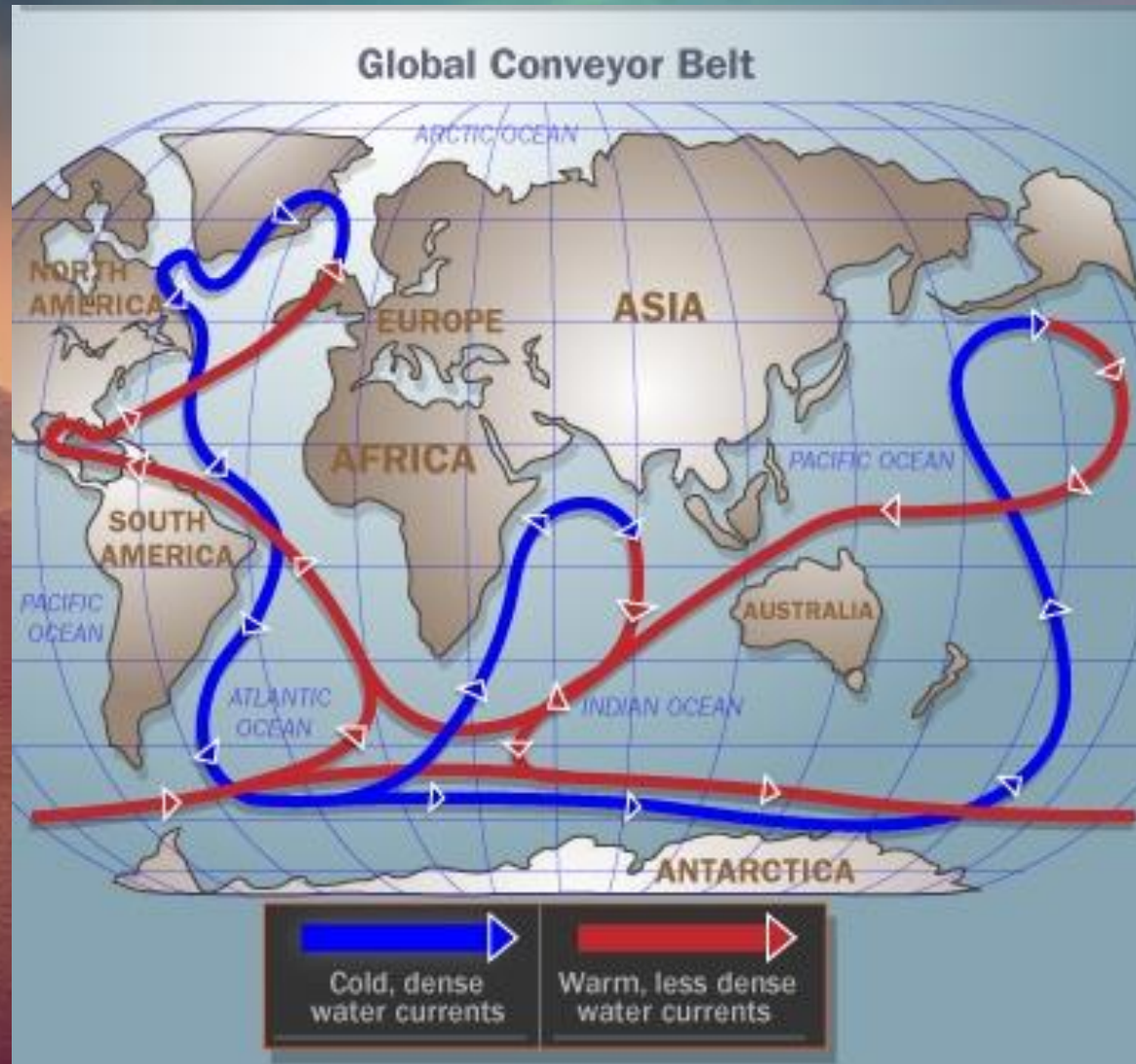




Earth and Space Science

