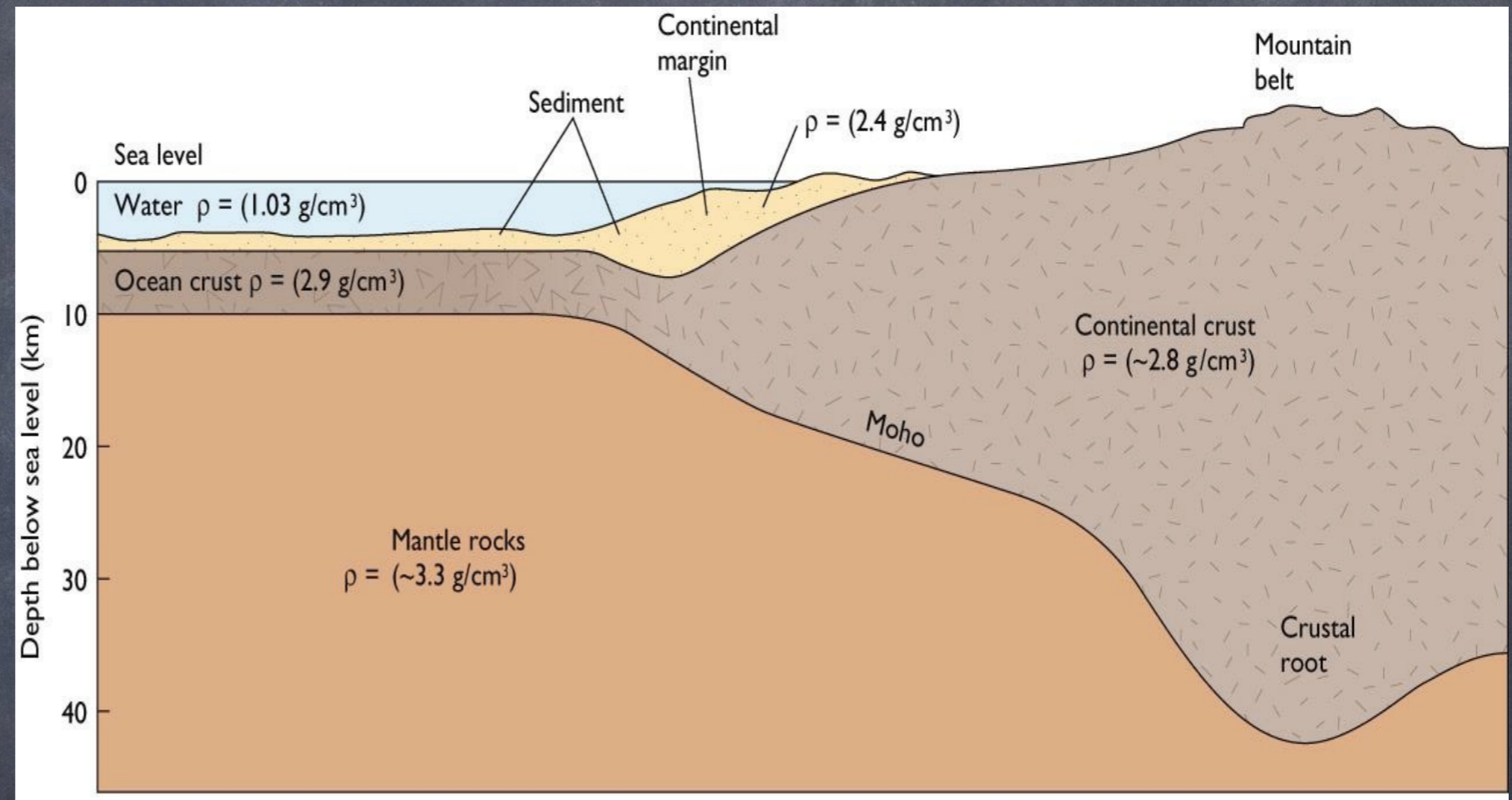


Geography of the world's oceans and major current systems

Lecture 2

Geologic Differences between Continents and Ocean Basins

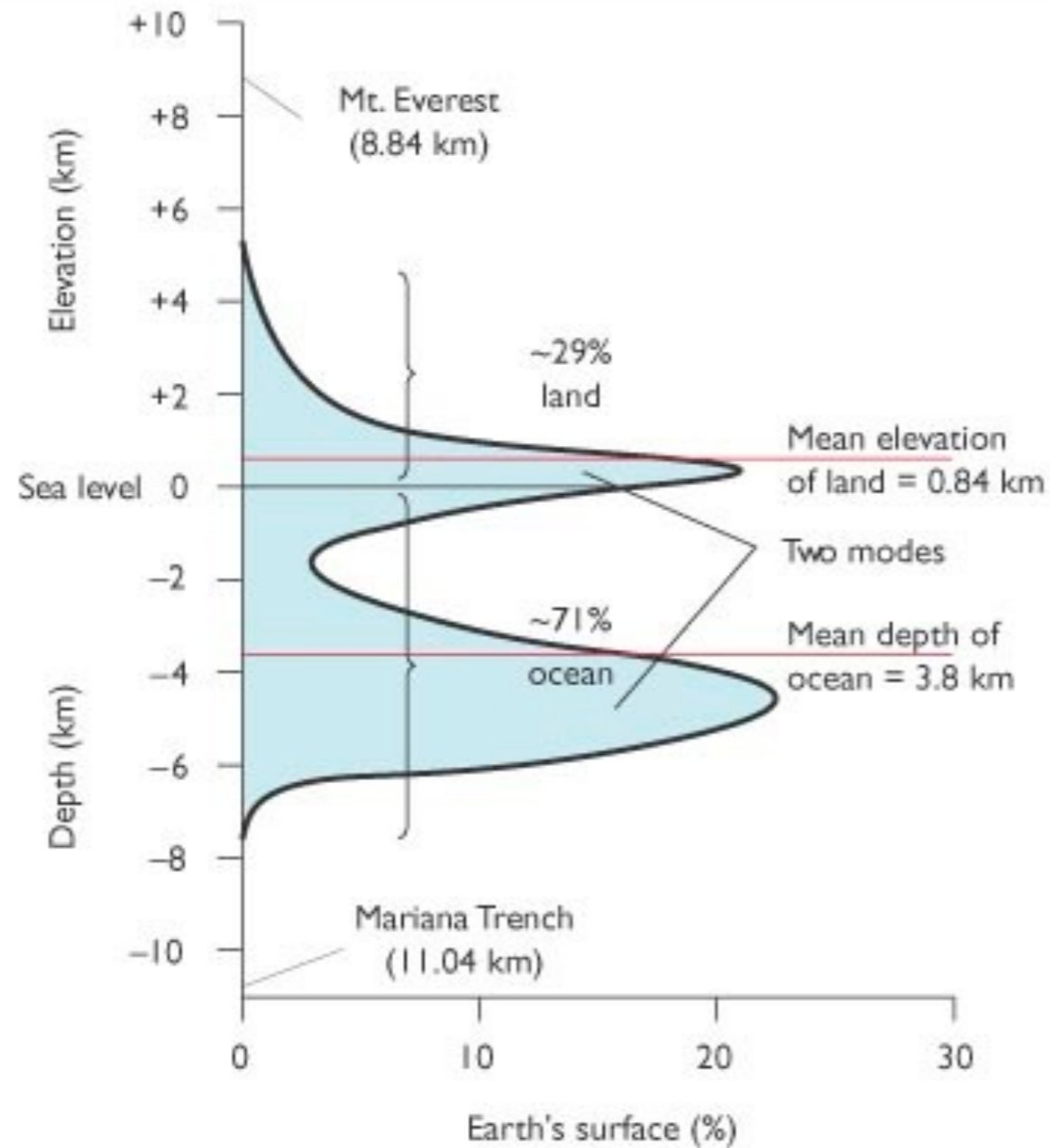
Oceanic crust is thin and dense.
Continental crust is thick and light.



