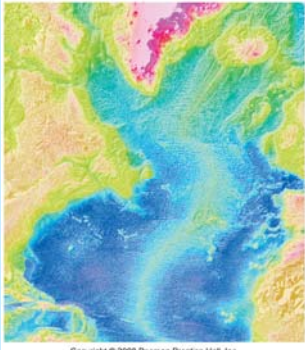


CHAPTER 3 Marine Provinces



Measuring bathymetry

- Ocean depths and topography of ocean floor
- **Sounding**
 - Rope/wire with heavy weight
 - *Known as lead lining*
- **Echo sounding**
 - Reflection of sound signals
 - 1925 German ship *Meteor*

Measuring bathymetry

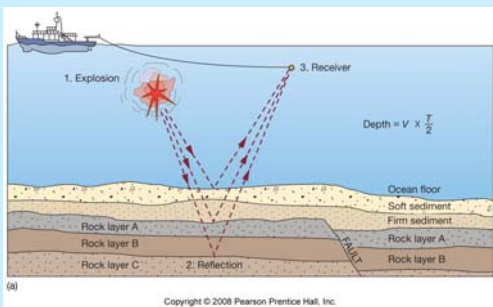


Fig. 3.3a

Measuring bathymetry

- Precision depth recorder (PDR) 1950s
 - Focused beam
- Multibeam echo sounders
- Side-scan sonar
- More detailed "picture" of the sea floor
- Satellite measurements
- Seismic reflection profiles looks at ocean structure beneath sea floor

Measuring bathymetry

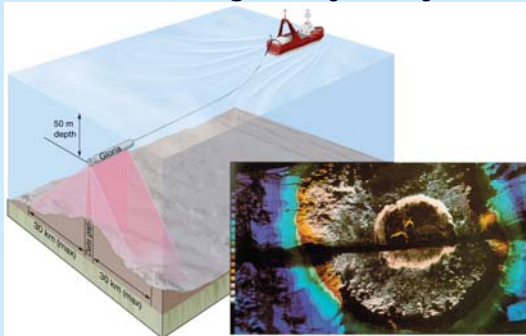


Fig. 3.2

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Hypsographic curve

- Amount of Earth's surface (%) at different elevations and depths
- 70.8% of Earth covered by oceans
- Average depth ocean 3729 m
- Average elevation land 840 m
- Uneven distribution of areas of different depths/elevations

Hypsographic curve

- Shape of curve supports plate tectonics
- Earth shaped actively by plate tectonics

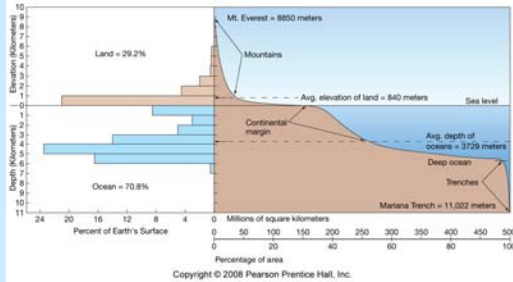


Fig. 3.4

Ocean provinces

- 3 major provinces
- Continental margins
 - Shallow-water areas close to shore
- Deep-ocean basins
 - Deep-water areas farther from land
- Mid-ocean ridge
 - Submarine mountain range

Continental margins

- Passive or active
- Passive
 - Not close to any plate boundary
 - No major tectonic activity
 - Example: east coast of United States

Continental margins

- **Active**
 - Associated with convergent or transform plate boundaries
 - Much tectonic activity
- **Convergent active margin**
 - Oceanic-continental convergence
 - Example: western South America

Continental margins

- **Transform active margin**
 - Associated with transform plate boundaries
 - Example: Coastal California along the San Andreas fault

Continental margins

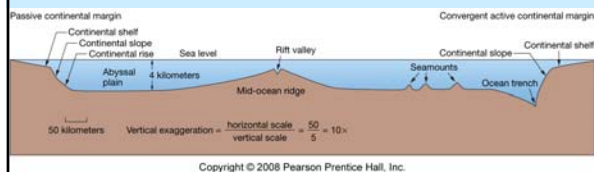


Fig. 3.6

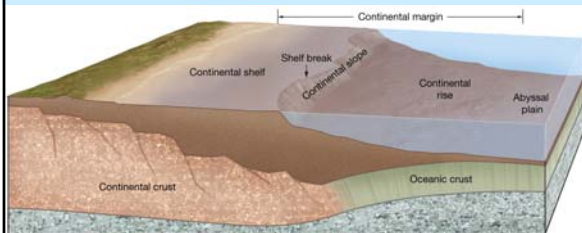
Continental margin features

- Continental shelf
- Shelf break
- Continental slope
- Continental rise

Continental shelf

- Extends from shoreline to shelf break
- Shallow, low relief, gently sloping
- Similar topography to adjacent coast
- Average width 70 km (43 m) but can extend to 1500 km (930 m)
- Average depth of shelf break 135 m (443 ft)

Continental margin



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Fig. 3.7

Continental slope

- Change in gradient from shelf
- Average gradient 4°
- Submarine canyons cut into slope by turbidity currents
 - Mixture of seawater and sediments
 - Move under influence of gravity
 - Erode canyons
 - Deposit sediments at base of slope

