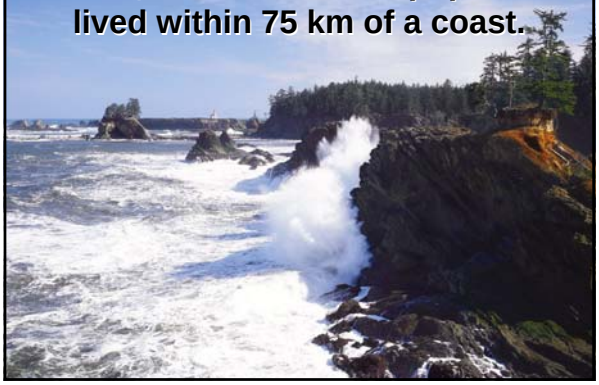
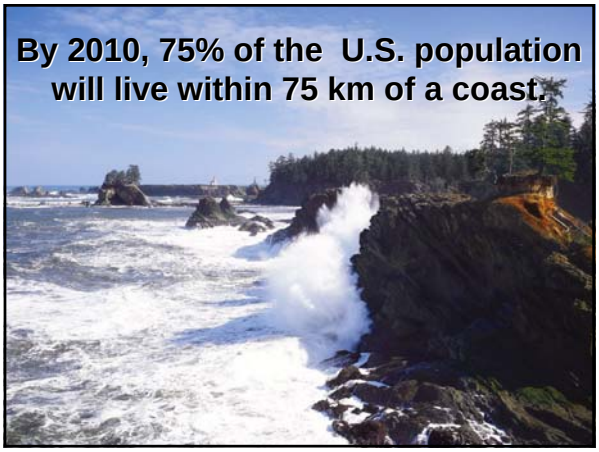
In 1990, 50% of the U.S. population lived within 75 km of a coast.



By 2010, 75% of the U.S. population will live within 75 km of a coast.



High Tech Methods for Surveying the Deep Sea Floor

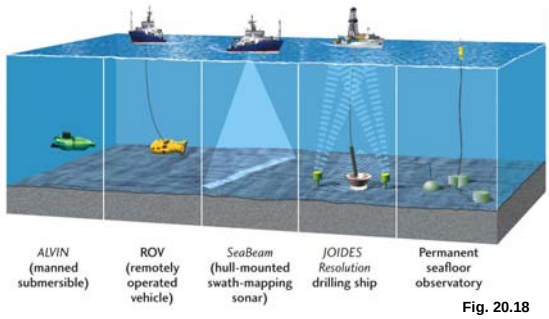


Fig. 20.18

Sea Floor Off the Coast of Southern California

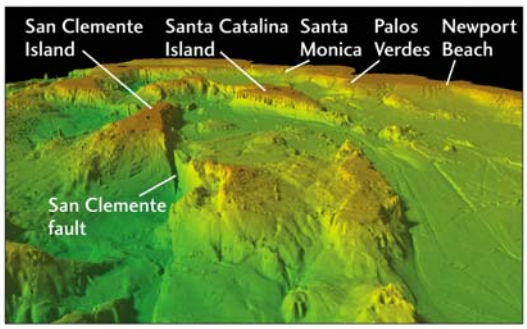
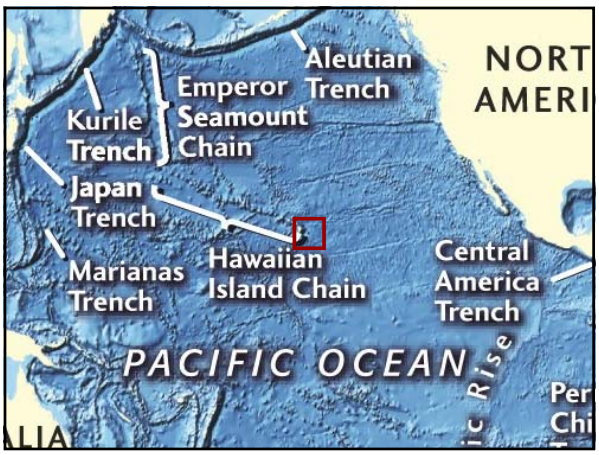


