

## Origins of Oceans

4.5 BYA - Origin of Earth

Formation of Oceans:

- 1) Volcanism - water vapor
- 2) Mantle Degassing

Took 500 million years

Cross-section indicating how echo sounding, seismic reflection and sidescan sonar are used to study the ocean floor.

Methods of studying the sea floor

- 1) Rock Dredge
- 2) Seafloor Drilling
- 3) Submersibles
- 4) Echo Sounders
- 5) Seismic Profiling
- 6) Other
  - a. Other surveys - Magnetic
  - b. Seismic Refraction
  - c. Gravity

## **Passive Continental Margins**

Continental Rise: Wedge of Sediments

Deposited By: 1) Turbidity Currents (driven by gravity)

- 2) Contour Currents- Flows parallel to continental margin

## **Active Continental Margin**

Trenches may be 8-10 km deep

=> Largest negative gravity anomalies in the world (held down)

=> Very low heat flow

### **Features of the Seafloor**

#### **1) Continental Shelves and Slopes**

Continental Shelf: shallow marine platform at the edge of a continent inclining very gently seaward, generally at an angle of 0.1 degrees.

- \* Vary in width: Pacific a few km wide, New Foundland- 500 km wide

- \* Covered with sediment derived from the continent

Continental Slope: relatively steep slope that extends from a depth of 100-200 m at the edge of the continental shelf down to ocean depths. Average angle 4-5 degrees, although some parts can be steeper.

- \* Harder to study, deep underwater - little known

- \* Where two crusts meet

#### **2) Submarine canyons- V shaped valleys that run across continental shelves and down continental slopes.**

- \* May be miles offshore, or near surf zone

- \* At the base of submarine canyons, abyssal fans may be found

- \* Erosive features: can have sand falls, turbidity, or glacial-like movement

- \* Turbidity Currents- great masses of sediment-laden water pulled down hill by gravity

  - > Caused by: Earthquakes, landslides, strong storms, floods, of sediment- laden rivers discharging into the sea

Hard to Witness =>

Evidence: breaking of submarine cables

1929 Grand Banks Earthquakes Cable Breaks

### **The Mid-Oceanic Ridge**

- Giant undersea mountain range that extends around the world like the seams on a baseball
  - Composition: mostly basalt
  - Length: 80,000 km long
  - Width: 1500 to 2500 km wide
  - Height: 2-3 km above seafloor
- Rift Valley- runs down the center or crest

#### Geologic Activity of the ridge

- 1) Shallow focus Earthquakes (0-20km)
- 2) Very high heat flow
- 3) Basalt eruptions- mafic lava (including pillows)
  - a) seamounts- small volcanoes, sometimes reach the surface (Iceland)
- 1974- used submersibles to study bottom (including Alvin)
  - Famous- French American Mid-Ocean undersea study
- 4) Extensional Faults
- 5) Black Smokers- hot springs

#### Biologic Activity on the Ridge

- 6) Lots of cool critters- critters not found anywhere else
  - live near hot springs, which are rich in  $H_2S$  rather than  $H_2O$

#### Ocean Floor and Stratified Lakes (more density stratification)

### **Other Ocean Floor Features**

#### Fracture Zones- lines of weakness that offset the mid-oceanic ridge

- \* Transform Faults- have Earthquakes
- \* Offset rift valley

#### Seamounts- conceal undersea mountains that rise 1000 meters or more above the seafloor.

- sometimes rise to form islands
- only a few are active volcanoes
  - a) some associated with a mid-ocean ridge
  - b) associated with hot-spots

#### Guyots- flat topped sea mounts, found mostly in the western pacific

- corals found on top

Aseismic Ridges- chains of seamounts and/or guyots, like the Hawaiian Islands- not Earthquake prone like MOR.

Reefs- are wave resistant ridges of coral, algae and other calcareous organisms.

- 1) Fringing Reefs- flat, table-like reefs attached to the shore
- 2) Barrier Reefs- parallel to shore, separated from shore by lagoon.
- 3) Atolls- circular reefs that rim lagoons

Sediments of the Sea Floor

1) Terrigenous Sediment- land derived sediment, found all the way out on the abyssal floor

2) Pelagic Sediment- sediment that settles slowly through the ocean

-fine clays- terrestrial as well- volcanic component- gets there by wind

Oceanic Crust and Ophiolites

Marine sed. rock  
Pillow Basalt  
Sheeted Dikes  
Gabbroic Intrusions  
UM rock

Age of the seafloor