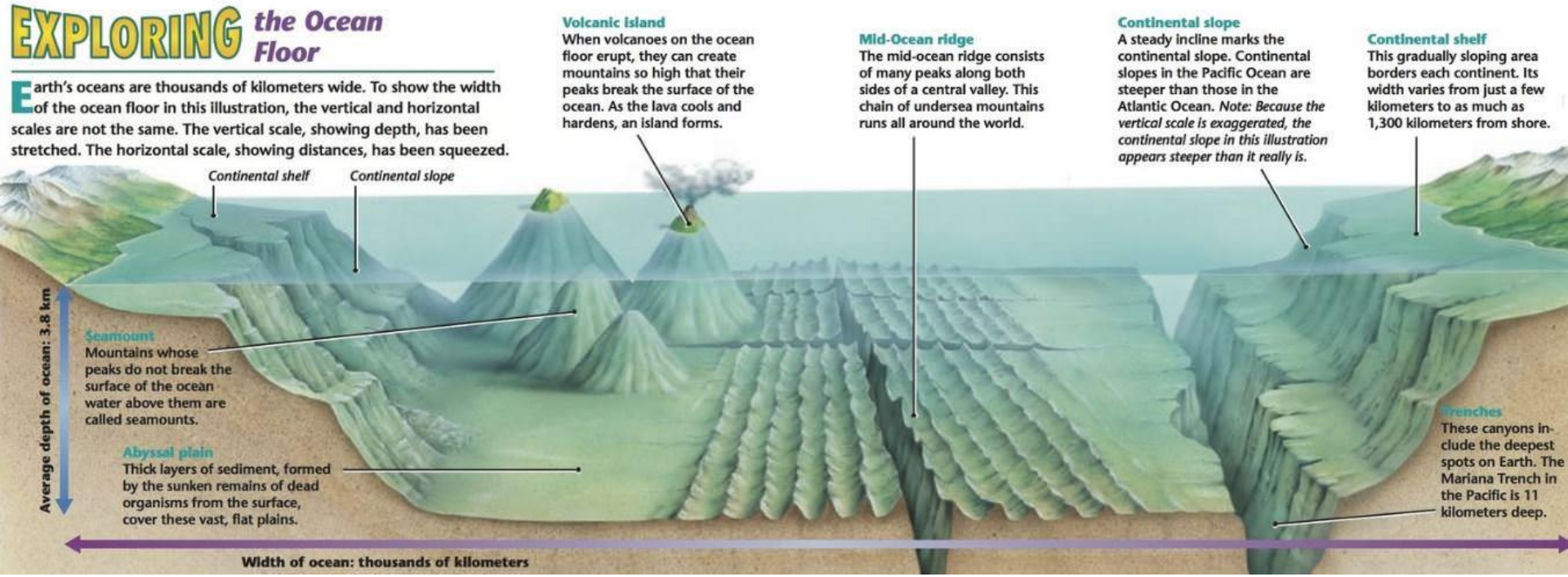
Walter H. F. Smith and David T. Sandwell, Seafloor Topography Version 4.0, SIO, September 26, 1996


SABLE ISLAND
-2218.
Boston
-12.
New York
LAURENTIAN CONE
-15900.
KELVIN SEAMOUNT
-4582.
SOHM ABYSSAL PLAIN
-17400.
HUDSON CANYON
-16200.
BERMUDA
-834.
-18300
HATTERAS ABYSSAL PLAIN
OUTER RIDGE
-17480
-3100.
(2100)
BAHAMA
-18150.
NARES ABYSSAL PLAIN
-19200.
ISLANDS
PUERTO RICO
TRENCH
Atlantic Ocean
10417

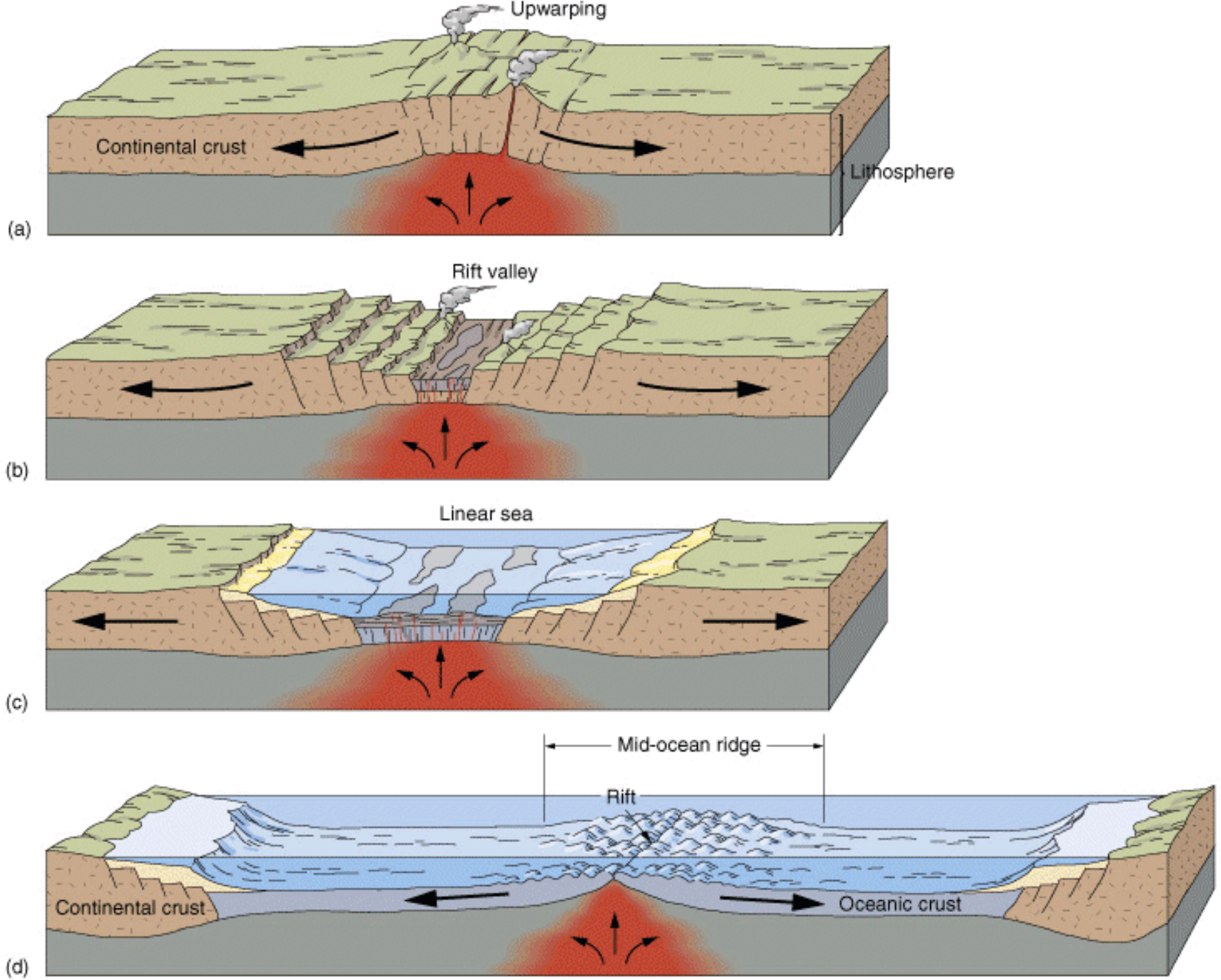

A
North America
Mid-ocean ridge
B
Africa
Continental margin
Ocean basin floor
Mid-ocean ridge
Ocean basin floor
Continental margin
A
B


Elevation (Kilometers)
10
9
8
7
6
5
4
3
2
1
0
Land = 29.2%
Mt. Everest = 8850 meters
Mountains
Avg. elevation of land = 840 meters
Sea level
Continental
margin
Avg. depth of
oceans = 3729 meters
Deep ocean
Trenches
Mariana Trench = 11,022 meters
Depth (Kilometers)
1
2
3
4
5
6
7
8
9
10
11
Ocean = 70.8%
24
20
16
12
8
4
0
Percent of Earth's Surface
Millions of square kilometers
0
50
100
150
200
250
300
350
400
450
500
0
20
40
60
80
100
Percentage of area

