OCEANOGRAPHY

10. The Coast:
Beaches, Shoreline Processes and the Coastal Ocean, part 2

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10.3 – What Features Exist along Erosional and Depositional Shores?

- Erosional Shores
  - Well-developed cliffs
  - Exist where tectonic uplift of coast occurs
  - U.S. Pacific coast is one example
- Depositional Shores
  - Gradually subsiding shore
  - Barrier islands and sand deposits are common

erosional shores

- Wave refraction causes:
  - concentration of wave energy around headlands
  - dissipation of wave energy in bays

- As a result, headlands are eroded and bays tend to be filled with sediment

- Waves pound at the base of a headland, undermining its upper portion , which would eventually collapse to form wave cut cliffs

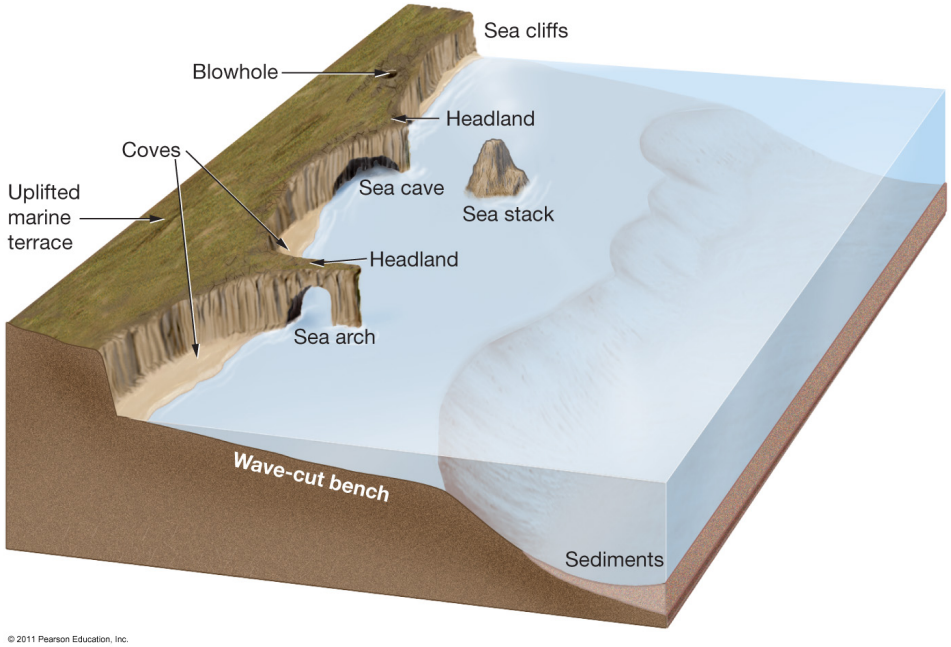
Waves can also carve sea caves at the base of a cliff.

Sea arches form where sea caves in headlands erode all the way through.

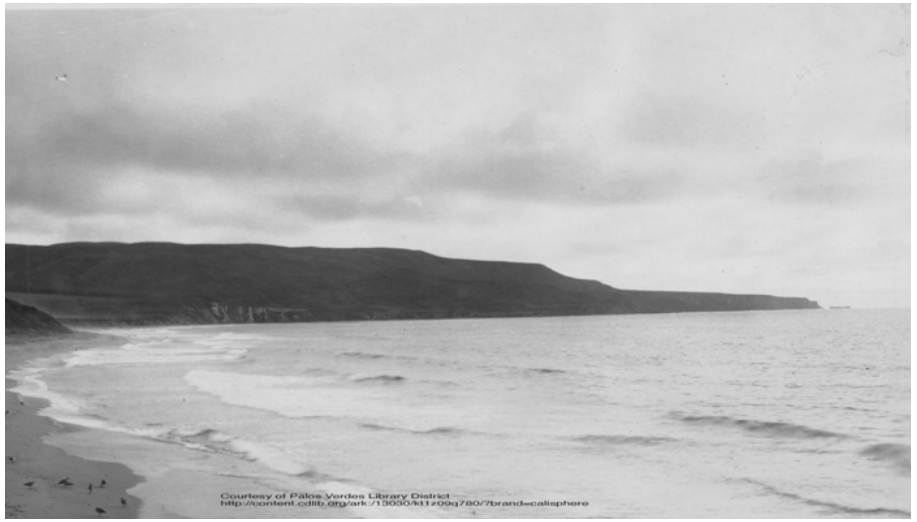
Sea stacks form when the tops of sea arches erode away completely.

Waves also erode the wave-cut bench, down to a depth that reflect the average wave-base for the are, forming a flat to gently sloping surface.

Bedrock uplift generates a marine terrace.



