# Coasts, Beaches and Estuaries

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# Coasts, Beaches and Estuaries

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# Easy way to understand Oceanography

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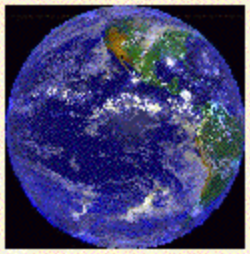
# Oceans & Our Global Environment

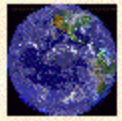
## Coasts, Beaches and Estuaries



**Topics:**

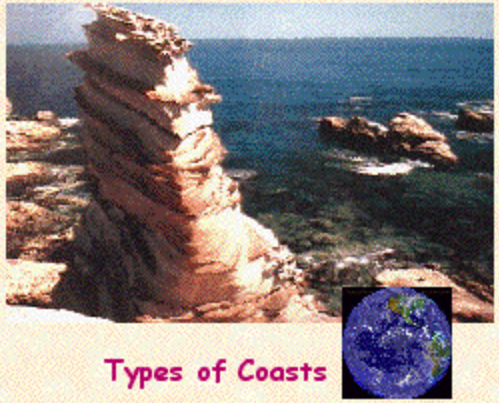
- Major Coastal Zones: Coasts, Shores, Beaches
- Types of Coasts
  - primary (land-dominated), secondary (ocean-dominated)
- Beaches and Beach Dynamics
  - shapes, structures, sizes, composition, color of materials
  - processes: longshore transport, coastal circulation
- Estuaries
  - salt wedge, well-mixed, partially-mixed, fjords
  - circulation patterns, evaporation





# Types of Coasts:

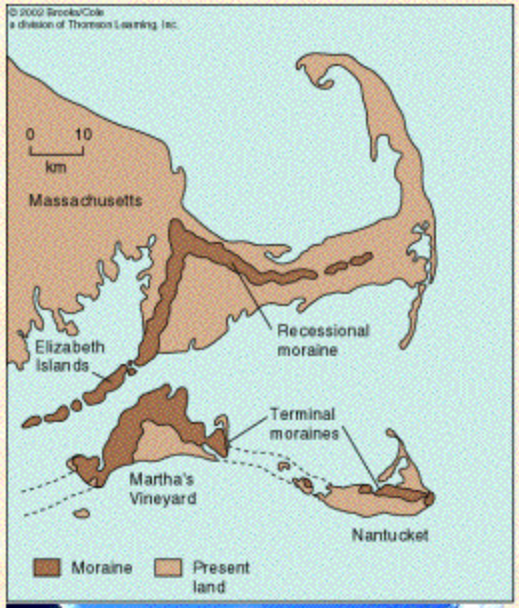
- Landform Features governed by Coastal Processes
  - geomorphology, modified by sea-level changes
  - affected by rivers, currents, storms, ice, organisms (e.g. corals)
  - dominated by either *Land* or *Ocean* processes
- Primary Coasts: Land-dominated
  - erosion by water, wind, ice, sea-level
  - sediments deposited by rivers, winds, glaciers
  - formed by volcanic activity, or earth movements
- Secondary Coasts: Ocean-dominated
  - erosion by waves, currents, seawater
  - sediments deposited by waves, tides, currents, storms
  - deposits formed or altered by marine plants and animals



# Primary Coasts:

- U-shaped valleys carved by glaciers: fjords
  - shallow sill at mouths, formed as morraine when glacier retreated
- V-shaped valleys formed from drowned rivers
  - created by sea-level rise

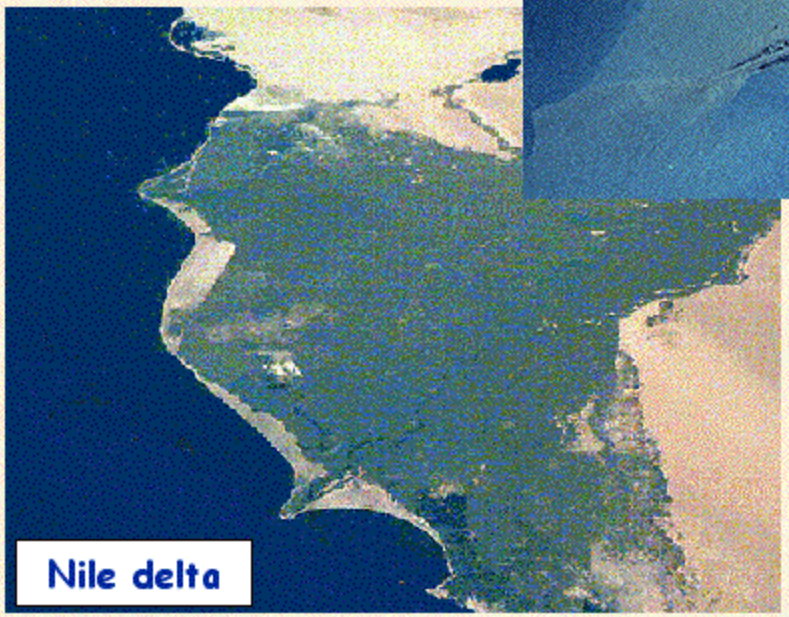
glacial valley




fjord

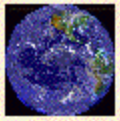
# Primary Coasts:

- Deltas
  - sediment deposits at mouths of large rivers


- sediments accumulations tend to thicken with time and progress (prograde) seaward
- course of deltas changes periodically