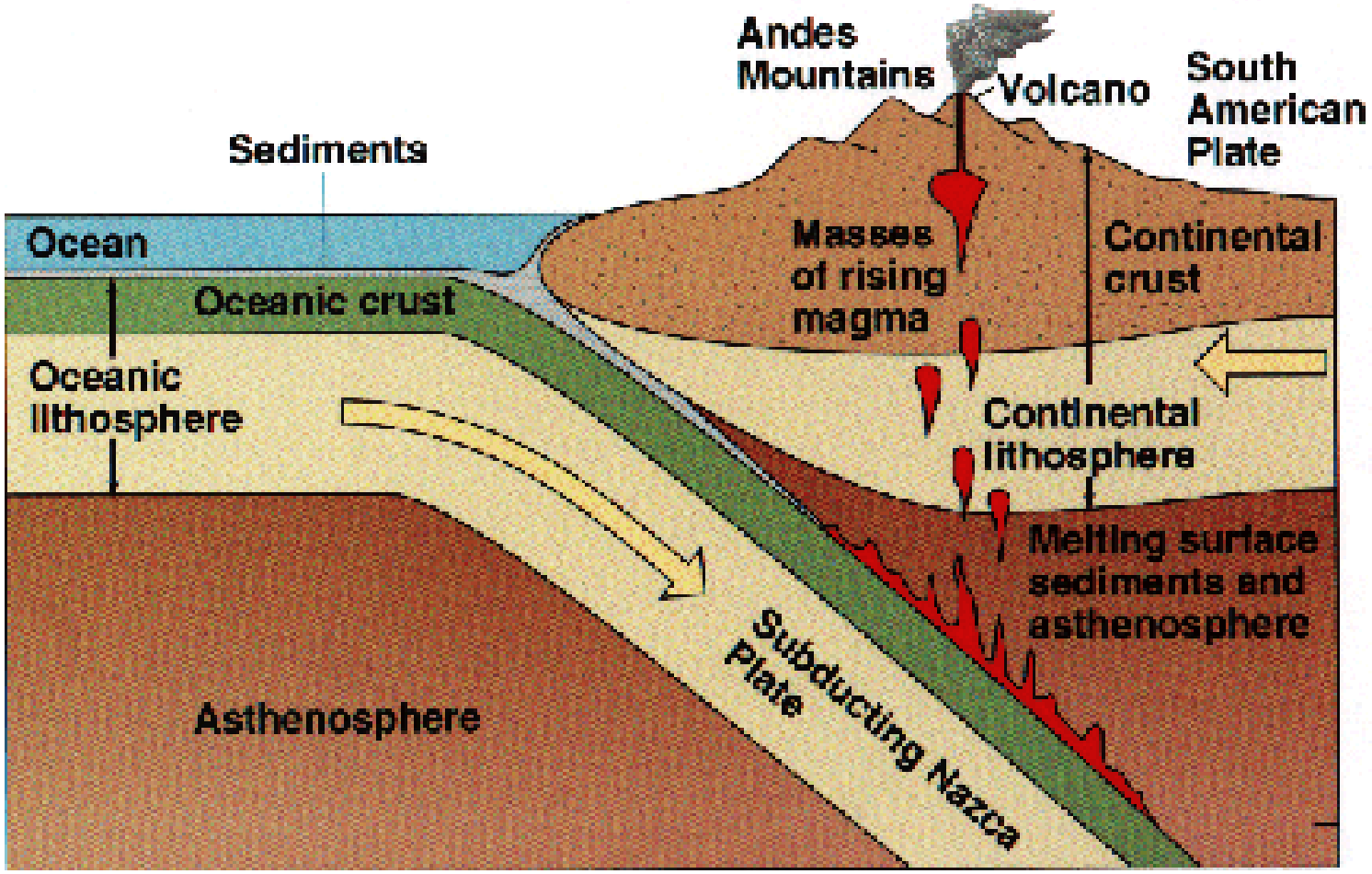




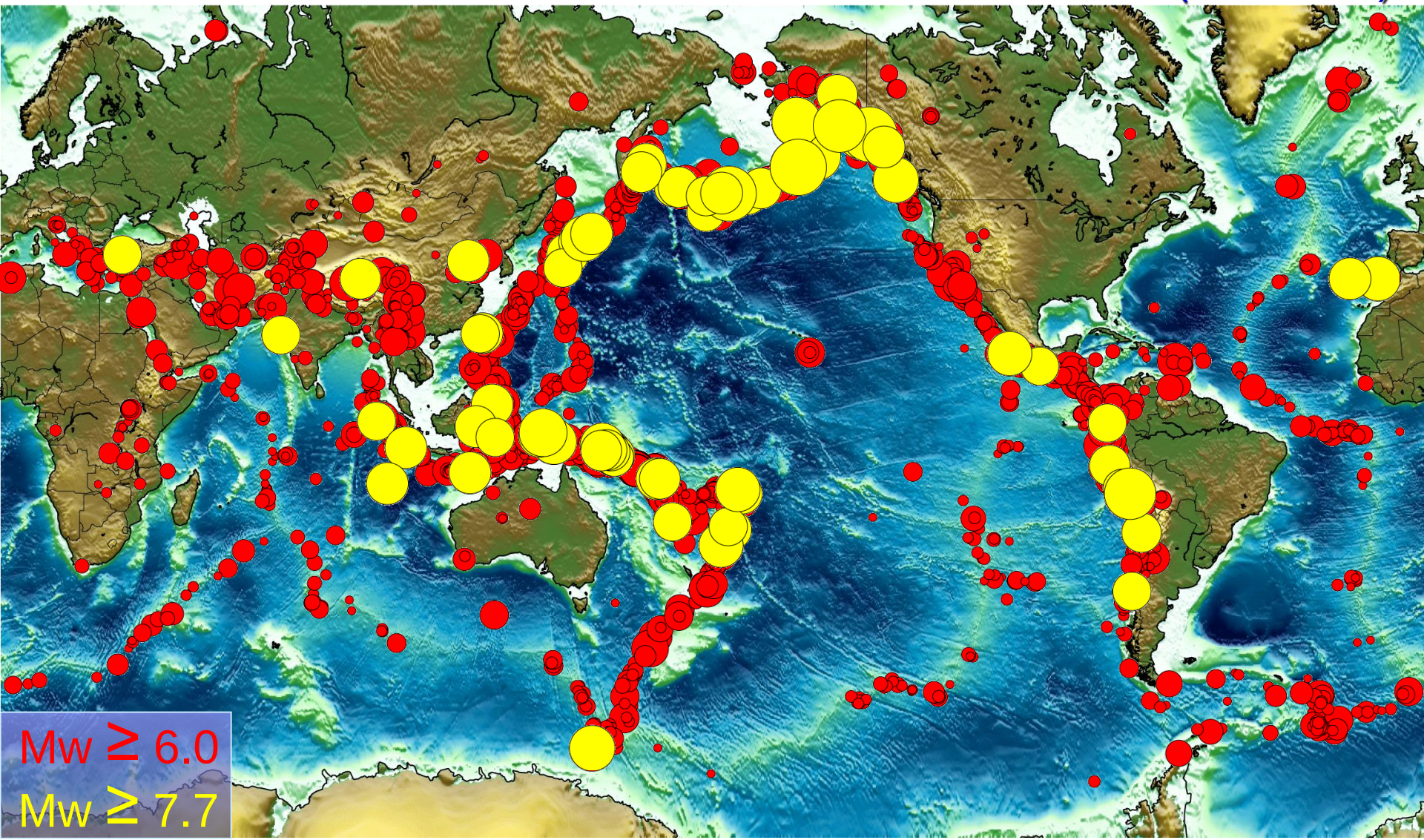
So how do the ocean basins form?


Upwarping
Continental crust
Lithosphere
(a)
Rift valley
(b)
Linear sea
(c)
Mid-ocean ridge
Rift
Continental crust
Oceanic crust
(d)

Because Earth's size is constant, expansion of the crust in one area requires destruction of the crust elsewhere – these are called subduction zones and >6000 m deep sea trenches.