- in Southern California, the continuous uplift of coastal areas and offshore islands has generated a whole series of progressively older marine terraces



to the right, two profiles along the Palos Verdes peninsula, in Los Angeles' South Bay

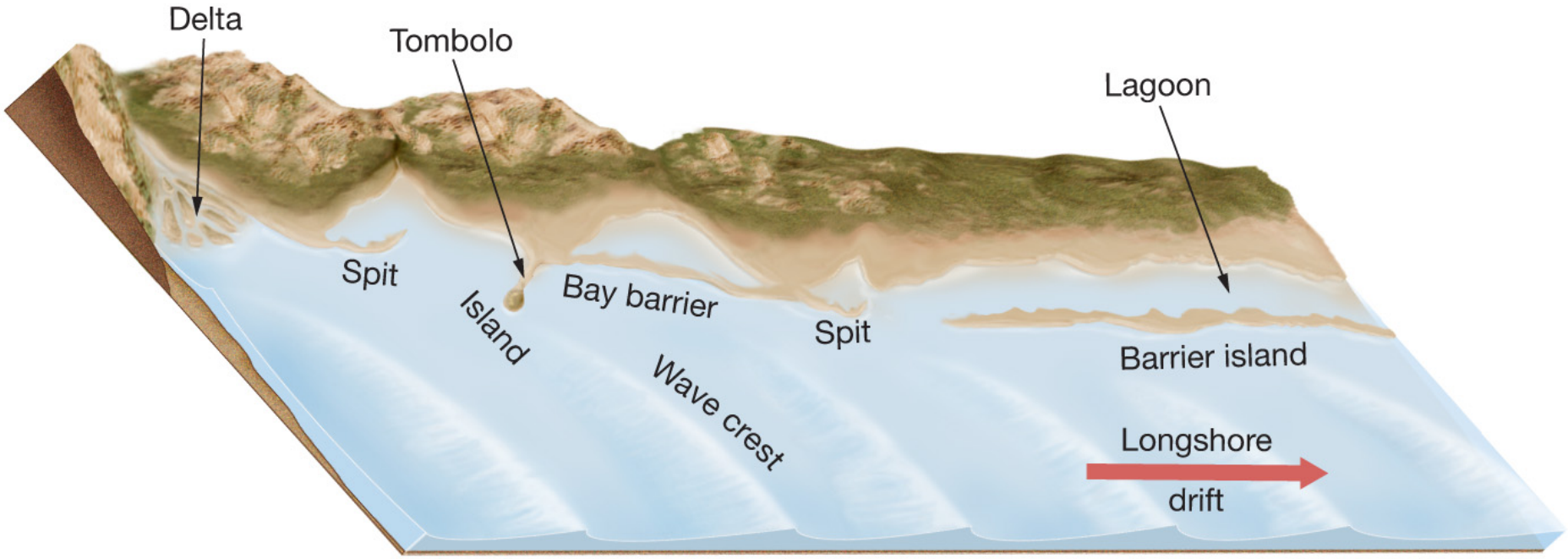
- Wave erosion *increases* with
  - More shore exposed to open ocean
  - Smaller tidal range
  - Weaker bedrock

- Regardless of the erosion rate, all coastal regions follow the same developmental path, as long as there is no change in elevation of the landmass relative to the ocean surface:
  - cliffs will continue to erode and retreat
  - beaches widen sufficiently
  - waves cannot reach the cliffs anymore
  - eroded materials are carried away from high-energy areas and deposited in low-energy areas

depositional shores

- Sediment (mostly sand) is
  - carried to shore by rivers, originating from erosion of inland rocks
  - produced by coastal erosion
- Waves (longshore currents) distribute all this sediment along the continental margin
- Depositional features
  - primarily, consist of deposits of sand moved by a longshore current
  - can be modified by a variety of coastal processes
  - can be partially or wholly separated form the shore itself

- A bay barrier, or bay mouth bar, seals off a lagoon from the ocean
- A Tombolo is a sand bar that connects an island to the mainland
- Barrier islands are long offshore sand deposits that parallel the coast (unattached to it)
- A spit connects at one end to the mainland and hooks into a bay at the other




MEXICO
1
Transpeninsular Highway
Baja California Sur, Mexico

Orbetello, Grosseto, Italy: three tombolos connect Italy's mainland (to the right) with the (former) island of Monte Argentario to the left. This location is where the name "tombolo" originates from.