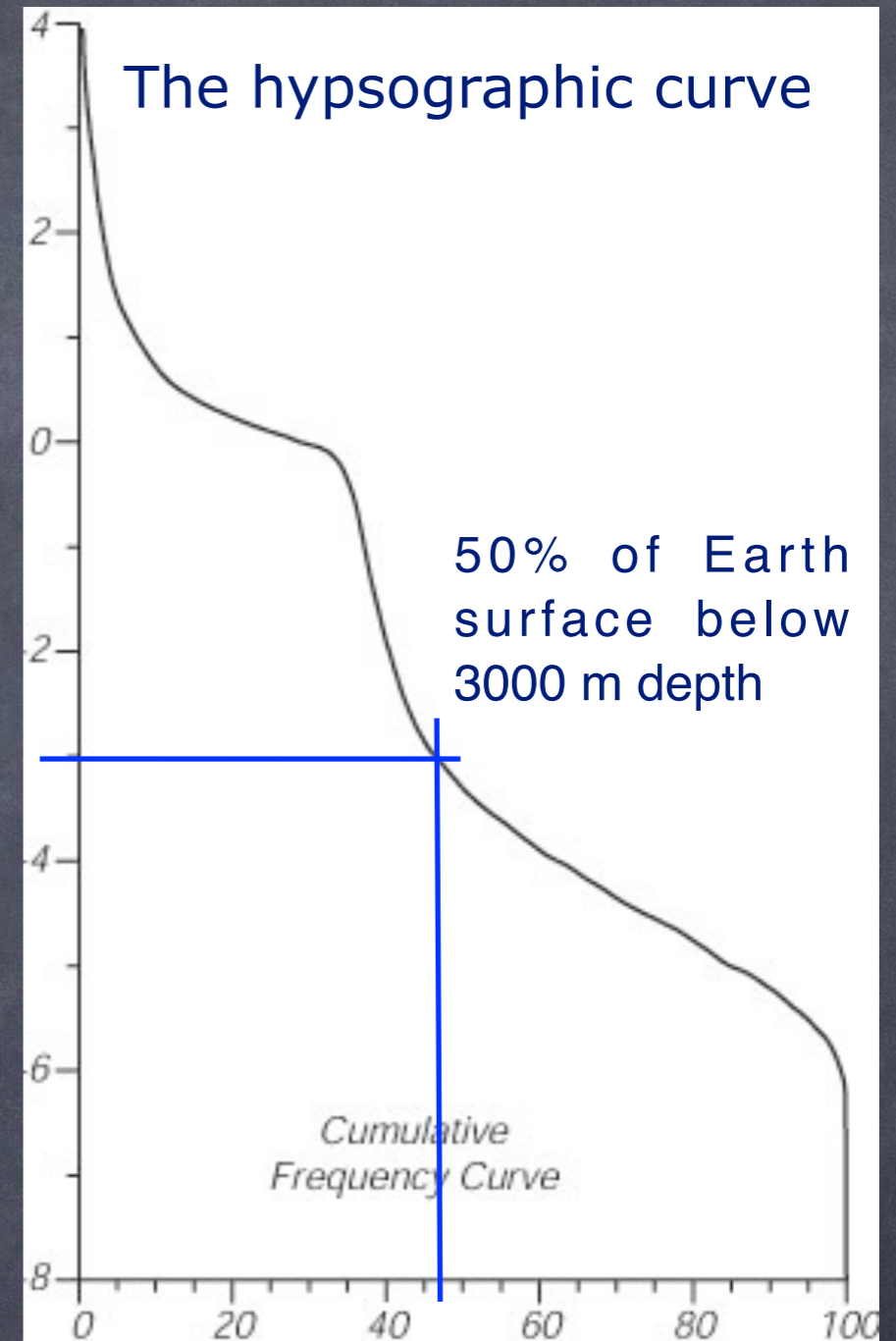
- **Continental crust** is mainly composed of granite, a light colored, lower density (2.8 gm/cm^3) igneous rock rich in aluminum, silicon and oxygen.
- **Oceanic crust** is composed of basalt, a dark colored, higher density (2.9 gm/cm^3) volcanic rock rich in silicon, oxygen and magnesium.

Isostasy is a Geological term referring to the gravitational equilibrium between the Earth's crust (lithosphere) and mantle (asthenosphere) such that the tectonic plates (continental and ocean crusts) "float" at an elevation which depends on their thickness and density.

Oceanic crust floats lower on the mantle.

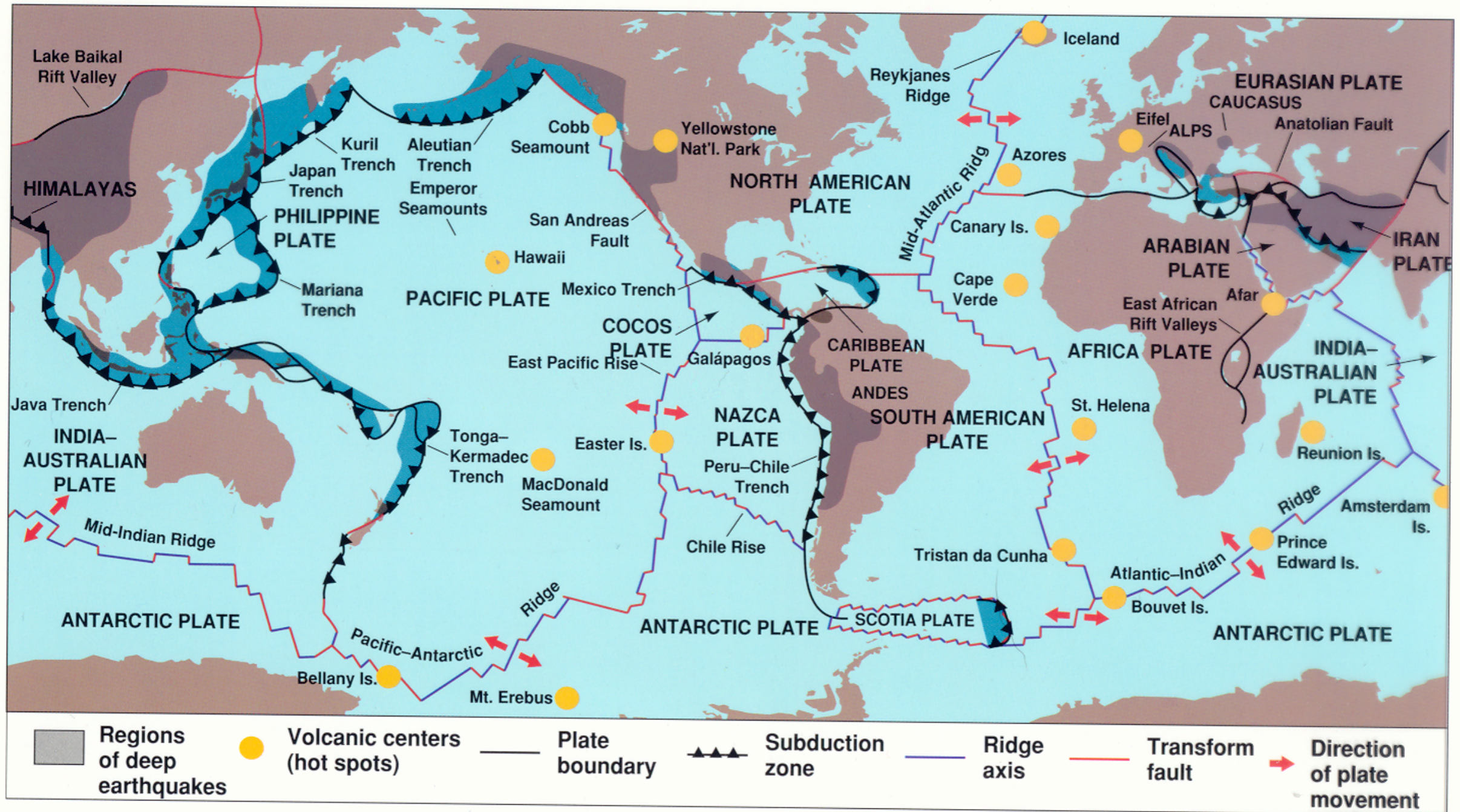


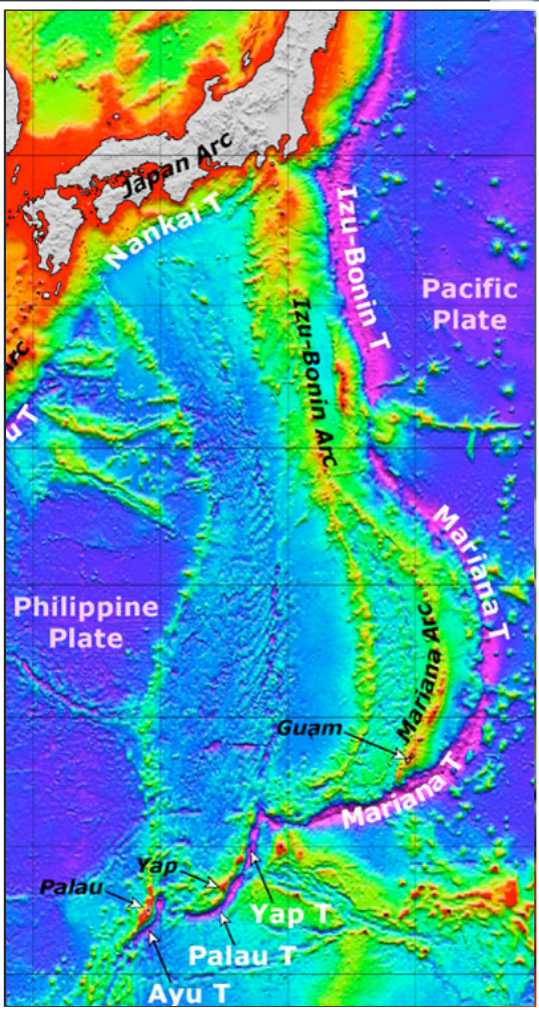
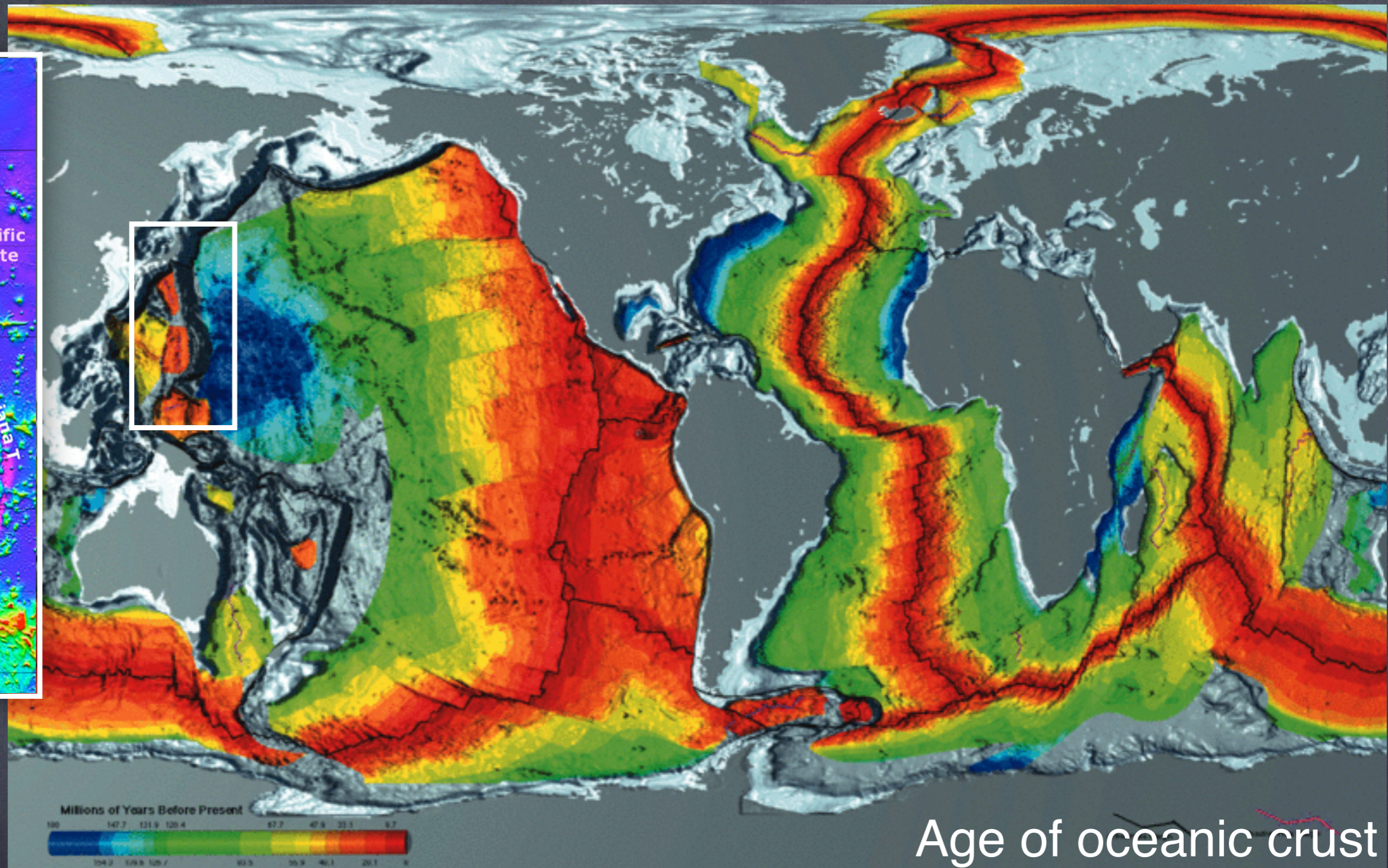
(b) FREQUENCY PLOT OF TOPOGRAPHY AND BATHYMETRY