Fig. 20.19



Loihi Seamount

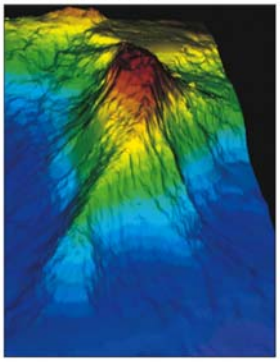


Fig. 20.19

Topographic Profile Across the North Atlantic

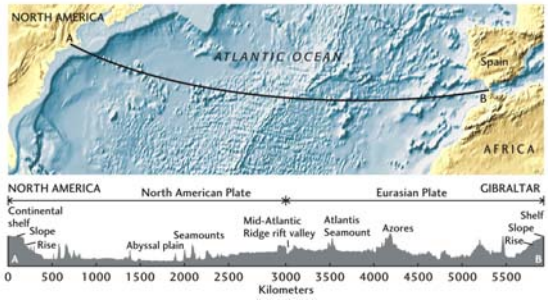


Fig. 20.20

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.

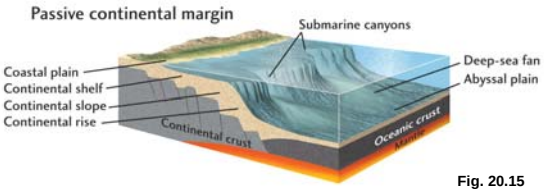


Fig. 20.15

Continental Slope

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

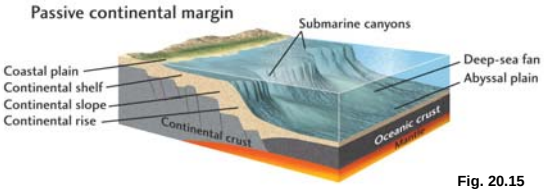


Fig. 20.15

Typical Passive Continental Margin

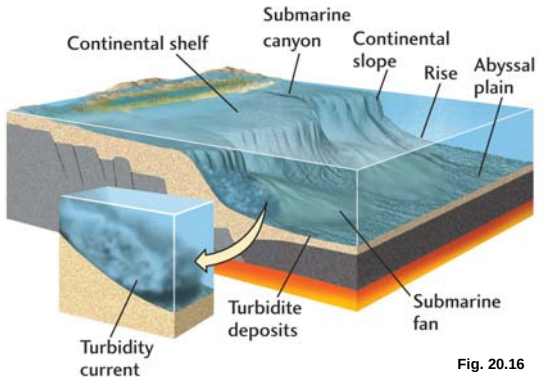


Fig. 20.16

Submarine Canyons

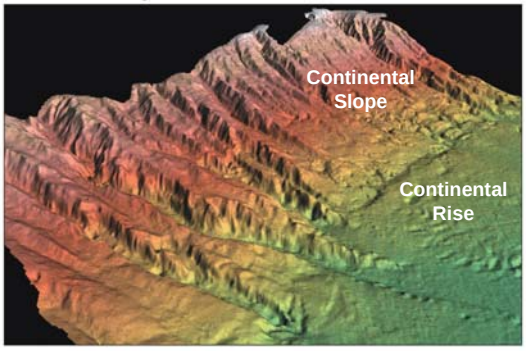


Fig. 20.19

Slump

Fig. 20.16

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.

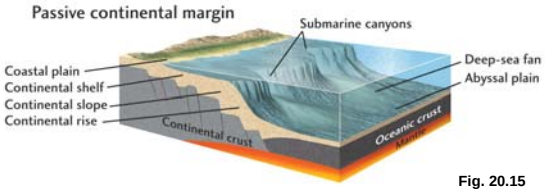


Fig. 20.15

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*.