Morro Bay, California
Spit, lagoon, and tombolo
Morro Bay
Morro Bay
Baywood Park
Baywood-Los Osos

San Diego, California
spit and lagoon

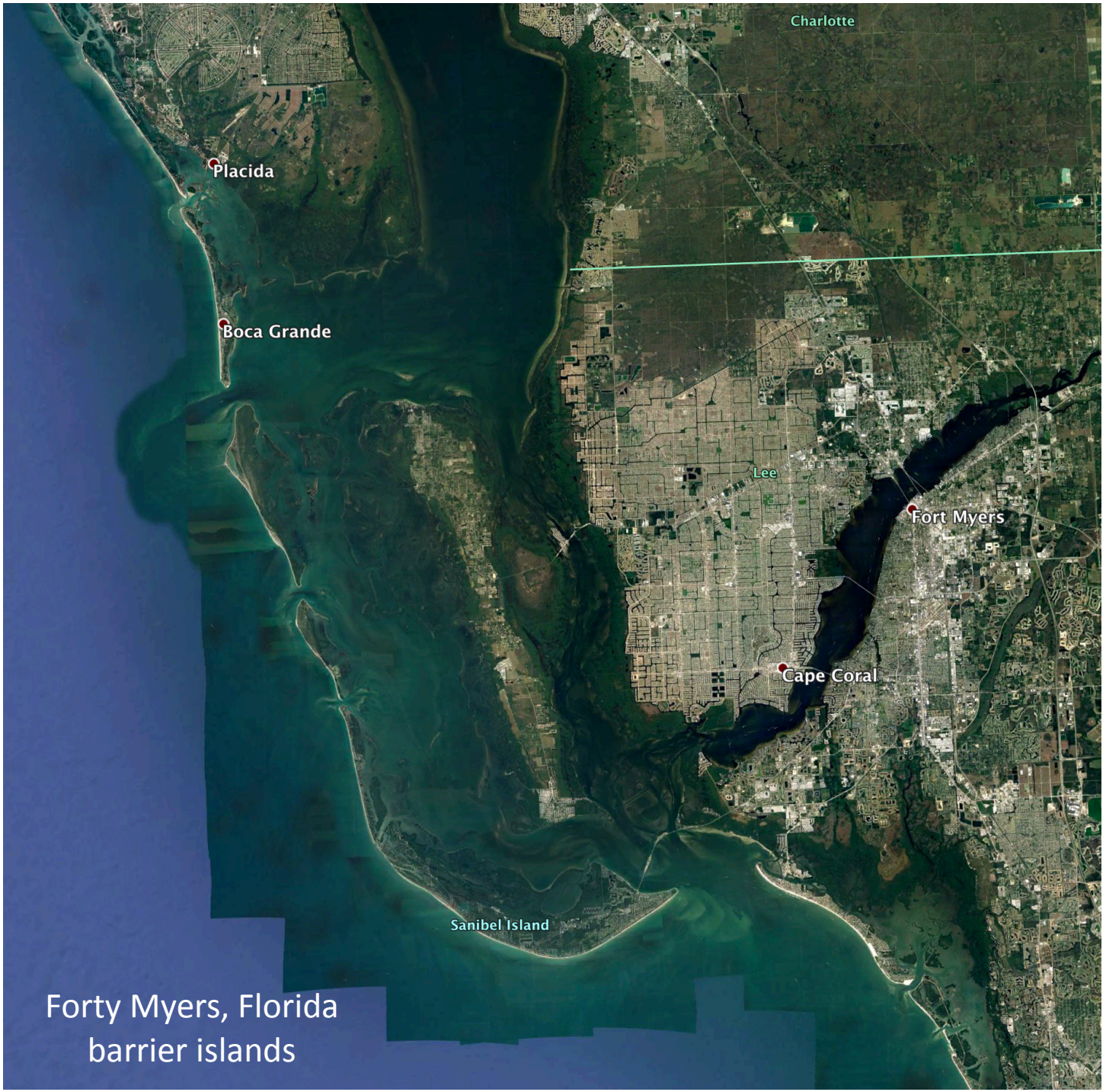
San Elijo Lagoon,
Solana Beach, California

