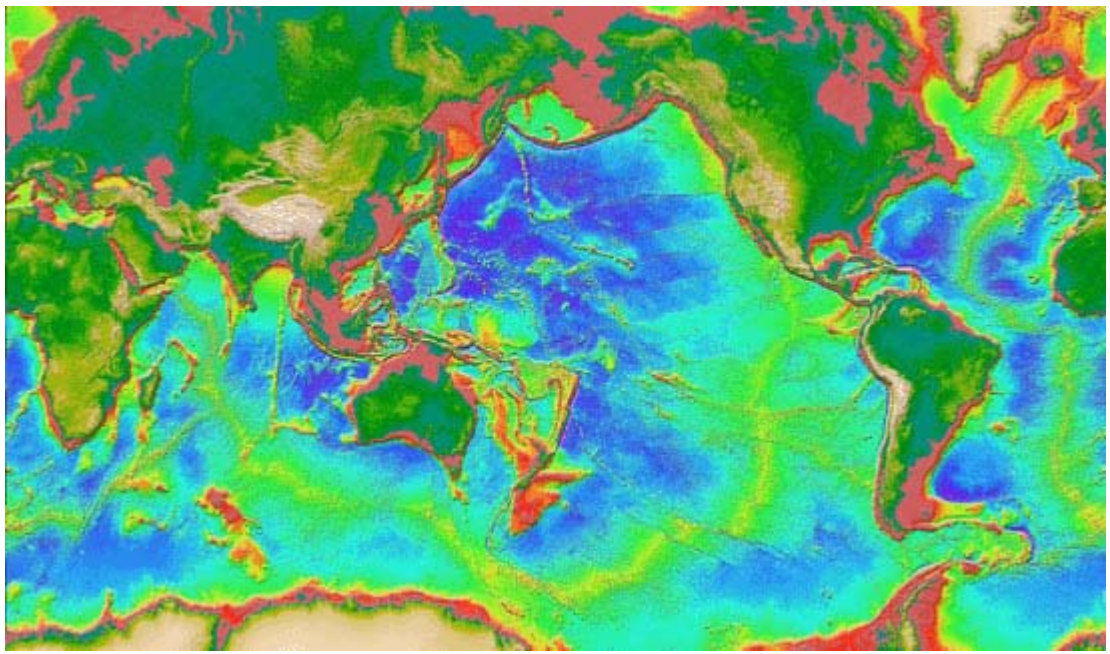
Geological Oceanography

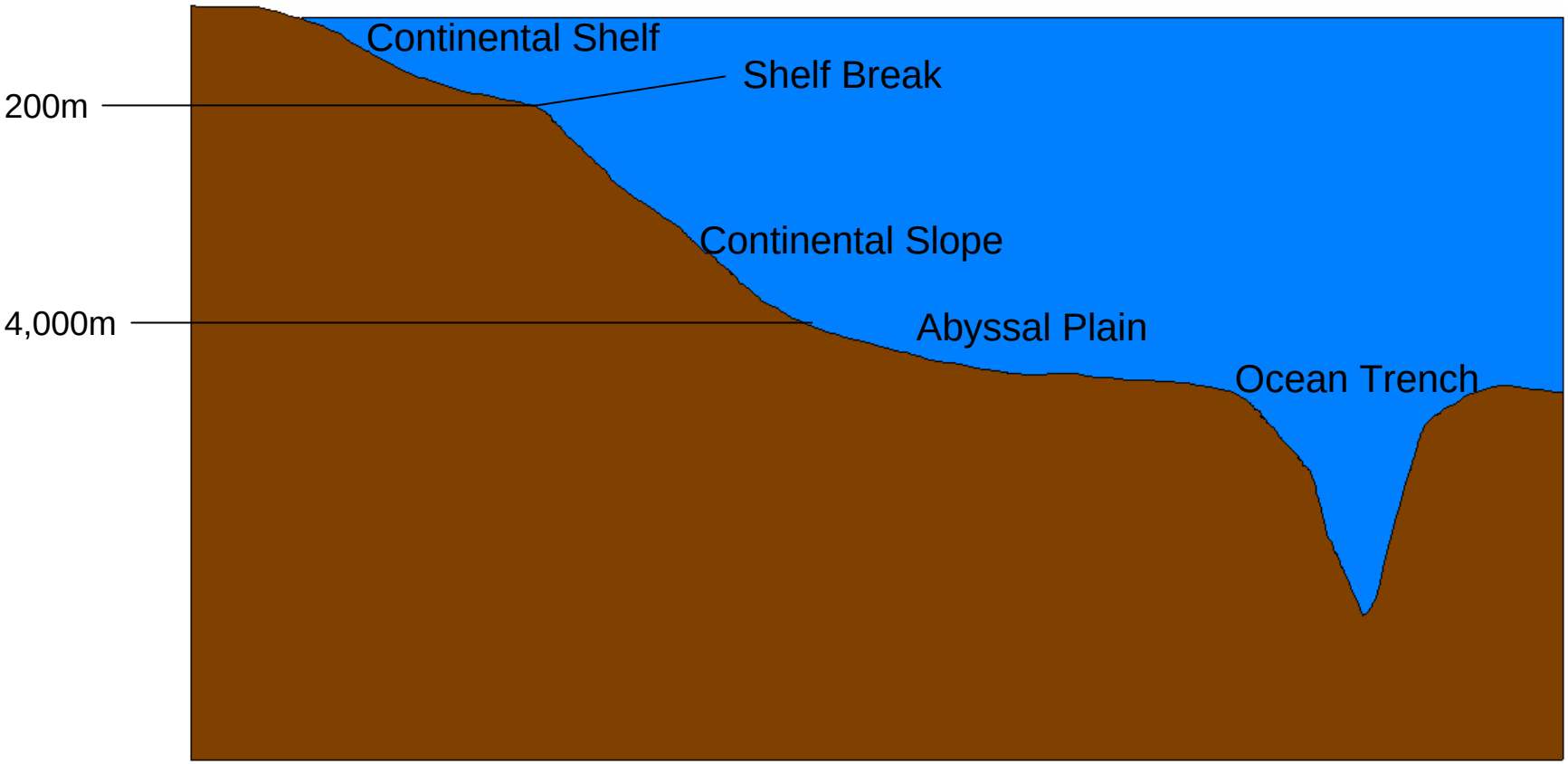


What is Geological Oceanography?

- Study of the sea floor
  - The sediments that make up the sea floor
  - How the sea floor is formed and destroyed
  - Movement of plates

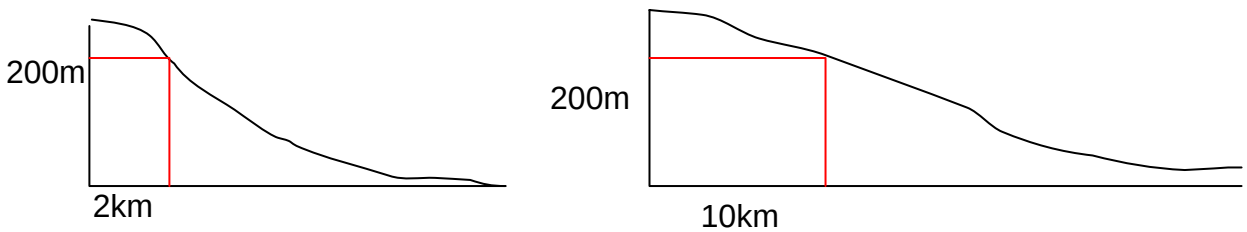
Continental Shelf: extension of continent. Extends down 100-200m. Most productive area of ocean

Continental Slope: Begin at shelf break and extend down 3-5km. Steepest gradient.

