Chapter Outlines

NOTE: This is intended to help students 'organize' their understanding of each topic. It is <u>not</u> a comprehensive study guide for quizzes or midterms, i.e. <u>study your text!</u>

Ocean Floor

Earth's oceans

1) The vast world ocean

a) Earth is often referred to as the blue planet - **71%** of Earth's surface is represented by oceans and marginal seas

b) Northern Hemisphere is called the land hemisphere, and the Southern Hemisphere the water hemisphere *(this changes over geologic time)*

c) Four main ocean basins:

i) Pacific Ocean—the largest and has the greatest depth

ii) Atlantic Ocean—about half the size of the Pacific and not quite as deep

iii) Indian Ocean—slightly smaller than the Atlantic, largely a Southern Hemisphere body

iv) Arctic Ocean—about 7 percent the size of the Pacific

2) Mapping the ocean floor

a) Bathymetry—measurement of ocean depths and the charting the topography of the ocean floor

b) **Echo sounder** (also referred to as *sonar*)

i) Invented in the 1920s, it is the primary instrument for measuring depth

ii) Reflects sound from ocean floor

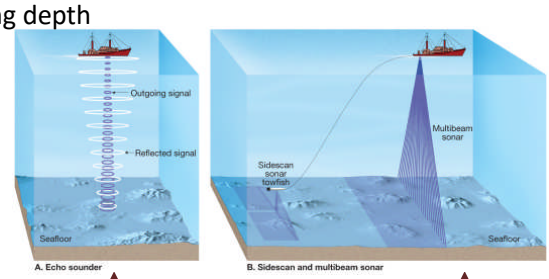
c) Multibeam sonar

i) Employs an array of sound sources and listening devices

ii) Obtains a profile of a narrow strip of seafloor

d) Measuring the shape of the ocean surface from space

e) Three major topographic units of the ocean floor: continental margins, ocean-basin floor, mid-ocean ridge



Sonar, and multibeam sonar

3) Continental margins

a) **Passive continental margins** – coasts not associated with plate boundaries

i) Found along most coastal areas that surround the Atlantic ocean

ii) Have little volcanism and few earthquakes

iii) Features of a passive continental margin include:

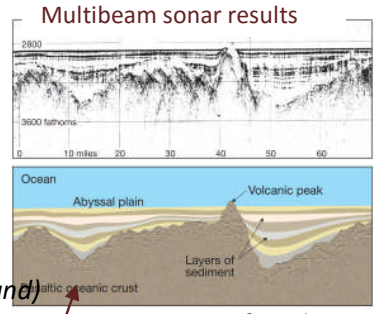
(1) Continental shelf

(a) The gently sloping flooded extension of the continent; …can vary greatly in width

(b) Often contains important mineral deposits: oil; natural gas; sand and gravel

(c) Some areas are blanketed by extensive glacial deposits *(Long Island)*

(d) Most consist of thick accumulations of shallow-water sediments



Interpretation of results

(2) Continental slope

(a) The relatively steep structure, marking the seaward edge of the continental shelf

(b) Boundary between continental crust and oceanic crust

(3) Submarine canyons and turbidity currents

(a) Submarine canyons

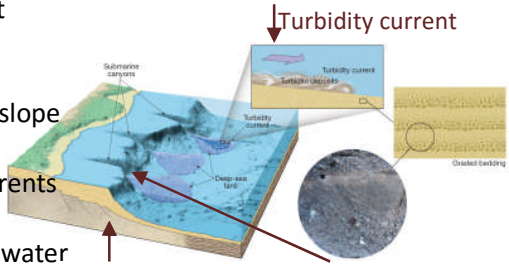
(i) Deep, steep-sided valleys cut into the continental slope

(ii) Some are seaward extensions of river valleys, but most appear to have been eroded by turbidity currents

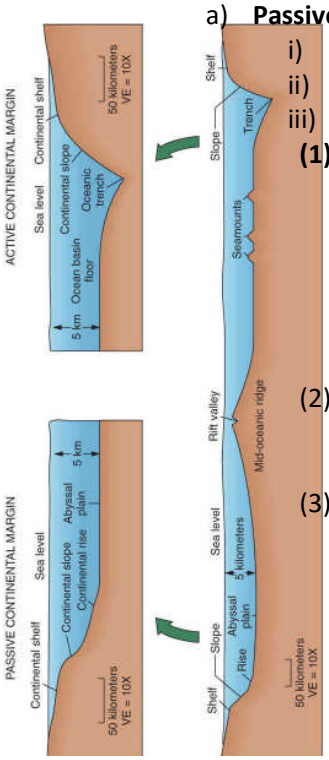
(b) Turbidity currents

(i) Downslope movements of dense, sediment-laden water

(ii) These layered deposits are called *turbidites* - Consist of graded bedding—decrease in sediment grain size from bottom to top