Elevation of Earth's surface has a bimodal distribution:
 29% land at +0.8 km mean elevation
 71% ocean at -3.8 km mean elevation

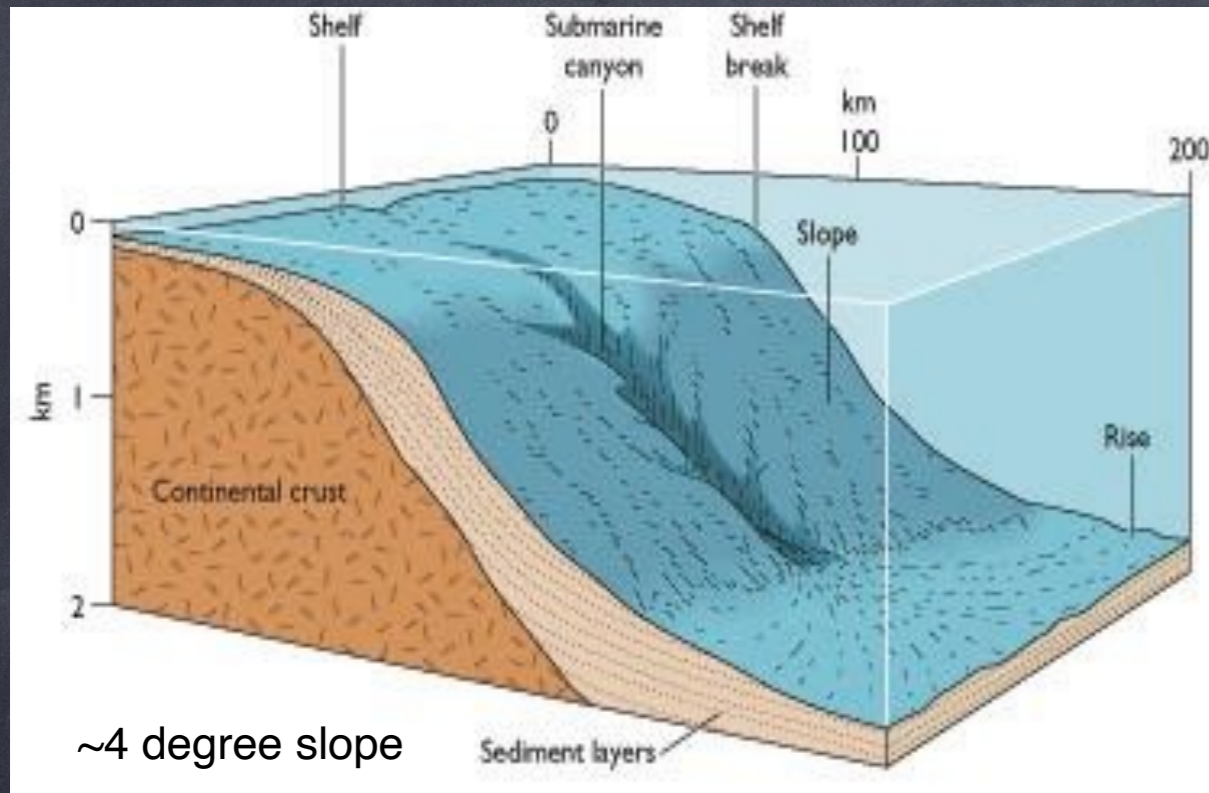
In the 1960's there was a geological revolution: Earth's crust is in motion, with rifts, subduction zones, and spreading centres dividing a number of major plates.



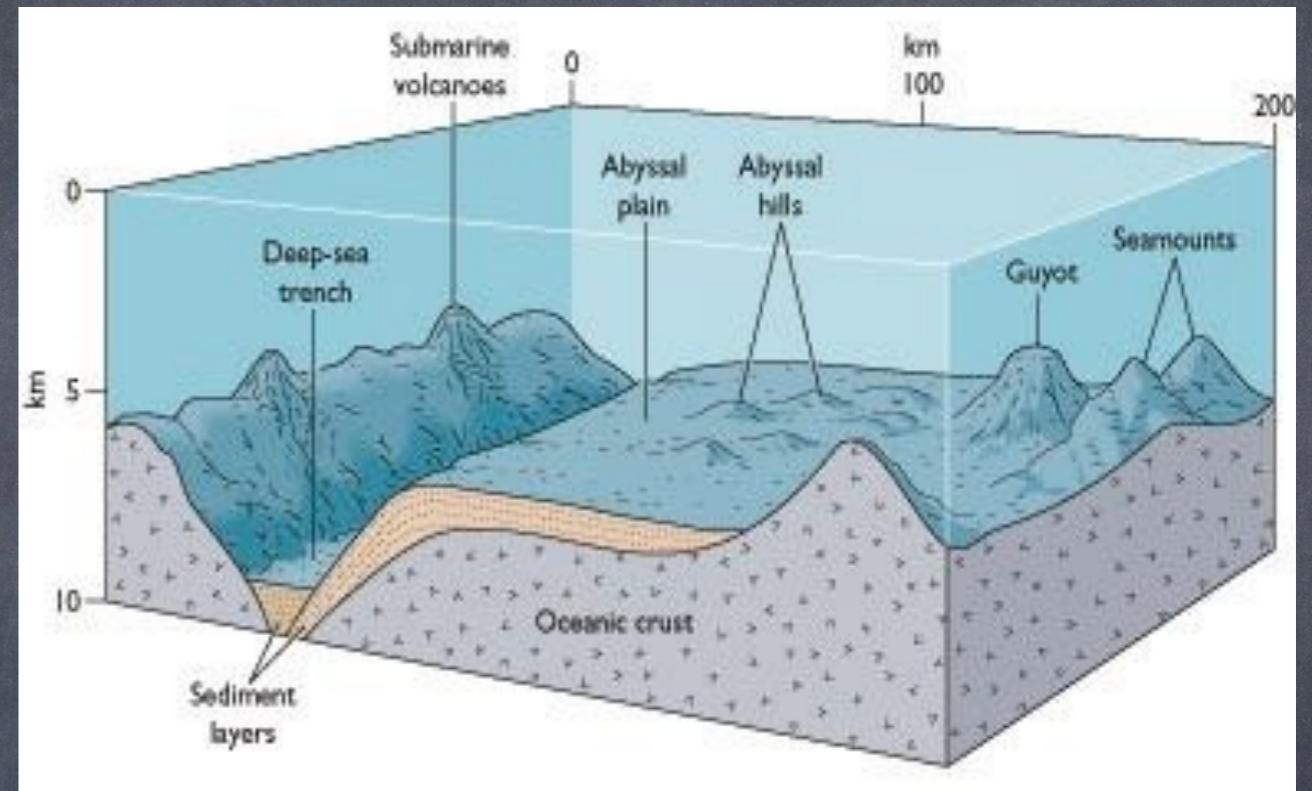


- Mid-ocean ridges = youngest crust = volcanic spreading centers = abyssal topography of highest elevation
- Trenches = oldest crust = subduction = deepest ocean

