

# OCEANOGRAPHY

## 10. The Coast: Beaches, Shoreline Processes and the Coastal Ocean, part 1

notes from textbook, integrated with original contributions

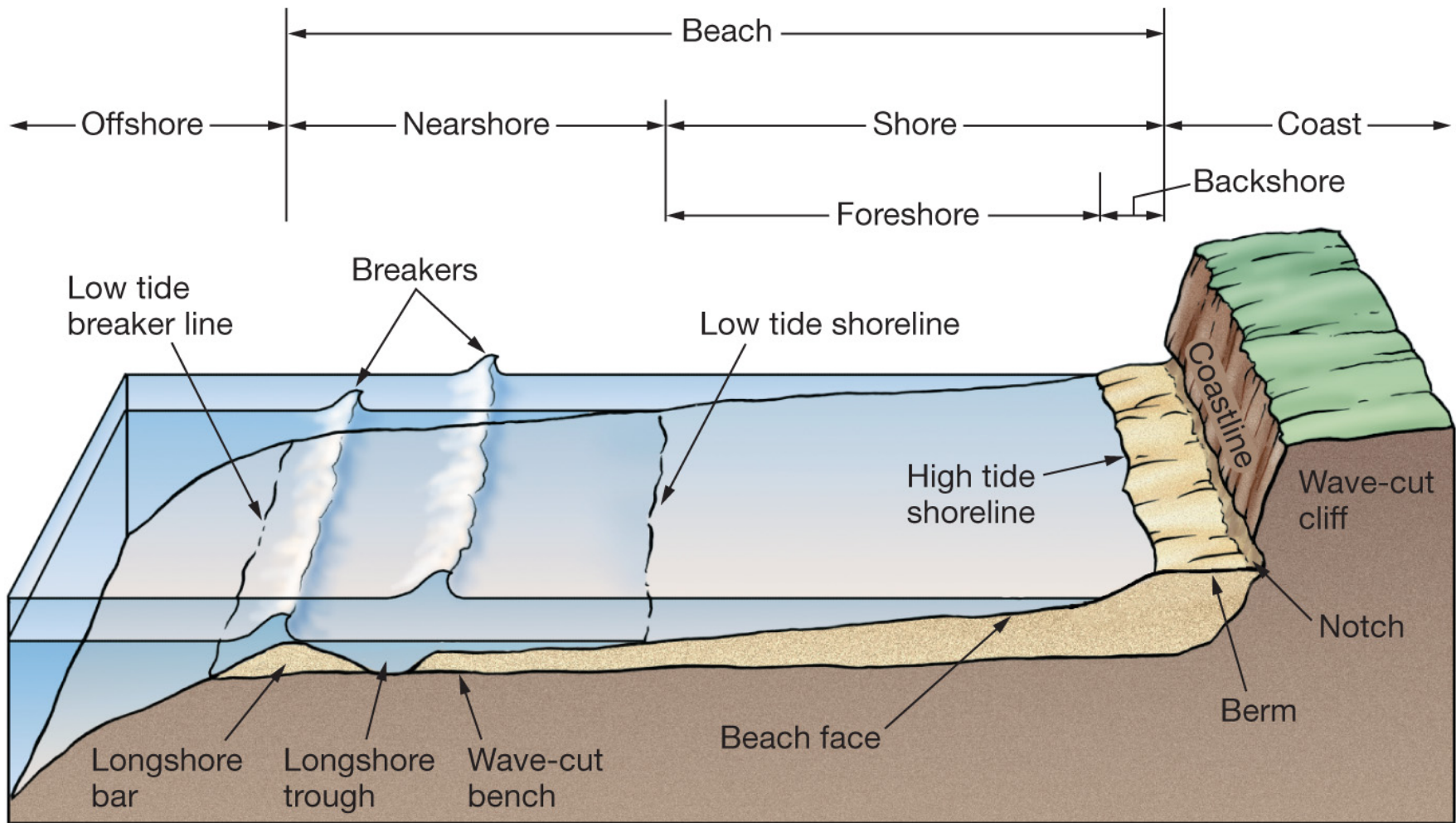
Alessandro Grippo, Ph.D.