# Primary Coasts:

- Dune Coasts
  - wind-modified coasts formed by sand migration
- Lava Coasts
  - produced by volcanic deposits
- Tectonic Coasts
  - shaped by tectonic activity

dune coast, OR

dunes, CA

lava coast, HI

tectonic coast, CA



# Secondary Coasts:

- Cliffs, Pinnacles and Sea Stacks
  - shaped by waves
  - eroded materials form bars, barrier islands, sand spits

sea cliffs

sea stacks

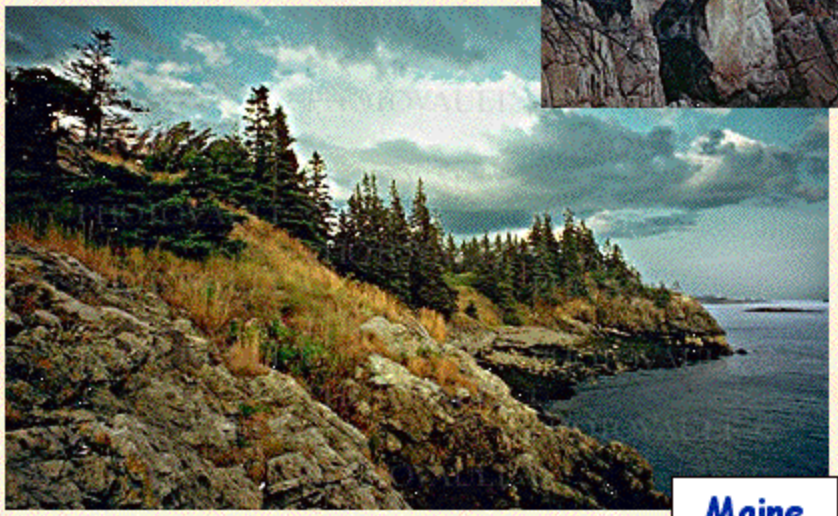
sea arch



# Secondary Coasts:

- Cliffs, Coasts
  - shaped by waves
  - depends on rock types, especially weaknesses

Monterey, CA



Maine

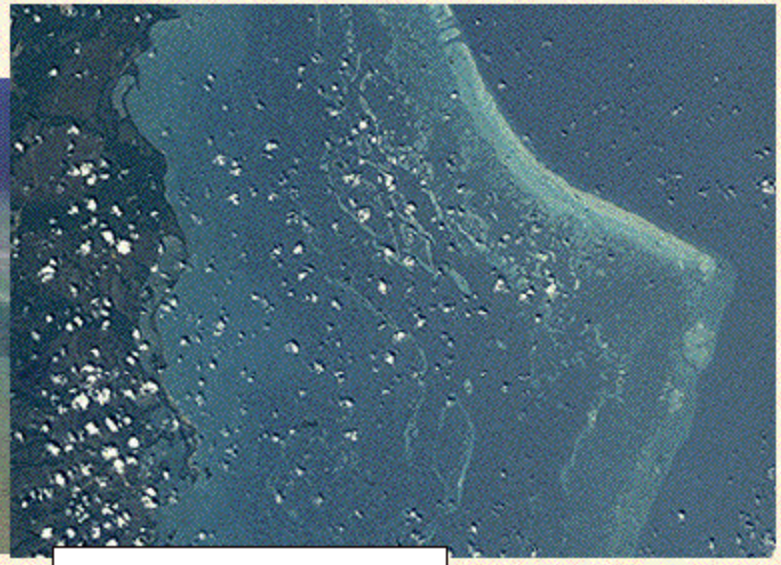


# Secondary Coasts:

- Reef Coasts:
  biological influences
  - biological influences of plants and animals
  - progressive growth

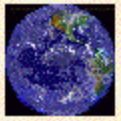
Bora Bora

coral atoll, Australia



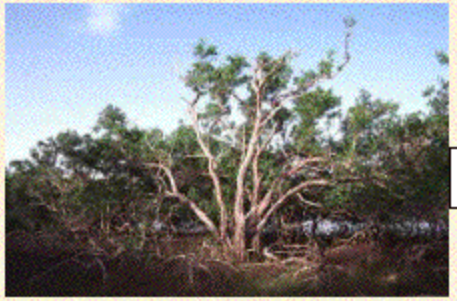
barrier reef, Belize





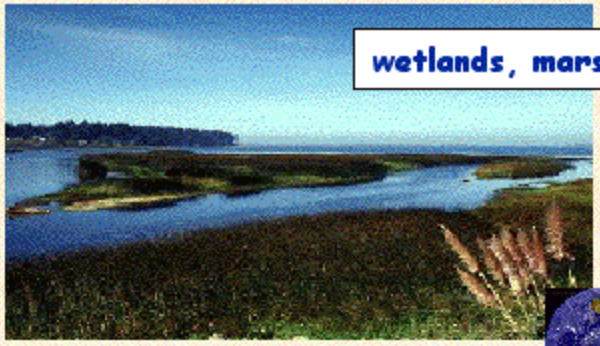
# Secondary Coasts:

- Mangroves and salt marshes
  - plants retaining sediments, periodic tidal flooding
  - plants that tolerate saline conditions