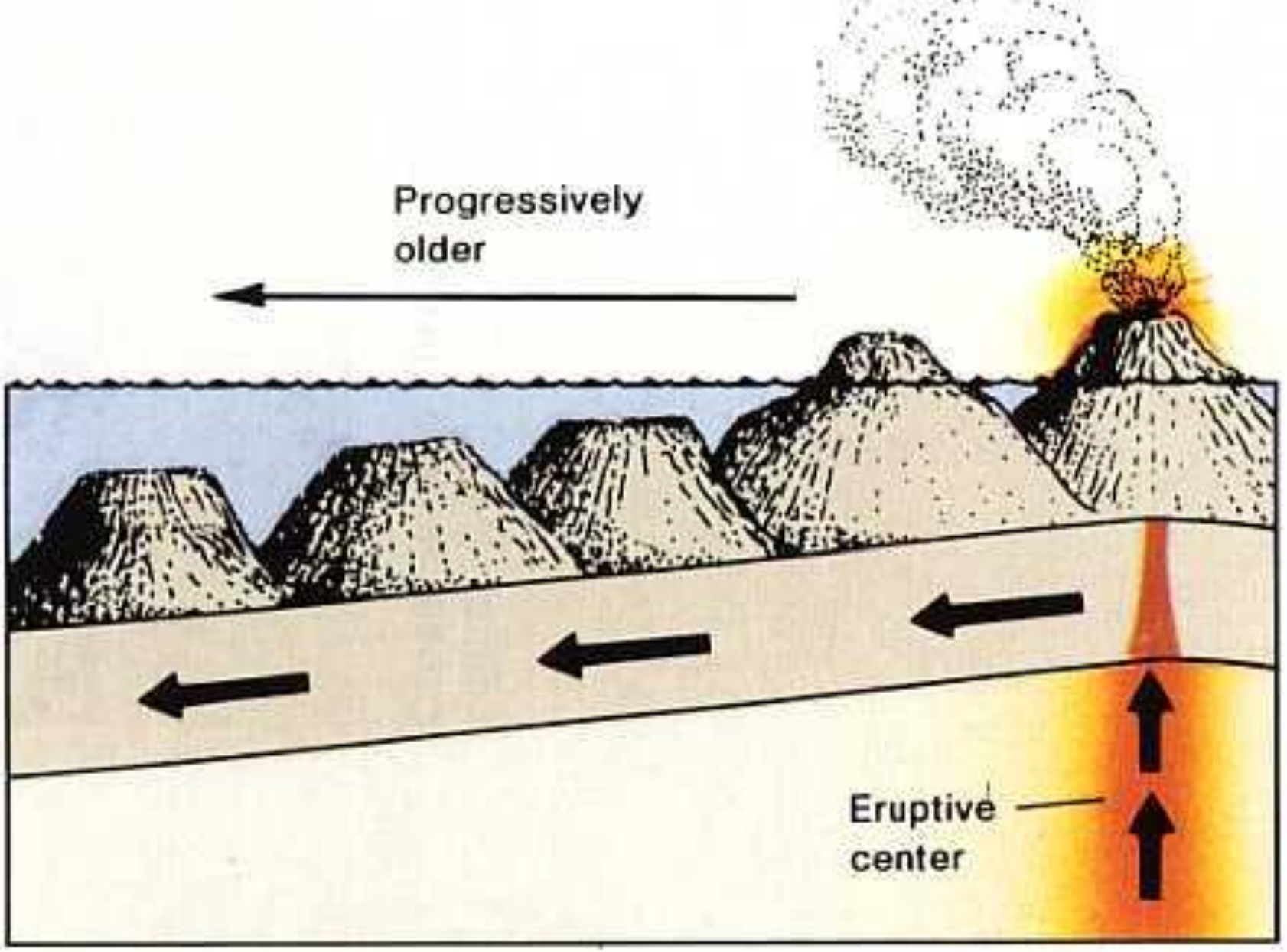
(1898-2003)



Many large earthquakes occur along subduction zones

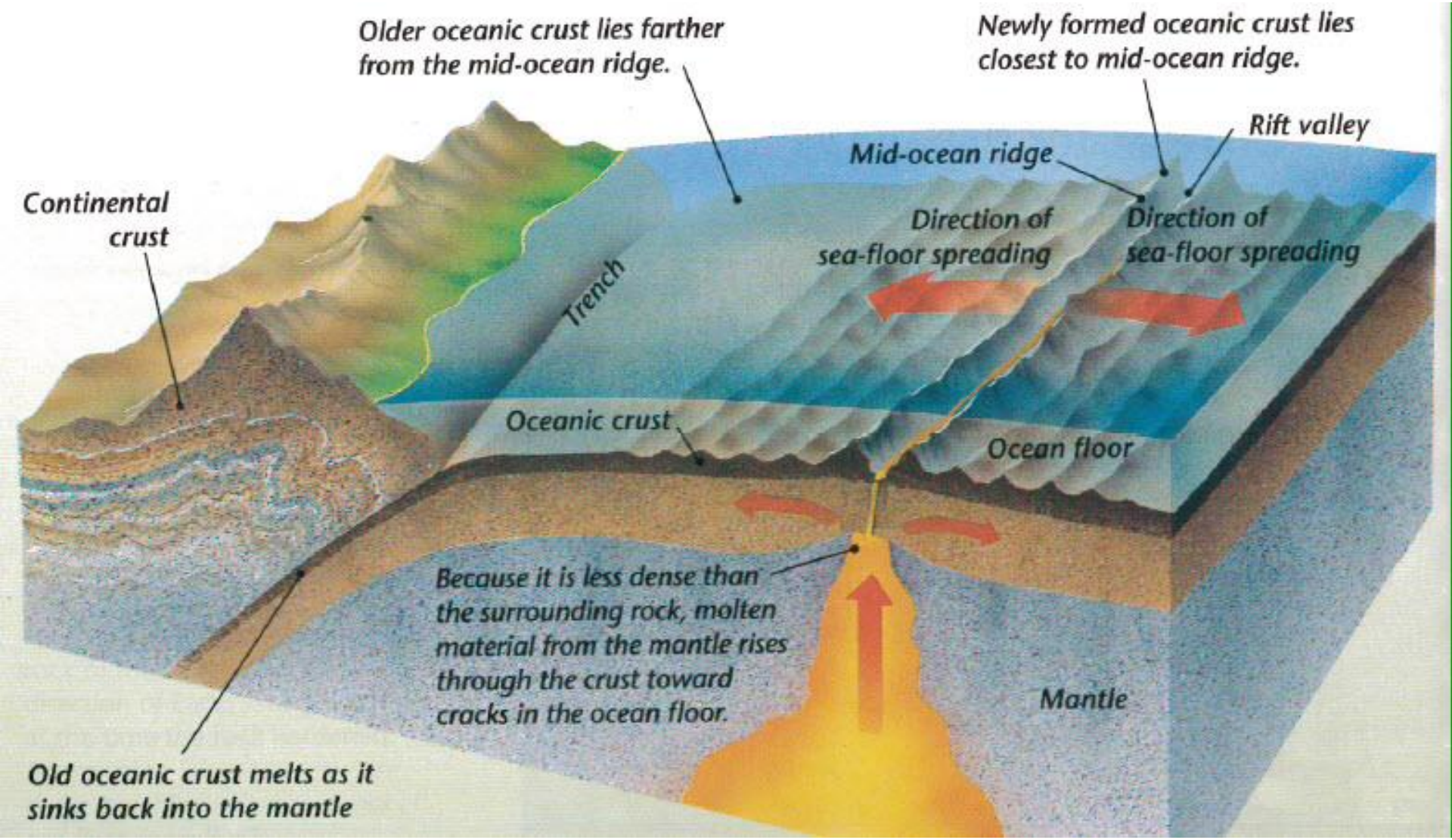
Most “Great” earthquakes are subduction mega-thrust events

14th November 1963 seamen, observed an undersea eruption that originated at a 130 m. The island of Surtsey rose to 169 m above sea level and an area of 2,5km².