Bay-mouth bar

barrier islands

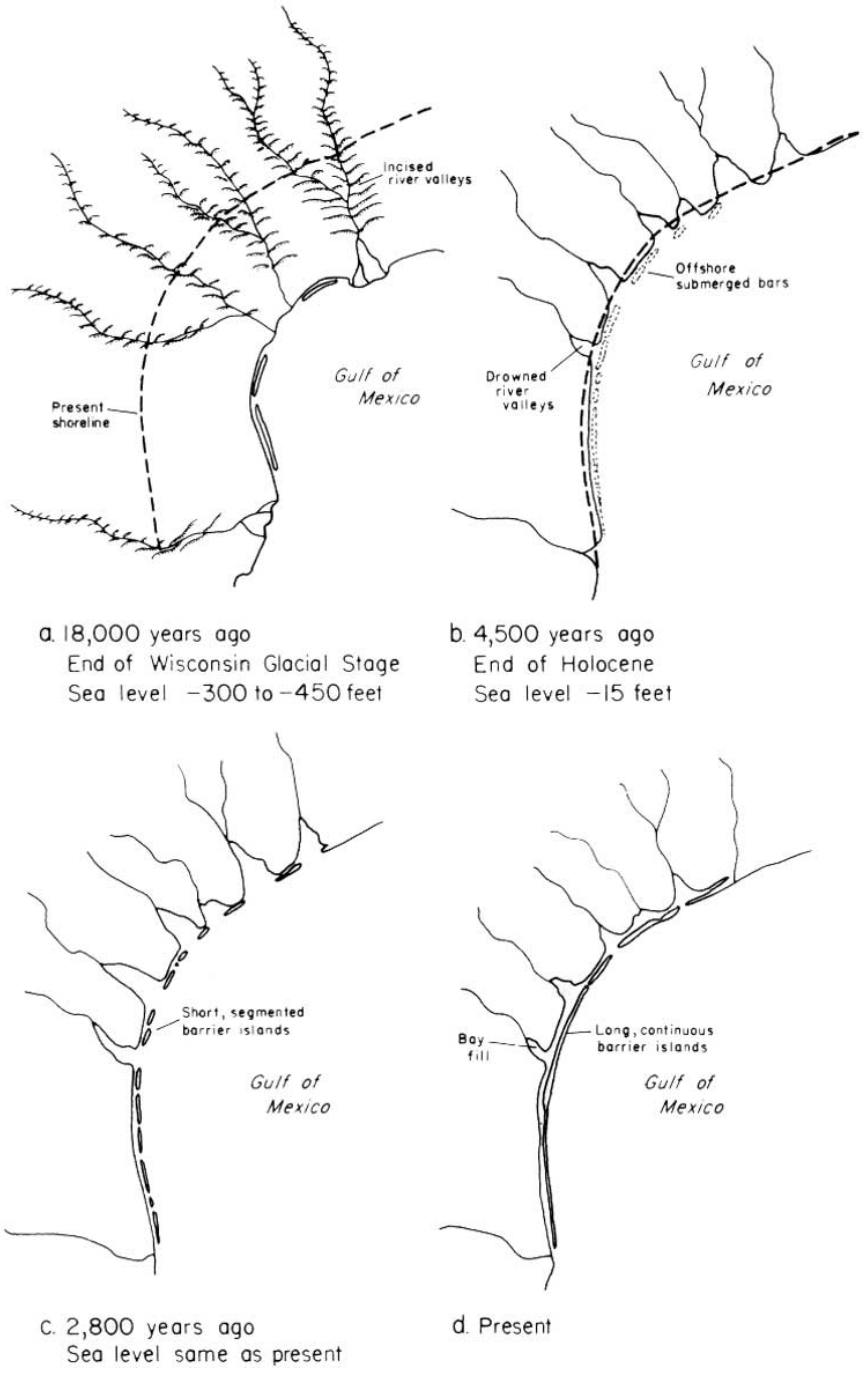
- extremely long offshore sand deposits, parallel to coast
- more than 2000 around the world, in all climates, all tides and waves combination
- common along East and Gulf coasts of the U.S.

- often forming a first line of defense against rising sea level and high energy storm-waves
- not present along erosional shorelines
- can migrate landward over time



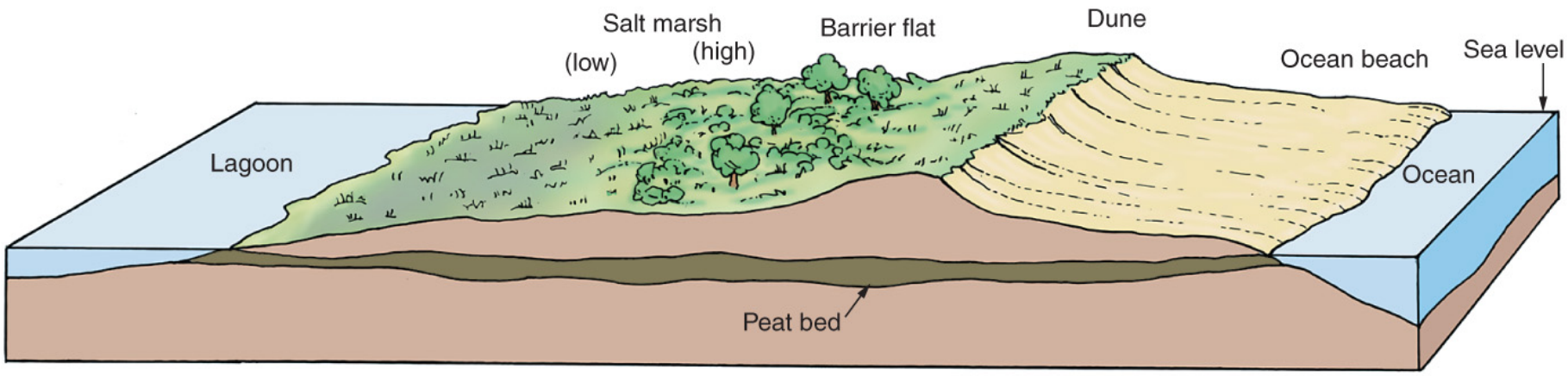
Forty Myers, Florida
barrier islands

- their origin is possible due to the rising sea levels that have occurred since the last glaciation