mangroves

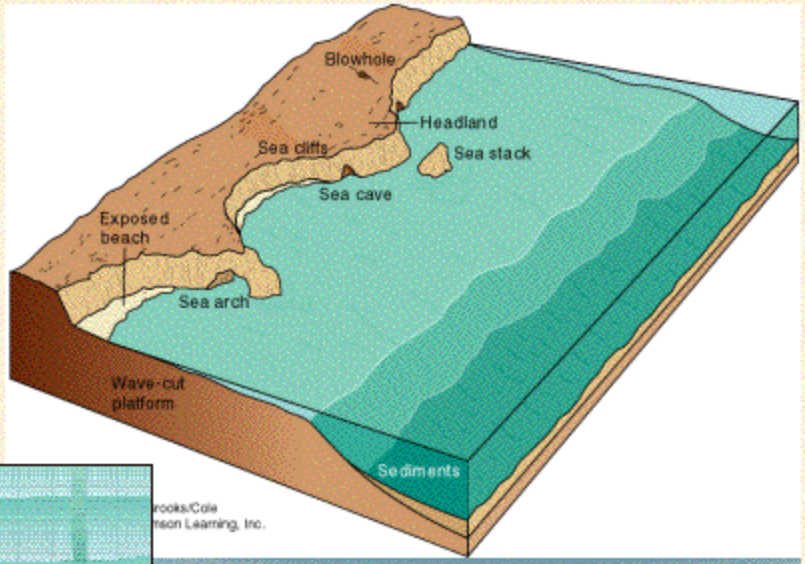
mangroves

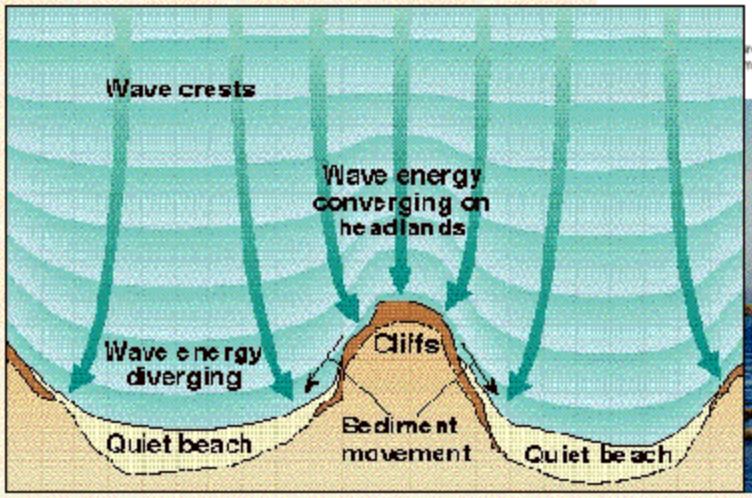


wetlands, marshes

# Secondary Coasts:

- Shaped by ocean processes:
  - wave action and energy distribution
  - balance of erosion and deposition

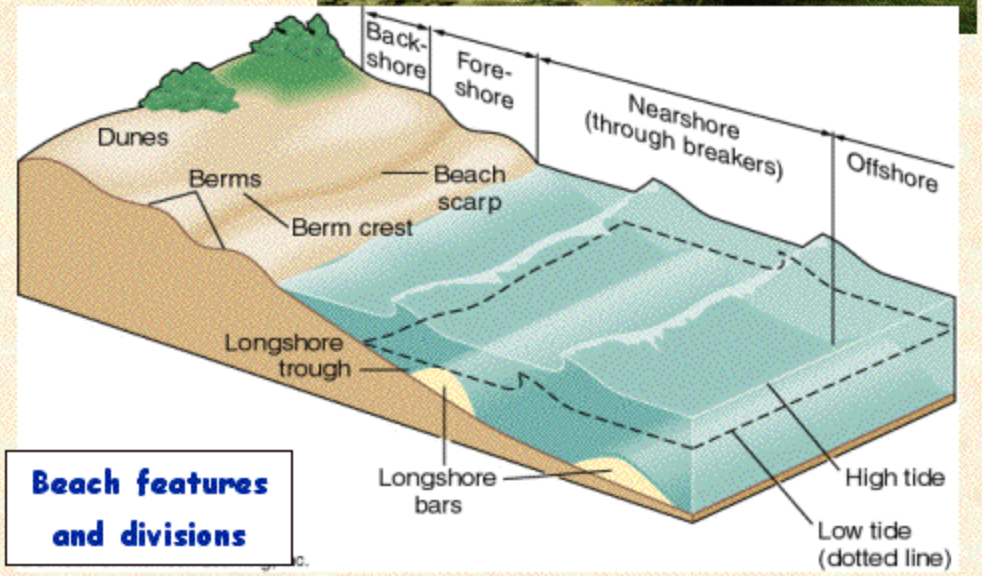



Oregon

# Beach Characteristics:

- Division of shoreline related to tides:
  - offshore, foreshore, backshore
  - features tend to parallel coastline
- Features:
  - longshore bars & troughs
  - summer & winter berms (high tide crests)




Beach features and divisions

# Types of Beaches:

- Described by several factors, first:
  - shape and structure
    - wide/narrow
    - steep/flat
    - long/discontinuous

flat

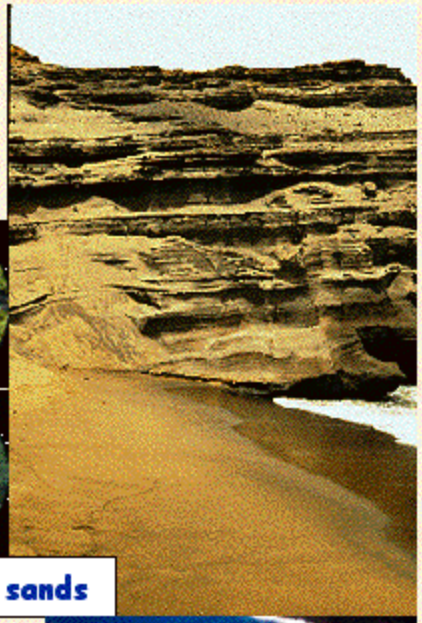
discontinuous

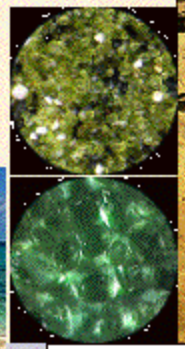
bay beach



# Types of Beaches:

- Described by several factors, second:
  - composition, size and color
    - sand, coral, shells, lava
    - mud, sand, pebbles
    - white, black, green, pink





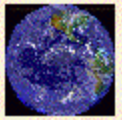
green sands

black sands, HI

white sands (coral)

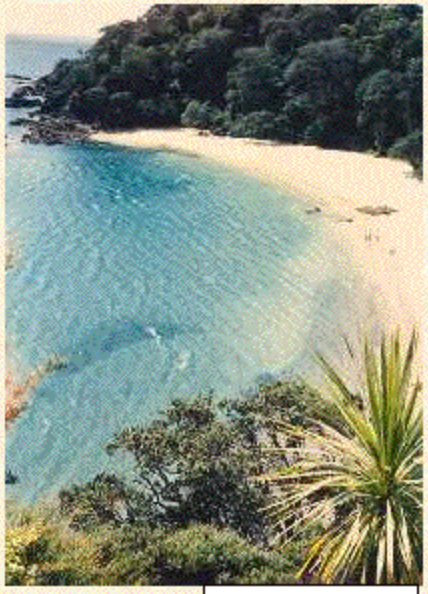
pink sands, Bahamas

shells



# Types of Beaches:

- Processes and forces determine:
  - composition and size of beach materials
    - create lag deposits, armored beach