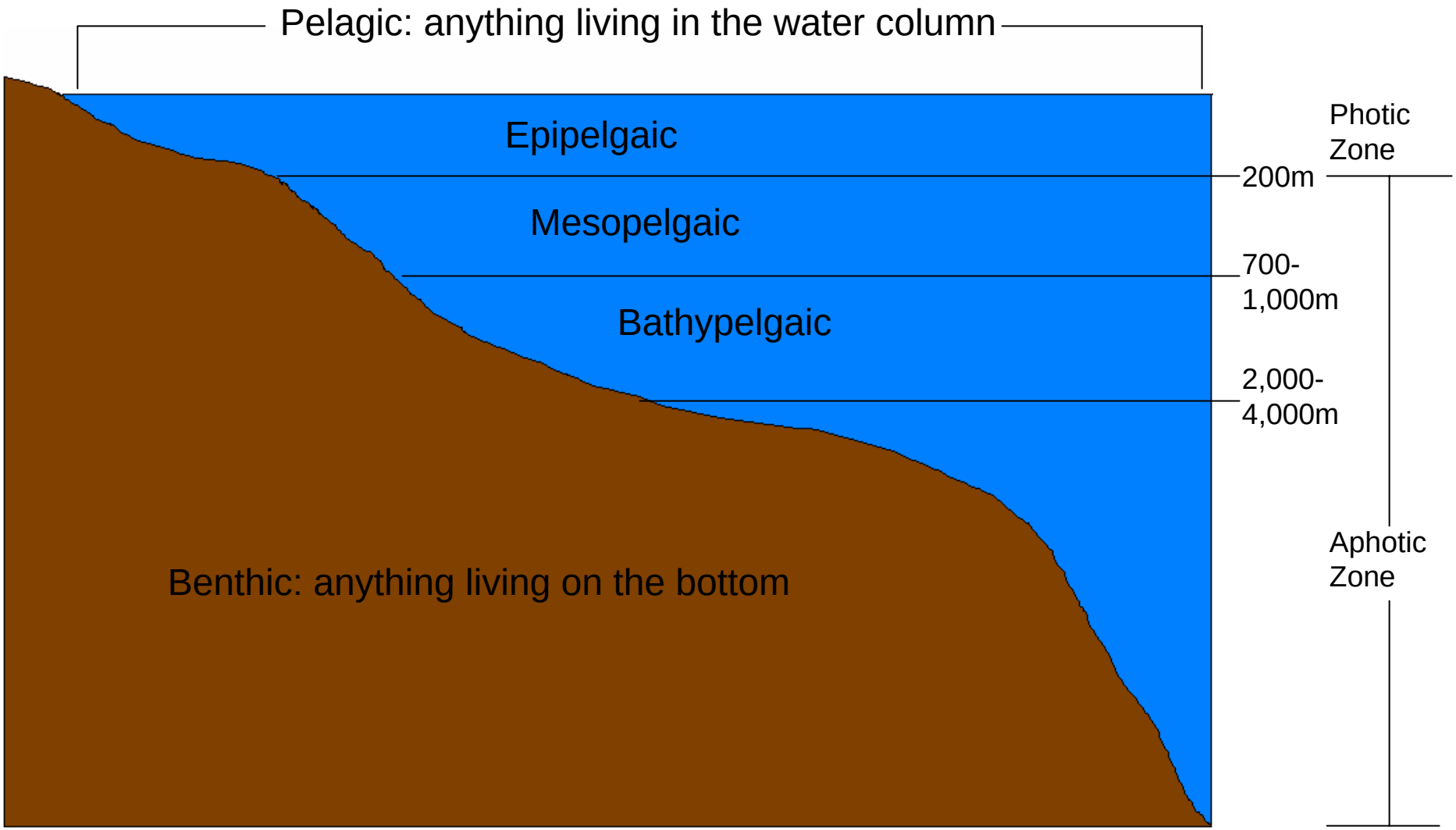


Continental Shelf

- Length varies in different parts of the world
  - East Coast of Canada: up to 400km long
  - West Coast of US: only a couple of km long
- Steepness will affect how water moves along the coast
  - Steeper shelf = bigger waves