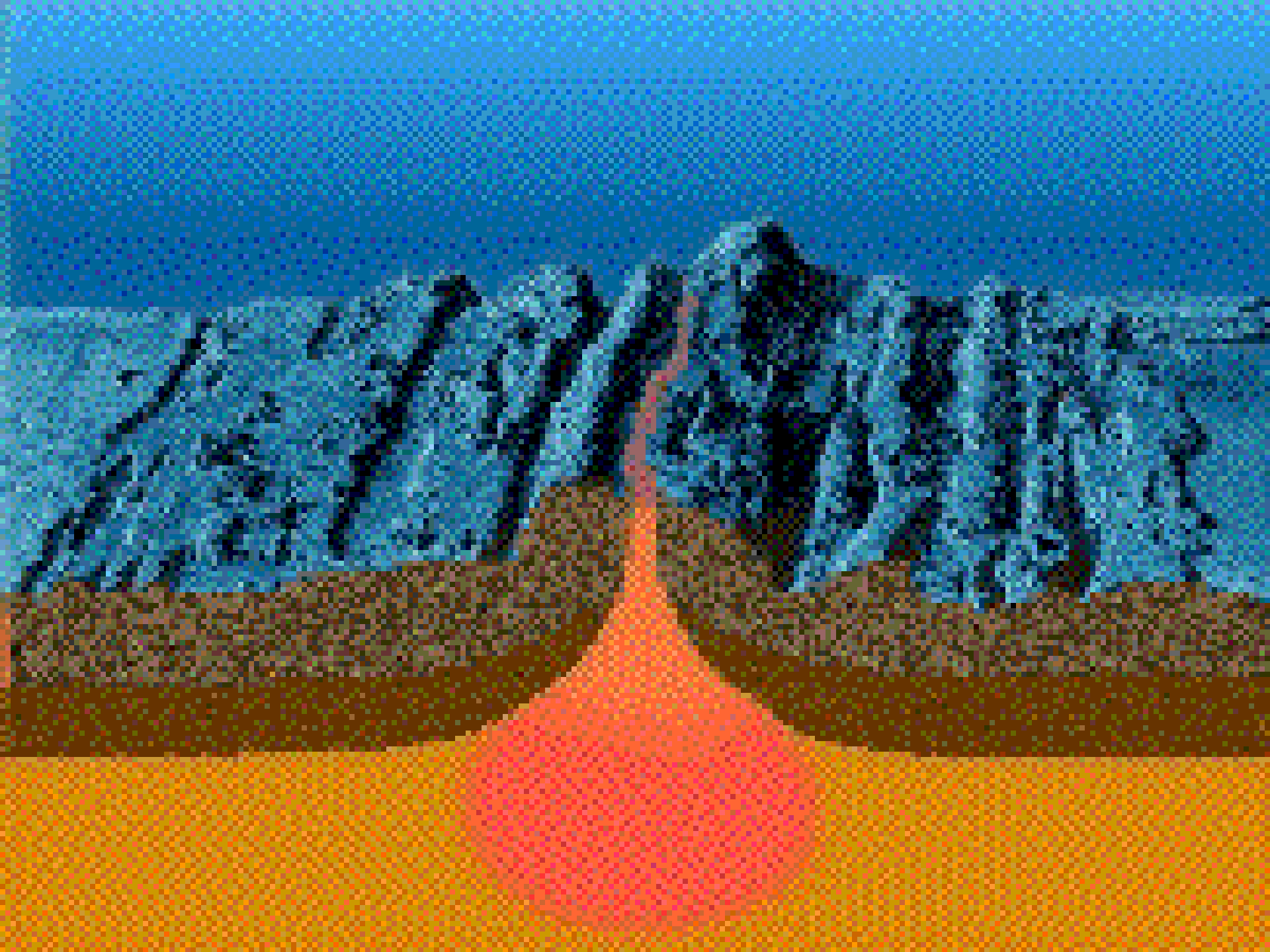


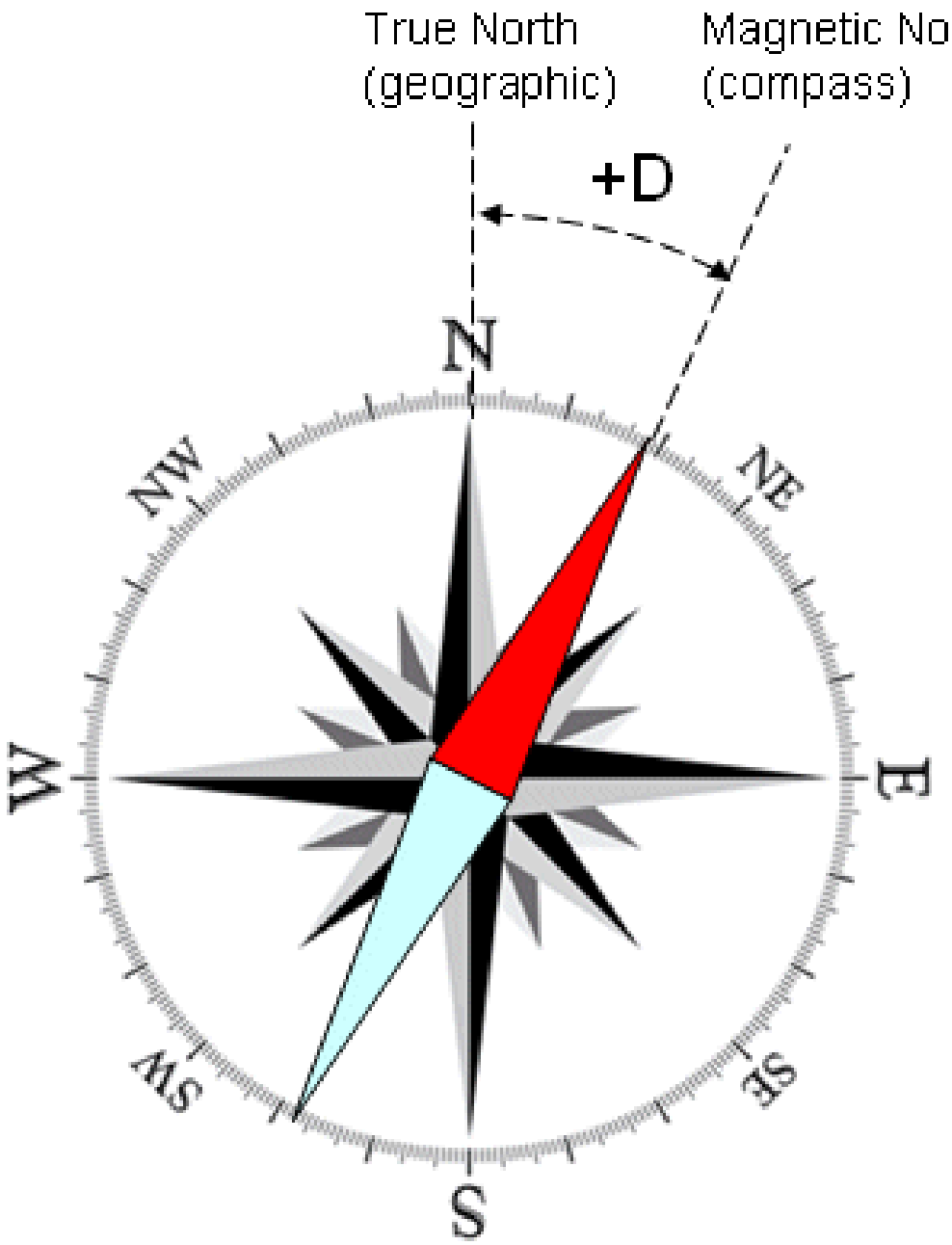
Sea Floor Moving Over a Mantle Plume

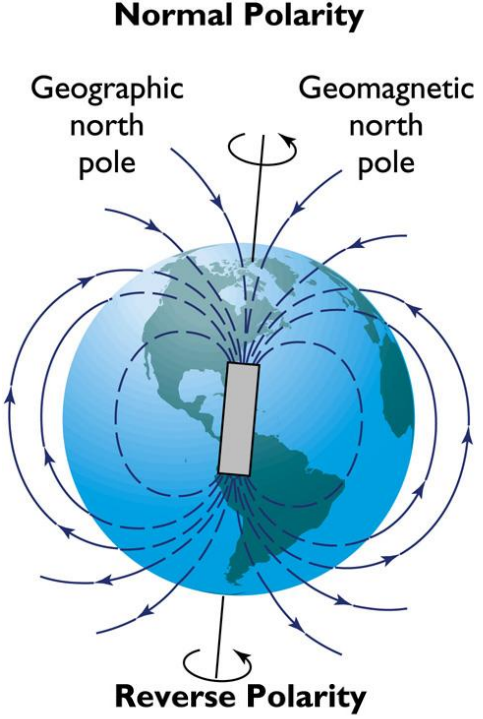

Tristan da Cunha – in the middle South Atlantic!

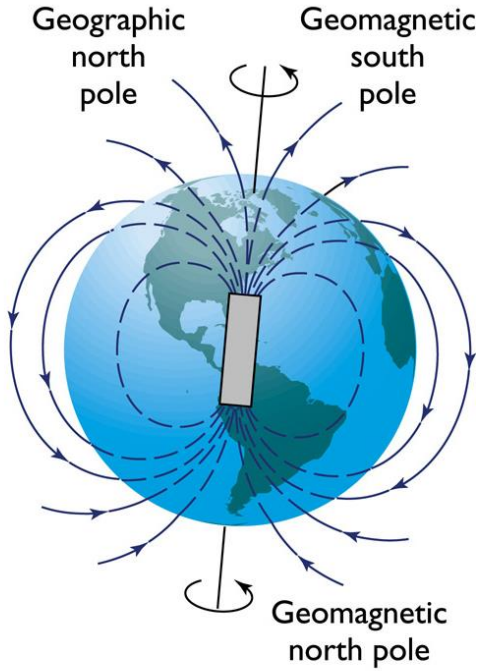


But how can we date the floor?