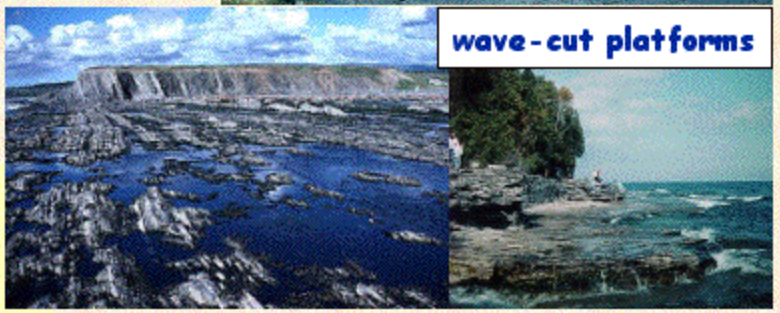
white sands

eroded, or armored beach mud and pebbles

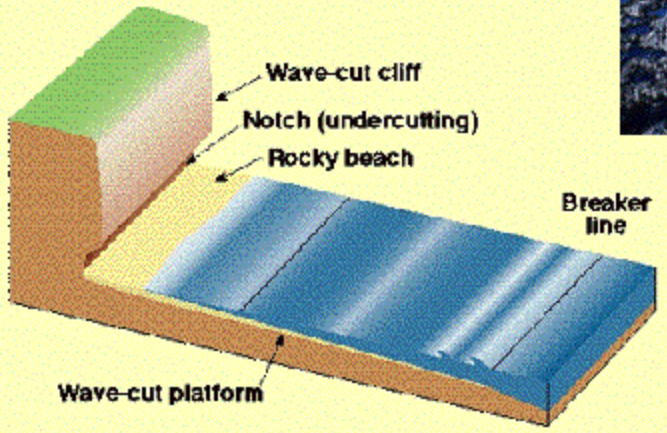


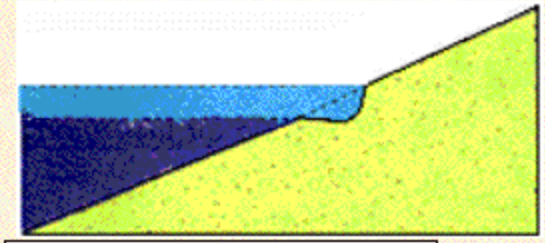
# Wave-Cut Cliffs & Platforms:

- Product of wave-action:
  - may undercut cliffs
  - creates terraces or platforms
  - depends on rock strata
  - progressive erosion



wave-cut platforms



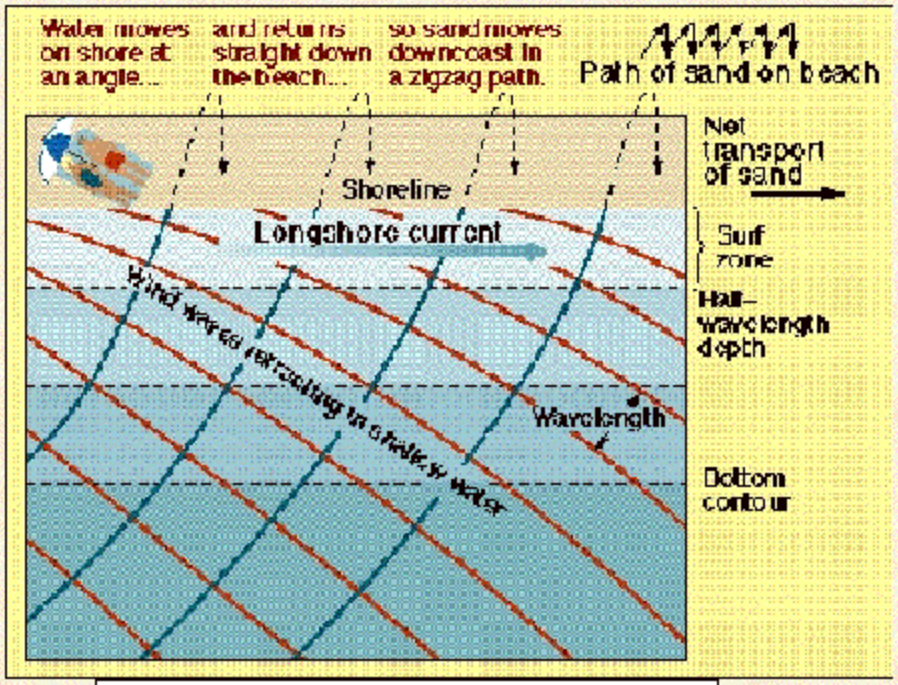
sequence of formation



Wave-cut platform

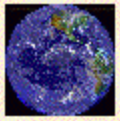
# Beach Dynamics:

- Dynamic equilibrium between depositional and erosional processes
- Water motion:
  - onshore current creates surf zone where waves break
  - longshore currents parallel to shoreline moves sediment in zigzag path along shore
  - transport direction determined by waves



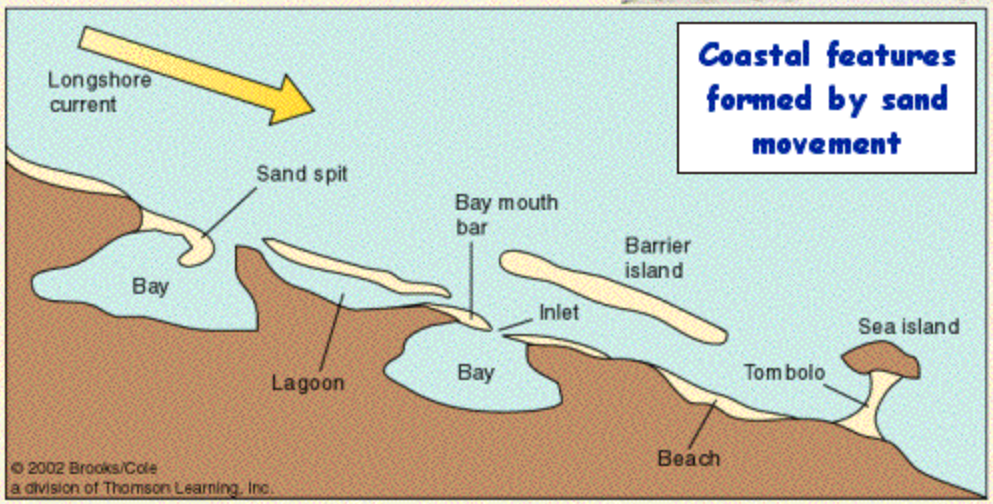

wave-dominated shoreline processes





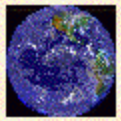
# Longshore Transport:

- Movement of sand driven by longshore current
- Shapes features of coastline

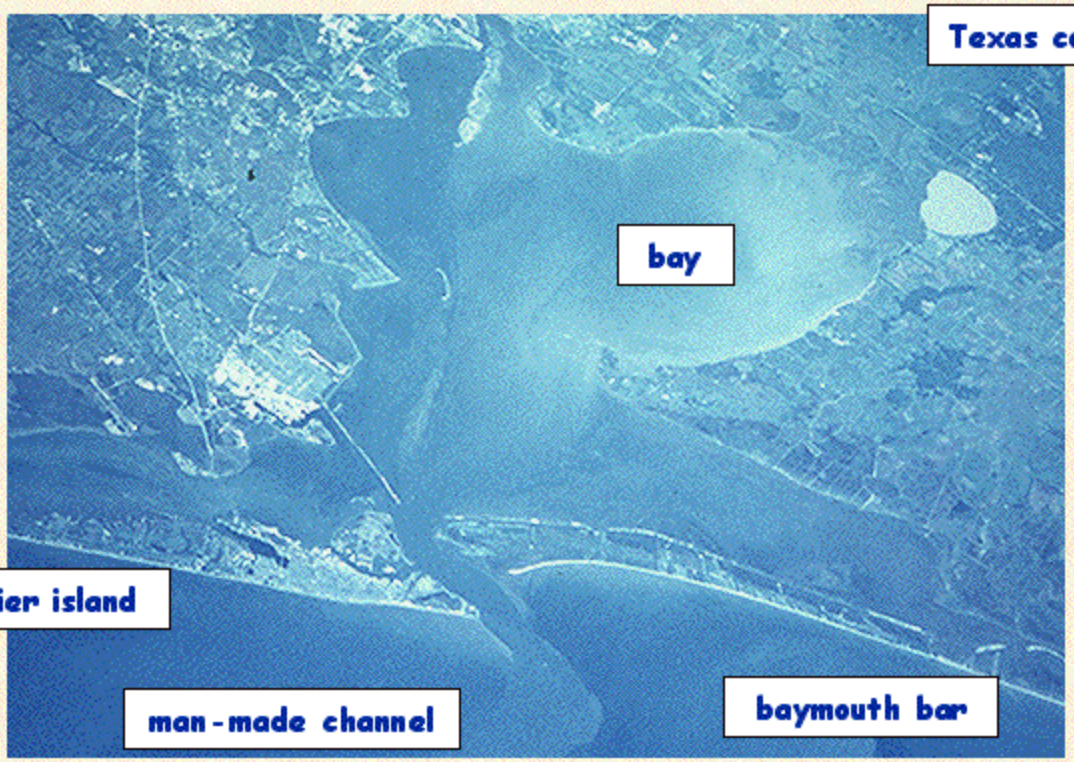

- sand spits across bays, bars, barrier islands, lagoons, tombolos





# Barrier Islands and Bays:

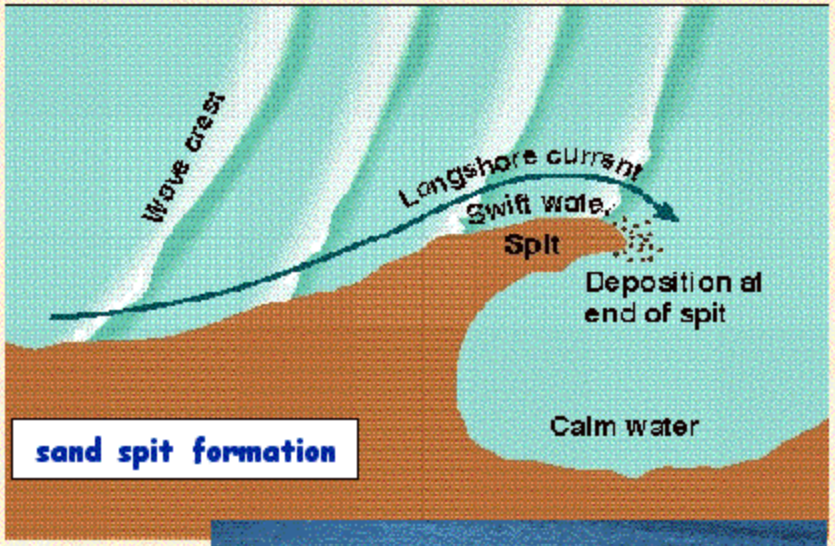
- Created by longshore movement of sand






# Sand Spit Formation:

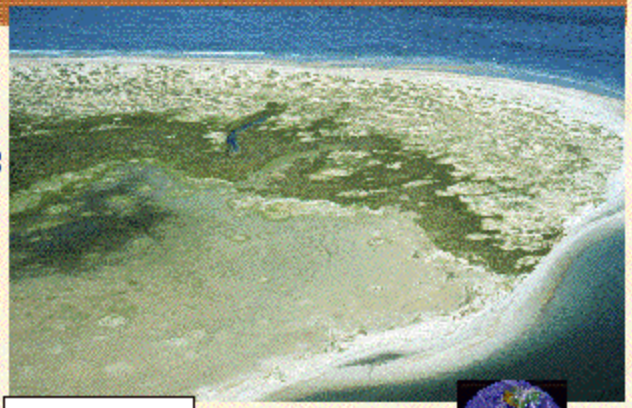
- Sand Movement:
  - created by longshore current and sand movement




sand spit formation

sand spit

- sand deposited in calmer waters
- spits gradually grow and migrate as sand accumulates