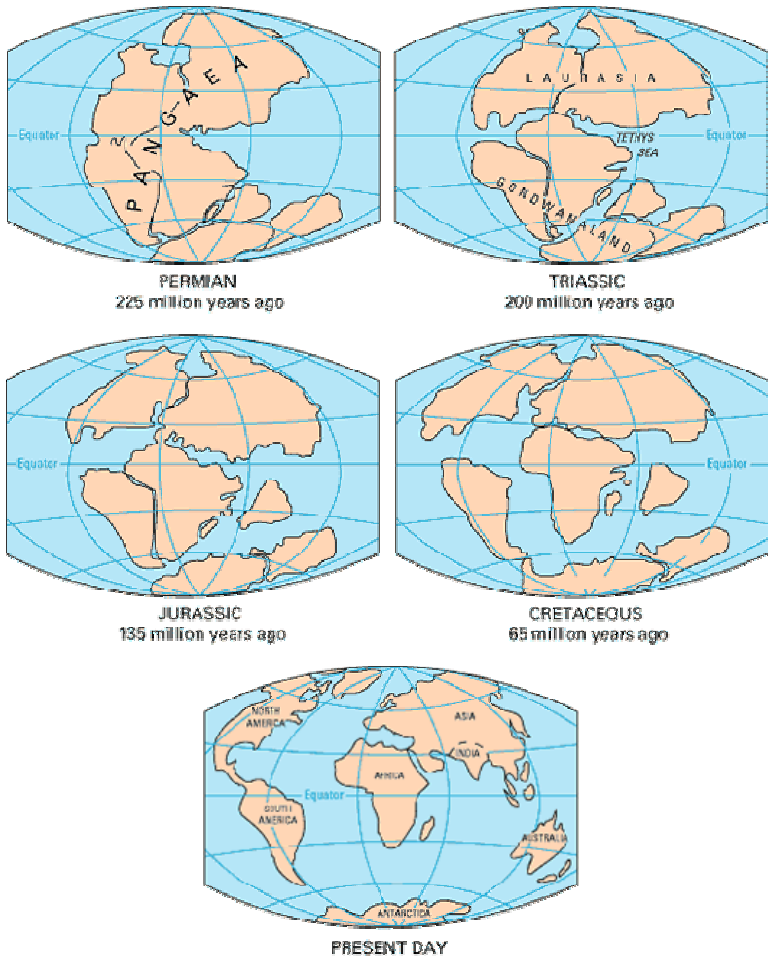


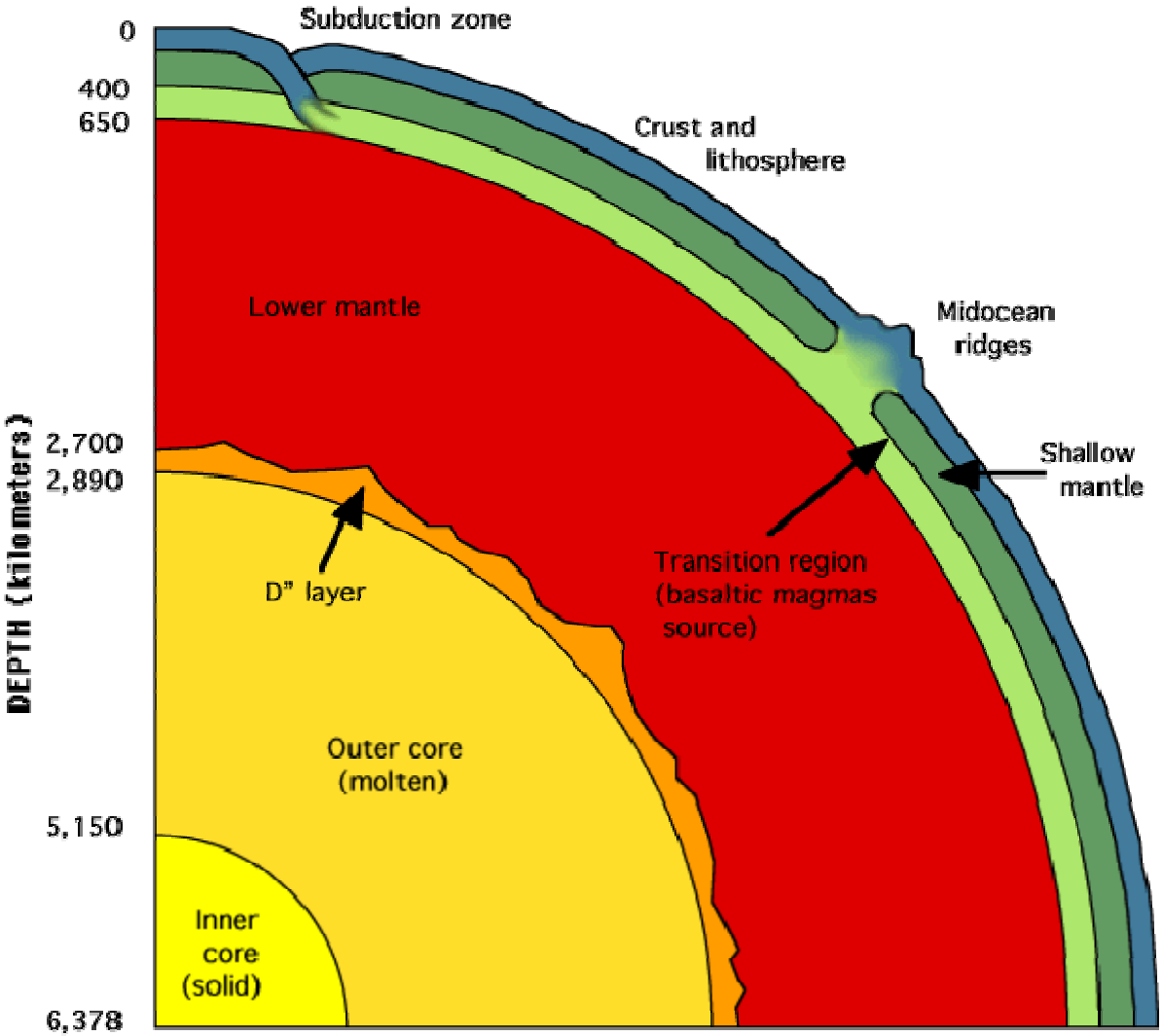
Photic Zone: area where photosynthesis occurs, depth depends on water characteristics