Ripples at Incinerator Rock (Long Beach), Tofino (Vancouver Island), British Columbia, Canada

# 10.1 – How Are Coastal Regions Defined?

- General Features
  - **Shore** – the zone that lies between the lowest tide level (low tide line) and the highest elevation on land affected by storm waves
  - **Coast** – extends inland from the shore as far as ocean-related features can be found
  - **Coastline** – boundary between shore and coast; it is the landward limit of the effect of the highest storm waves on the shore



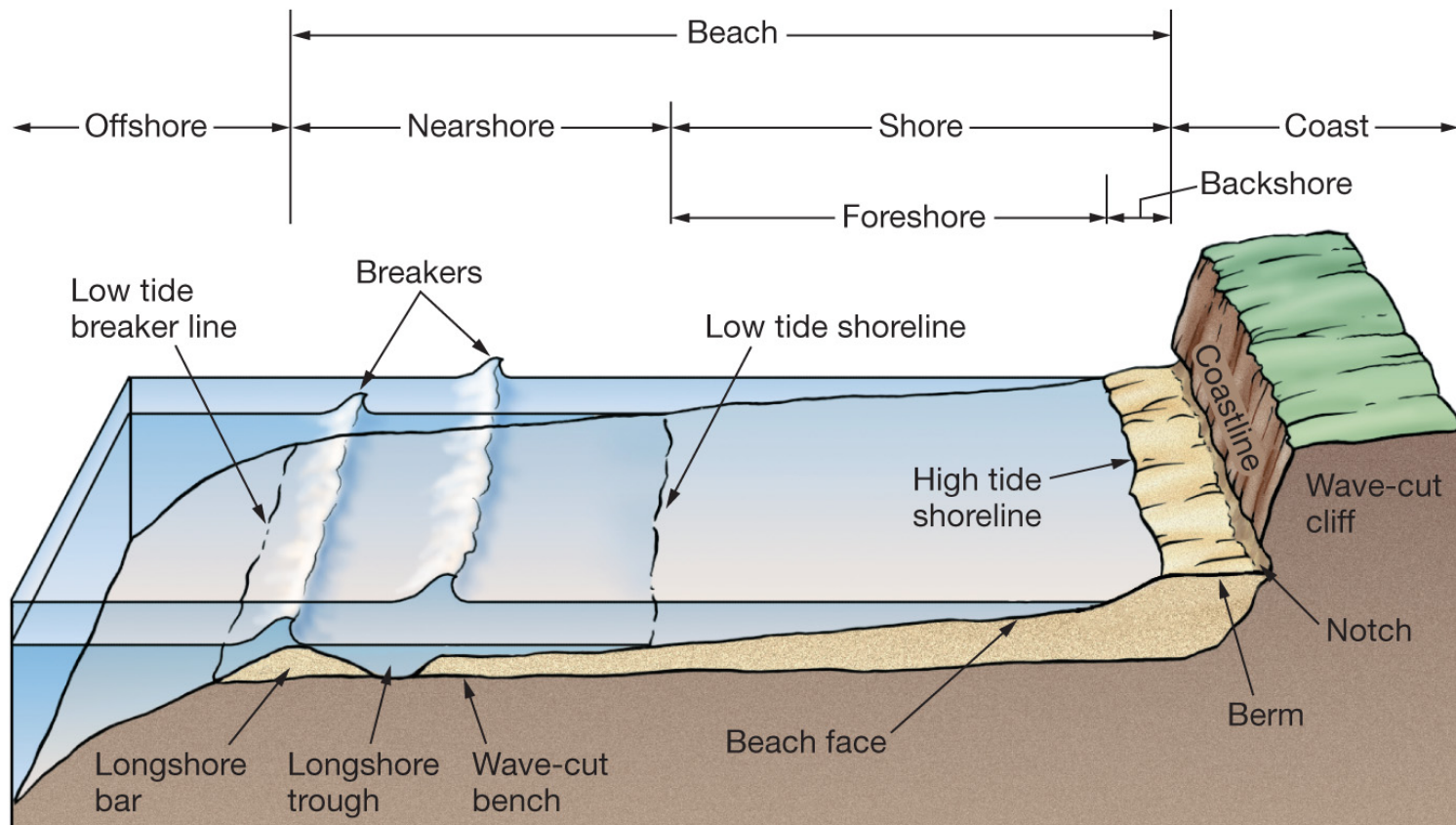