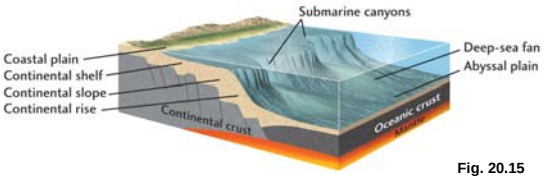
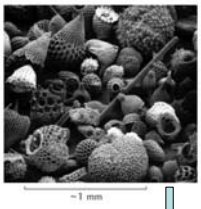


Fig. 20.15

Carbonate Compensation Depth (CCD)

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



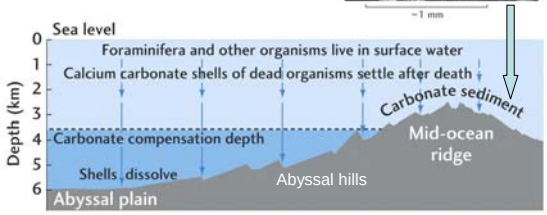


Fig. 20.24

Abyssal Hills

Linear ridges of basalt covered with a thin veneer of deep-sea sediment on the flanks of the Mid-ocean ridge.

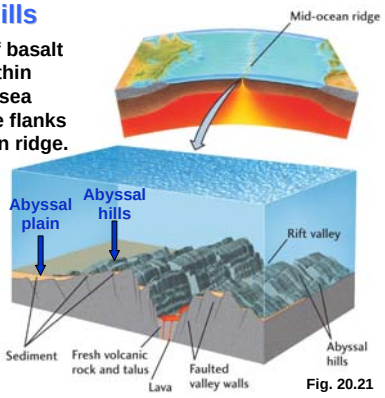
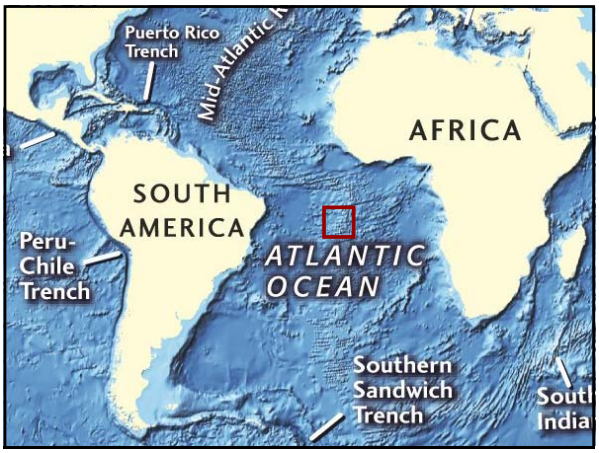


Fig. 20.21


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

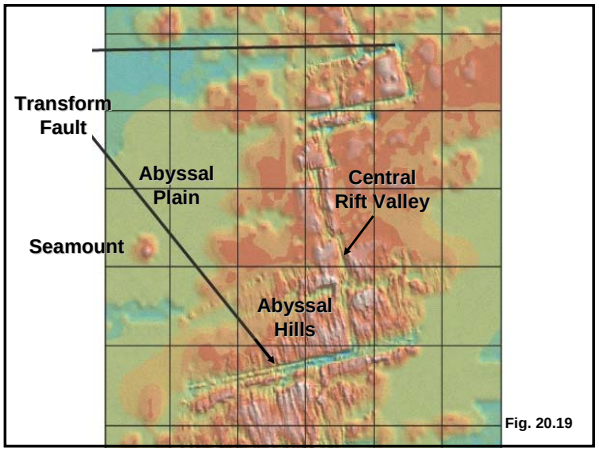
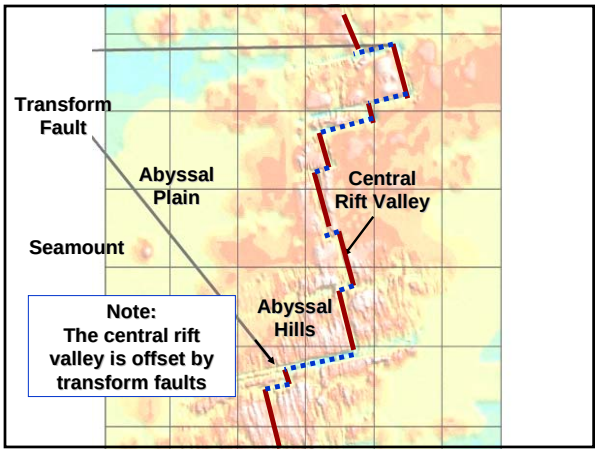