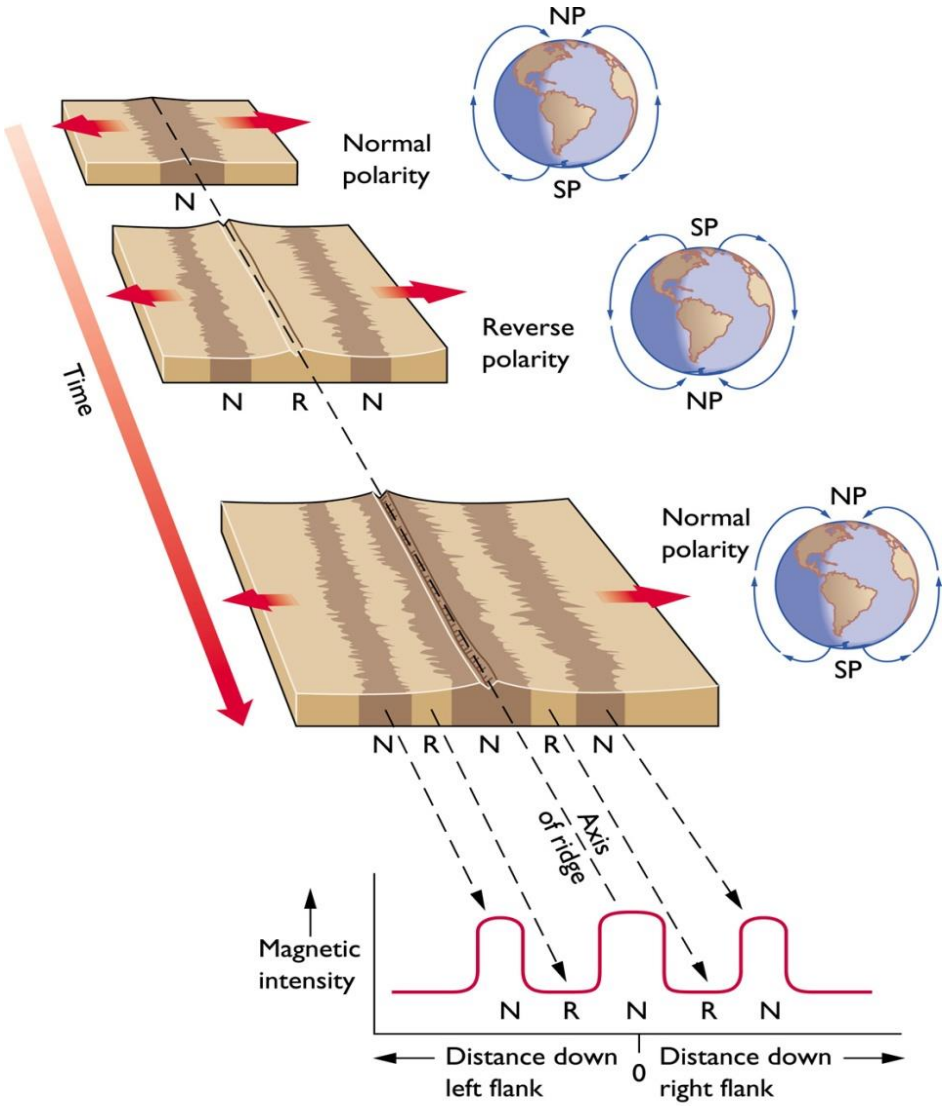

True North
(geographic)
Magnetic North
(compass)
+D
N
NE
E
SE
S
SW
W
NW


Normal Polarity
Geographic
north
pole
Geomagnetic
north
pole
Reverse Polarity

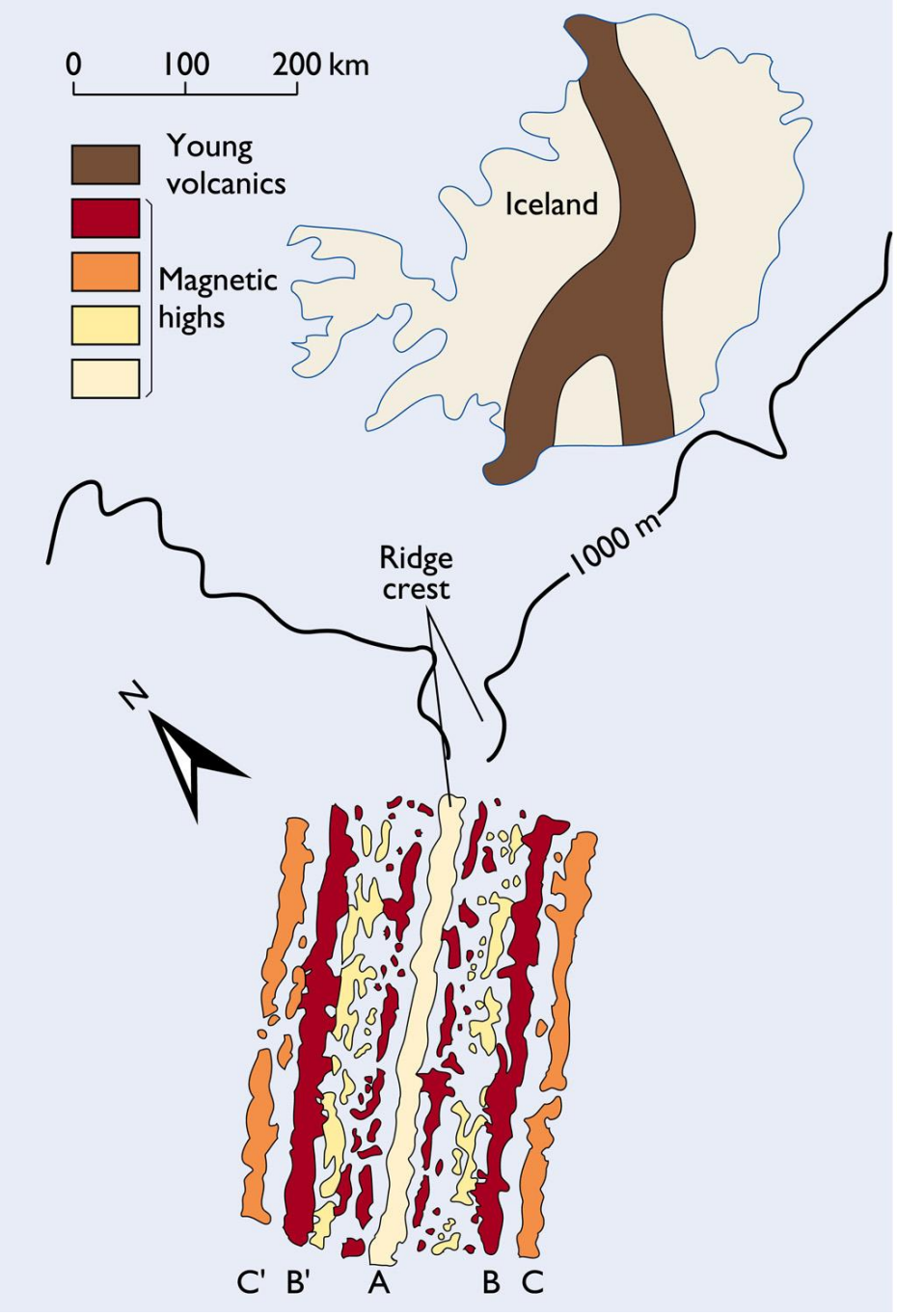

Geographic
north
pole
Geomagnetic
south
pole
Geomagnetic
north pole

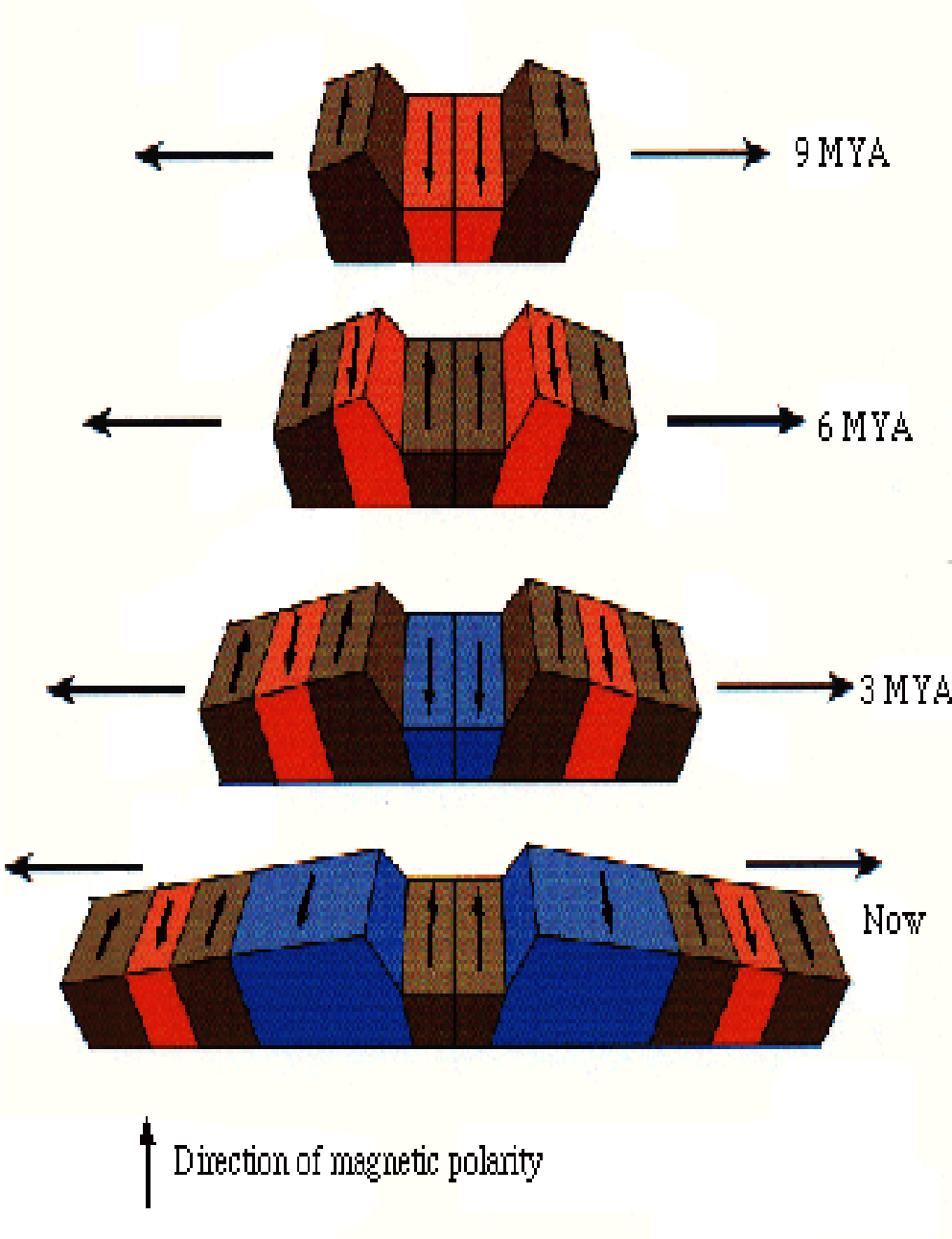
Rocks forming at the ridge crest record the magnetism existing at the time they solidify – crystal structure.

- ✓ **Normal polarity = stronger, positive magnetic field.**