# Beach Terminology

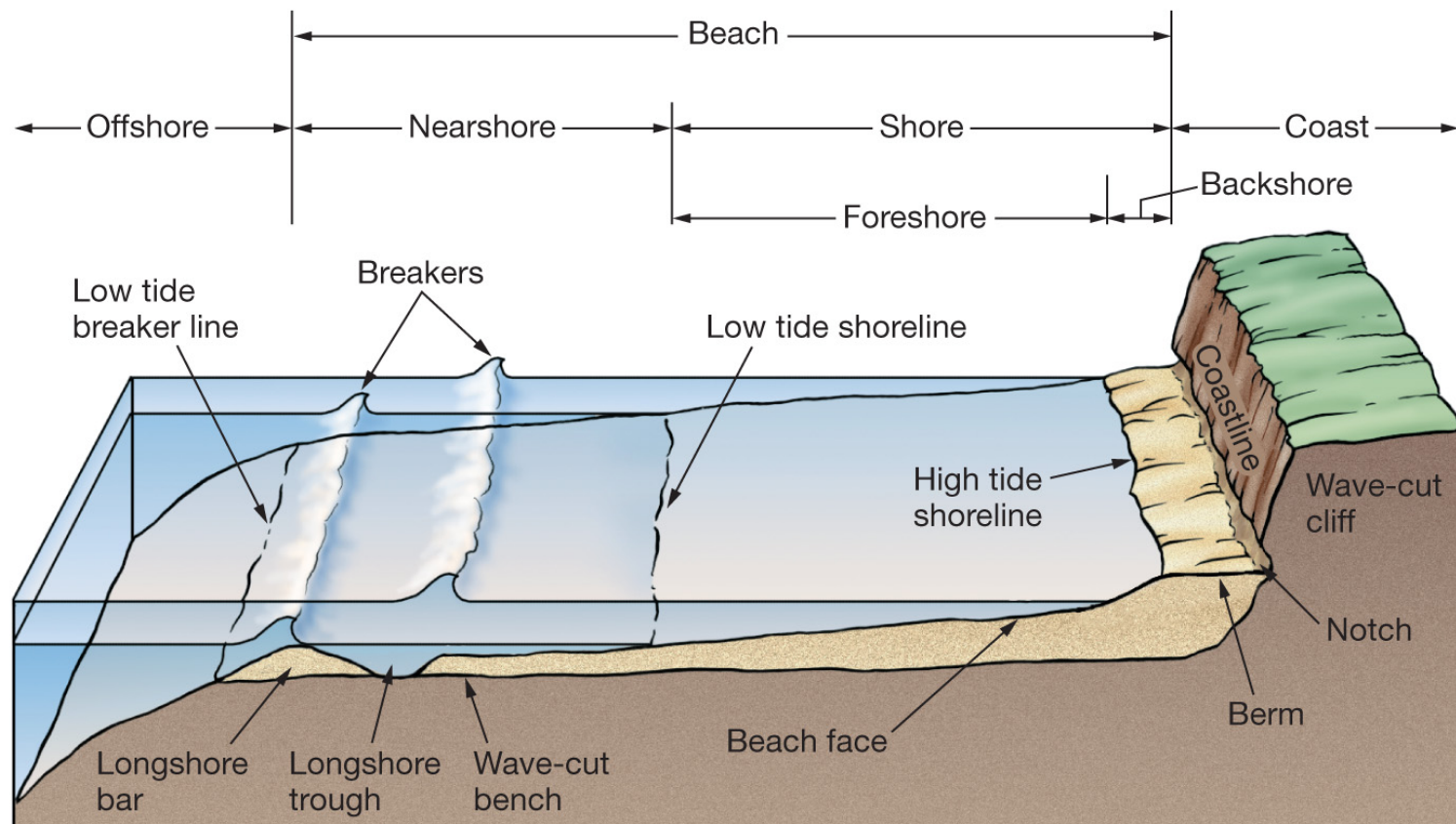
- **Shore** is divided into:
  - **Backshore** – above high tide line; covered with water only during storms
  - **Foreshore** – exposed at low tide, submerged at high tide
  - **Shoreline** – migrates back and forth with the tide and is the water's edge
  - **Nearshore** – from low tide water line to where waves break at low tide (it is never exposed to air)
  - **Offshore** – area beyond low tide breaking waves. It is deep enough that waves rarely affect the bottom