Transform Fault
Abyssal Plain
Central Rift Valley
Seamount
Abyssal Hills

Fig. 20.19


Transform Fault
Abyssal Plain
Central Rift Valley
Seamount
Abyssal Hills
Note:
The central rift valley is offset by transform faults

"Black Smoker" Hydrothermal Vent

Topographic Profile Across the South Pacific

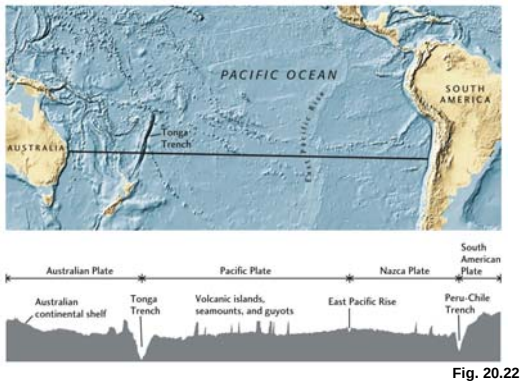


Fig. 20.22

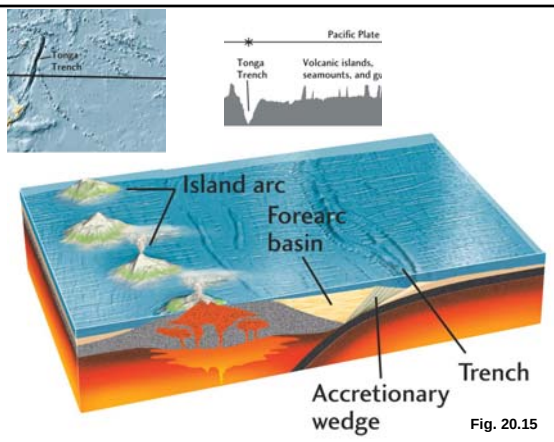


Fig. 20.15

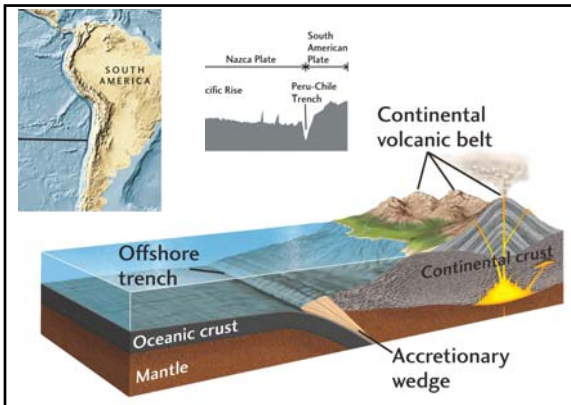


Fig. 20.15

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

Fig. 20.1

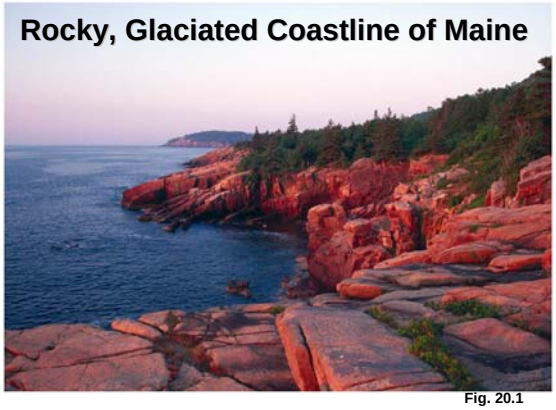


Fig. 20.1

Fig. 20.1