- ✓ **Abnormal polarity = weaker, negative field**



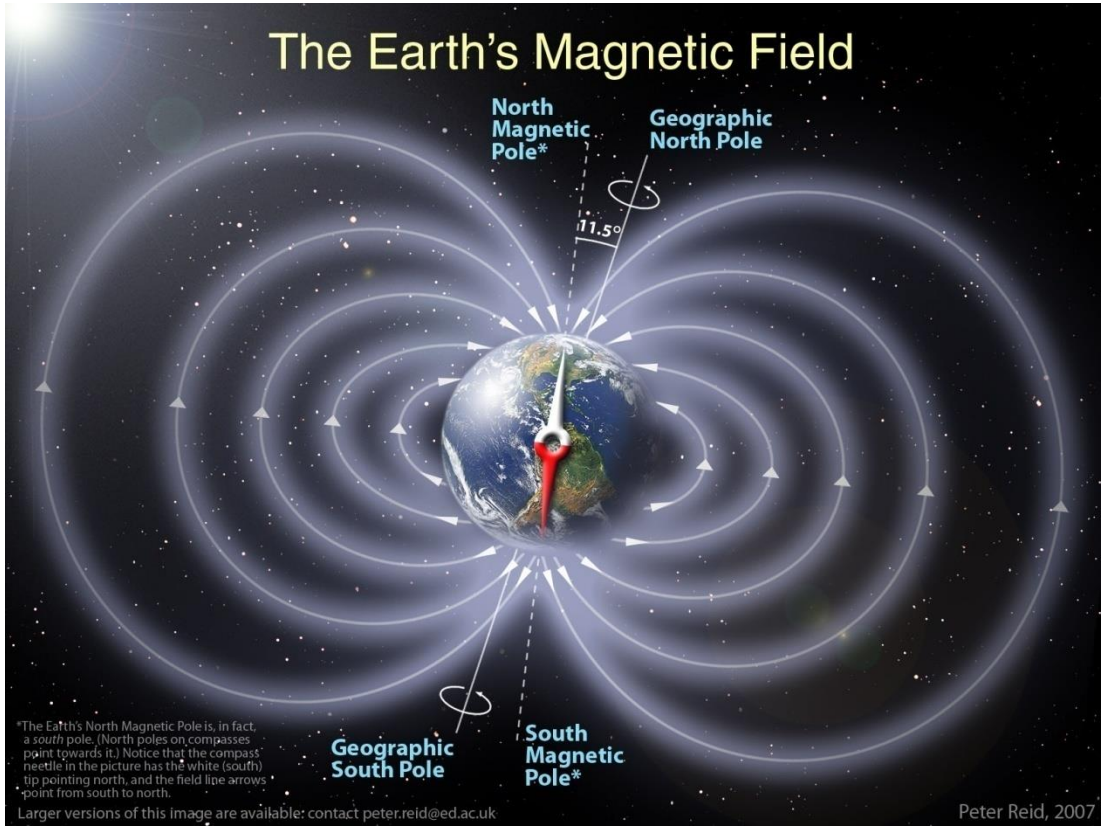
(a) MAGNETIC ANOMALY STRIPES


0
100
200 km
Young volcanics
Magnetic highs
Iceland
1000 m
Ridge crest
N
C' B' A B C

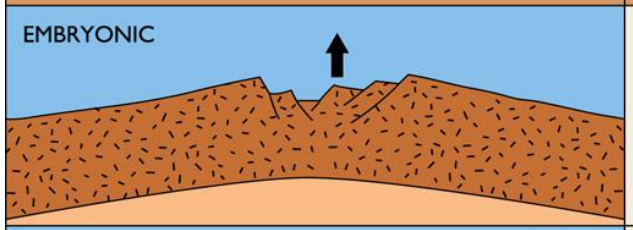
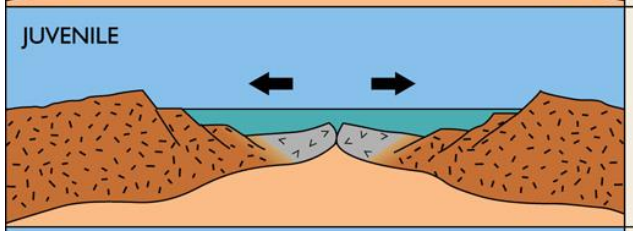
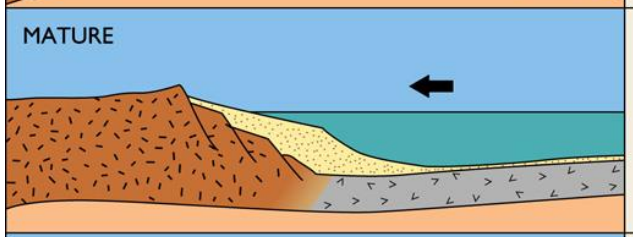
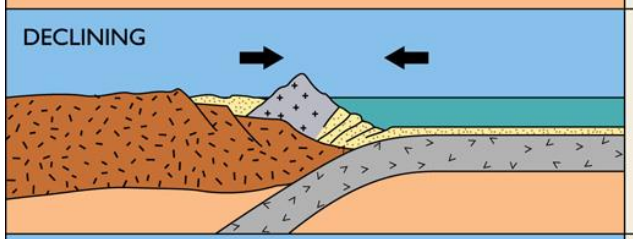
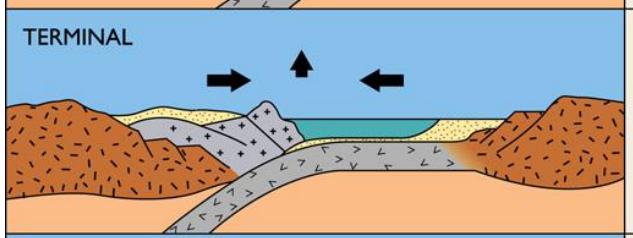
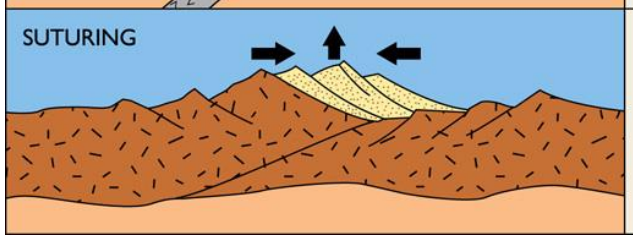