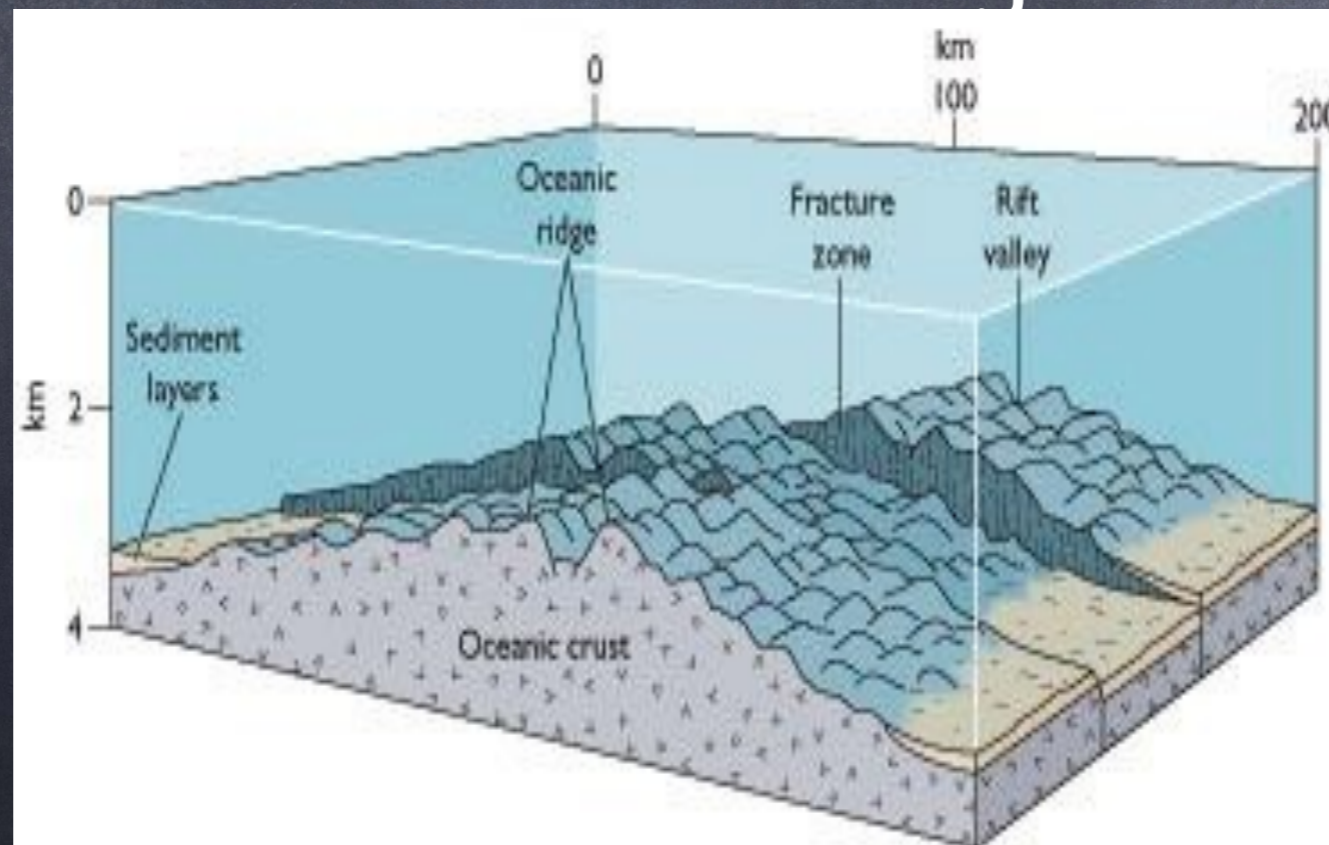
Continental margin

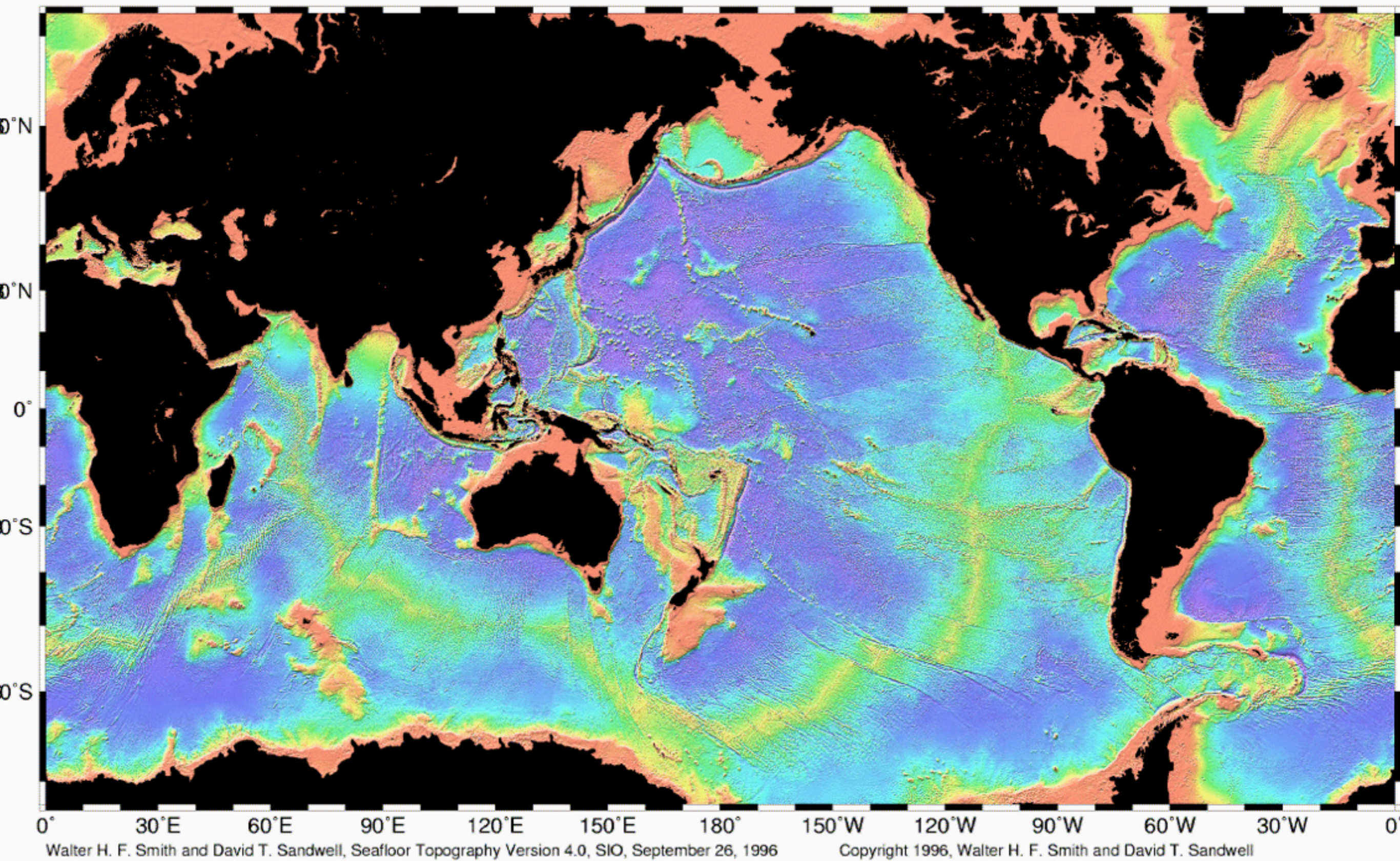


Ocean basin



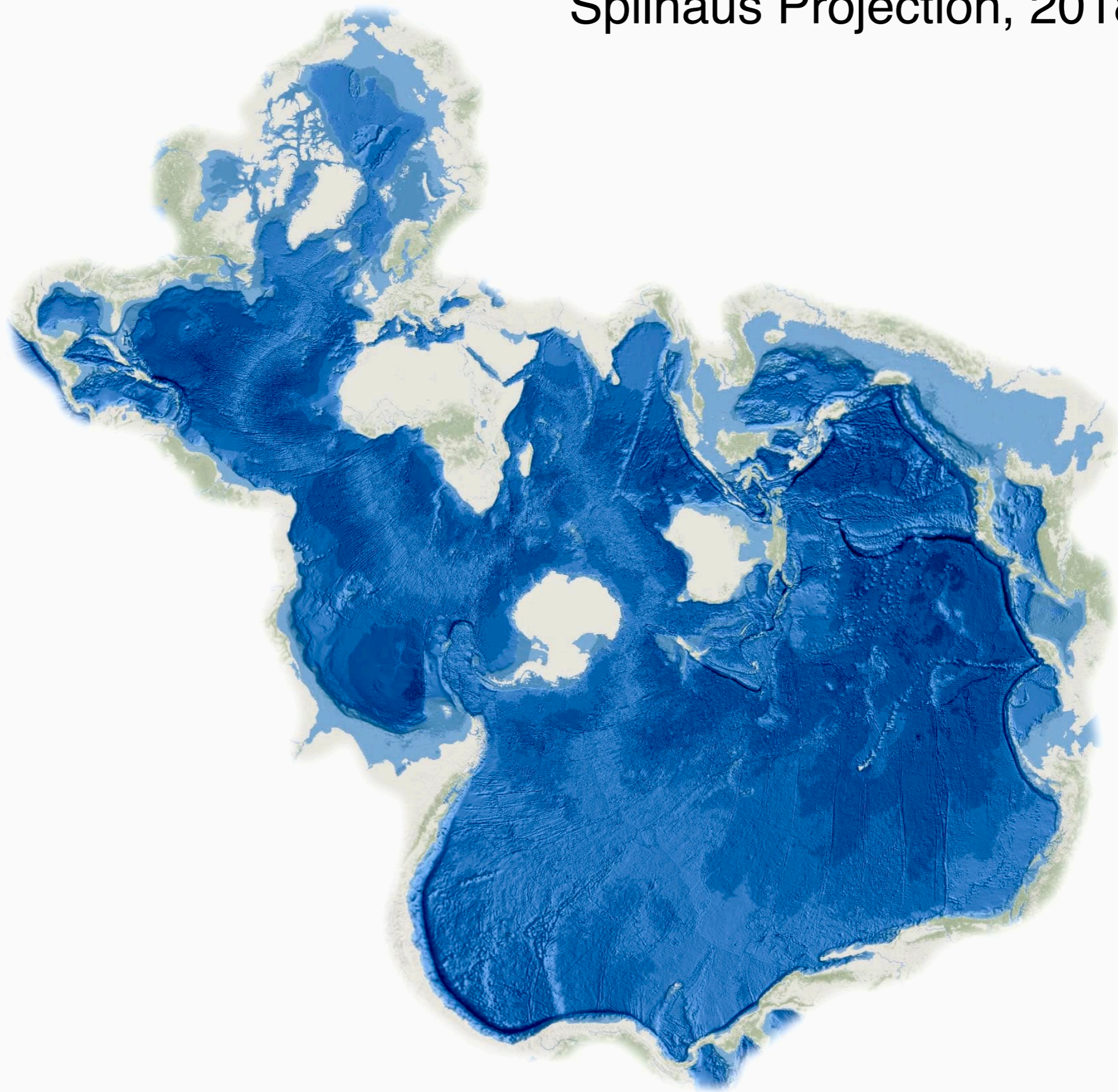
Mid-ocean ridge





name ocean basins? widest shelf? longest ridge/trench? seamount cluster? marginal seas?

Spilhaus Projection, 2018



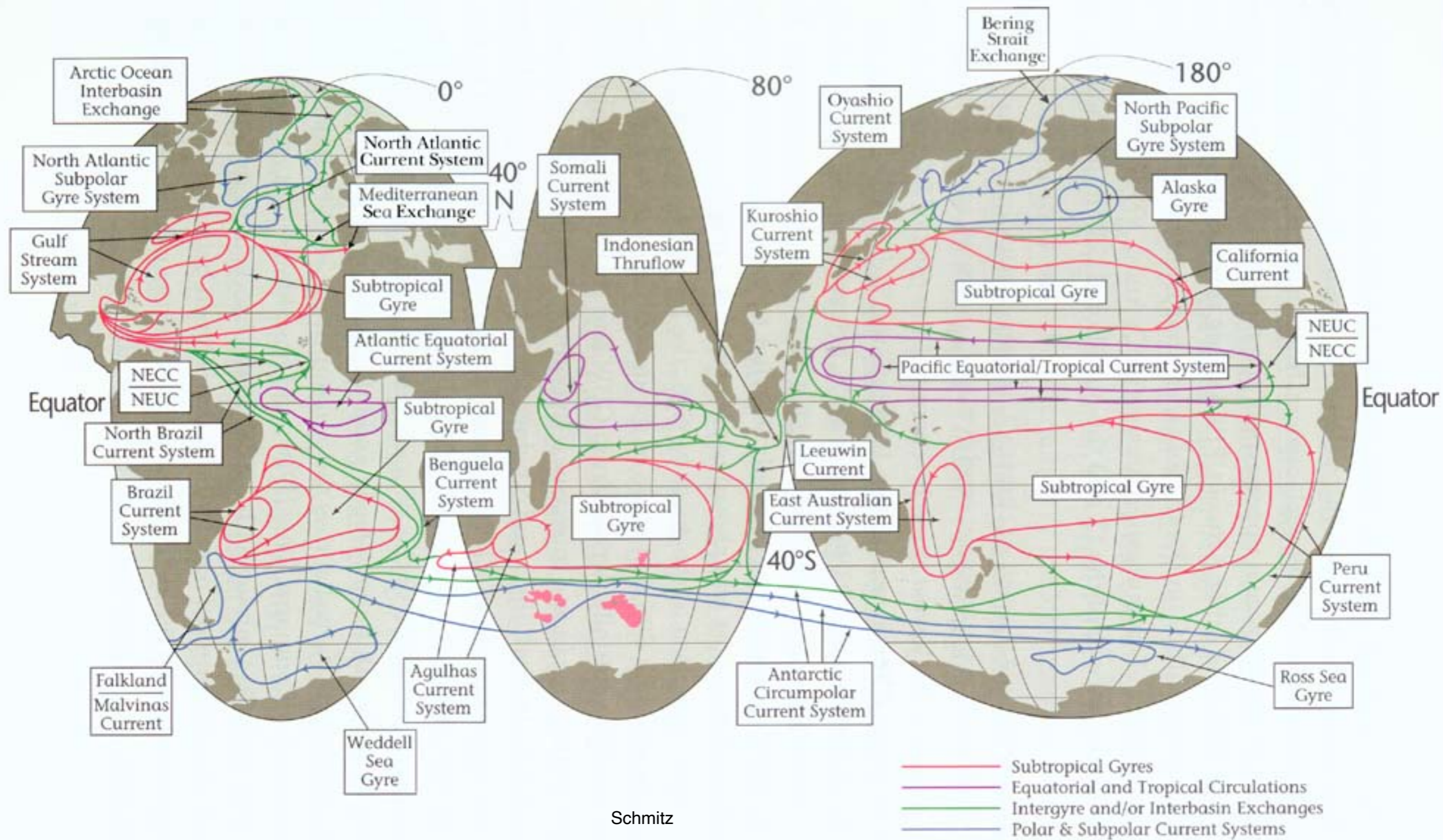
Distance in the Ocean

- Earth's radius = 6,378 km at equator, 20 km more than around the poles. Why?
- Distance measured in degrees longitude and latitude
 - $^{\circ}\text{lat} = 2 \pi R / 360 = 111 \text{ km}$
 - $^{\circ}\text{lon} = 2 \pi R \cos\theta / 360 = 111 \cos\theta \text{ km}$, $\theta = \text{latitude}$
- 1 nautical mile = 1 minute of great circle of Earth = 1.852 km
- Horizontal = 1000 x vertical dimension, scale $u/w = dx/dz = 1000$