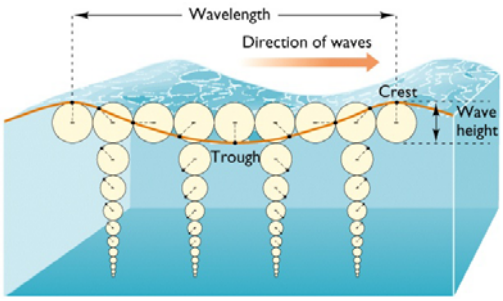
Fig. 20.1

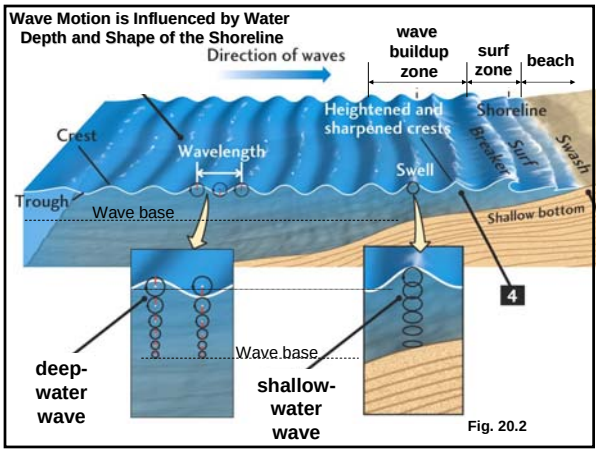
Variables Controlling Wave Energy

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

W. R. Dupre'

Wave-generated Orbital Waves





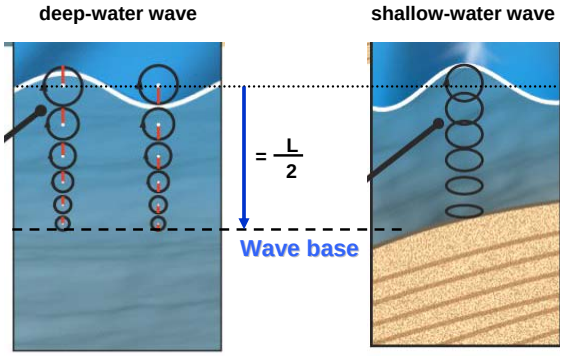


Fig. 20.2

Wave Refraction:

the bending of waves as they change velocity

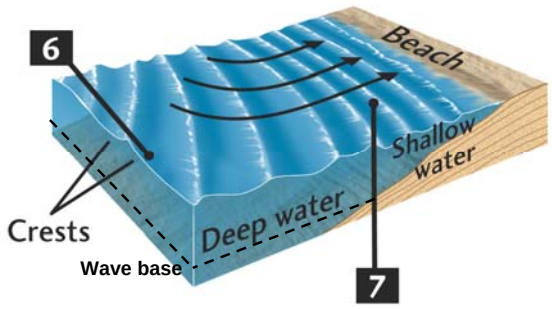
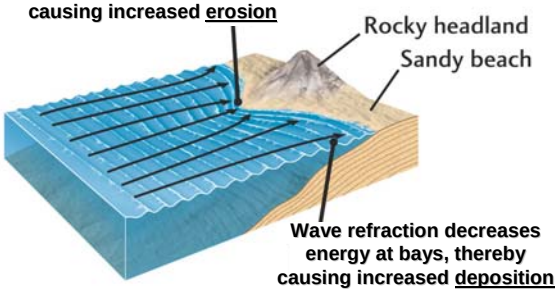


Fig. 20.2

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 <u>erosion</u>



Wave refraction decreases energy at bays, thereby causing increased <u>deposition</u>