9 MYA
6 MYA
3 MYA
Now
Direction of magnetic polarity

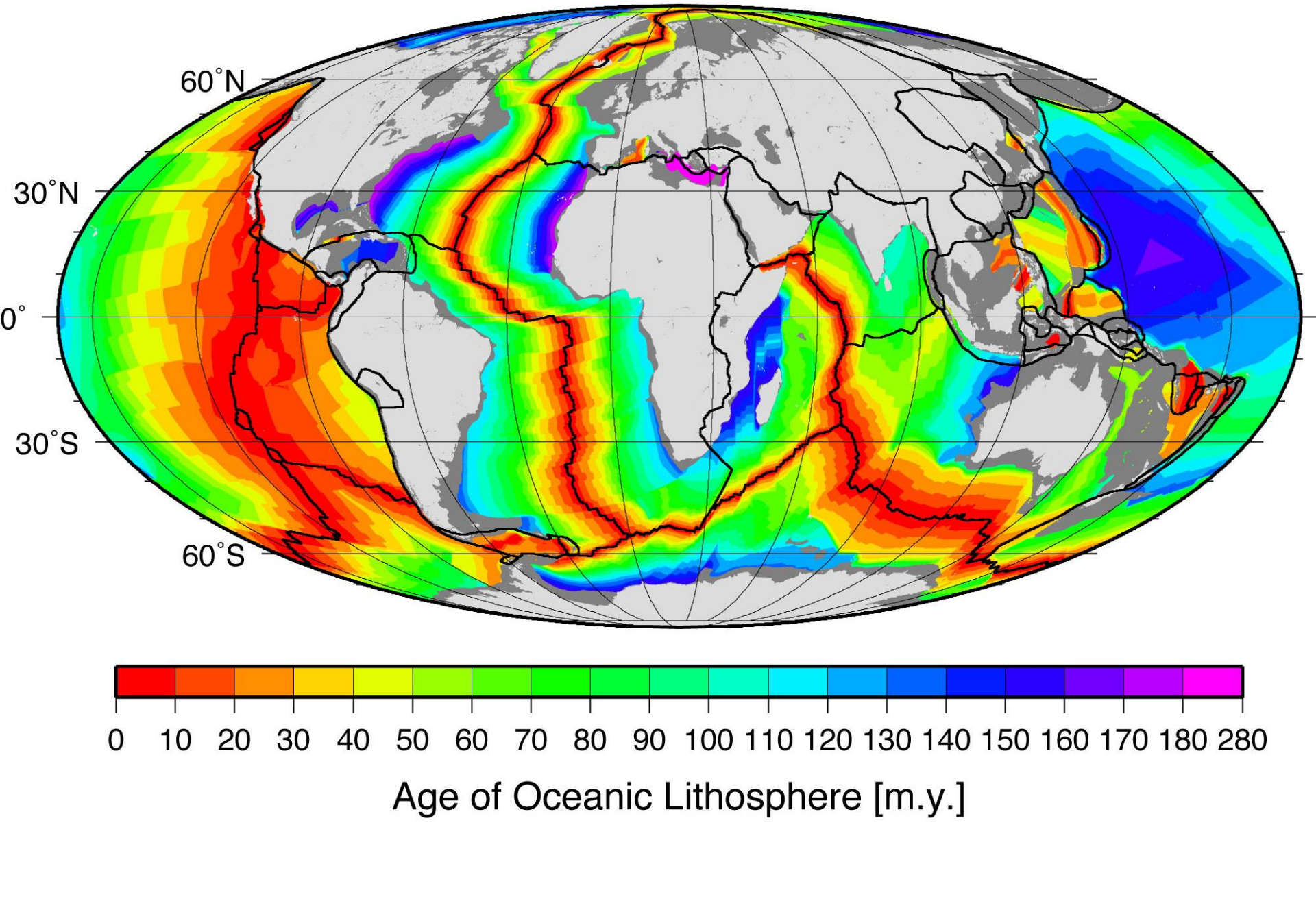
“model simulations reveal that compasses could start pointing south in mere thousands of years!”

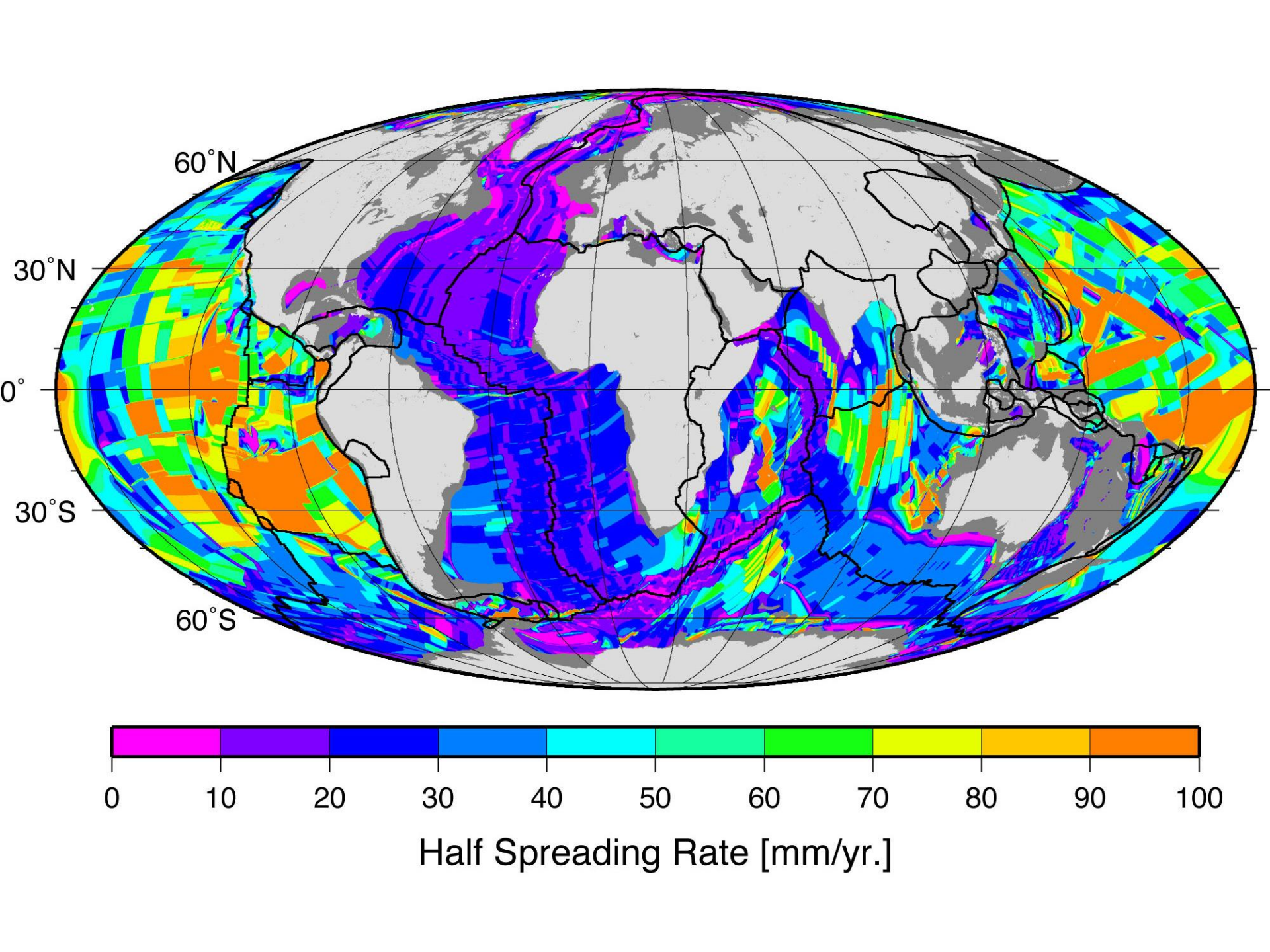
- **What are the causes?**
  - **Instability in which the magnetic field flips over!**
  - **Chaotic nature of the liquid metal in the earth’s core**
  - **Links with solar magnetic field**