- **Wave-cut bench** – flat, wave-eroded surface
- **Recreational beach** – area above the shoreline
- **Berm** – dry, gently sloping region



- **Beach face** – wet, sloping surface between berm and shoreline
- **Longshore bar** – underwater sand bar parallel to the coast
- **Longshore trough** – separates longshore bar from the beach



# Beach Composition

- Formed from locally available material
- Most of the time, the dominant size is SAND, but:
  - May be coarse or fine grained sediment
    - Boulders from local cliffs
    - Sand from rivers
    - Mud from rivers
- Significant biologic material on tropical beaches
  - Example, Coral reef material
- Material is always in transit along the shoreline.



# beaches from around the world



Clockwise from upper left: white carbonate sand; dark volcanic sand; immature quartz sand; mature quartz sand

© Alessandro Grippo



## 10.2 – How Does Sand Move on the Beach?

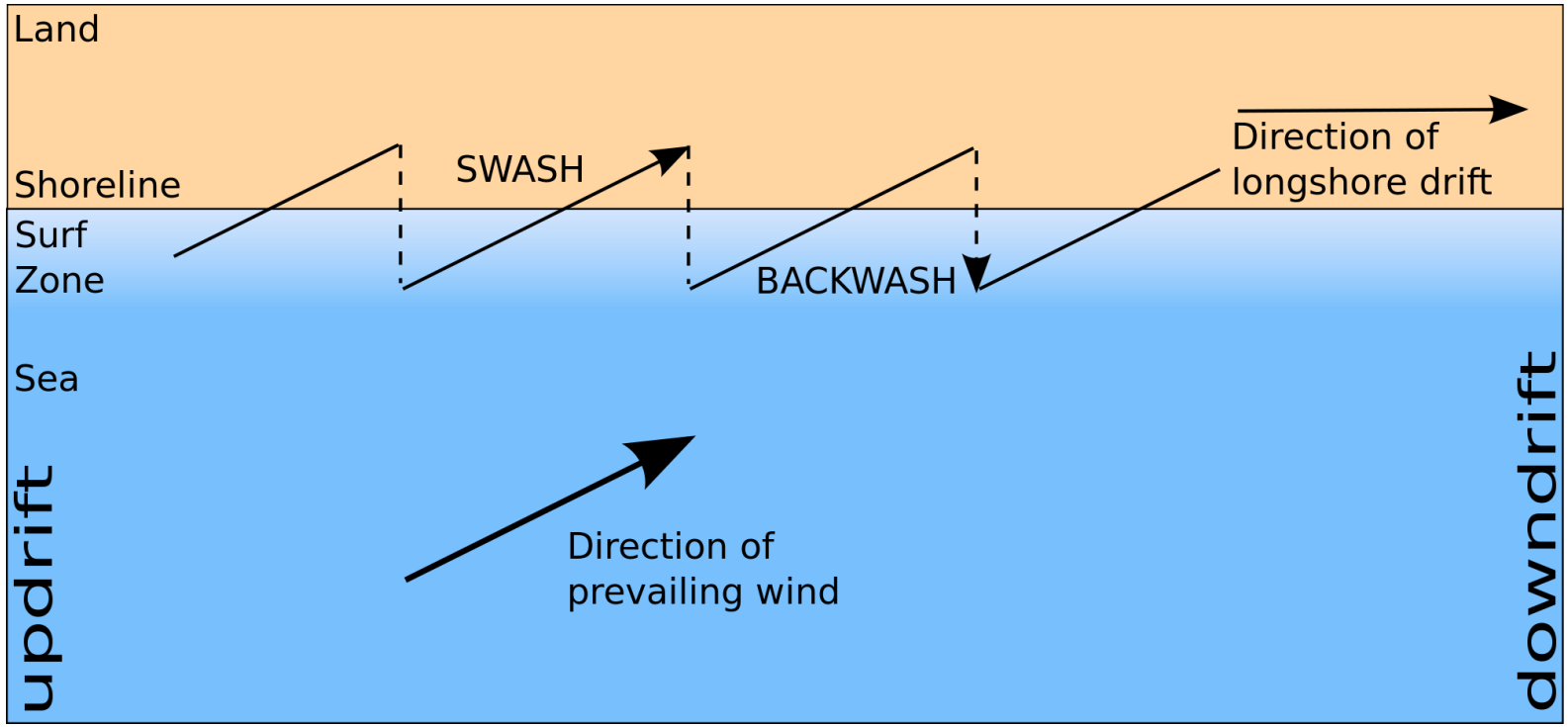
- There are two major types of movement:
  - Perpendicular to the shoreline
  - Parallel to the shoreline