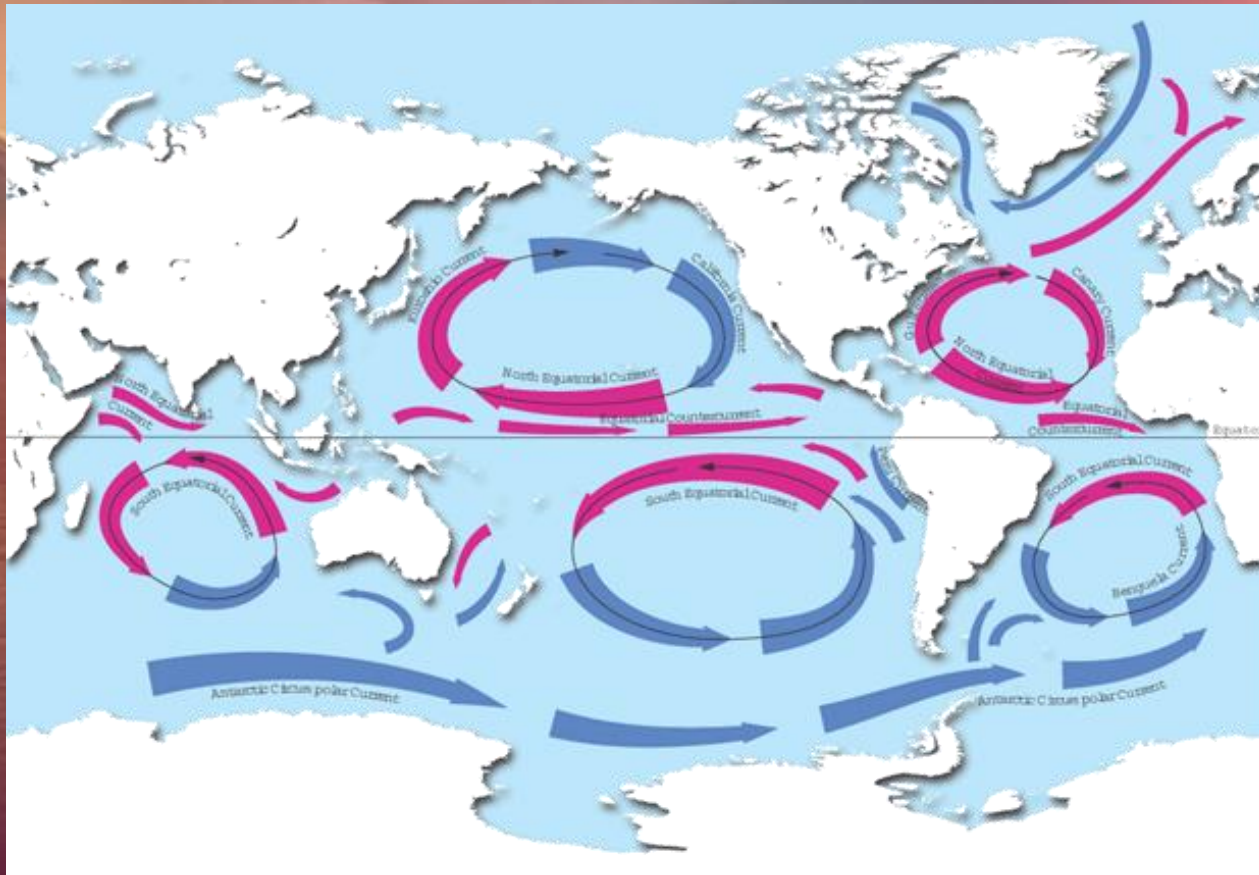
Unit 6 Lecture 3:
The Dynamic Ocean
(Chap. 15)

