Coasts: Big Ideas

- Humans cannot eliminate natural hazards but can engage in activities that reduce their impacts by identifying high-risk locations, improving construction methods, and developing warning systems
- Water's unique physical and chemical properties are essential to the dynamics of all of Earth's systems
- Earth's systems are dynamic; they continually react to changing influences from geological, hydrological, physical, chemical, and biological processes
- Humans cause global change through fossil fuel combustion, land-use changes, agricultural practices, and industrial processes

High Tech Methods for Surveying the Deep Sea Floor

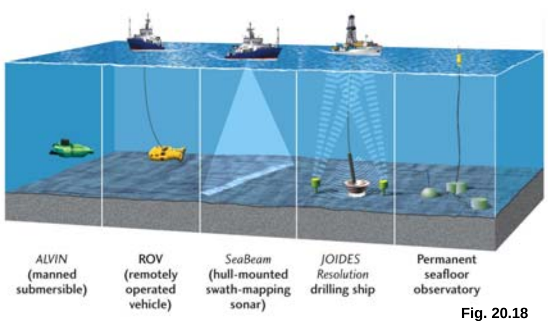


Fig. 20.18

Topographic Profile Across the North Atlantic

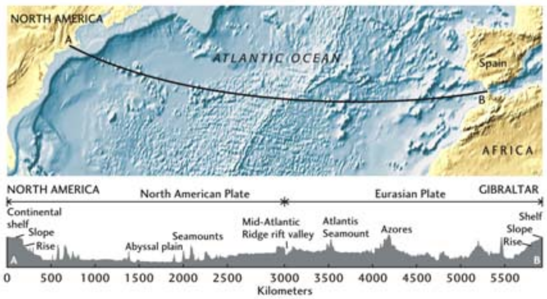


Fig. 20.20

Major Physiographic Features in the Atlantic Ocean

- **continental margin**
  - continental shelf
  - continental slope
  - continental rise
- **abyssal plain**
- **seamounts and guyots**
- **Mid-ocean ridge**
  - abyssal hills
  - central rift valley

Continental Shelf

A broad, flat platform extending from the shoreline to the beginning of the continental slope. Usually less than 200 m deep, it may extend 100's km offshore. It is underlain by continental crust.

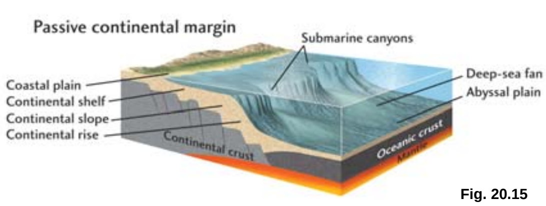


Fig. 20.15

Continental Slope

A steeper (~4º) , typically mud-draped slope marking the edge of the continental shelf.

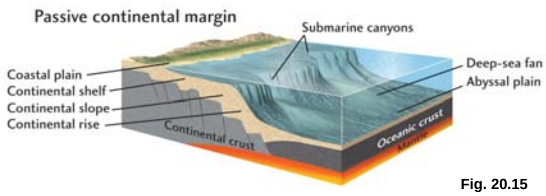


Fig. 20.15

Submarine Canyons

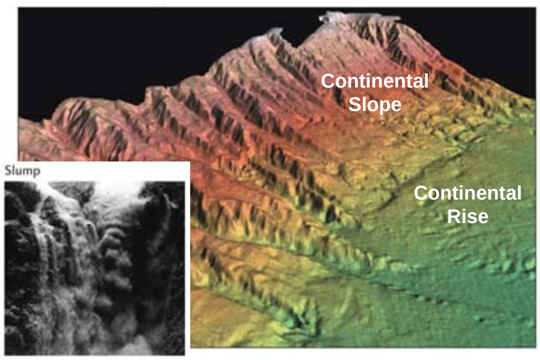


Fig. 20.19

Continental Rise

A gently sloping apron of sediment formed by deposition of sands and muds at the base of the continental slope (typically at depths of 2-3 km). May include large submarine fans underlain by several kilometers of sediment.