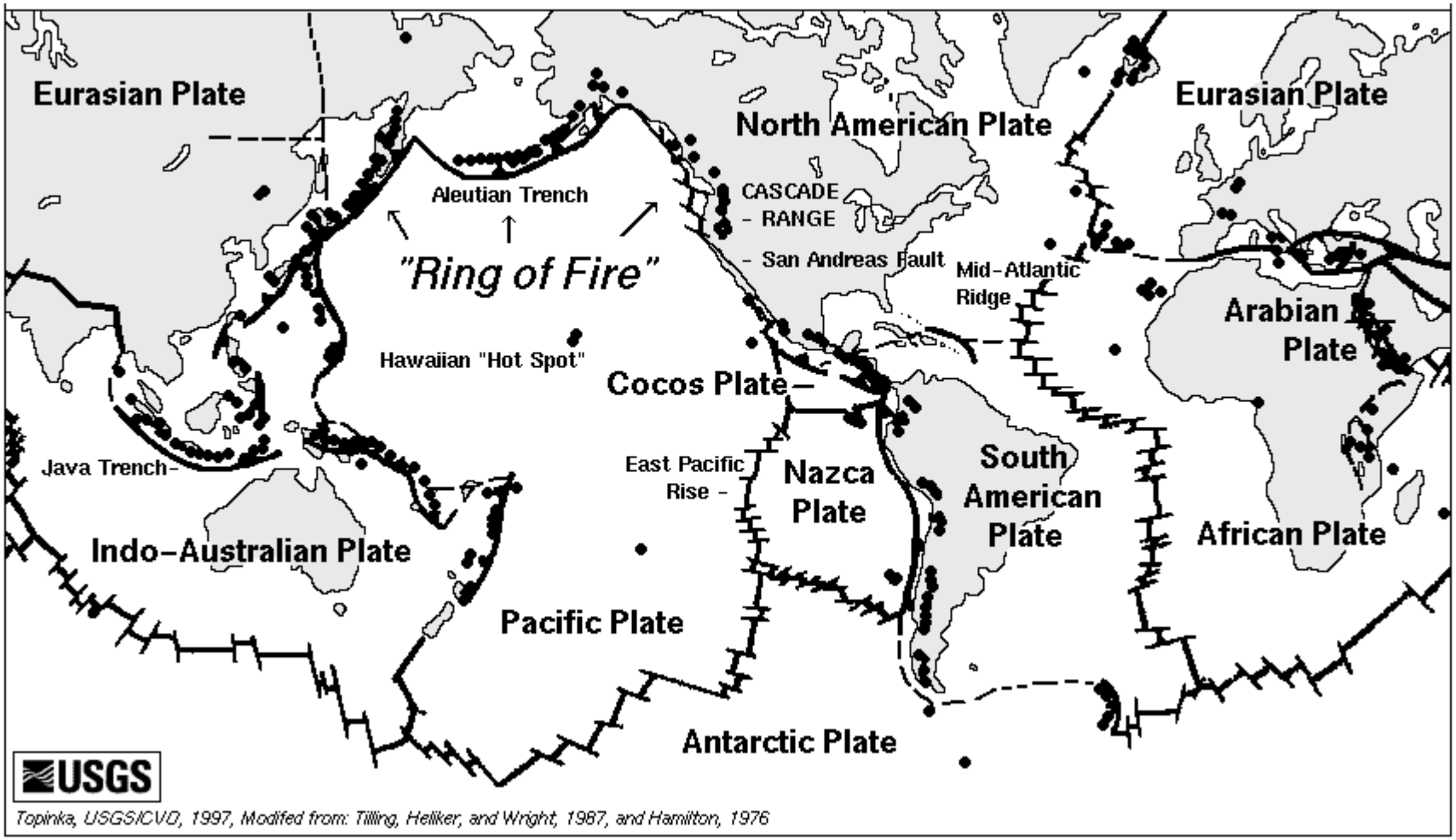


Continental Drift

- Earth's continents are moving over time




Subduction zone
0
400
650
Crust and
lithosphere
Lower mantle
Midocean
ridges
Shallow
mantle
DEPTH (kilometers)
2,700
2,890
D" layer
Transition region
(basaltic magmas
source)
Outer core
(molten)
5,150
Inner
core
(solid)
6,378



Topinka, USGS/CVO, 1997, Modified from: Tilling, Heliker, and Wright, 1987, and Hamilton, 1976

Plate Boundaries

- Divergent
- Convergent
- Transform

Plate Boundaries

- Divergent
  - Plates move away from each other
  - New crust is formed from magma = seafloor spreading
  - Produce volcanoes
  - Example: North American plate moving away from Eurasian plate