Ocean Water Movements



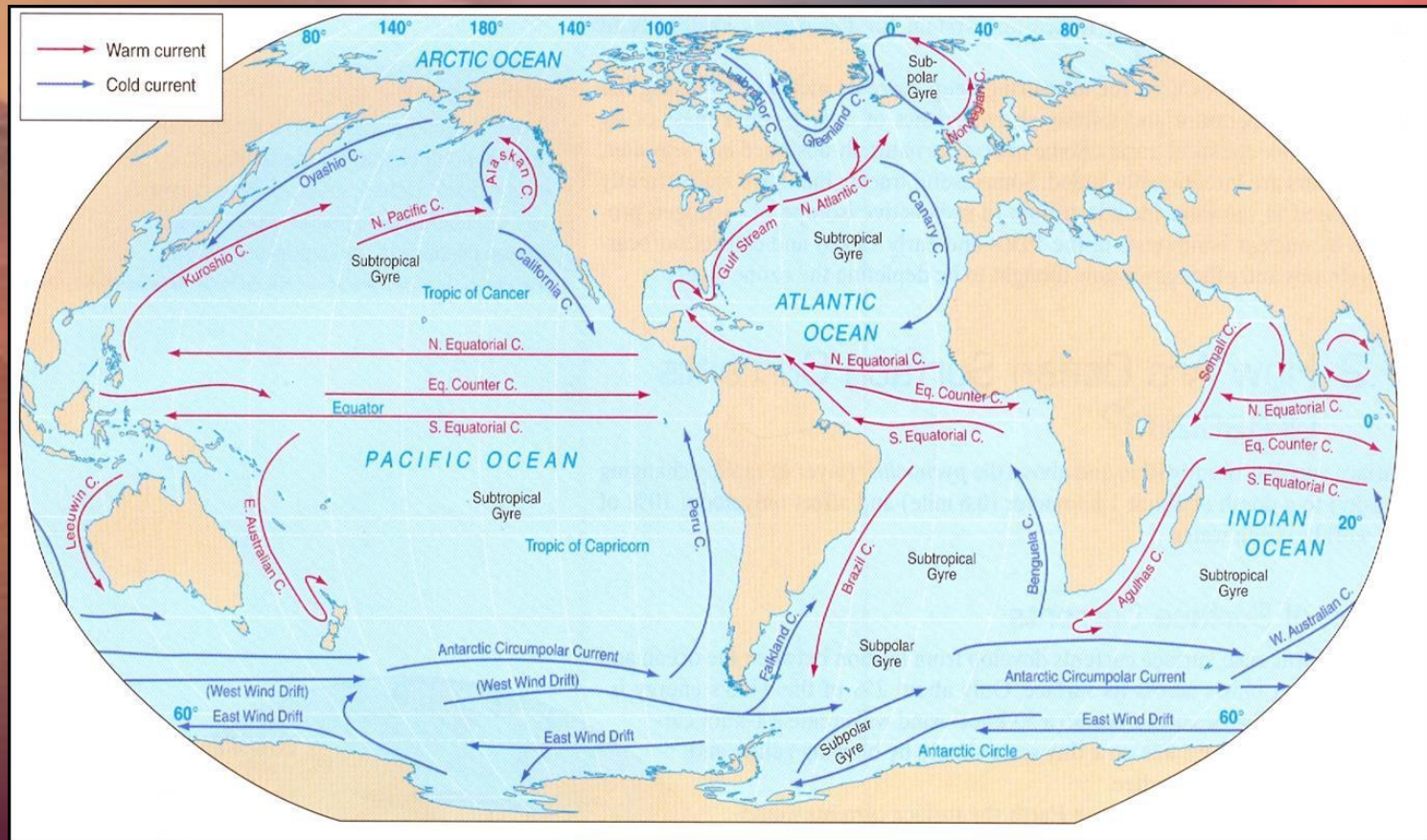
Surface Currents

- Huge, slowly moving gyres
 - gyre - a ring-like system of ocean currents rotating clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere)



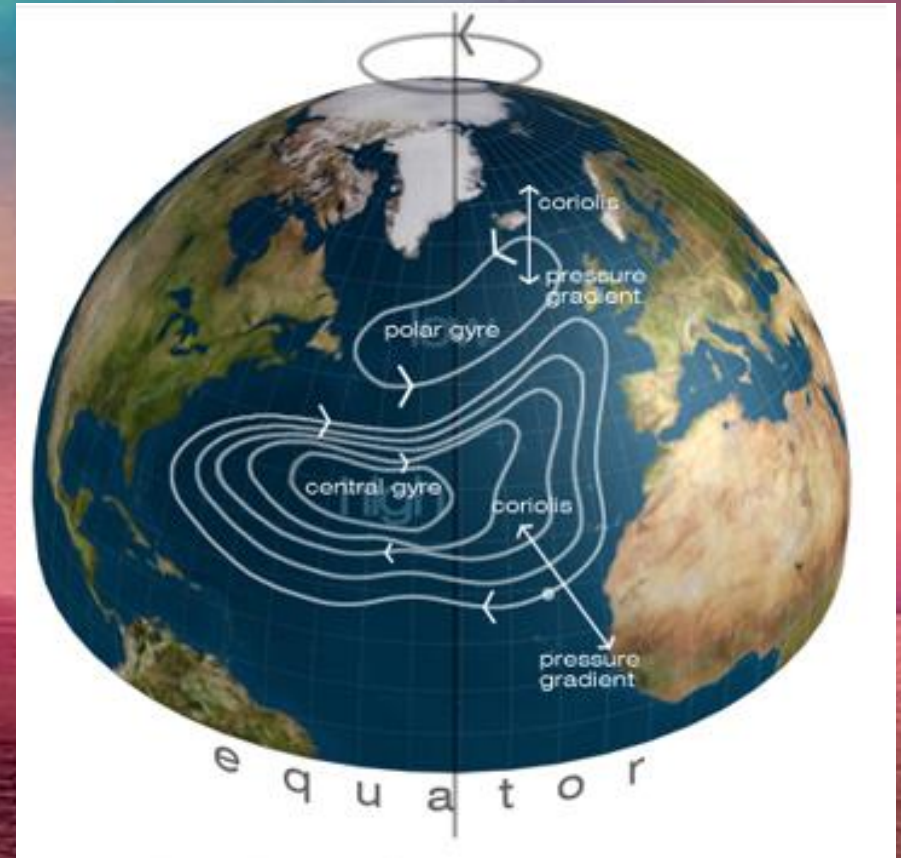
Surface Currents (cont.)