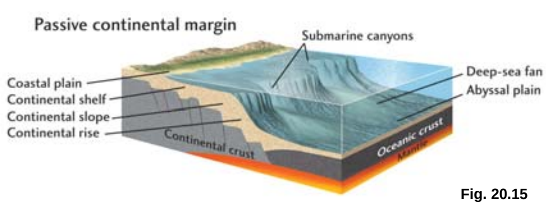


Fig. 20.15

Abyssal Plain

This plain extends beyond the continental rise typically 4-6 km below sea level. It is the flattest surface on the earth. May include submerged volcanoes called *Seamounts*.

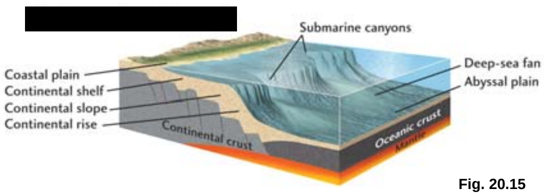
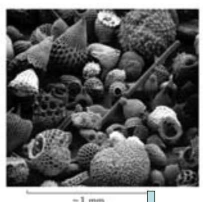


Fig. 20.15

Carbonate Compensation Depth (CCD)

The depth below which carbonate tends to dissolve. Only siliceous shells can be found below the CCD.



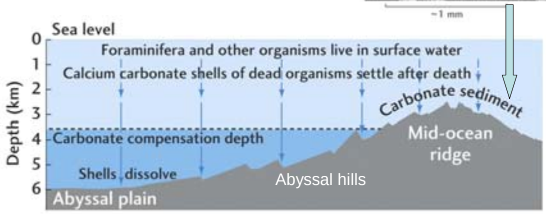
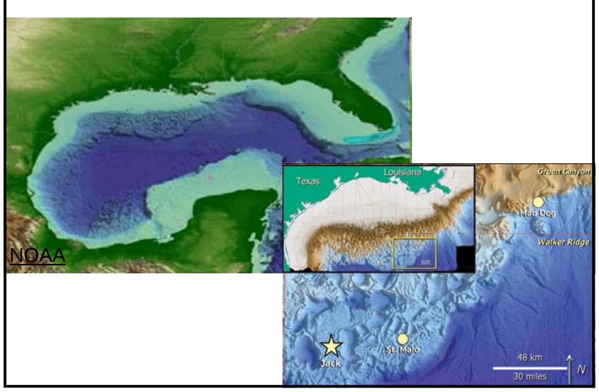
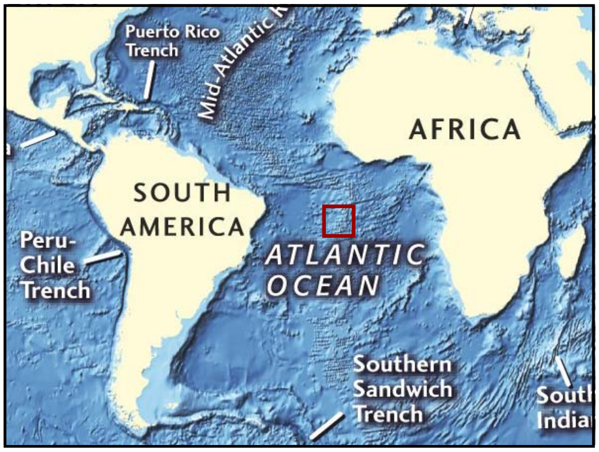
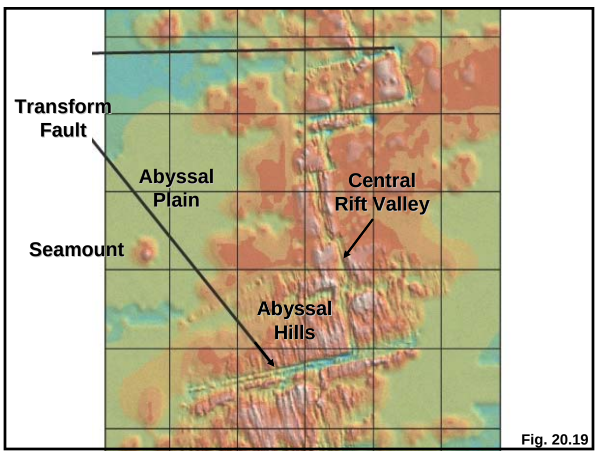