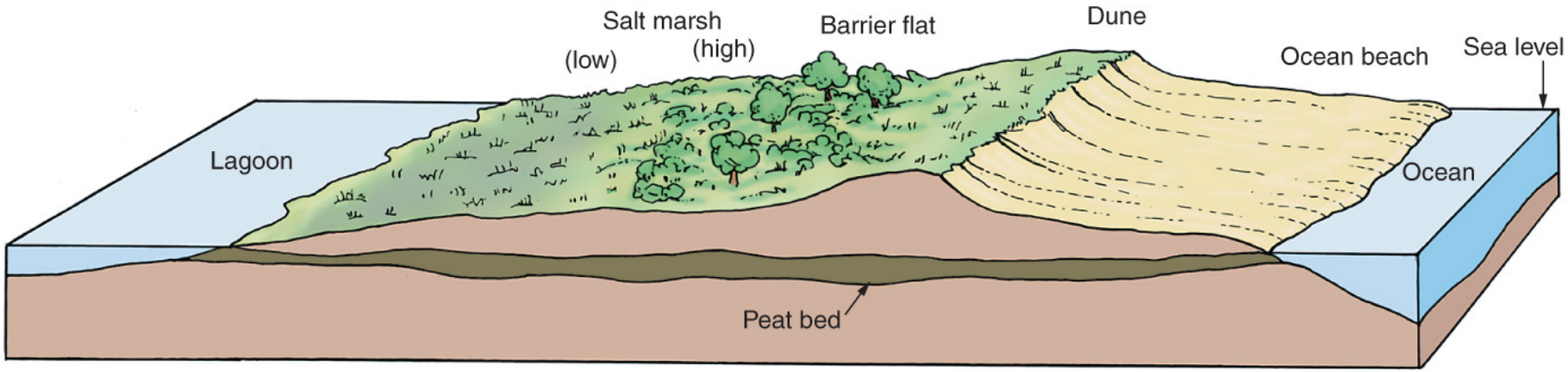
Barrier Island Anatomy

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



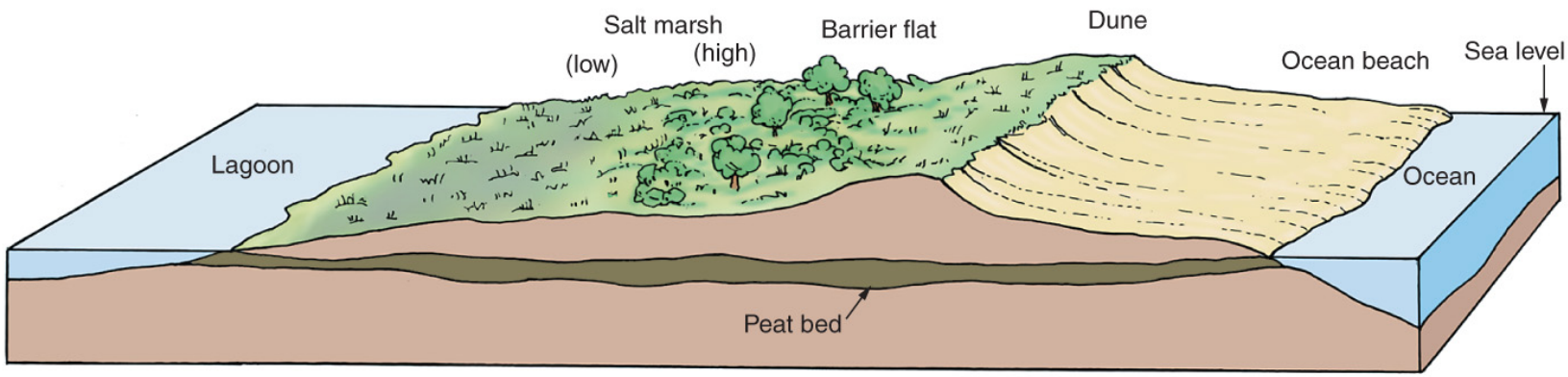
(a)

- Ocean Beach – closest part of the island to the ocean
  - expands during summer, shrinks during winter
- Dune –protect lagoon from strong storms
  - wind blows sand inland, dunes are stabilized by colonizing plants that would withstand salt spray and burial form sand
  - passages exist through the dunes
- Barrier flat – grassy area that forms behind dunes
  - wind can blow through the interdune passes
  - if storms are infrequent, grasses can be replaced by thickets, woodlands, and eventually real forests