- Generated by the wind
- Related to atmospheric circulation



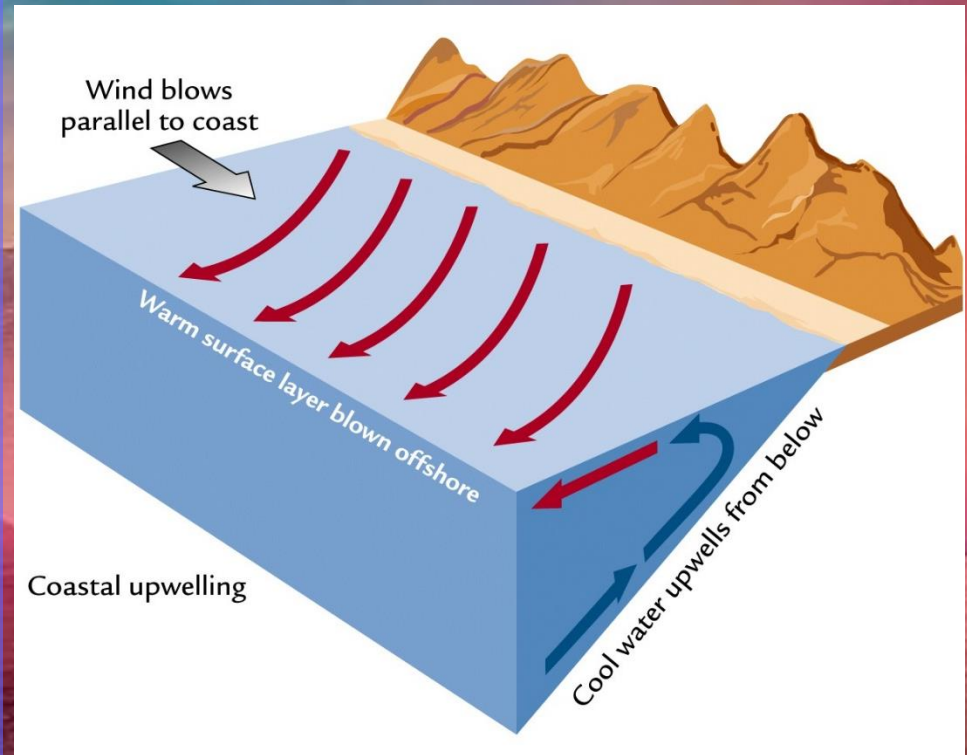
Surface Currents (cont.)

- Deflected by the Coriolis effect
 - To the right in the Northern Hemisphere
 - To the left in the Southern Hemisphere
- Importance of surface currents
 - Navigation
 - Influence Climates



Upwelling

- Vertical water movement
- Along eastern shores of oceans
- Caused by
 - Coriolis effect
 - Surface water moving from the shore