Oceanic Ridges associated with Divergent Boundaries

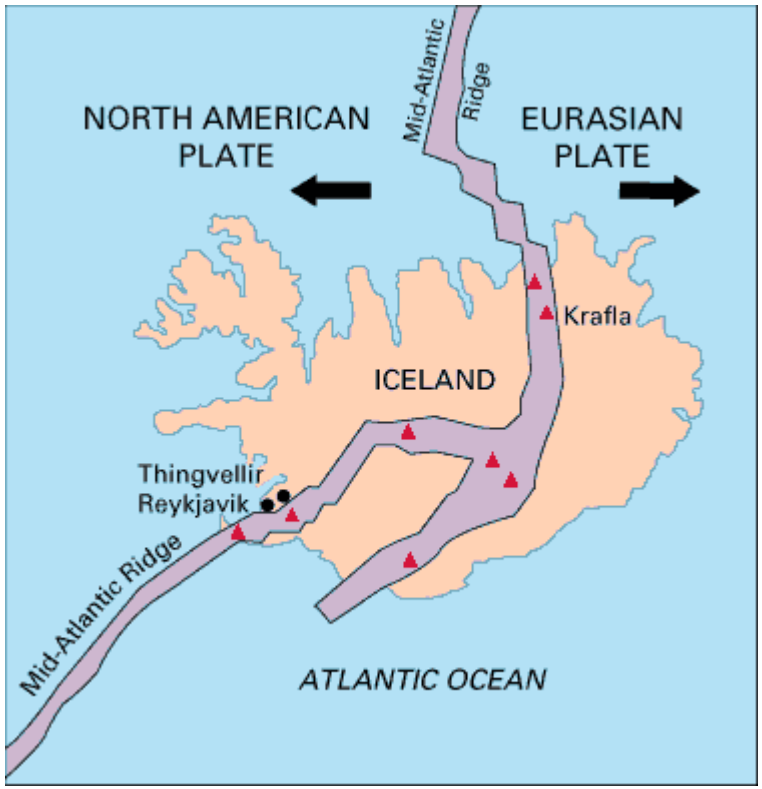
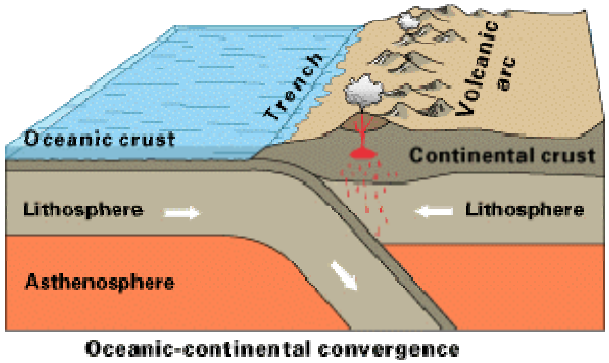


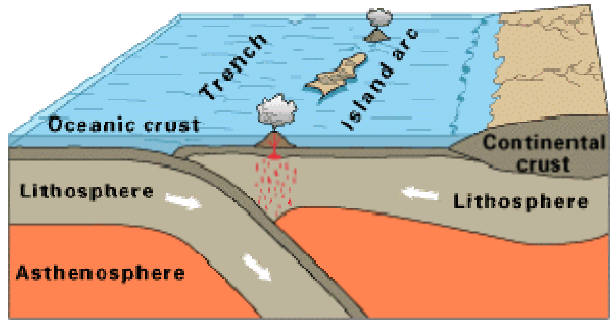
Plate Boundaries

- Convergent
  - Plates move towards each other
  - One plate sinks (subducted) under another
  - Crust is destroyed
  - Subduction Zone: place where one plate is sinking under another plate
  - Subduction creates trenches
  - Earthquakes, volcanoes, and mountains
  - Examples: Nazca and South American Plate



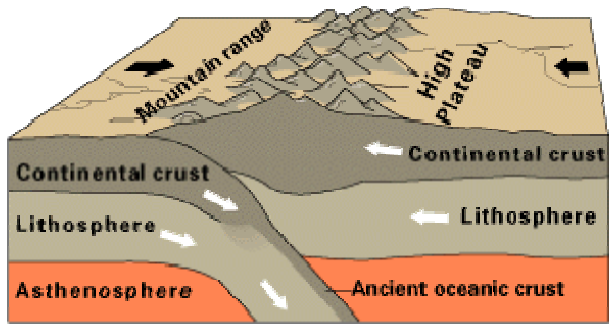
Oceanic-continental convergence

Mountain formed by this type of boundary: Cascades



Oceanic-oceanic convergence

Islands formed by this type of plate boundary: Aleutian Islands (Alaska)