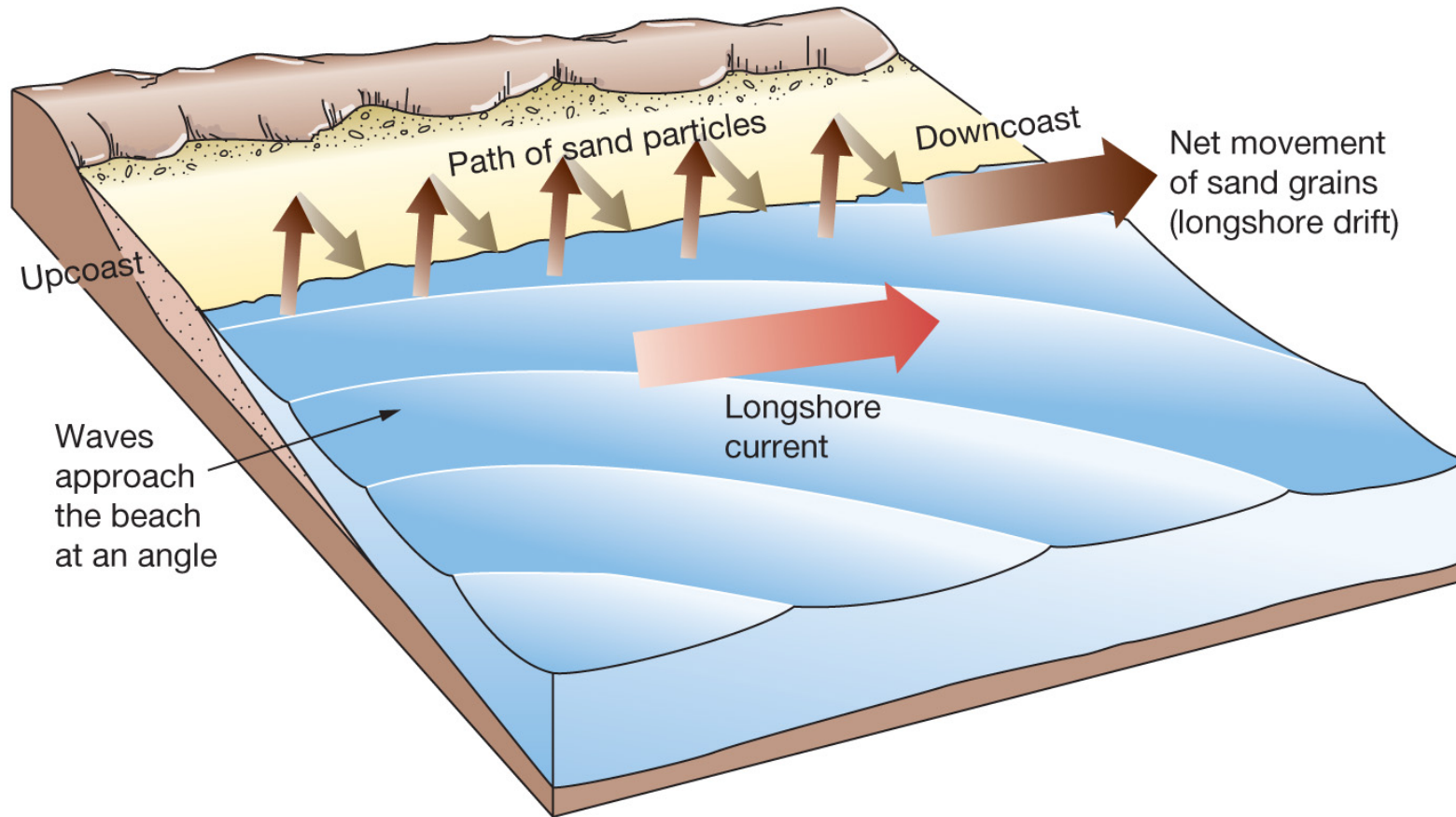
## movement perpendicular to the shoreline