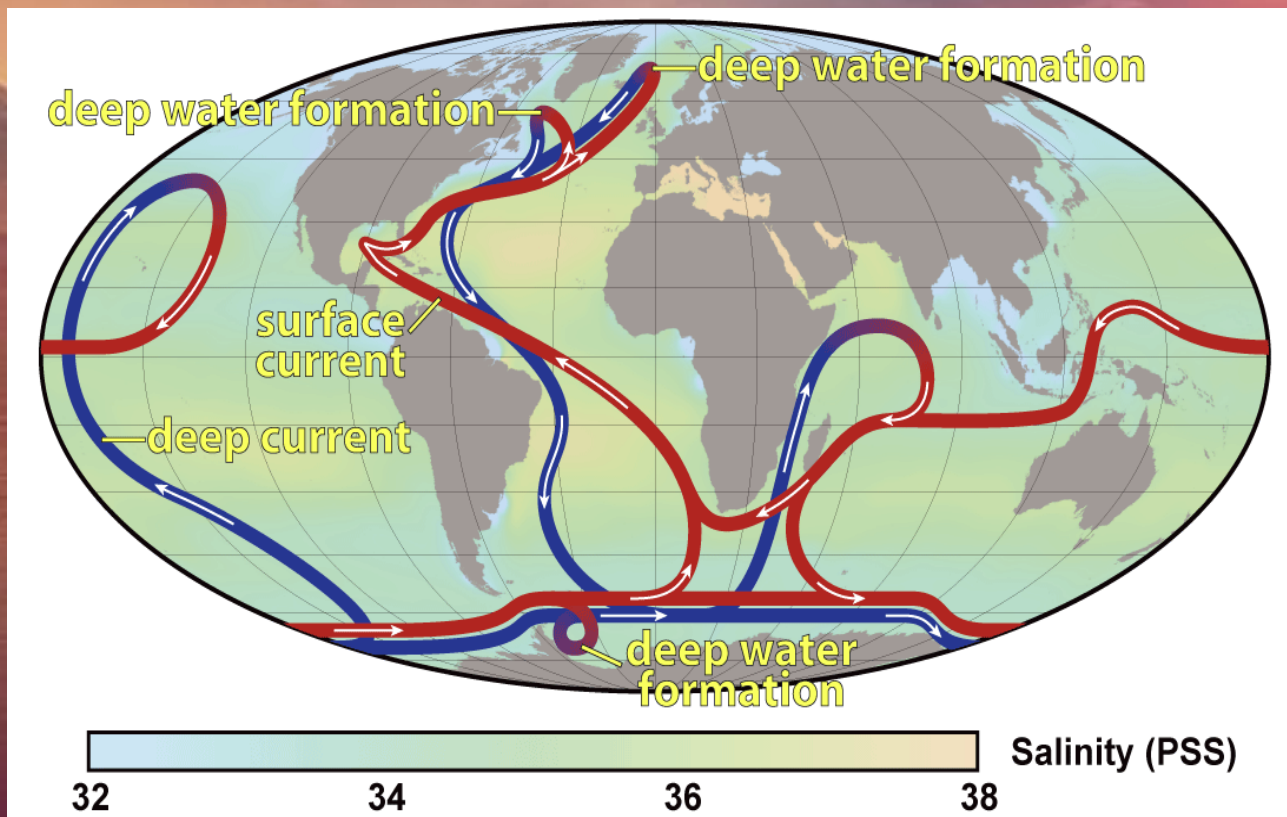


Deep-Water Circulation

- Governed by gravity
- Driven by density differences
- Factors creating a dense mass of water
 - Temperature – cold water is dense
 - Salinity – density increases with increasing salinity

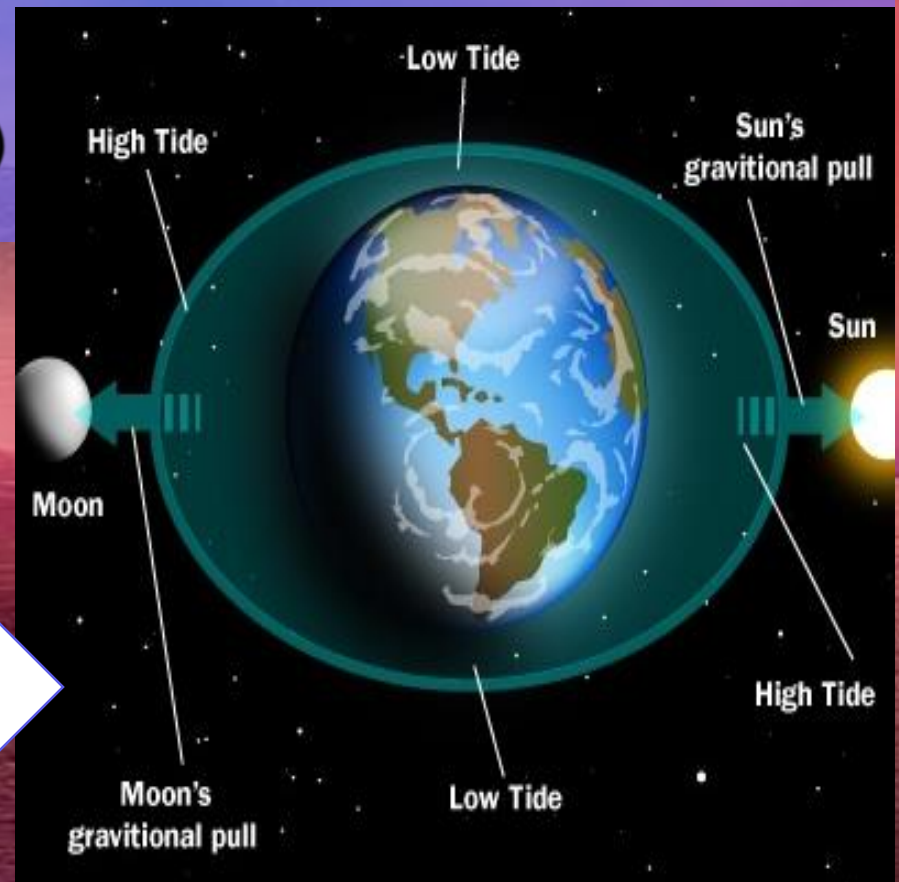
Deep-Water Circulation (cont.)

- Called thermohaline circulation
- Dense water masses are created in
 - Arctic regions
 - Antarctic regions (most dense sea water in the world)