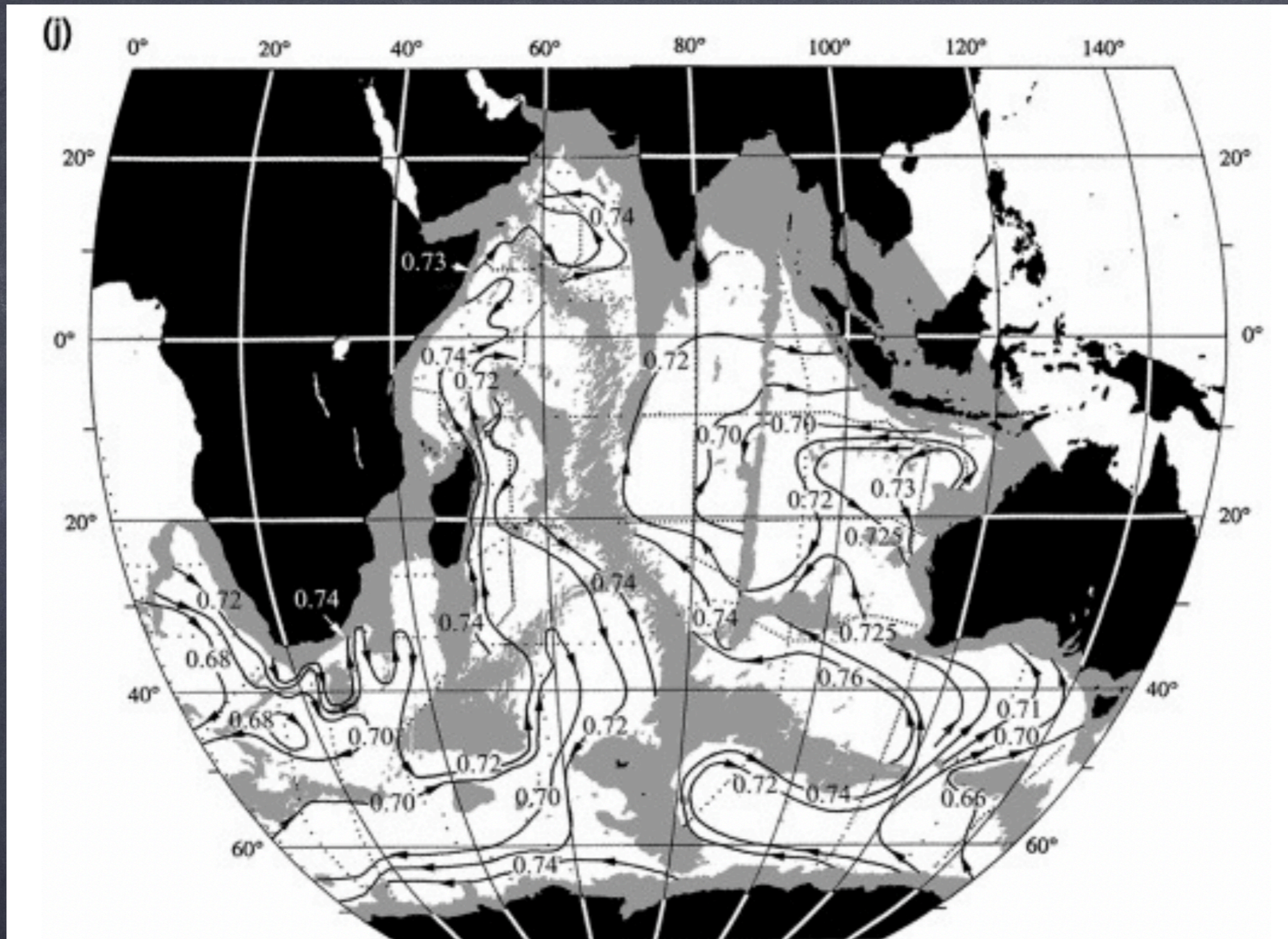
Major ocean current systems



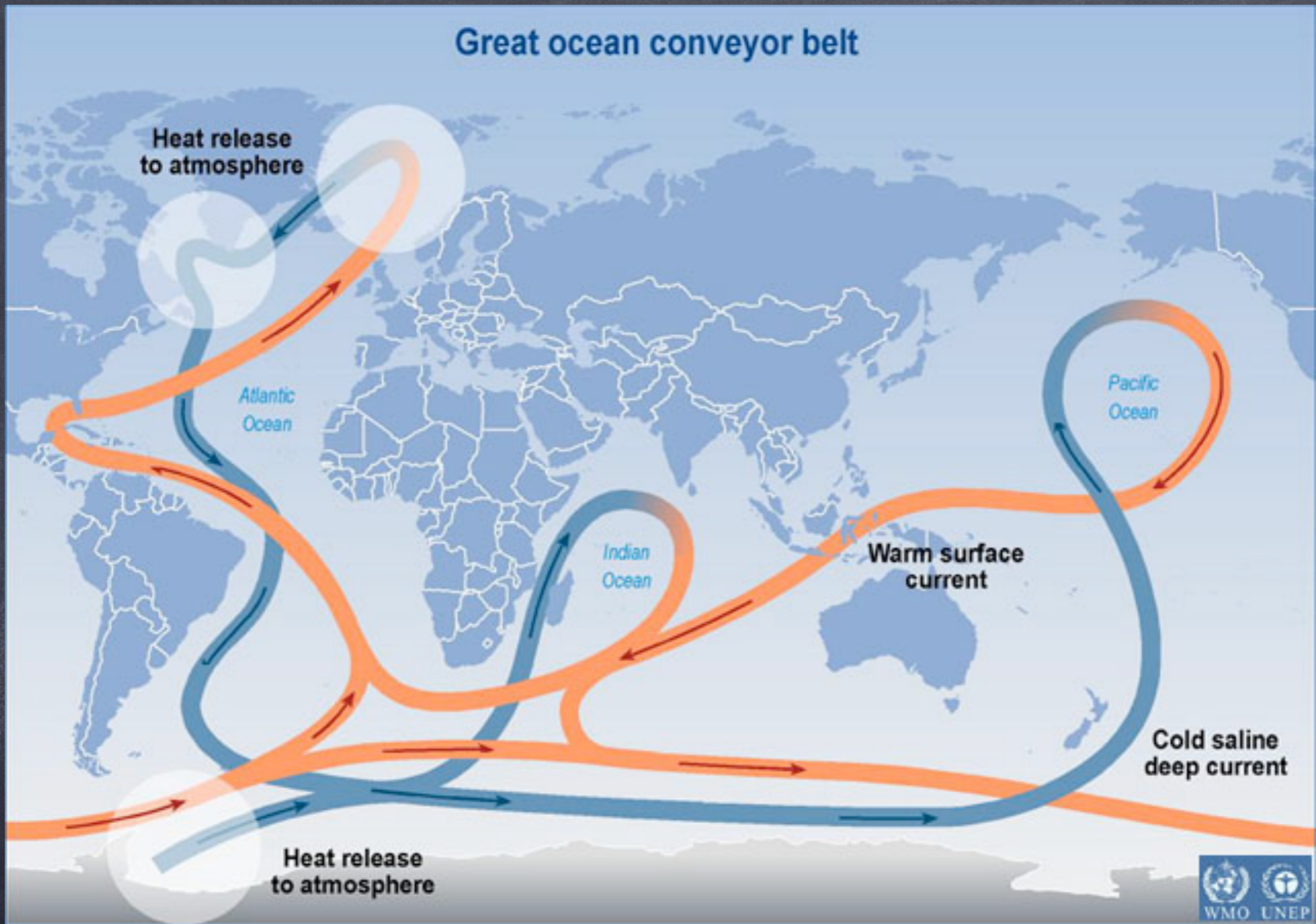
Subtropical **gyres** separated by continents and zonal flow at the equator



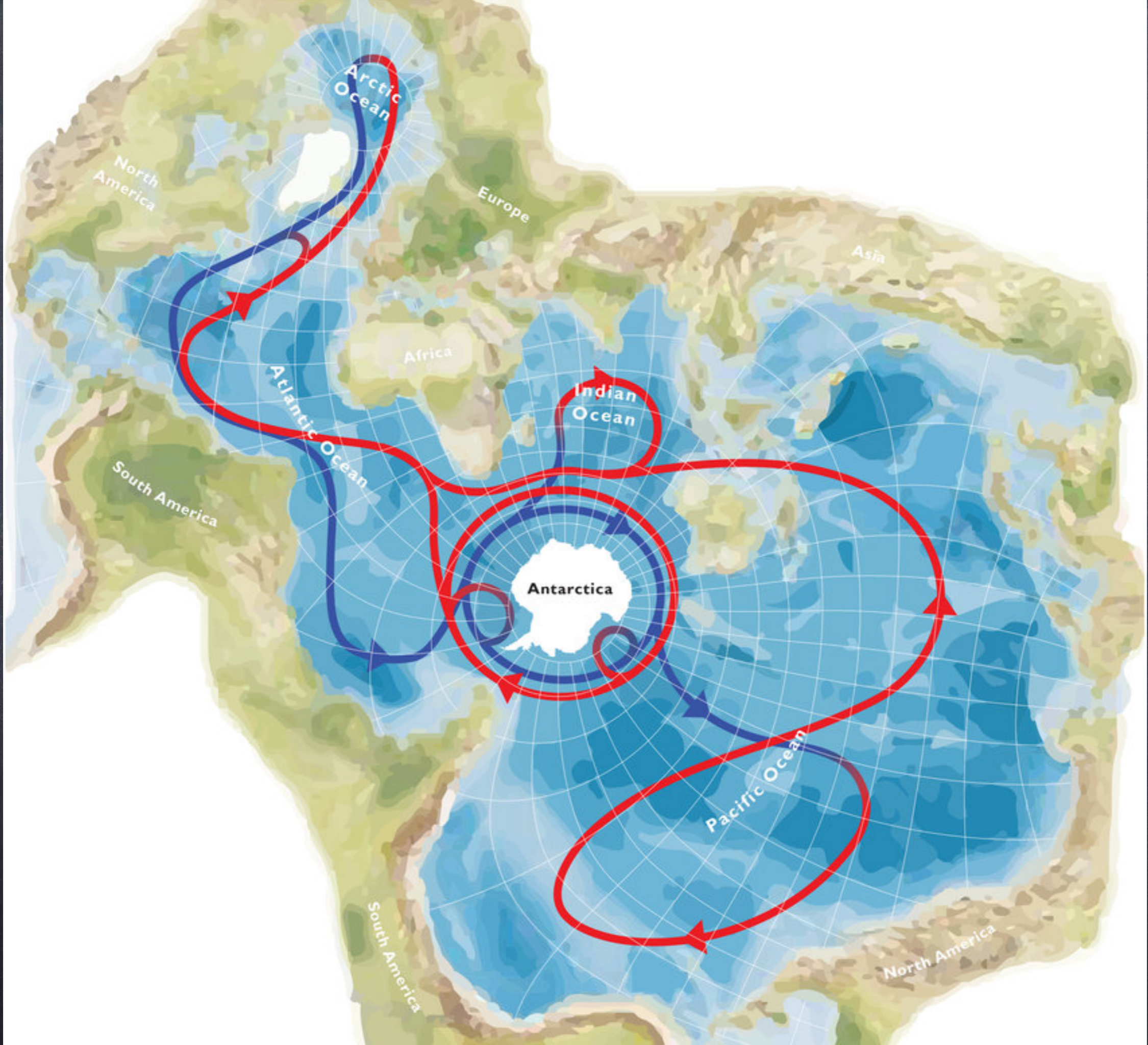
Gyres and ocean basins are linked. Interhemispheric and interocean flow