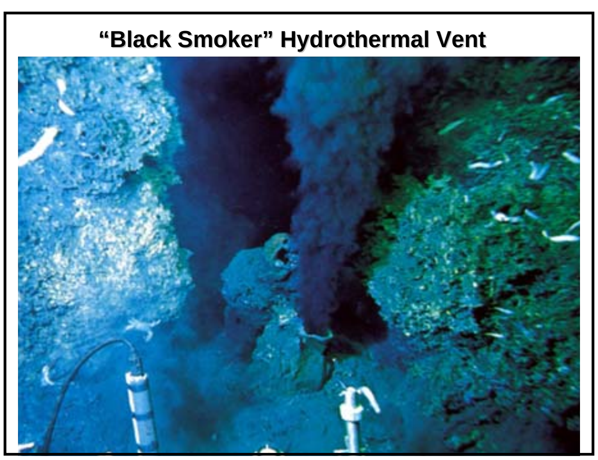
Fig. 20.24

Gulf of Mexico




Puerto Rico Trench
AFRICA
SOUTH AMERICA
Peru-Chile Trench
ATLANTIC OCEAN
Southern Sandwich Trench


Transform Fault
Abyssal Plain
Central Rift Valley
Seamount
Abyssal Hills
Fig. 20.19


"Black Smoker" Hydrothermal Vent

Topographic Profile Across the South Pacific

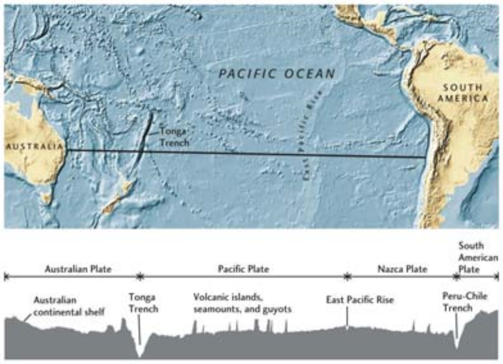


Fig. 20.22

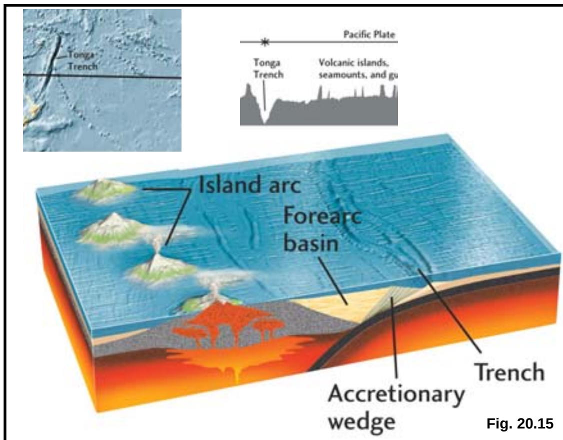


Fig. 20.15

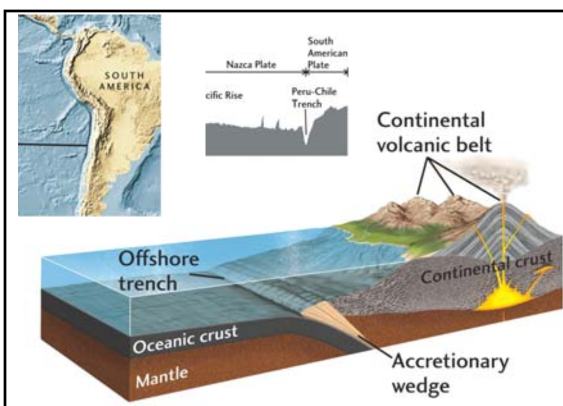


Fig. 20.15

Coastal Landscapes are Highly Variable, Depending on:

- stability of the coastal region
  - (e.g. uplifting, subsiding, stable)
- nature of rocks or sediments at the shoreline
- long-term changes in sea level
- wave energy
- tidal energy

Sandy Barrier Coastline of N. Carolina

Fig. 20.1

Rocky, Glaciated Coastline of Maine

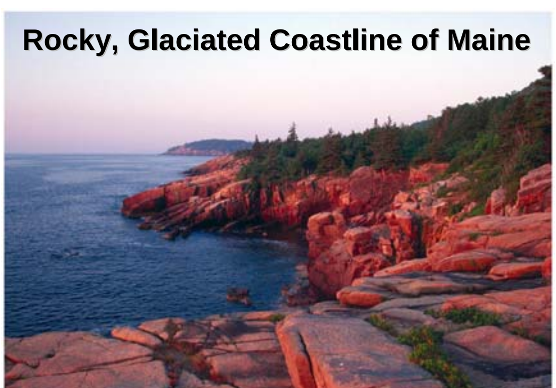


Fig. 20.1

Wave Cut Cliffs and Sea Stacks, Australia

Fig. 20.1

Coral Reef Coastline, Florida

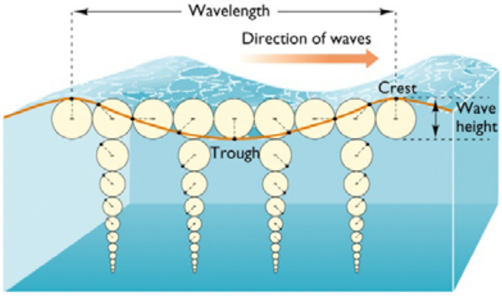
Fig. 20.1

Variables Controlling Wave Energy

- **wind velocity**
- **wind duration**
- **fetch** **(area over which the wind blows)**

W.R. Dupre'

Wave-generated Orbital Waves



Wave Motion is Influenced by Water Depth and Shape of the Shoreline

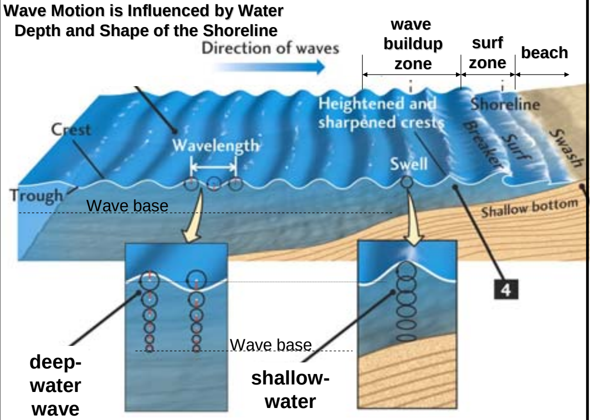


Fig. 20.2

Wave Refraction:

the bending of waves as they change velocity

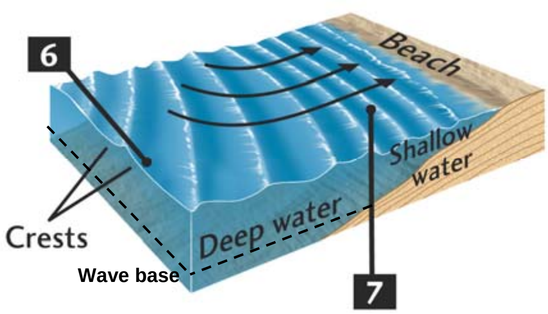
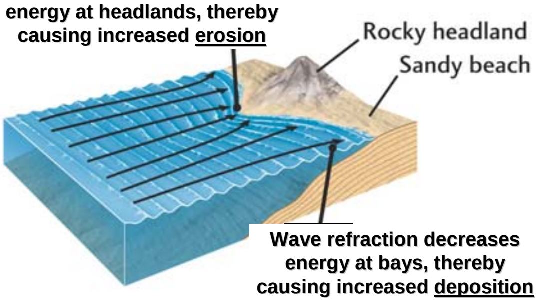


Fig. 20.2

Bending of wave crests due to refraction as waves slow down in progressively more shallow water depths

Fig. 20.2

Wave refraction concentrates energy at headlands, thereby causing increased erosion



Wave refraction decreases energy at bays, thereby causing increased deposition

Fig. 20.2

Longshore Drift

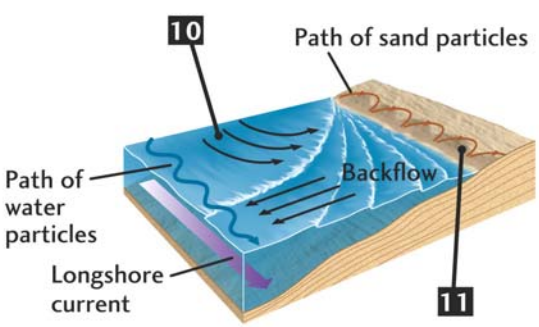


Fig. 20.2

Tidal fluctuations alternately expose and submerge tidal flats which almost surround Mont-Saint-Michel, France

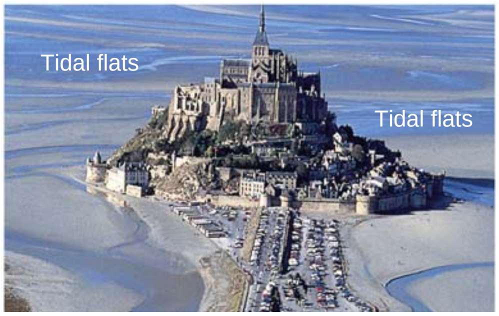


Fig. 20.4

Ocean tides are the result of the gravitational attraction of the moon and sun on the ocean. The tides formed by the moon are the **lunar tides**, and those formed by the sun are the **solar tides**.

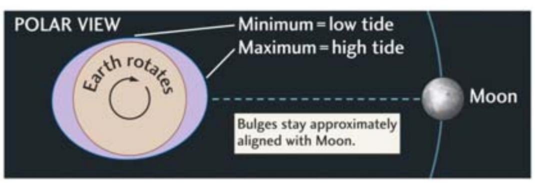
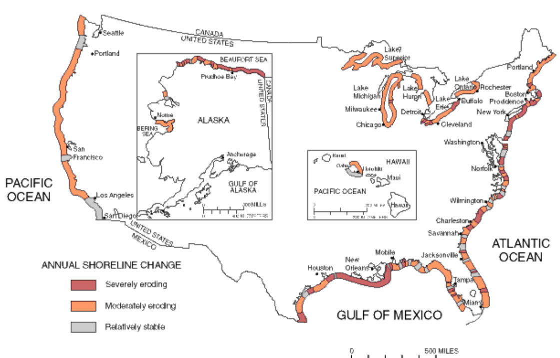


Fig. 20.3

Coastal Erosion Rates in the U.S.