Tides

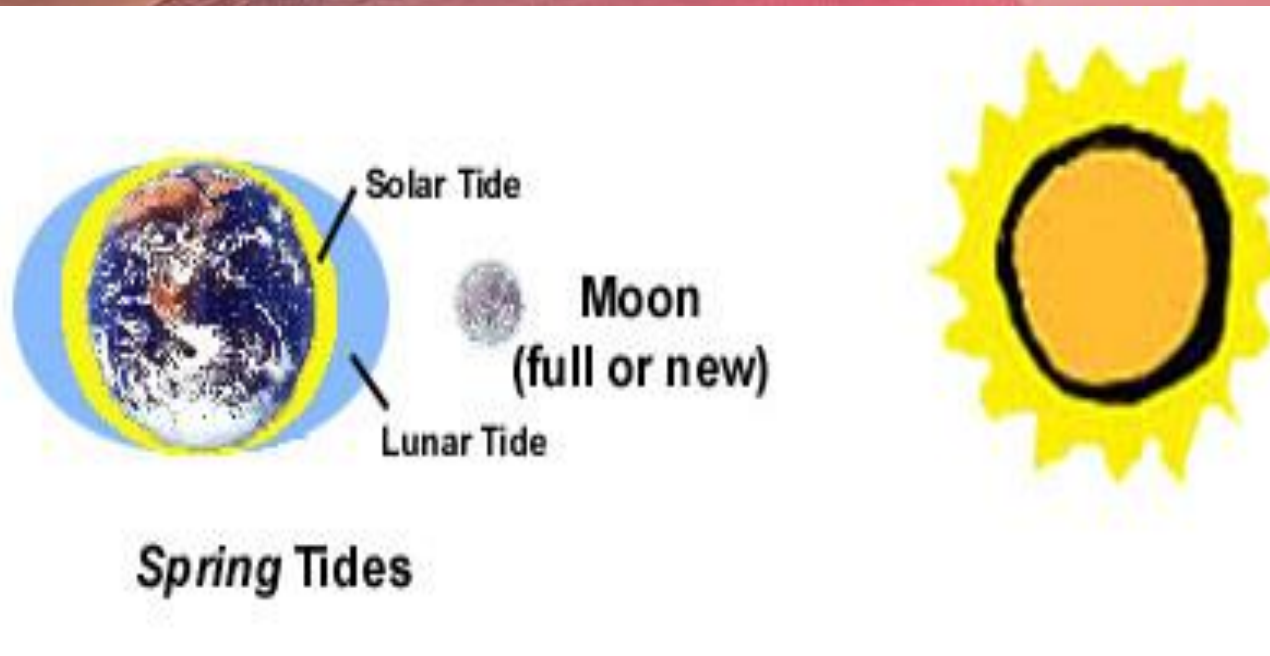
- Changes in elevation of the ocean surface
- Caused by the gravitational forces of the
 - Moon
 - Sun (to a lesser extent)



I'm a link

Tides (cont.)

- Tidal heights
 - Spring tide
 - During new and full moons
 - Gravitational forces added together
 - Especially high and low tides
 - Large daily tidal range



Tides (cont.)

- Tidal heights (cont.)
 - Neap tide
 - First and third quarters of the moon
 - Gravitational forces are offset
 - Daily tidal range is least



Tides (cont.)

- Other influencing factors
 - Shape of the coastline
 - Configuration of the ocean basin



Tides (cont.)

- Types of Tides
 - Semidiurnal tide
 - Two high and two low tides each tidal day
 - Little difference in the high and low water heights
 - Occur along the Atlantic coast of the U.S.

Tides (cont.)

- Types of Tides (cont.)
 - Diurnal tide
 - A single high and low water height each tidal day
 - Occur along the northern shore of the Gulf of Mexico

Tides (cont.)

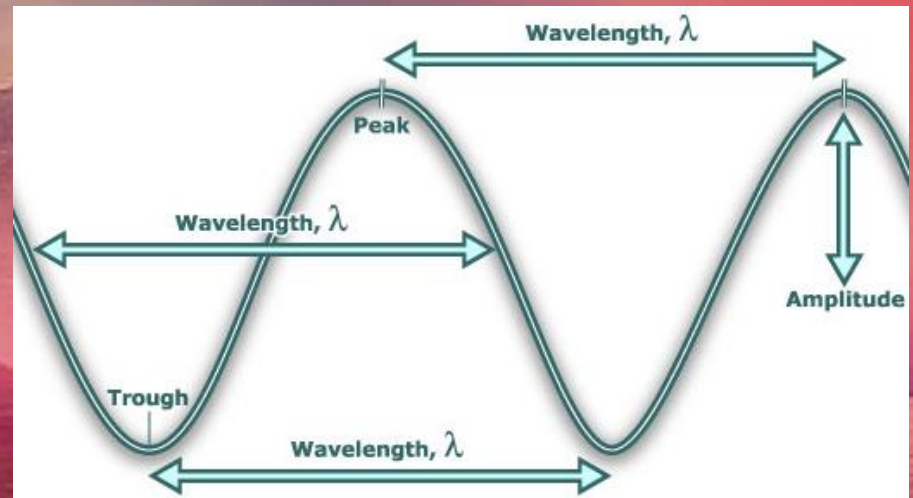
- Types of Tides (cont.)
 - Mixed tide
 - Two high and two low waters each day
 - Large inequality in high water heights, low water heights, or both
 - Prevalent along the Pacific coast of the U.S.

Tides (cont.)