- **Swash** – water rushes up the beach face towards the berm
  - some of this swash soaks into the beach and eventually goes back, but most of the water goes back to the ocean as backwash
- **Backwash** – water drains back to the ocean
- whether swash or backwash dominates determines whether sand is deposited or eroded from the berm





# Longshore Transport



(b)

© 2011 Pearson Education, Inc.

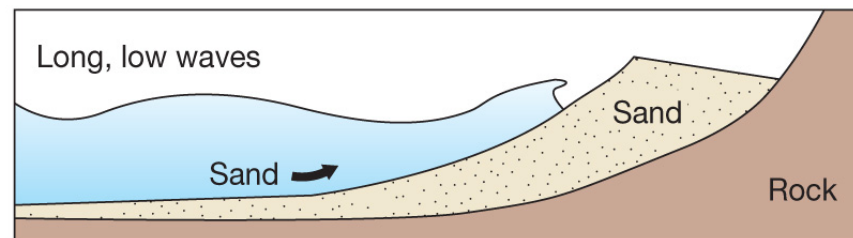
© 2011 Pearson Education, Inc.

## light versus heavy wave activity

- During **light wave activity** much of the swash soaks into the beach, and backwash is reduced
- There is a net movement of the sand up the beach face toward the berm, which grows wider and wider
- During **heavy wave activity**, the sand cannot absorb any more water (the pores are saturated) so backwash dominates.
- There is a net movement of sand away from the berm, which is being eroded
- This eroded sand cannot go far away (remember sand needs to have a surface to move on, and that water does not move below wave base: it will accumulate just beyond where waves break, forming **sand bars**)

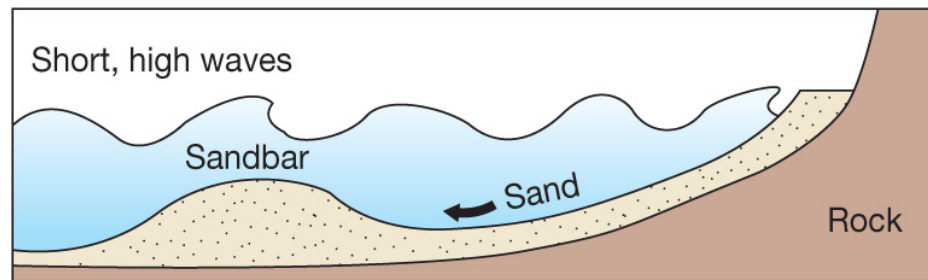


# Swash and Backwash



(a) Summertime beach (fair weather)

© 2011 Pearson Education, Inc.