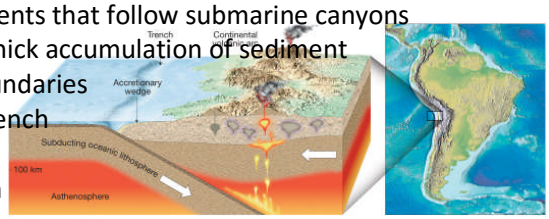
Passive margin, submarine canyons



Seafloor profiles

(4) **Continental rise** - found in regions where trenches are absent
   (a) Continental slope merges into a more gradual incline—the continental rise
   (b) At the base of the continental slope turbidity currents that follow submarine canyons deposit sediment that forms deep-sea fans, and thick accumulation of sediment

b) **Active continental margins** – coasts associated with plate boundaries
   i) Continental slope descends abruptly into a deep-ocean trench
   ii) Located primarily around the Pacific Ocean
   iii) Accumulations of deformed sediment and scraps of ocean crust form accretionary wedges



Active continental margin

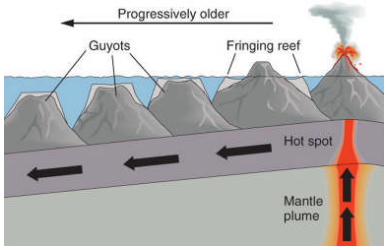
4) Ocean-basin floor features

a) Deep-ocean trenches – the deepest parts of the ocean
   i) Long, relatively narrow features
   ii) Associated with volcanic activity such as volcanic island arcs, and continental volcanic arcs
   iii) Most are located in the Pacific Ocean
   iv) Sites where moving lithospheric plates plunge into the mantle

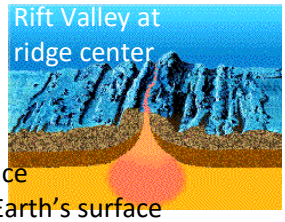
b) **Abyssal plains** – are likely the most level places on Earth - found in all oceans, often with thick accumulations of sediment

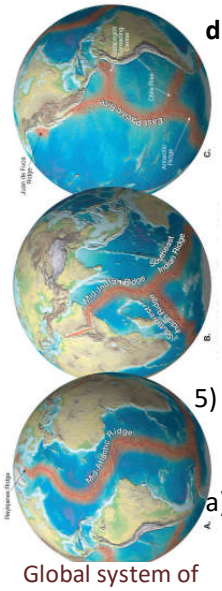
c) **Seamounts** and **guyots**
   i) Isolated under-sea volcanic peaks that sometimes emerge as an island
   ii) Many form near oceanic ridges
   iii) Through time may sink and form flat-topped seamounts called *guyots* or *tablemounts*

Guyot formation



d) Mid-ocean ridge
   i) Characteristics
      (1) An elevated position above the abyssal plain
      (2) Extensive faulting
      (3) Numerous volcanic structures that have developed on newly formed crust
   ii) Interconnected ridge system is the longest topographic feature on Earth's surface
      (1) More than 70,000 kilometers *(43,000 miles)* in length and includes 23% of Earth's surface
      (2) Winds through all major oceans *(similar to the stitching on a baseball)*
   iii) Along the axis of some segments are deep down-faulted structures called **rift valleys**
   iv) Consist of layer upon layer of basaltic rocks that have been faulted and uplifted



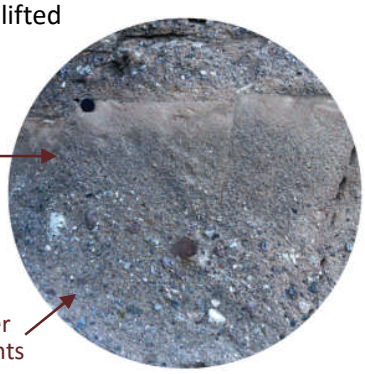

Global system of mid-ocean ridges

5) **Seafloor sediments** – ocean floor is blanketed with sediment. Sources include:
   i) Turbidity currents
   ii) Fine sediment that slowly settles to the bottom from above

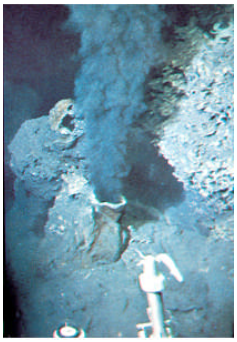
a) Thickness varies
   i) Thickest in trenches—accumulations may approach 10 kilometers
   ii) Pacific Ocean—about 600 meters or less *(approx average)*
   iii) Atlantic Ocean—from 500 to 1000 meters thick *(approx average)*

b) Mud is the most common sediment on the deep-ocean floor

c) Types of seafloor sediments
   i) **Terrigenous** sediment - material weathered from continental rocks - coarse materials settle near shore, and fine particles remain suspended for a long time
   ii) **Biogenous** sediment – mostly calcium carbonate and silica - consists of shells and skeletons of marine animals and plants
   iii) **Hydrogenous** sediment - minerals that crystallize directly from seawater through various chemical reactions. Includes:
      (1) Manganese nodules.
      (2) Calcium carbonates – which form limestone
      (3) Metal sulfides – precipitated near **black smokers**
      (4) Evaporites – such as table salt (NaCl), anhydrite ($CaSO_2$) and gypsum ($CaSO_4 \cdot 2H_2O$)



Graded beds in a turbidite


Black Smoker

Microscopic skeletons on seafloor