- Tidal currents
 - Horizontal flow accompanying tides
 - Types of tidal currents
 - Flood current – advances into the coastal zone
 - Ebb current – seaward-moving water

Wind-generated Waves

- Derive their energy and motion from wind
- Parts
 - Crest
 - Trough
- Measurements of a wave
 - Wave height [also called: Amplitude]
 - Wavelength (λ)
 - Wave period (Frequency) [f]



Wind-generated Waves (cont.)

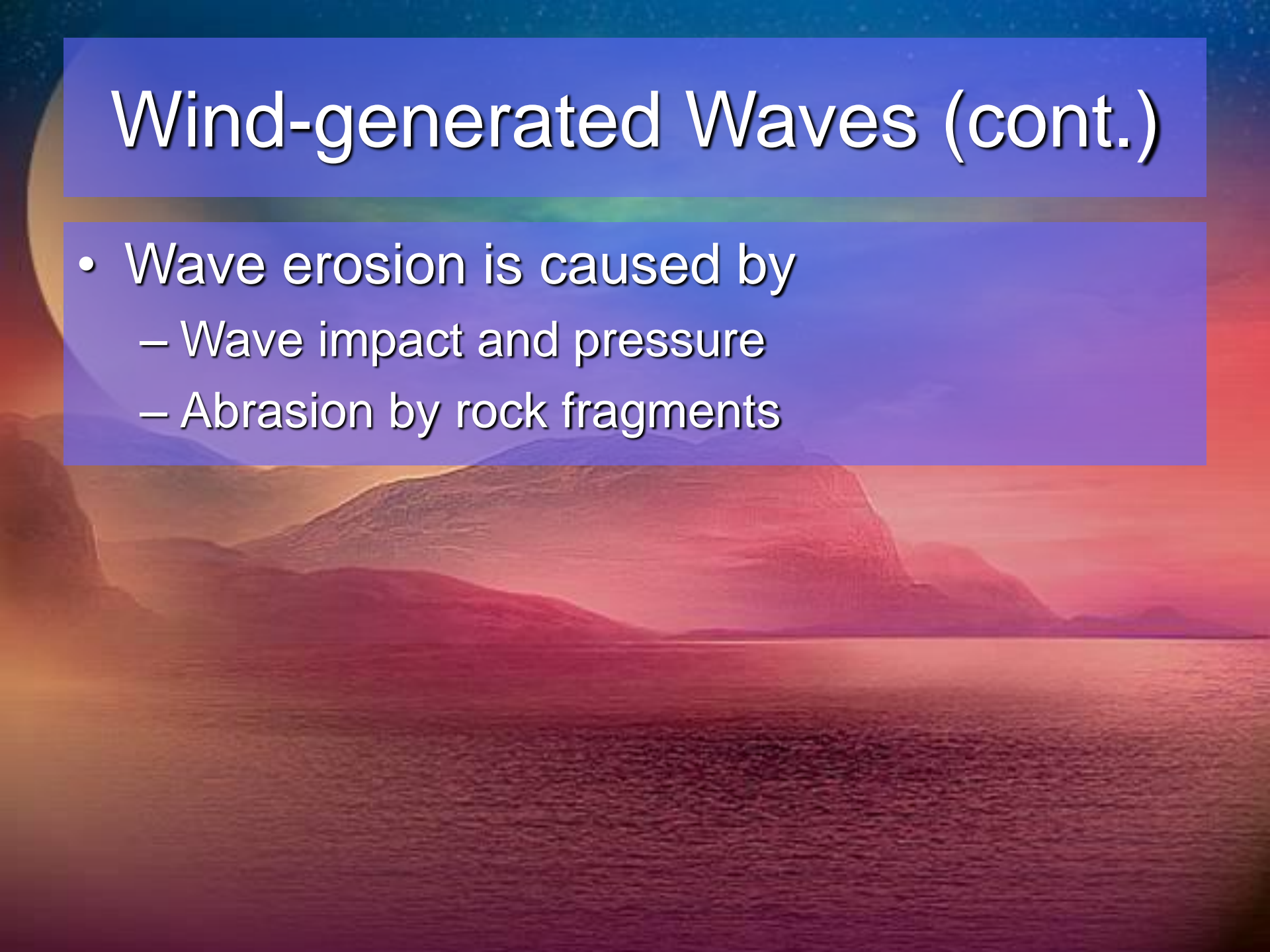
- Height, length, and period depend upon
 - Wind speed
 - Length of time wind blows
 - Fetch – the distance wind travels

Wind-generated Waves (cont.)

- Types of waves
 - Wave of oscillation
 - In open sea
 - Shape moves forward
 - Wave of translation
 - Wave breaks along the shore
 - Water advances up the shore
 - Forms surf

Wind-generated Waves (cont.)