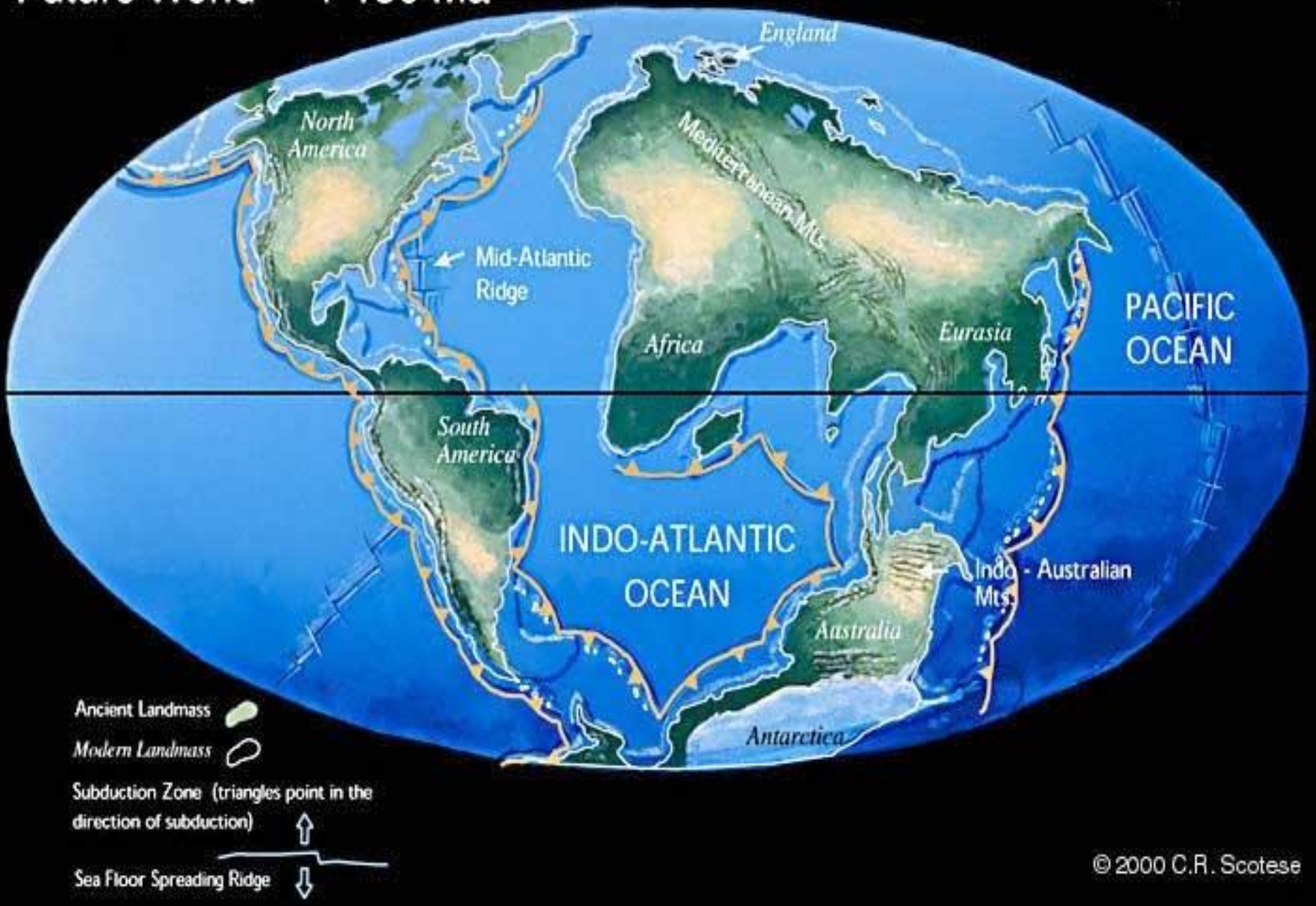
Scientists have revealed that the earths liquid core is rotating slower than in previous years

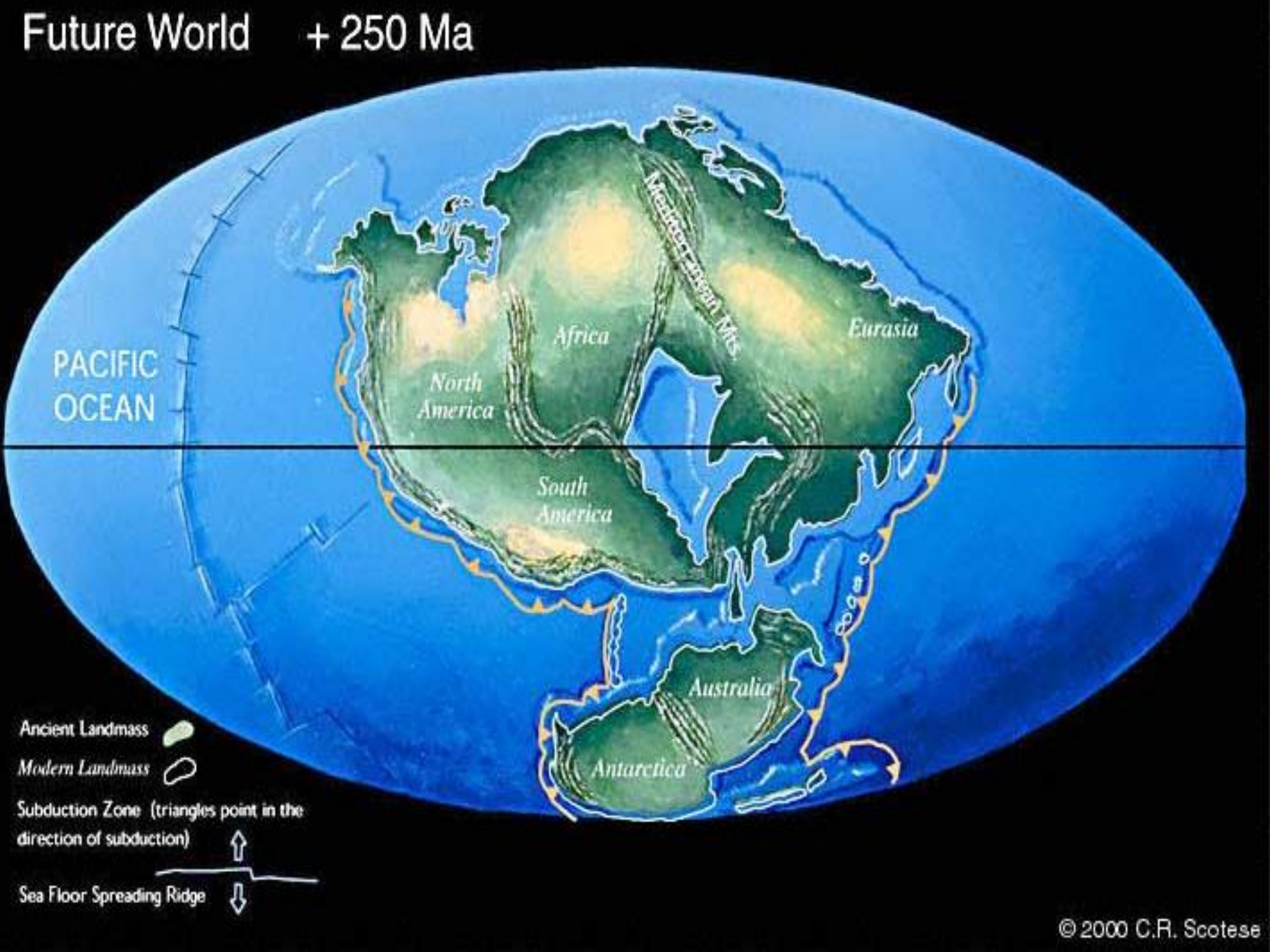
STAGE	MOTION	PHYSIOGRAPHY	EXAMPLE
	Uplift	Complex system of linear rift valleys on continent	East African rift valleys
	Divergence (spreading)	Narrow seas with matching coasts	Red Sea
	Divergence (spreading)	Ocean basin with continental margins	Atlantic, Indian, and Arctic oceans
	Convergence (subduction)	Island arcs and trenches around basin edge	Pacific Ocean
	Convergence (collision) and uplift	Narrow, irregular seas with young mountains	Mediterranean Sea
	Convergence and uplift	Young to mature mountain belts	Himalayas


60˚N
30˚N
0˚
30˚S
60˚S
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 280
Age of Oceanic Lithosphere [m.y.]


60˚N
30˚N
0˚
30˚S
60˚S
0
10
20
30
40
50
60
70
80
90
100
Half Spreading Rate [mm/yr.]

Future World + 150 Ma




Future World + 250 Ma
PACIFIC OCEAN
Mediterranean Mts.
Africa
Eurasia
North America
South America
Australia
Antarctica
Ancient Landmass
Modern Landmass
Subduction Zone (triangles point in the direction of subduction)
Sea Floor Spreading Ridge
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