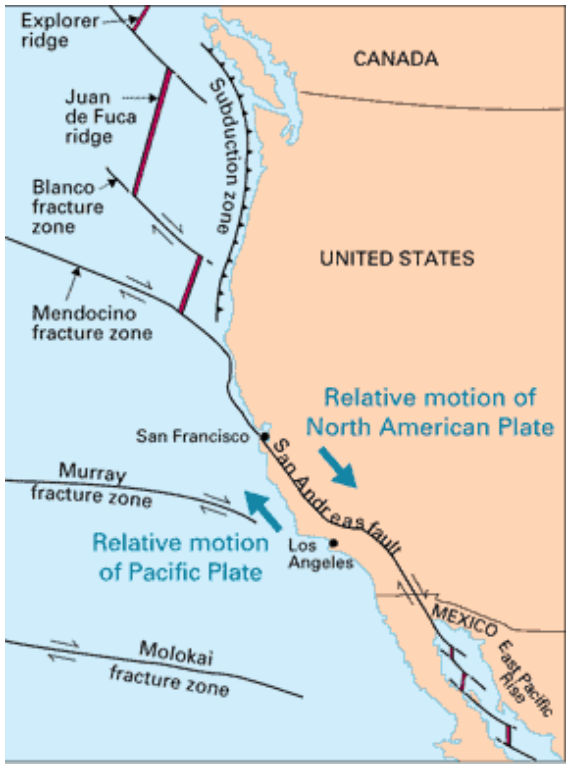


Continental-continental convergence

Mountain ranges formed by this type of boundary: Himalayan

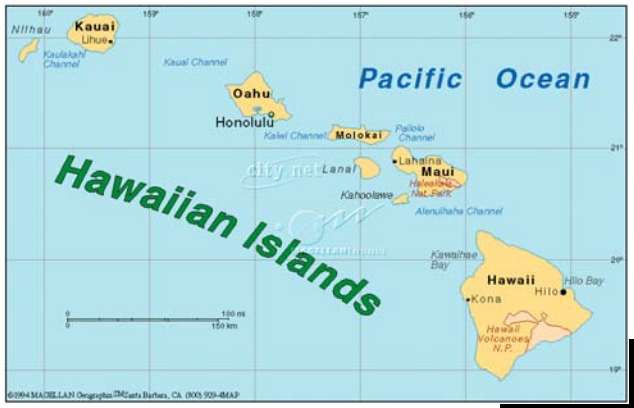
Plate Boundaries

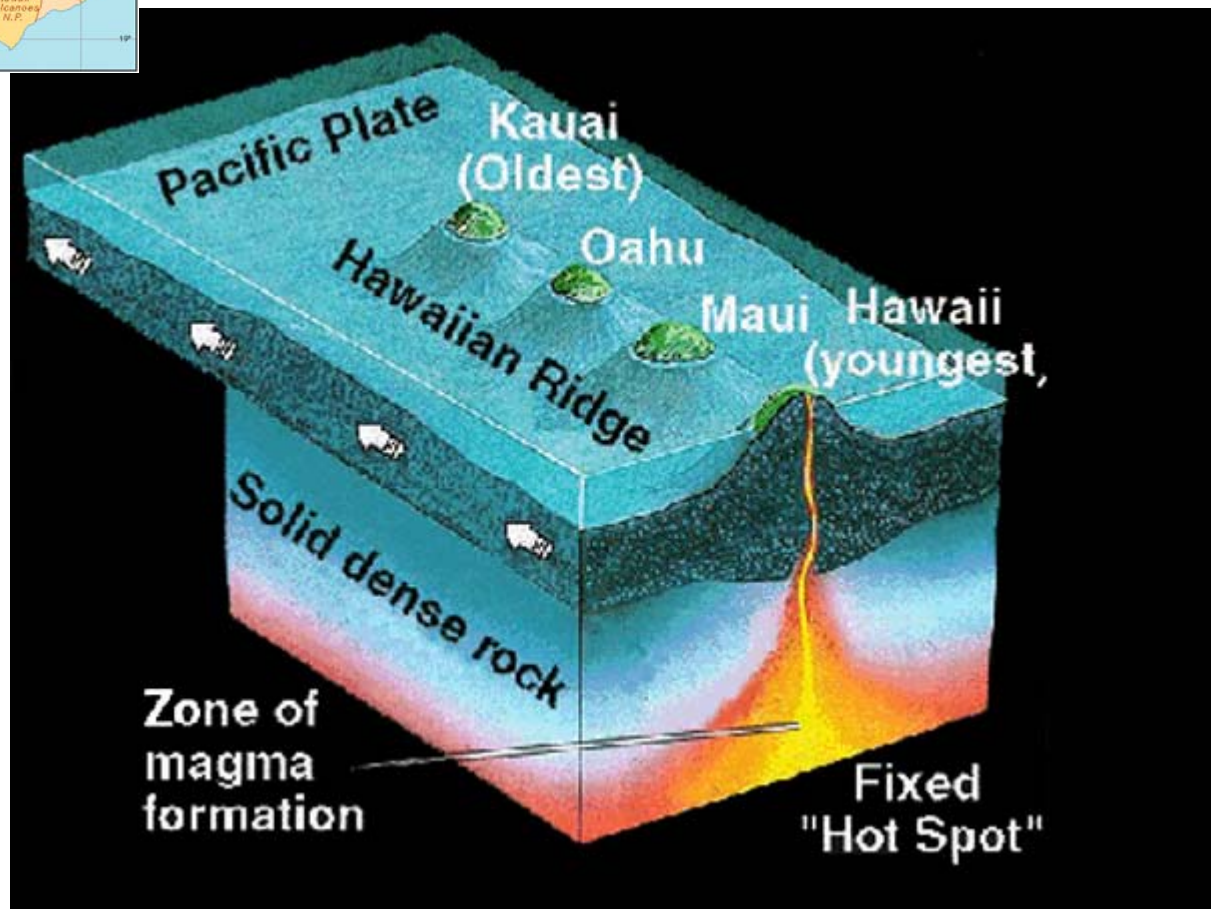
- Transform
  - 2 plates slide past each other
  - Crust neither formed nor destroyed
  - Most occur in the ocean, but some occur on land
  - Earthquakes
  - Example: North American plate and Pacific plate