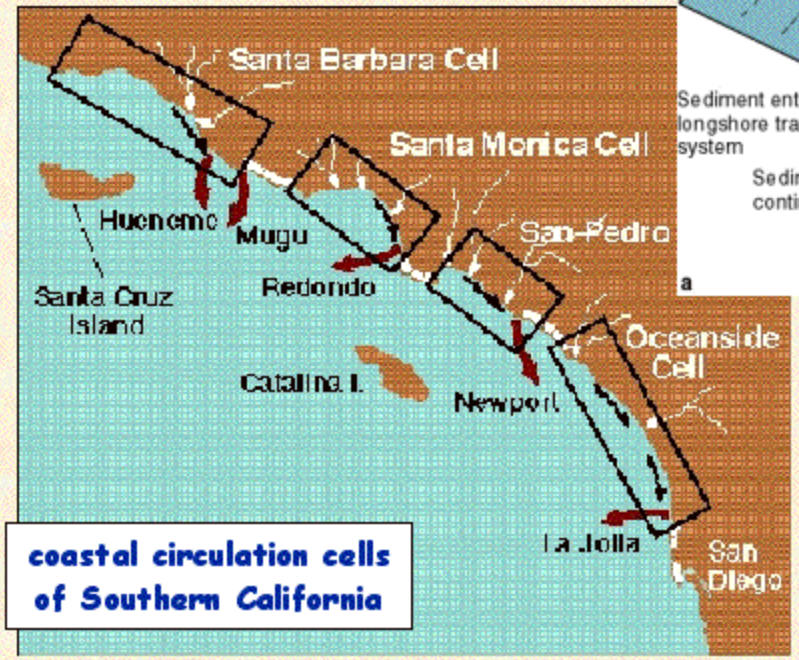


sand spit

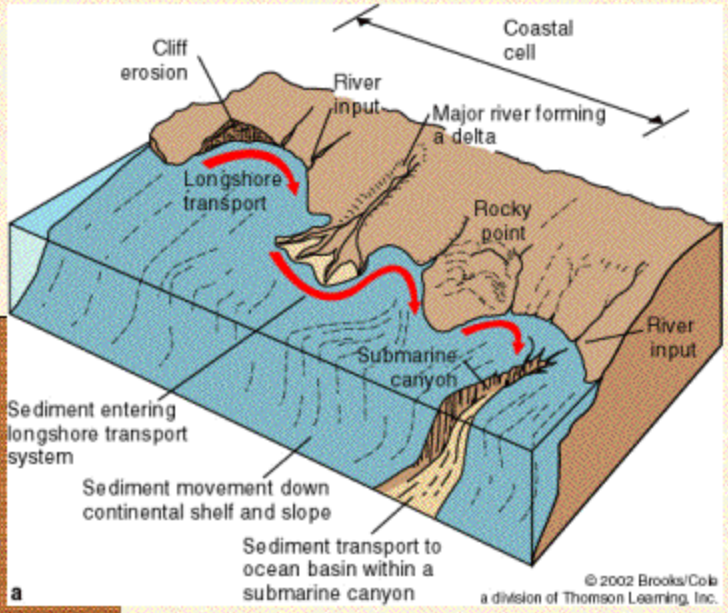


# Coastal Sediment Circulation Cells:

- Division of coast based on sediment budgets:



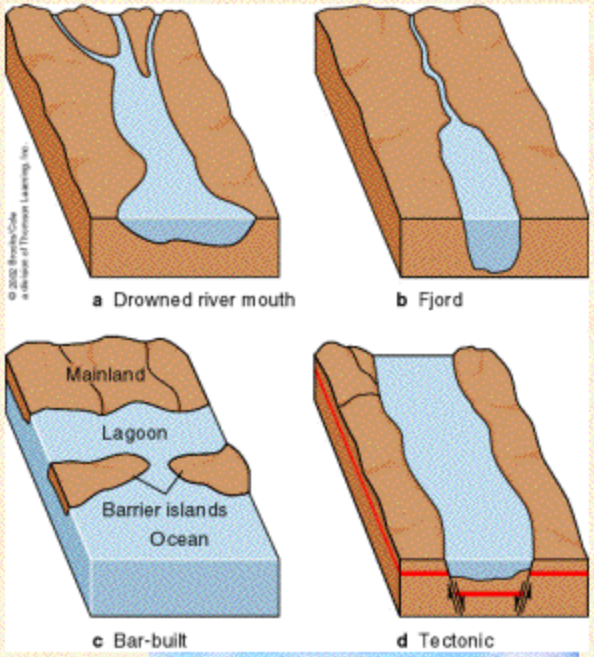

coastal circulation cells of Southern California




- each cell begins and ends at rocky headlands
- sand moved by longshore transport
- sand transported offshore into submarine canyon

# Estuaries:

- Mixing zones of dense sea-water, less dense freshwater
  - semi-enclosed embayments created in various ways:
    - flooded river valleys (e.g. Chesapeake Bay)
    - coastal plain estuaries (e.g. Cape Hatteras)



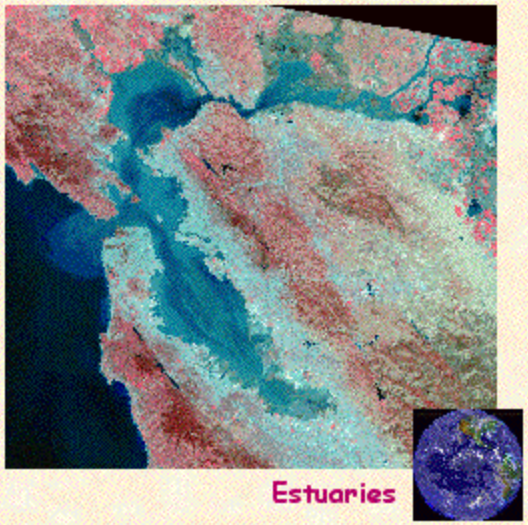

Cape Hatteras

- fjords, flooded glacial valleys (e.g. in Norway)
- tectonic estuaries (e.g. San Francisco Bay)