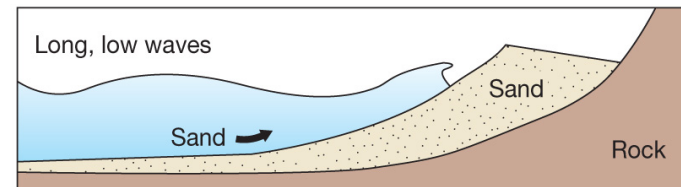


(b) Wintertime beach (storm)



# Summertime Beach

- **Light** wave activity
  - Wide, sandy berm
  - Steep beach face
  - Swash dominates
- Longshore bars not present
- Generally milder storms



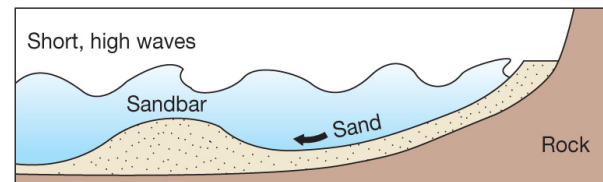
(a) Summertime beach (fair weather)

© 2011 Pearson Education, Inc.



# Wintertime Beach

- **Heavy** wave activity
  - Backwash dominates
  - Sediment moved away from shore
  - Narrower beach
  - Flattened beach face
- **Longshore bars** are present
- Stormy weather



(b) Wintertime beach (storm)

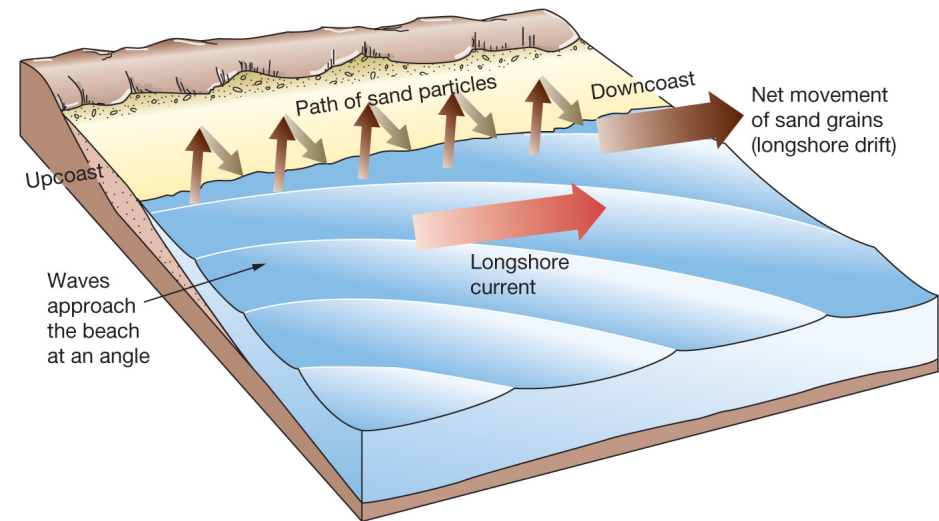
© 2011 Pearson Education, Inc.

## movement parallel to the shoreline

- at the same time movement occurs perpendicular to shore, movement parallel to shoreline also occurs (**longshore current**)
- the longshore current is strong enough to move sand around (**longshore drift**, or littoral drift)

# Longshore Current

- Parallel motion of water along shoreline
- Caused by **wave refraction**
  - Causes zigzag motion of water in surf zone
- Longshore currents travel at speeds up to 4 km (2.5 miles) per hour