Fig. 20.2

Longshore Drift

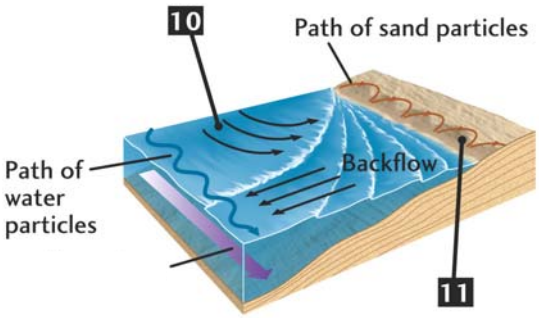


Fig. 20.2

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

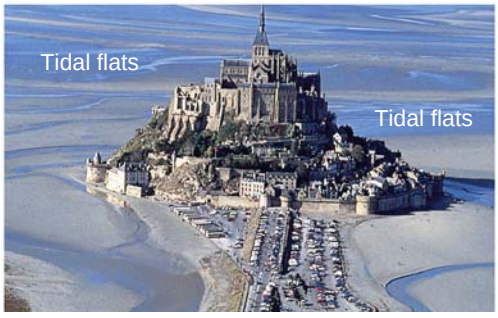


Fig. 20.4

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**.

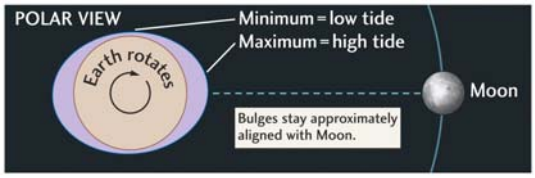
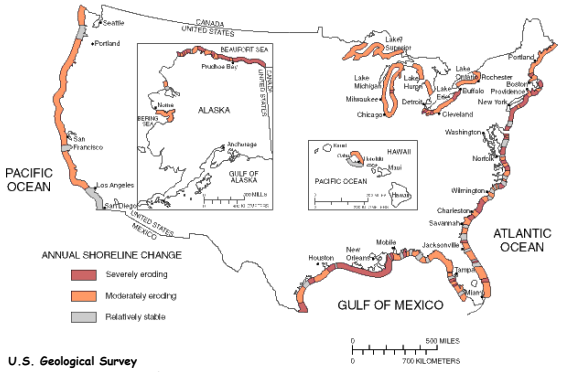


Fig. 20.3

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

Q. What determines whether a beach is eroding or stable?

A. the sand budget

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

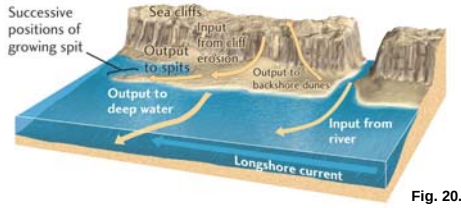


Fig. 20.12

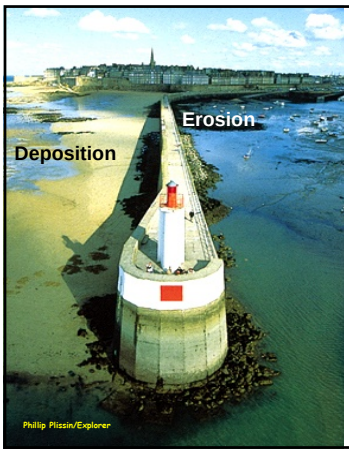
How can we prevent coastal erosion?

Structural approaches:

- Groins
- Jetties
- Seawalls
- Breakwaters

Non-structural approaches:

- beach nourishment
- abandonment/relocation/zoning



Groin

Prevents up-drift erosion

BUT… causes down-drift erosion

Q.What do jetties, groins, seawalls, and breakwaters all have in common?