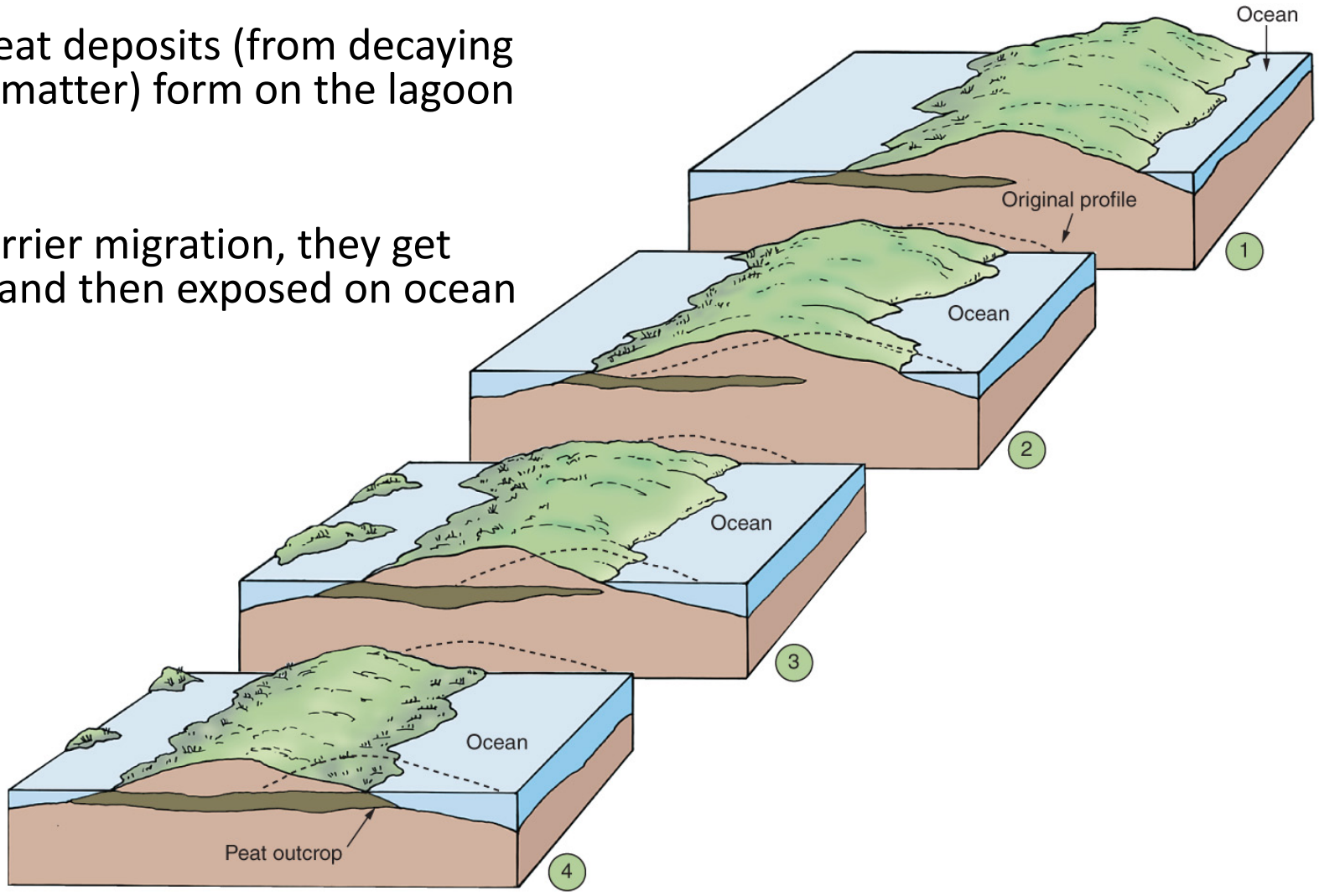
(a)

- Salt marshes – lie inland of the barrier flat
  - divided into high marsh and low marsh
    - high marsh – extends to the highest spring tide line
    - low marsh – extends from mean sea level to the high neap tide line; low marsh is by far the most biologically productive wetland
  - new marshland forms as overwash carries sediment into the lagoon
    - marshes may be poorly developed on parts of the island away from floodtide inlets
- Lagoon – water between barrier island and mainland



(a)

- Migrate landward over time due to rising sea levels
- Older peat deposits (from decaying organic matter) form on the lagoon side
- With barrier migration, they get buried, and then exposed on ocean beach



(b)

human impact on barrier islands

- barrier islands are an attractive place to build
- much construction happened on barrier islands
- some structures have either fallen or have needed to be moved