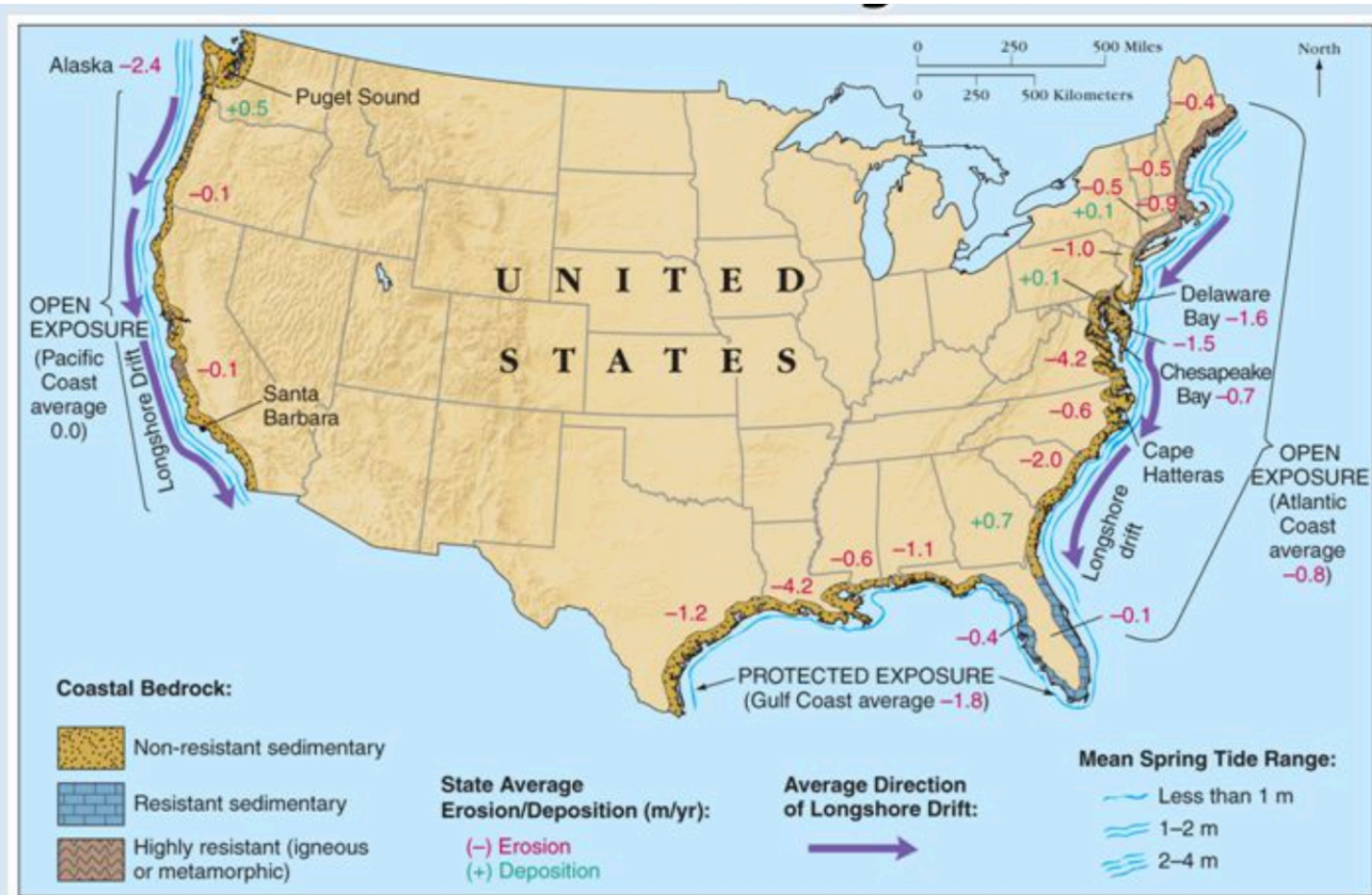
# Longshore Drift

- Also called longshore transport, beach drift, or littoral drift
- Only occurs in the shallow water surf zone
- Transports beach sediment in a zigzag fashion in the direction of the longshore current
- Beaches sometimes called “*rivers of sand*”

# Longshore Drift

- Millions of tons of sediment moved yearly
- Direction of transport changes due to wave approach
- In general, net sediment movement is **southward** along the Atlantic and Pacific coasts of the United States





# Chapter 10

**end of part 1**