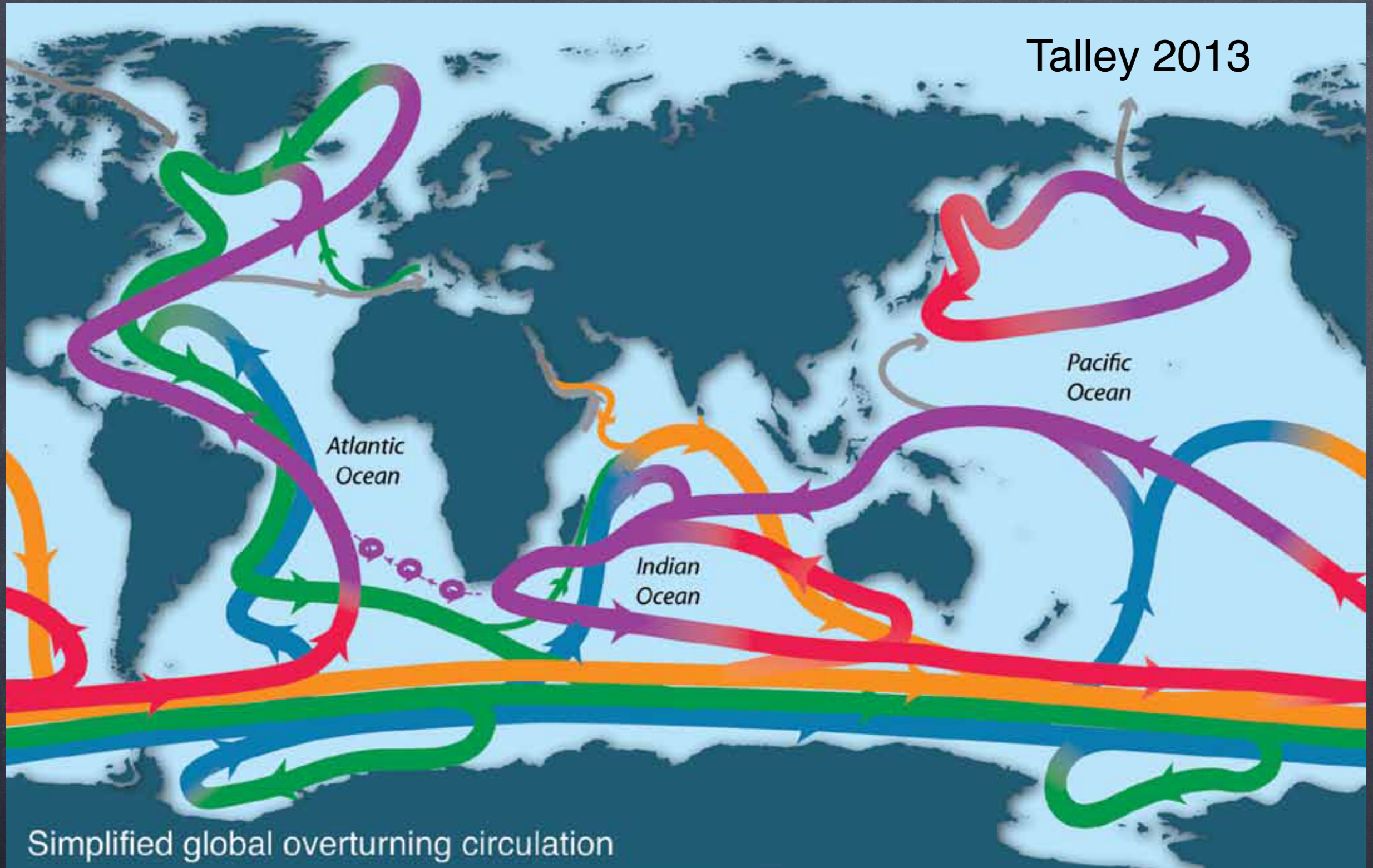
Deep circulation steered by topography
of the ocean floor (Reid, 2003)



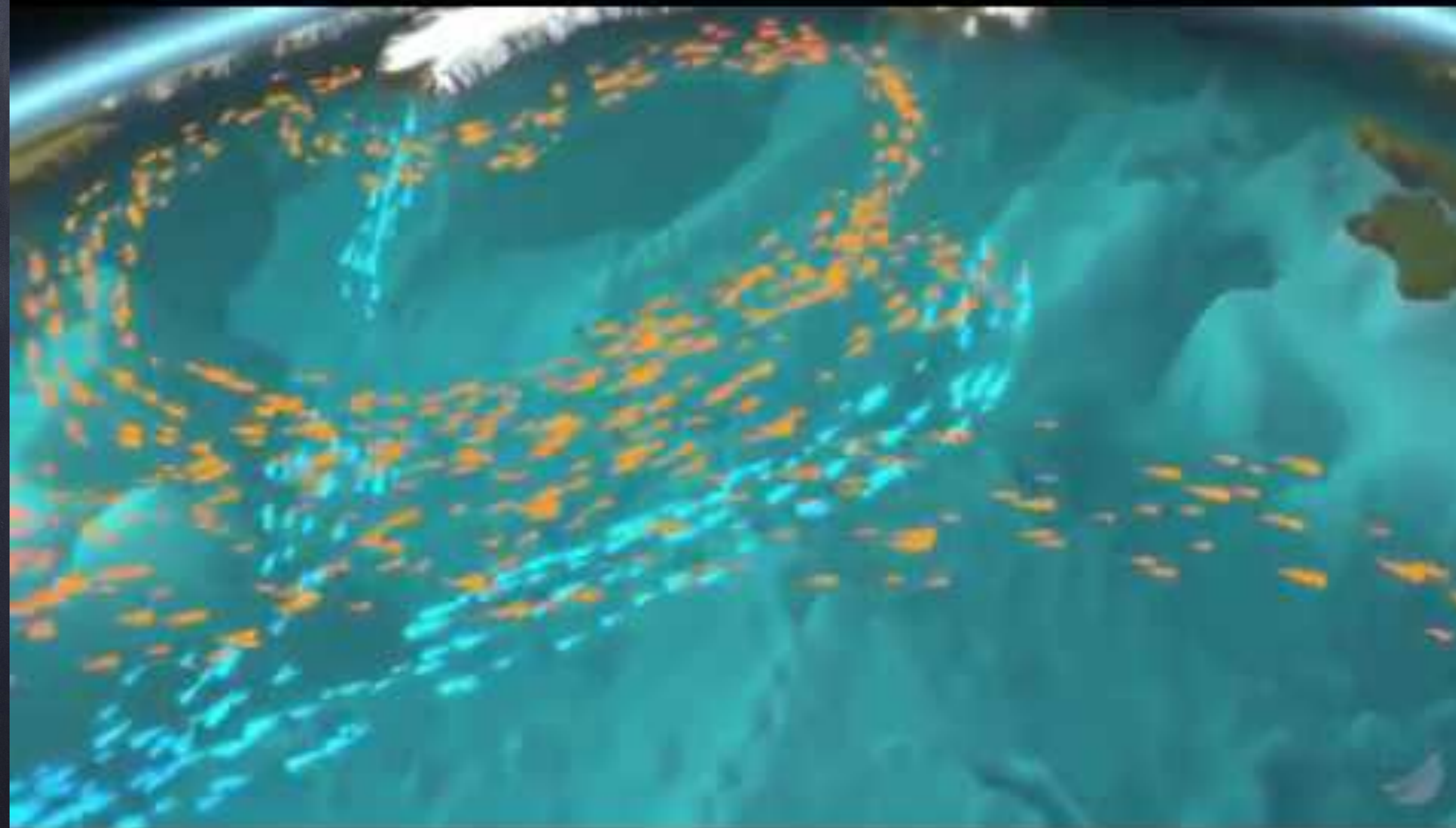
Surface and deep circulations are linked to form a global circulation