deltas

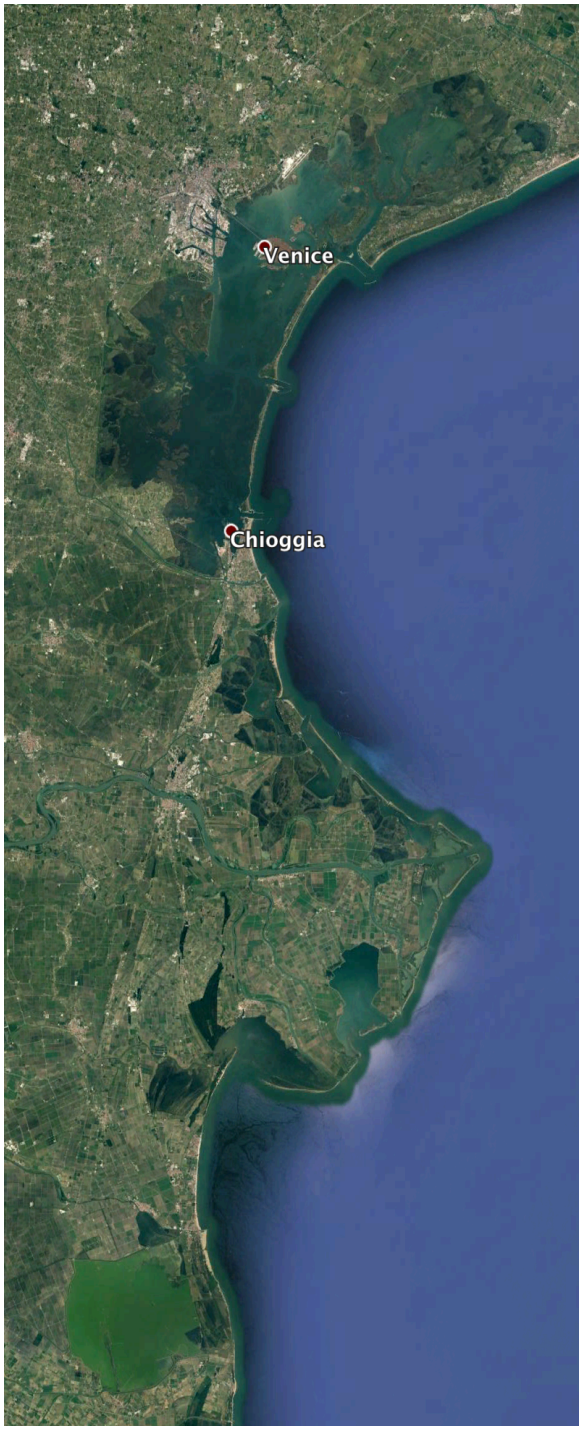
- when rivers carry sediment to the ocean, a build-up forms because of the contrast in water speed
- some rivers can also carry more sediment than the longshore current can carry
- in that case, a delta-like feature develops at the river mouth
- deltas can grow through the formation of distributaries

Nile River delta, Egypt

Above:
Mississippi delta,
Louisiana, U.S.A.

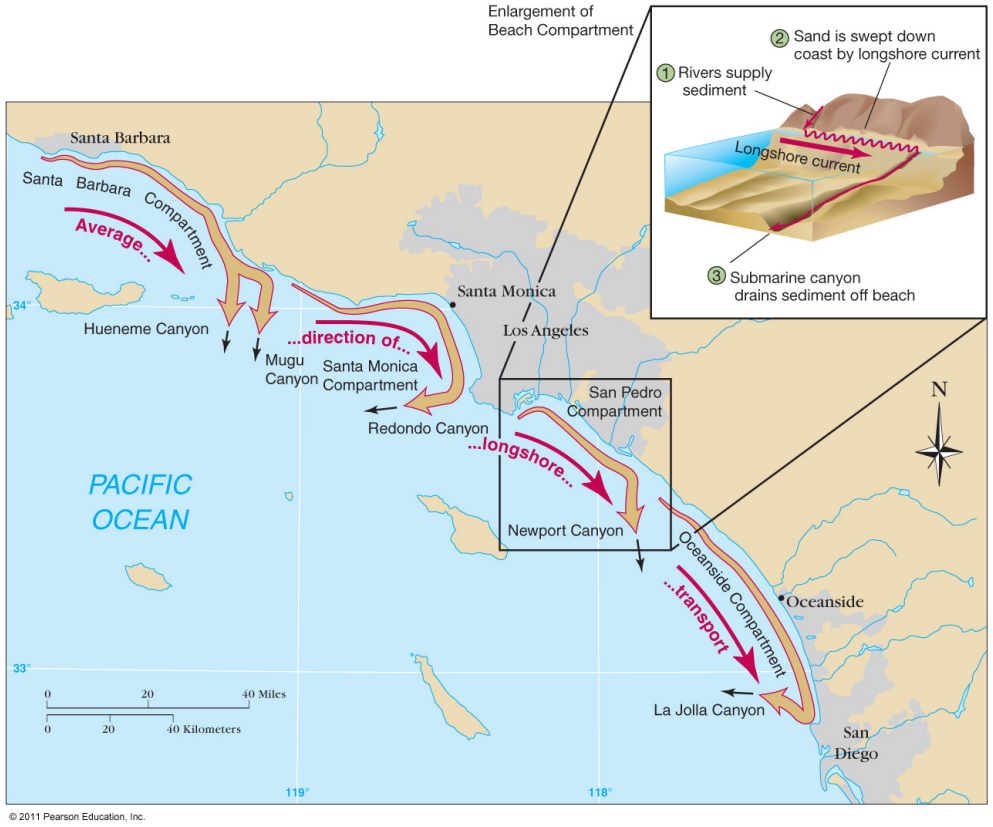
Right:
Po delta and
Venice lagoon,
Venice, Italy