A. They all cause 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!

Beach Nourishment
Monmouth Beach, New Jersey

Box 20.2

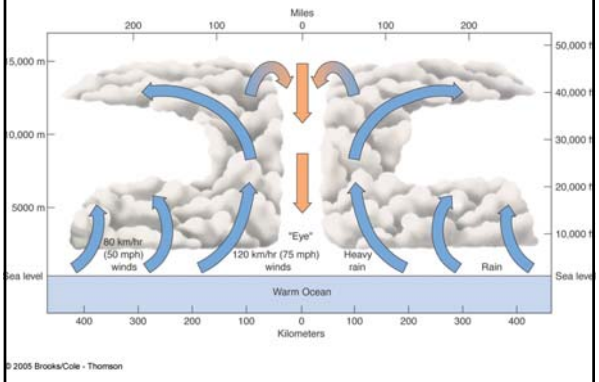
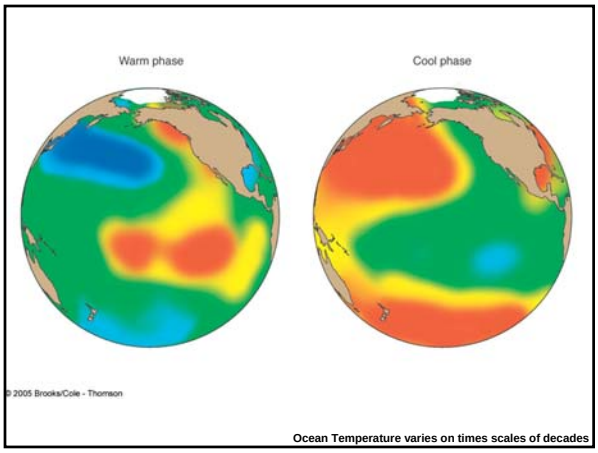
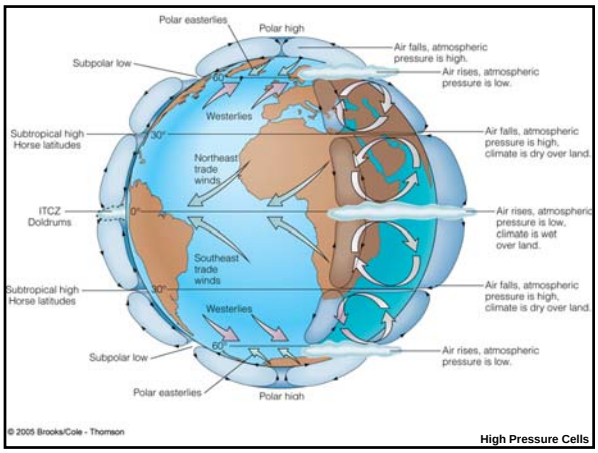


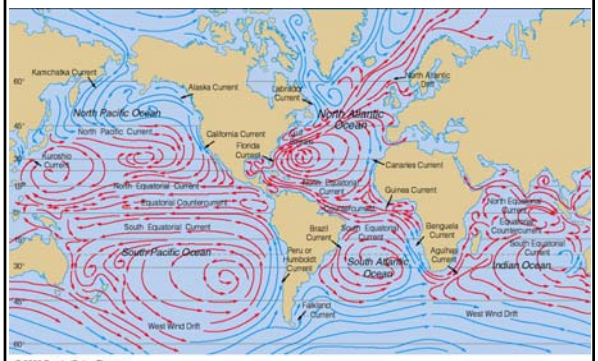
Fig. 10-28a, p. 279

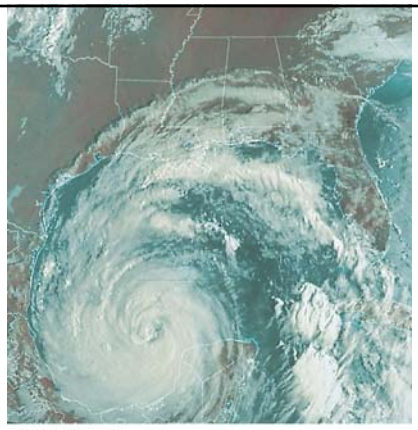


Ocean Temperature varies on times scales of decades

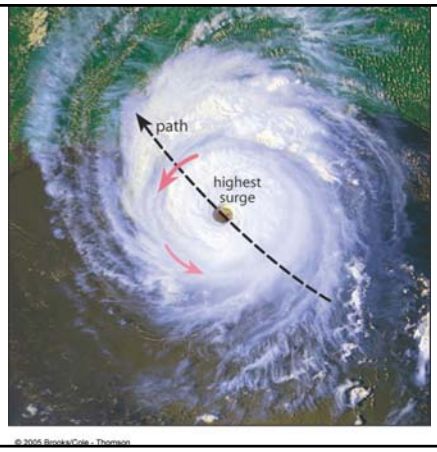


High Pressure Cells





Gilbert in 1988



Biloxi Bridge July 2006