Chapter Objectives

Recognize the various landforms characteristic of beaches and coastal regions.
Identify seasonal changes that beaches experience.
Discuss how longshore currents are created and what longshore drift is.
Note the origin of sediment for beaches and how the coastline responds to variations in supply.
Describe how coastal features are formed by wave erosion and deposition.

Chapter Objectives (continued)

Understand local changes that occur in coastline elevation and explain observed trends in the relative position of sea level.
Explain how climate change can affect the nature of the coastline.
Recognize barrier island features and describe how barrier islands are formed and evolve.
Identify the types of hard stabilization and discuss the effects they have on shorelines.

Overview

Coastal region constantly changes
Primarily due to waves
   Erosion
   Deposition
Many people live in coastal regions
   80% of people in U.S. live within easy access of coast

Coastal regions

Coast and coastline
   Beach
   Shore, foreshore, backshore
   Nearshore, offshore

Beach profile

Beach
   Wave-worked sediments
   Wave-cut bench
   Recreational beach
   Berm
   Beach face
   Longshore bars
   Longshore trough

Composition of beaches

Locally available material
May be coarse or fine
   Boulders from local cliffs
   Sand from rivers
   Mud from rivers
Significant biologic material at tropical beaches
   Example, Coral reef material

Sand movement along beach

Perpendicular to shoreline (toward and away)
   Swash and backwash
Parallel to shoreline (up-coast or down-coast)
- Longshore current

Swash and backwash
- Swash
  - After wave breaks, uprush of water (swash) on beach
  - Sediment moved toward land
- Backwash
  - Water returns to ocean
  - Sediment moved away from shore
- Light wave activity
  - Swash dominates
  - Sediment moved toward shore
  - Wider beach
- Fair weather
- Summertime beach

Swash and backwash
- Heavy wave activity
  - Backwash dominates
  - Sediment moved away from shore
  - Narrower beach
  - Sand forms offshore sand bars
  - Stormy weather
  - Wintertime beach

Longshore current
- Wave refraction causes water and sand to move parallel to shore
- Zigzag motion in surf zone
- Longshore current
- Longshore transport

Longshore transport
- Millions of tons of sediment moved yearly
- Direction of transport changes due to wave approach
- In general, sediment transported southward along Atlantic and Pacific coasts of U.S.

Erosional shorelines
- Well-developed cliffs
- Recent tectonic activity
- Headlands
- Wave-cut cliff with sea cave
- Sea arches
- Sea stacks
- Marine terrace
- Wave erosion increases with
  - More shore exposed to open ocean
  - Smaller tidal range
  - Weaker bedrock

Depositional shorelines
- Primarily deposited by longshore drift
- Beach
- Spit
Depositional shorelines

Barrier islands
- Long, narrow offshore deposits parallel to shore
- Most developed due to rise of sea level about 18,000 years ago
- Common East and Gulf coasts of U.S.
- Protect mainland from high wave activity

Barrier island
- Ocean beach
- Dunes
- Barrier flat
- High salt marsh
- Low salt marsh
- Lagoon

Barrier island
- Movement landward over time
- Associated with rising sea levels
- Older peat deposits found on ocean beach

Deltas
- River sediments reworked by ocean processes: waves, tides
- Distributaries carry sediment to ocean

Beach compartments
- Rivers supply sediment
- Beach
- Offshore submarine canyons “drain” sediments from beach
- Beach starvation

Emerging shorelines
- Shorelines above current sea level
- Marine terraces

Submerging shorelines
- Shoreline below current sea level
- Drowned beaches
- Submerged dune topography
- Drowned river valleys (estuaries)

Changing sea level
- Local tectonic processes
  - Example, Pacific Coast of U.S. and active plate margin
  - Isostatic adjustments
    - Ice-loading
- Global (eustatic) changes in sea level
  - Changes in seafloor spreading rates
  - Lake buildup or destruction
  - Ice volume changes

Eustatic changes in sea level
- Ice build up (glaciation)
- Ice melting (deglaciation)
Thermal contraction and expansion of seawater
About 120 m (400 ft) change in sea level

Global warming and changing sea level
About 0.6°C (1.1°F) warmer over last 130 years
Sea level rose 10-15 cm (4-10 in) over past 100 years
If global warming continues, higher sea level

U.S. coasts
Erosion or deposition dominates
Type of bedrock
Tidal range and wave exposure
Active tectonics
Eustatic changes in sea level

Atlantic coast
Most coasts open to wave attack
Barrier islands common
Varied bedrock from resistant rocks to non-resistant sedimentary rocks
Sea level rising about 0.3 m (1 ft) per century
Drowned river valleys common
Average erosion 0.8 m (2.6 ft) per year

Atlantic coast
Barrier islands
Drowned river valleys

Gulf coast
Low tidal range
Generally low wave energy
Tectonic subsidence
Mississippi delta dominates
Locally sea level rises due to compaction of delta sediments
Average rate of erosion 1.8 m (6 ft) per year

Pacific coast
Tectonically rising
Bedrock typically non-resistant sedimentary rocks
Open exposure to high energy waves
Average rate of erosion 0.005 m (0.016 ft) per year

Hard stabilization
Structures built to decrease coastal erosion and
Interfere with sand movement
Often results in unwanted outcomes
Some structures may increase wave erosion
Groins and groin fields
Jetties
Breakwaters
Seawalls

Groins and groin fields
Jetties
Breakwaters
Seawalls
Alternatives to hard stabilization
Construction restrictions
Limit building near shorelines
National Flood Insurance Program encouraged construction
Beach replenishment
Sand added to beach/longshore current

Alternatives to hard stabilization
Relocation
Move structures rather than protect them in areas of erosion

End of CHAPTER 10

Beaches and Shoreline Processes