Left:
Mouth of the
Ganges delta,
Bangladesh and
India



Beach Compartments

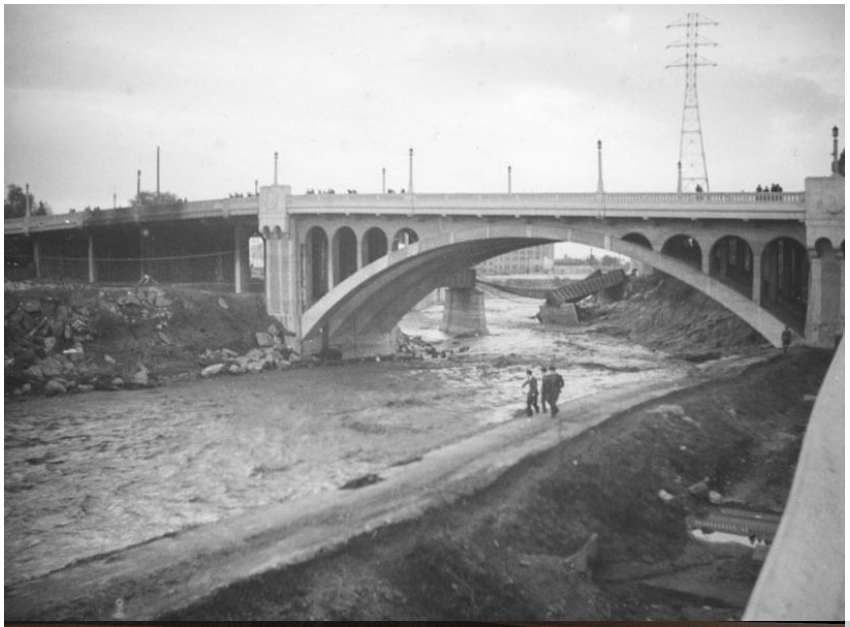
- Consist of three major components:
  1. Rivers that supply beach sediment
  2. Beach itself, where sand is moving because of longshore currents
  3. Offshore submarine canyons, where sand is drained away from the beach
     - turbidites



beach compartments

beach starvation

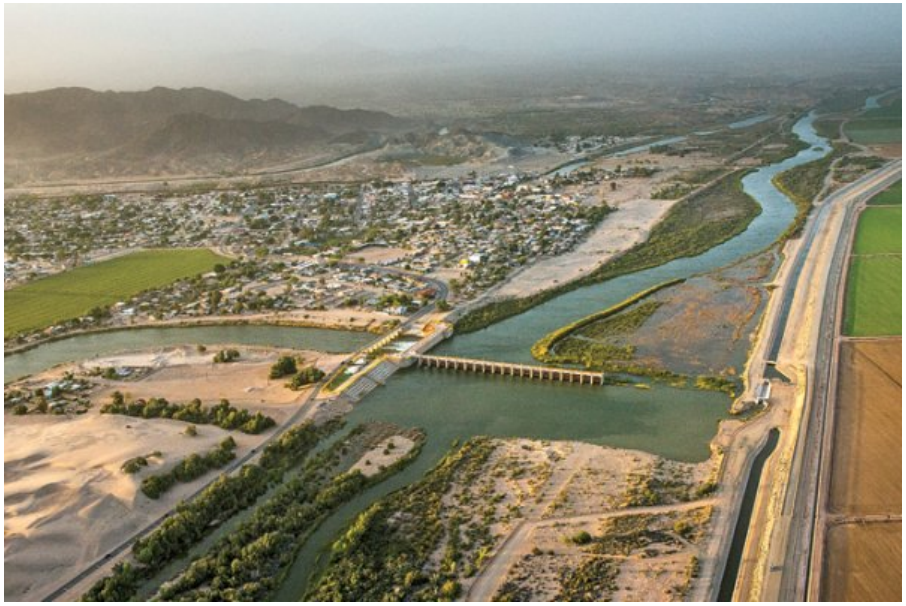
- human activities altered the natural system of beach compartments
- building a dam deprives a beach of sand (i.e. Colorado River delta)
- lining a river with concrete reduces the sediment load delivered to the ocean (i.e. Los Angeles River)
- if most rivers do not deliver sediment to the ocean, the longshore current takes whatever is available to submarine canyons
- beaches become narrower and experience beach starvation



the Los Angeles River

before and after lining it with concrete

Following a catastrophic flood in Los Angeles in 1938, the U.S. Army Corps of Engineers completely encased the river banks and bed in concrete, leaving only a trickle of water flowing down its middle



Morelos Dam, Arizona/Baja California

above: during normal activities

below: during experimental release of the Colorado River waters


El Centro
Mexicali
Yuma
San Luis Río Colorado
Isla Montague

Chapter 10

end of part 2