Explorer ridge
Juan de Fuca ridge
Blanco fracture zone
Mendocino fracture zone
Murray fracture zone
Molokai fracture zone
Subduction zone
CANADA
UNITED STATES
MEXICO
San Francisco
Los Angeles
San Andreas fault
Relative motion of North American Plate
Relative motion of Pacific Plate
East Pacific Rise

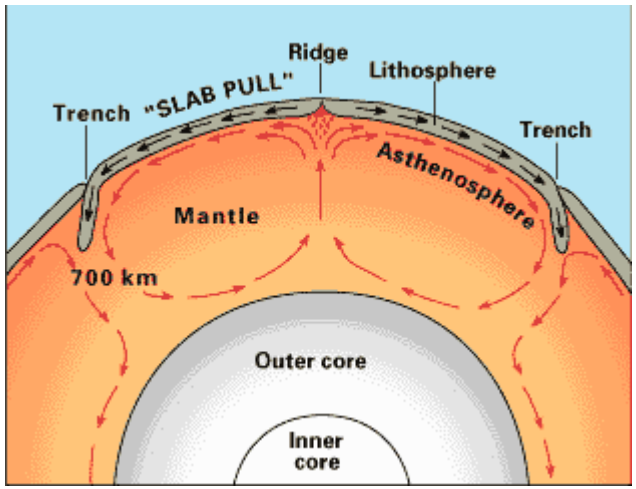
Hot Spots

- Most volcanic activity occurs at plate boundaries
- However, there are exceptions
- Hot Spots:
  - Persistent source of magma away from a plate boundary
  - Magma rises through the crust and forms a seamount
  - Continued eruptions cause seamount to grow


Niihau
Kauai
Lihue
Kaulakahi Channel
Kauai Channel
Pacific Ocean
Oahu
Honolulu
Kaiwi Channel
Molokai
Pailolo Channel
Lanai
Lahaina
Maui
Kahoolawe
Alenuihaha Channel
Hawaiian Islands
Kawaihae Bay
Hawaii
Hilo
Hilo Bay
Kona
Hawaii Volcanoes N.P.
100 mi
150 km


Pacific Plate
Kauai
(Oldest)
Oahu
Maui
Hawaii
(youngest)
Hawaiian Ridge
Solid dense rock
Zone of
magma
formation
Fixed
"Hot Spot"

What causes the plates to move?



- Crust “floats” on top of the mantle
- Mantle is molten and moves underneath the crust

Types of Marine Sediments

- Lithogenous
  - Sediment derived from break down of pre-existing rock material
  - Clay, silt, sand
- Biogenous
  - Sediment produced from living organisms
  - Primarily come from skeletons, shells, etc
- Hydrogenous
  - Precipitates from seawater
  - Many form around deep sea vents