

# OCEAN BASINS, GEOGRAPHY AND GEOLOGY OF THE OCEANS

**EARTH** – The earth is 4.5 billion years old and has inner defined regions. The floor is about 200my old and the continents are about 3.8 my old

Inner core –1200km, 4000oC or 7200oF - solid

Outer core – 1300km - liquid

Mantle – 2850 km thick, semi-solid but flows

Continental crust or lithosphere – 100km thick

Heat driven motion at the core creates convection currents and causes flowing and movement.

## HISTORY

200 million years ago – supercontinent Pangaea

–Sea was Panthalassa – ancestor of Pacific

–Tethy's sea separated Eurasia and Africa

180mya – Pangaea split into Laurasia –( N. America and Eurasia) and Gondwana (S. America, Antarctica, India, Australia) in the south

135mya – Atlantic was born

## FEATURES –

**4 OCEANS** (or 5) – Pacific–deepest, Atlantic, Indian, Arctic–smallest and the large Southern Ocean around the Antarctic.

**PLATES** –lithospheric "rock"plates 100km that are the upper crust –continental, oceanic or both. Float on upper mantle as they are less dense (like suds on top of bath or dish water).

## CONTINENTAL MARGINS – (draw a cross section)

The shape often reflects the age and the activity that has occurred along a particular margin types.

Active ones are steep (S. American plate) , Passive – ancient and gentle slope – Atlantic

General features of continental margins –

Continental shelf (200m)

Continental slope

Continental rise – mud, silt and sand turbidity currents

Abyssal plain (4000 – 6000m)

trenches (Marianas)  
ridges (Mid-Atlantic)  
seamounts (Hawaii)  
canyons – form from erosion and faulting (map of the Monterey Canyon)

**MID-OCEAN RIDGES** – continuous chain of submerged volcanic mountains  
Found undersea – 1950's & 60's, ridge on each side of border w/ central rift valley.  
Mid-Atlantic Ridge: earth's largest feature, 8km wide w/ walls as high & steep as Grand Canyon. Coincide w/ locations of earthquake centers: vents of hot water (350oC) rich in sulfur and other minerals and metals. This is a highly productive site and life is abundant through the process of chemosynthesis. Chemosynthetic bacteria derive energy from sulfur (H<sub>2</sub>S). Seafloor spreading causes the ridges,

### **THEORY OF PLATE TECTONICS OR "CONTINENTAL DRIFT"**

Movement of plates of up to 8–10 cm / year in the Pacific.

Evidence: Important feature discovered was magnetic differences – relate to times of formation that differ in distance away from the ridge. Fossils and rock types on different continents that match up.

### **SEA FLOOR SPREADING**

Spreading centers occur at ocean ridge and the formation of crust occurs. Energy comes from molten core giant heat engine driving plate movement through convection.

**SUBDUCTION ZONES** – Where plates **collide**–destruction of crust/lithosphere, becomes molten, leads to earthquakes and volcanic formation. When an oceanic plate and a continental plate collide – oceanic subducts(denser) = continental volcanoes– S. America denser, two oceanic plates – island arcs Eg. Aleutians, Marian's, Pacific Basin – "ring of fire" as is has many subduction zones.

Land influences – movement along plate boundaries also affect portions of continents– eg San Andreas Fault.

### **SEA FLOOR CHARACTERISTICS –**

- ridges – spreading centers
- trenches – subduction zones, Deepest is the Marianas Trench = 11,022m (36152ft) which is higher than Mt. Everest which is 8,848m (29021ft).
- sediments –lithogenous–sediment breakdown and biogenous–biological input. History in the sediments – cores to sample and micro fossil clues (CaCO<sub>3</sub> and SiSO<sub>3</sub>).

## **CONTINENTAL MARGINS**

The shape often reflects the age and activity that has occurred along a particular margin. Active ones are steep (South American Plate and our own), while passive ones are more ancient and more of a gentle slope (eg. East Coast of the US)

### General Features of the continental margins:

- Continental shelf: to about 200 meters. NOT an oceanic feature – a terrestrial feature
- Continental slope: to about 3,000-4,000 meters. Slope steepens.
- Continental rise: mud, silt, and sand turbidity currents – sediment accumulation
- Deep ocean:
- Abyssal Plain – to about 4,000-6,000 meters. Generally soft bottom and relatively flat
- Trenches
- Ridges, rises and underwater mountain ranges
- Seamounts (Hawaii)
- Canyons: erosion and faulting (eg. Monterey Canyon).
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## **CLASSIFYING MARINE ENVIRONMENTS**

Intertidal

Photic Zone: 50-100 meters, where light can accommodate photosynthesis

Shallow nearshore

Shallow open ocean

Aphotic zone

Benthos: ocean floor

Pelagic: nearshore (neritic), Oceanic (offshore)