U.S. Geological Survey

Erosion Fact

30-50% of all the structures within 500 feet of the present Gulf shoreline will be lost due to erosion in the next 60 years

•Source: Heinz Center Report to FEMA, 2000

Sand Budget

Inputs	Outputs
Sediments eroded from backshore cliffs by waves	Sediments transported to backshore dunes by offshore winds
Sediments eroded from upcurrent beach by longshore drift and current	Sediments transported downcurrent by longshore drift and current
Sediments brought in by rivers	Sediments transported to deep water by tidal currents and waves

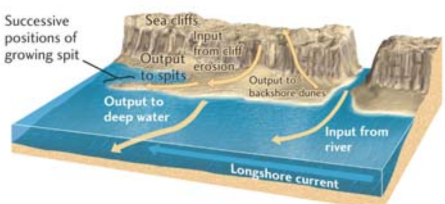


Fig. 20.12

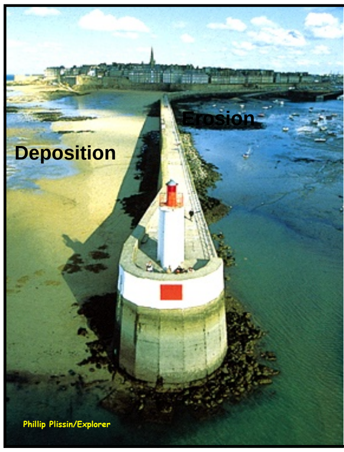
Can we prevent coastal erosion?

Structural approaches:

- Groins
- Jetties
- Seawalls
- Breakwaters

Non-structural approaches:

- beach nourishment
- abandonment/relocation/zoning



Groin

Prevents up-drift erosion

BUT… causes down-drift erosion

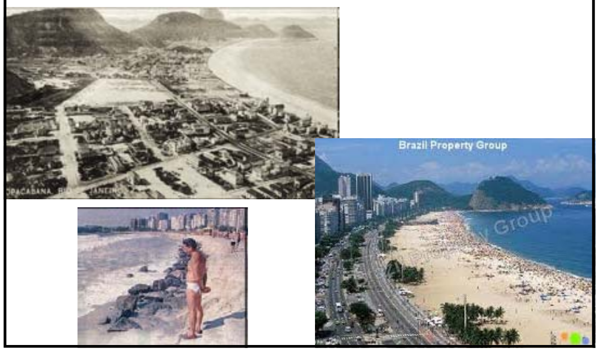
Beach Nourishment

The artificial addition of sand to the beach to reduce the rate of beach erosion.

But, it must be periodically replenished!

Box 20.2

Copacabana Beach



Huricanes

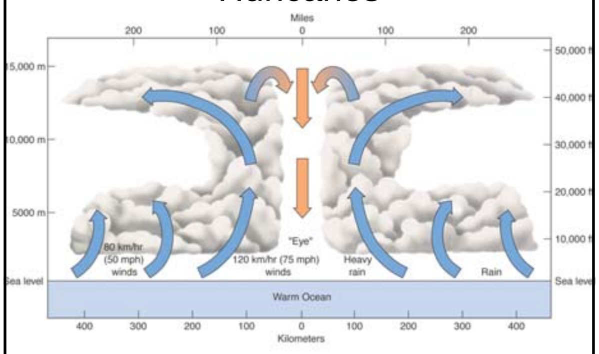
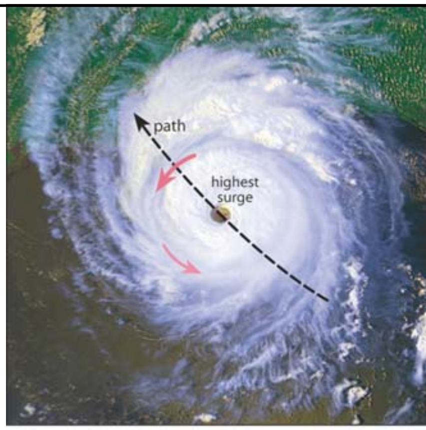


Fig. 10-28a, p. 279



Biloxi Bridge July 2006

Hurricane Gustav

Baton Rouge, 2008