fjord

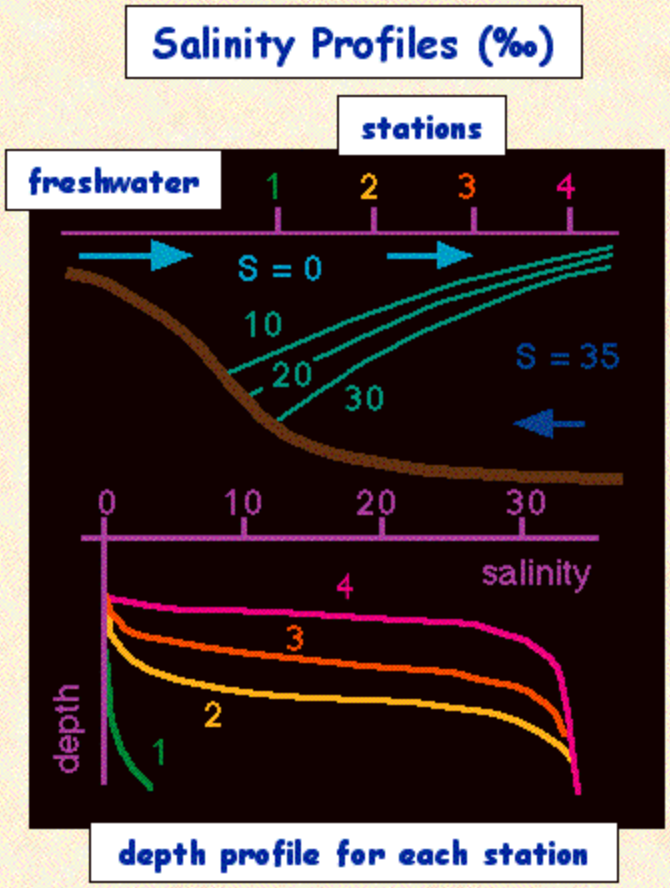
# Estuaries:

- Mixing zones of dense seawater and less dense freshwater
  - described by mode of formation or by circulation features
  - 4 principal types of circulation:
    - salt-wedge
    - well-mixed
    - partially-mixed
    - fjords
  - mixing depends on:
    - strength of tides
    - volume of freshwater influx (river flow)
    - topography



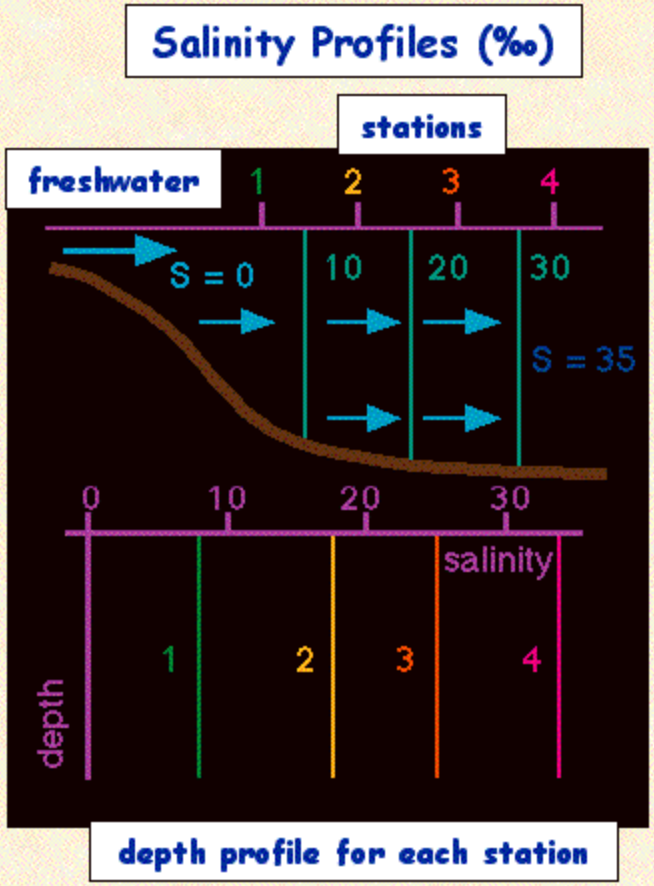
# Salt-Wedge Estuary:

- River Flow:
  - large; strong surface flow of freshwater
- Tidal Range:
  - low; small surface flux of seawater
- Result:
  - stratification: water is salty at depth
  - lower layer of salt water is entrained by freshwater
  - gradual mixing occurs
  - surface water salinities only increase toward ocean



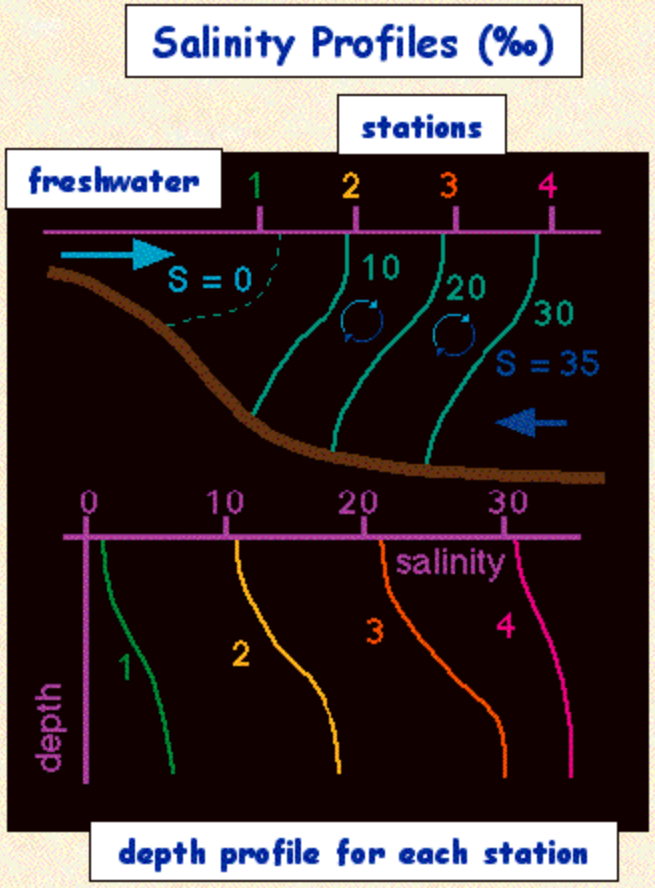
# Well-Mixed Estuary:

- River Flow:
  - low; weak surface flow of freshwater
- Tidal Range:
  - high; strong mixing of seawater and freshwater
- Result:
  - little depth stratification
  - turbulent mixing
  - surface water salinity progressively increases seaward



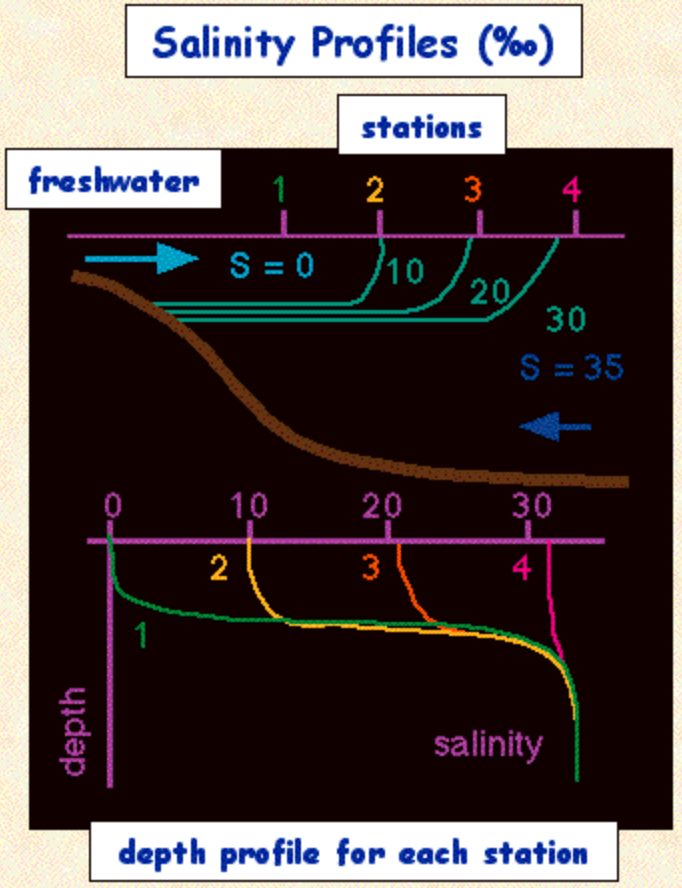
# Partially-Mixed Estuary:

- River Flow:
  - moderate; surface flow of freshwater
- Tidal Range:
  - moderate; gradual mixing of seawater and freshwater
- Result:
  - some stratification
  - strong net seaward flow of freshwater
  - surface water salinity gradually increases seaward



# Fjord-Type Estuary:

- Ocean Connection:
  - may be restricted by shallow sill (glacial moraine)
- River Flow:
  - moderate; surface flow of freshwater
- Tidal Range:
  - little tidal mixing of seawater and freshwater
- Result:
  - strong stratification, little mixing below surface
  - surface water salinity gradually increases
  - little influx of seawater

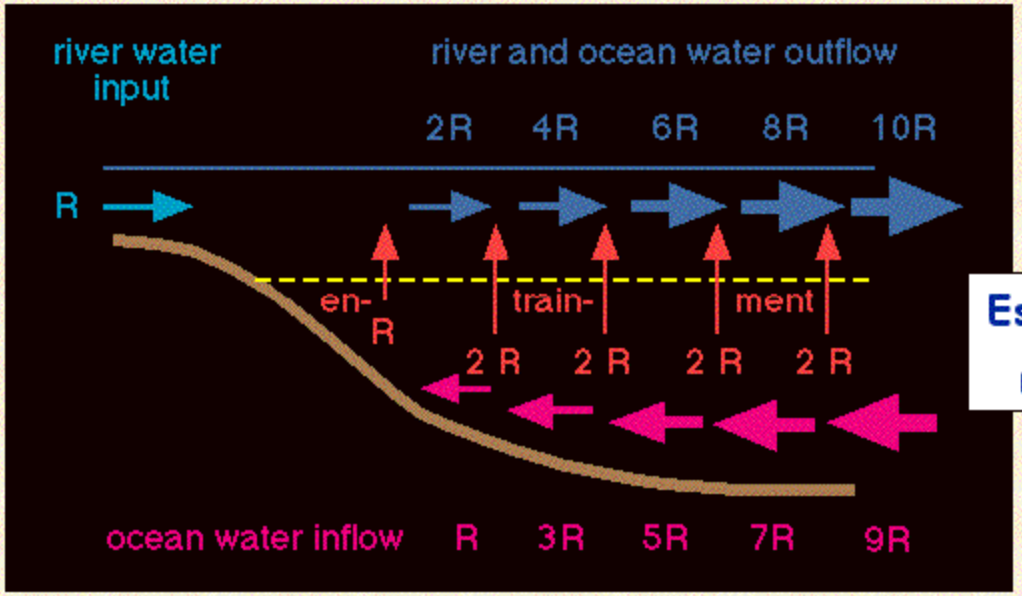







# Estuarine Circulation:

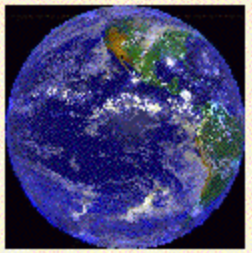
- Described by water and salt budgets:
  - mixing upward of 2 units of seawater reduces inflow and decreases outflow by 2 units
  - salinity gradually increases seaward






# Oceans & Our Global Environment

## Coasts, Beaches and Estuaries



## Key Concepts:

- Coastal Zones and Types of Coasts
  - primary (land-dominated) & secondary (ocean-dominated)
- Beaches, Shorelines and Beach Dynamics
  - characteristics: structures composition & materials
  - processes: longshore transport, coastal circulation
- Estuaries
  - mixing zones of seawater and freshwater
  - types: salt wedge, well-, partially-mixed, fjords