Talley 2013

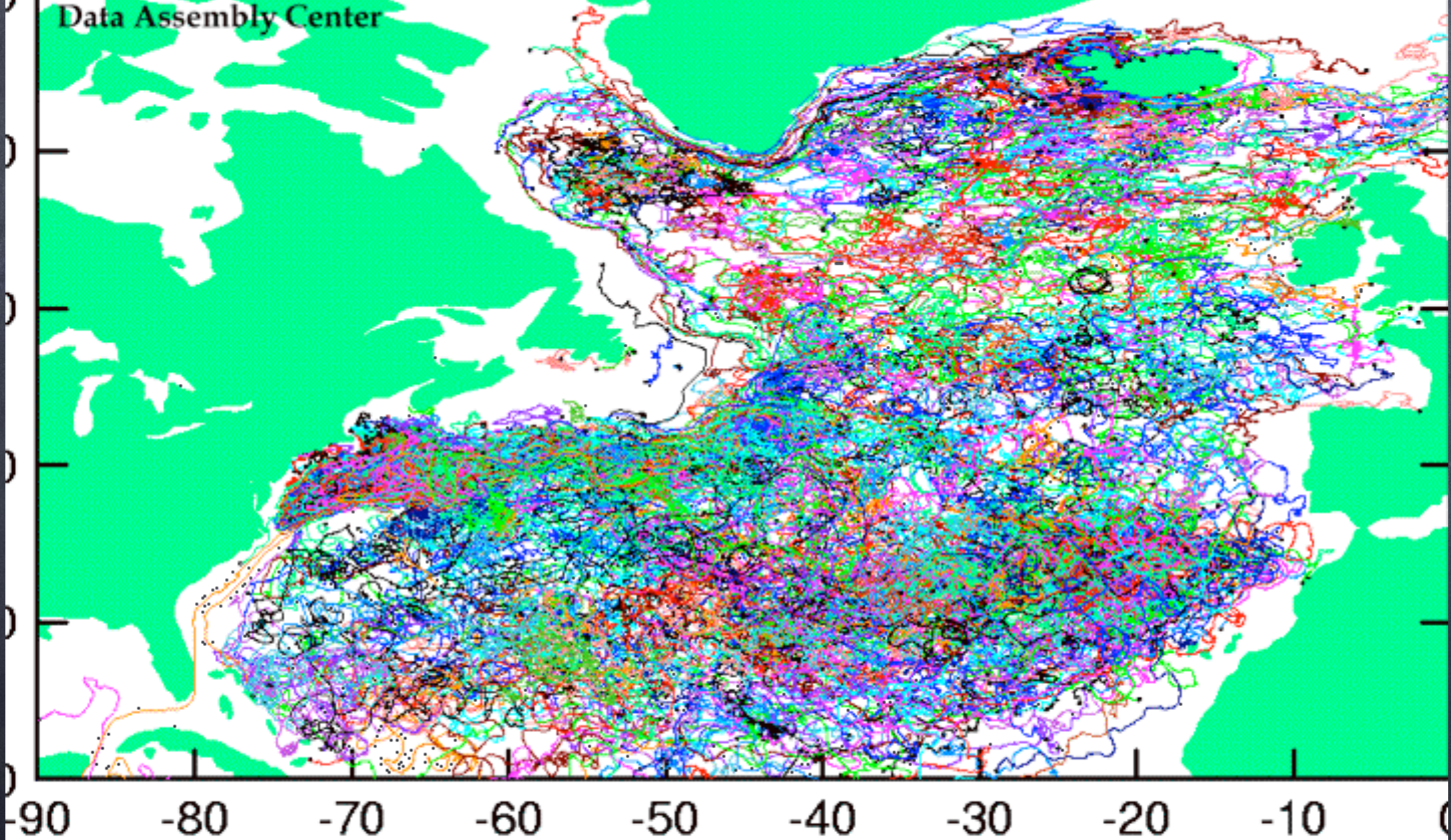


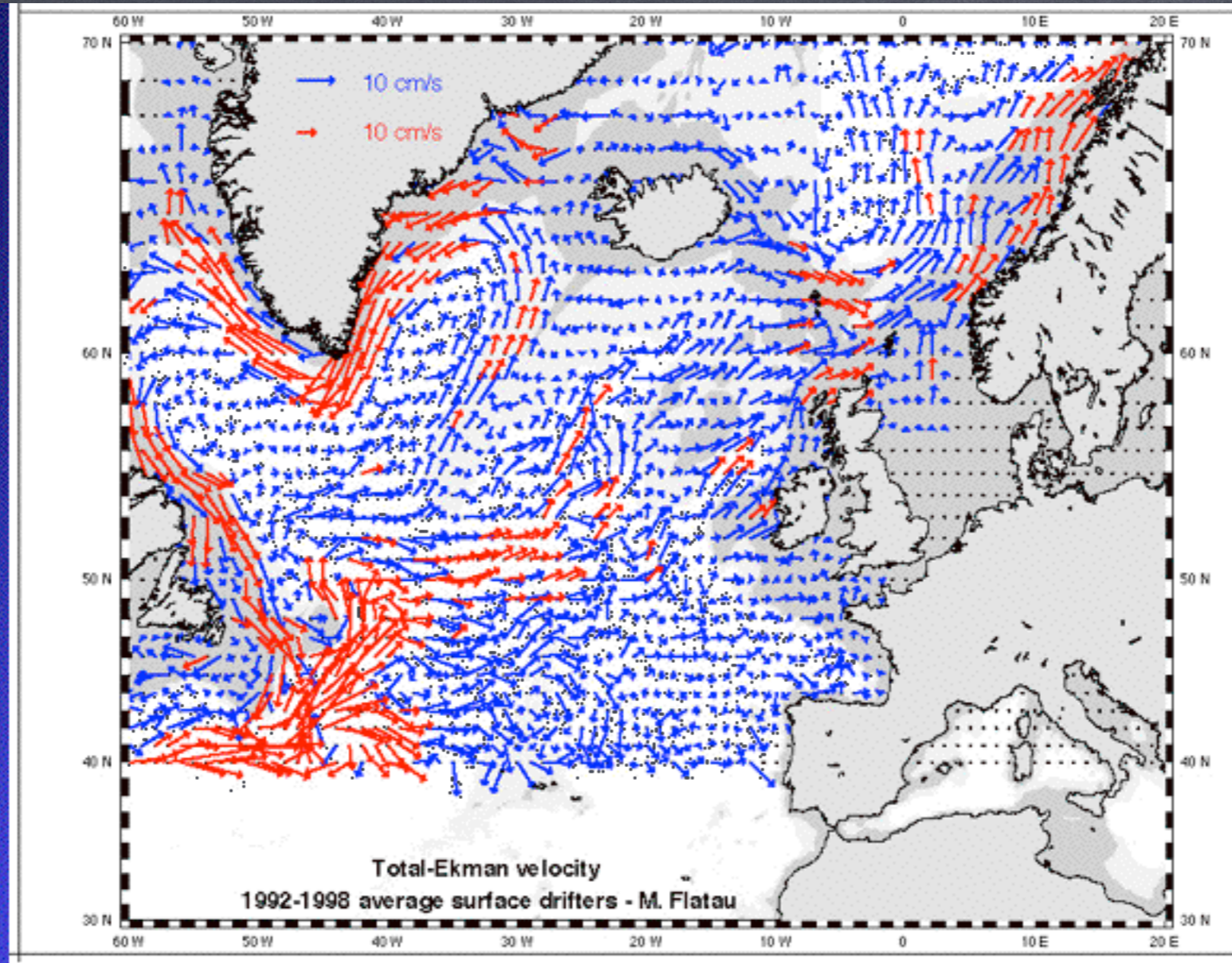
There are several, interlinked global overturning cells:
Mode, intermediate, deep, and abyssal.



North Atlantic Drifter Tracks Through August 1997

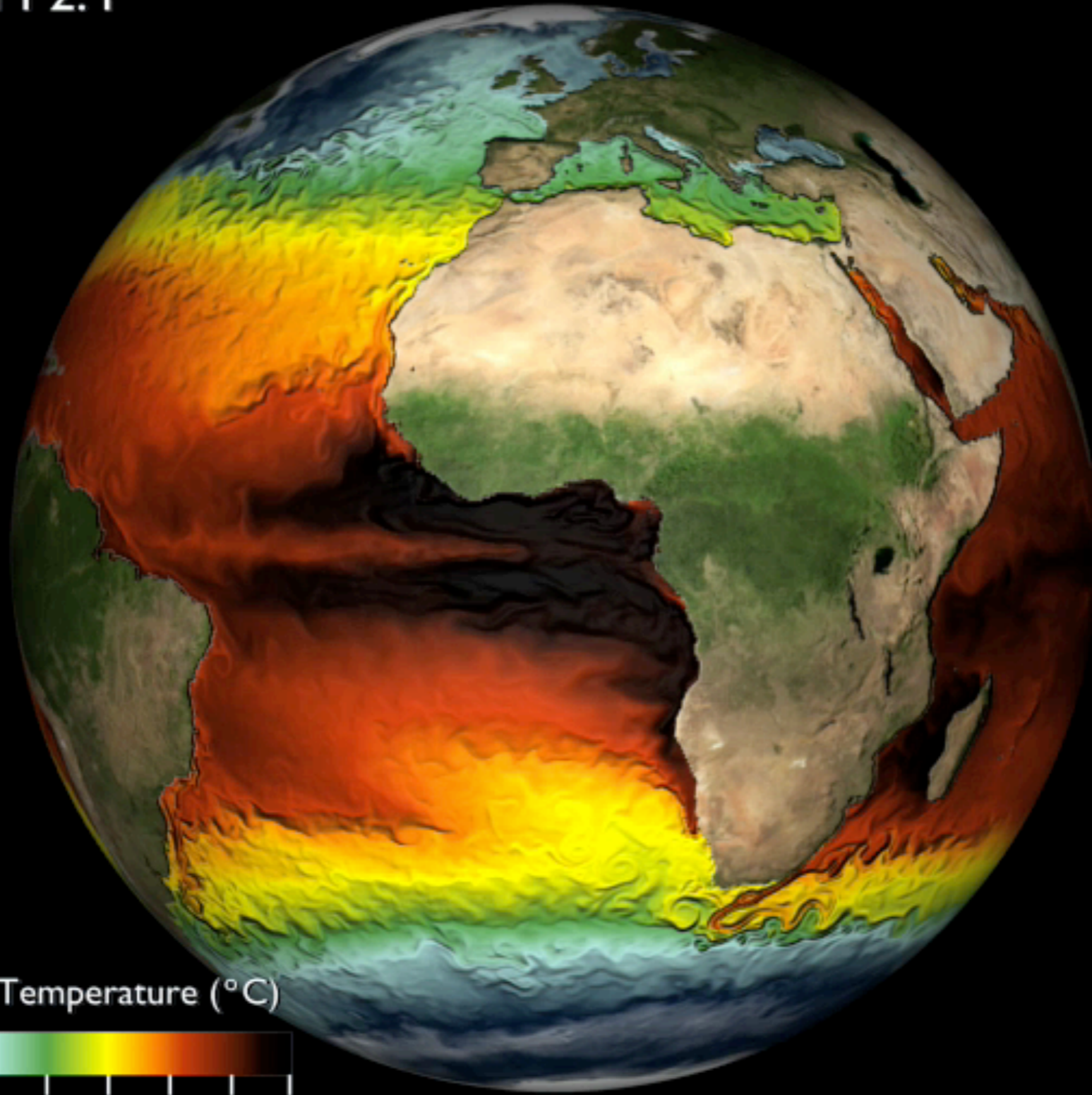
Data Assembly Center





Drifter tracks averaged over six years

GFDL CM 2.4



Sea Surface Temperature ($^{\circ}\text{C}$)