Continental slope and submarine canyons

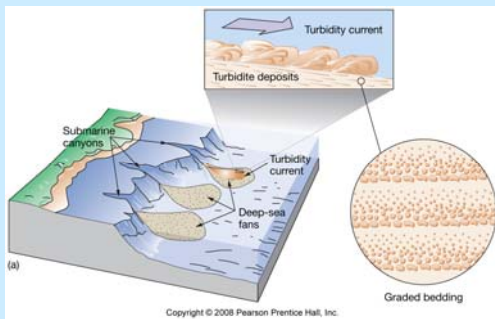


Fig. 3.9a

Continental rise

- Transition between continental crust and oceanic crust
- Turbidite deposits
 - Graded bedding
 - Submarine fans
- Distal end of submarine fans becomes flat abyssal plains

Deep ocean basin features

- Abyssal plains
- Volcanic peaks
- Ocean trenches
- Volcanic arcs

Abyssal plains

- Very flat depositional surfaces from base of continental rise
- Suspension settling of very fine particles
- Sediments cover ocean crust irregularities
- Well-developed in Atlantic and Indian oceans

Abyssal plains

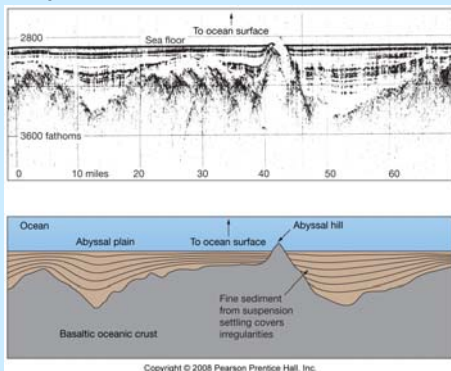


Fig. 3.11

Volcanic arcs

- Landward side of ocean trench
- **Island arc**
 - Chain of islands, e.g., Japan
- **Continental arc**
 - Volcanic mountain range, e.g., Andes Mountains

Mid-ocean ridge

- Longest mountain chain
- On average, 2.5 km (1.5 miles) above surrounding sea floor
- Wholly volcanic
- Basaltic lava
- Divergent plate boundary

Mid-ocean ridge features

- **Central rift valley, faults, and fissures**
- **Seamounts**
- **Pillow basalts**
- **Hydrothermal vents**
 - Deposits of metal sulfides
 - Unusual life forms
- **Fracture zones and transform faults**

Rift valley, faults, and fissures

- Downdropped rift valley at central crest
- Cracks (fissures) and faults common

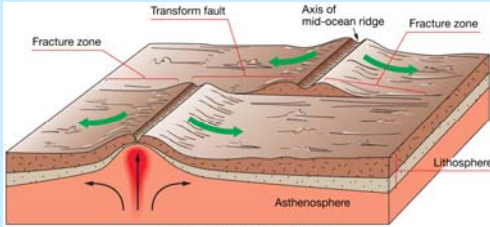


Fig. 3.17

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Mid-ocean ridge features

- **Oceanic ridge**
 - Prominent rift valley
 - Steep, rugged slopes
 - Example: Mid-Atlantic Ridge
- **Oceanic rise**
 - Gentler, less rugged slopes
 - Example: East Pacific Rise

Volcanic features of mid-ocean ridge

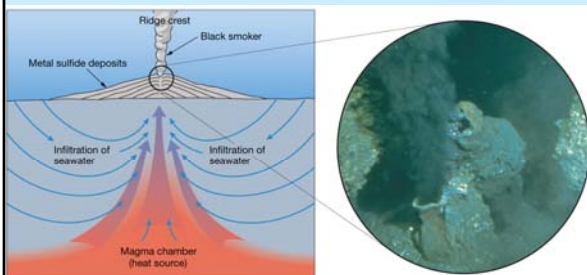
- **Pillow lava or pillow basalts**
 - Hot lava chilled by cold seawater
 - Smooth, rounded lobes of rock

Volcanic features of mid-ocean ridge

■ Hydrothermal vents

- Heated subsurface seawater migrates through cracks in ocean crust
 - Warm-water vents <30°C or 86°F
 - White smokers >30°C <350°C or 662°F
 - Black smokers > 350°C

Hydrothermal vents



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Fig. 3.16a

Hydrothermal vents

- Dissolved metals precipitate to form metal sulfide deposits
- Unusual biological communities
 - Able to survive without sunlight
 - Archaeons and bacteria oxidize hydrogen sulfide gas to provide food

Fracture zones and transform faults

- Long linear zones of weakness offset axes of mid-ocean ridge
- **Transform faults:** movement in opposite directions
- **Fracture zones:** extensions of fracture zones (aseismic)

Fracture zones and transform faults

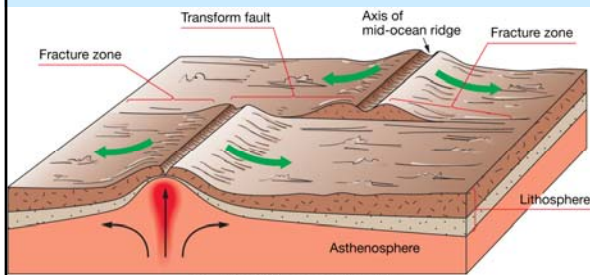


Fig. 3.17

End of CHAPTER 3 Marine Provinces

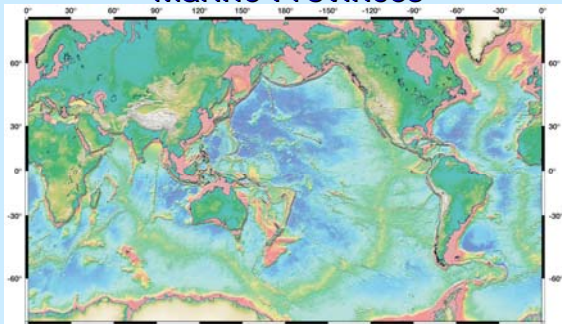


Fig. 3C