- Wave erosion is caused by
 - Wave impact and pressure
 - Abrasion by rock fragments



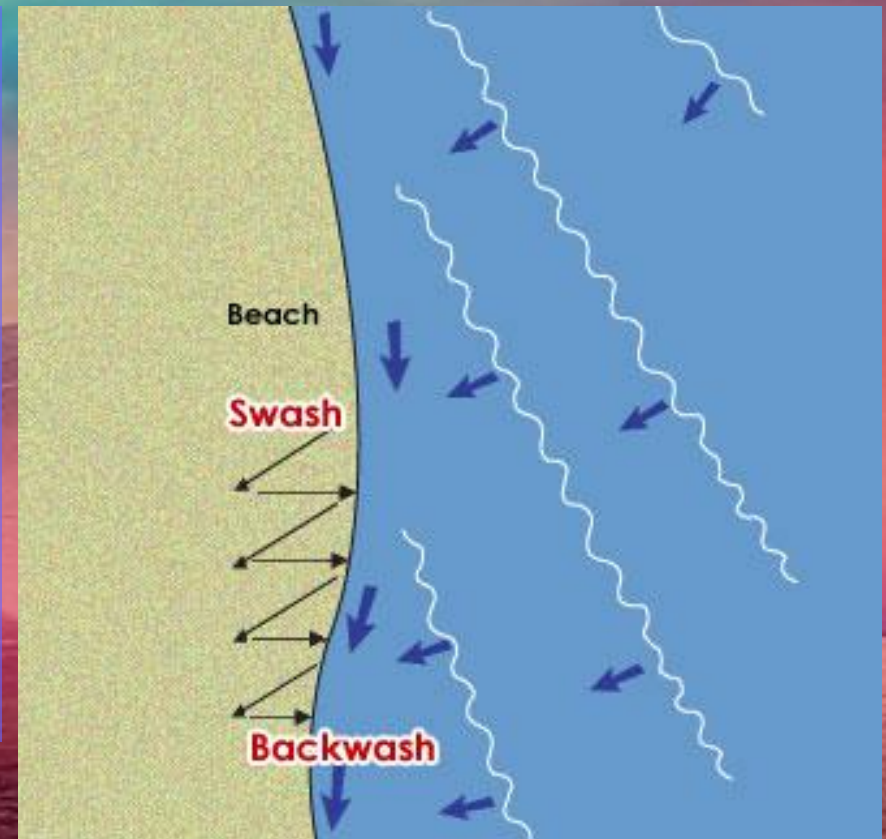
Wind-generated Waves (cont.)

- Wave refraction
 - Bending of a wave along a coast
 - Wave arrives parallel to shore
 - Results
 - Wave energy directed against headland
 - Wave erosion straightens an irregular shoreline



Wind-generated Waves (cont.)

- Moving sand along the beach
 - Beach drift – sediment moves in a zigzag pattern
 - Longshore current
 - Current in surf zone
 - Flows parallel to coast



Shoreline features



Features caused by wave erosion

- Wave-cut cliff
- Wave-cut platform
- Associated with headlands
 - Sea arch
 - Sea stack



Related to beach drift and longshore currents

- Split – a ridge of sand extending from the land into a bay with an end that often hooks landward



Related to beach drift and longshore currents (cont.)

- Baymouth bar – a sand bar that completely crosses a bay



Related to beach drift and longshore currents (cont.)

- Tombolo – connects an island to the mainland



Barrier island

- Mainly along the Atlantic and Gulf coasts
- Parallels the coast
- 3 to 30 kilometers offshore
- Originates in several ways



Shoreline features (cont.)

- Result of shoreline erosion and deposition is to eventually produce a straighter coast



Shoreline erosion problems



Influenced by the local factors

- Proximity to sediment-laden rivers
- Degree of tectonic activity
- Topography and composition of the land
- Prevailing wind and weather patterns
- Configuration of the coastline

Three basic responses to erosion problems

1. Building structures

- Type of Structures
 - Groin
 - Breakwater
 - Seawall
- Often no effective

Three basic responses to erosion problems (cont.)

2. Addition of sand to replenish the beaches
 - Called beach nourishment
 - Not a permanent solution
3. Relocation of buildings away from beach

Atlantic and Pacific Coasts

- Shoreline erosion problems are different along the opposite coasts
- Atlantic Coast
 - Broad, gently sloping coastal plains
 - Development occurs mainly on the barrier islands
 - Face open ocean
 - Receive full force of storms

Atlantic and Pacific Coasts (cont.)

- Pacific Coast
 - Relatively narrow beaches backed by steep cliffs and mountain ranges
 - Major problem is the narrowing of the beaches
 - Sediment for beaches is interrupted by dams and reservoirs
 - Rapid erosion along beaches

Emergent and Submergent Coasts



Emergent coast

- Caused by
 - Uplift of an area, or
 - A drop in sea level
- Features of an emergent coast
 - Wave-cut cliffs
 - Wave-cut platforms



Submergent coast

- Caused by
 - Land adjacent to sea subsides, or
 - Sea level rises
- Features of a submergent coast
 - Highly irregular shoreline
 - Estuaries – drowned river mouths

