Chapter Outlines

The California coast

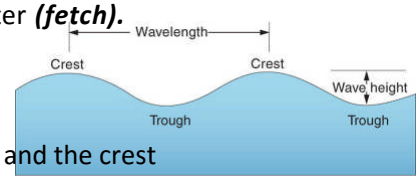
NOTE: This is intended to help students 'organize' their understanding of each topic. It is <u>not</u> a comprehensive study guide for quizzes or midterms, i.e. <u>study your text!</u>

Coasts

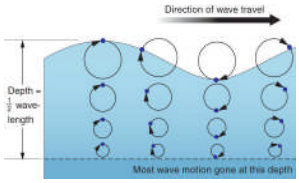
The shorelines of lakes and oceans are among the most rapidly changing parts of Earth's surface. All coastlines are subject to erosion *(wearing away)* by **waves.** A coastline comprised of loose sediment can be eroded easily and rapidly. A coastline composed of dense bedrock or plastic-like mud erodes much more slowly. Several factors determine the characteristic land-forms of shorelines. They include the shape of the shoreline, the materials that comprise the shoreline *(rock, mud, loose sediment),* the source and supply of sediments, the direction that currents move along the shoreline, and the effects of major storms.

Driven by wind, **waves** continuously erode, transport, and deposit sediments along coastlines. The sand is also continuously moved parallel to the beach by longshore currents and is frequently deposited in harbors, where it must be periodically dredged to keep the harbor open for boating and shipping.

- **Waves -** The dominant agents of erosion in coastal environments are waves. They are normally formed far out at sea…and can travel thousands of kilometers. Their height is dependent on wind speed, length of time the wind blows, and distance wind blows over the water ***(fetch).***
  - Parts of a wave and a wave's environment
    - **Wave crest** – top of a wave
    - **Wave trough** – the lower portion that separates the crests
    - **Wave height** – vertical distance between the bottom of the trough and the crest
    - **Wave length** – Horizontal distance between crests
    - **Surf** – the zone where waves break against the shoreline
    - **Tsunami –** a wave generated from a submarine earthquake

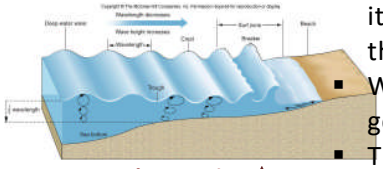


Names of the parts of a wave



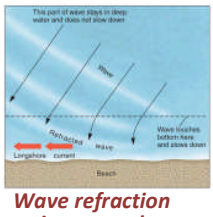
Water particle motion as a wave passes

  - **Wave movement** - Individual molecules of water are not physically transported with waves as they move across the surface. The energy of the wave passes *through* the water molecules and does not carry them along.
    - During the passing of the wave, the water particle follows a **circular path** and returns to its original position after the wave has passed. The deeper the water particle is from the surface of the ocean, the smaller is its orbit.
    - Water particles at depths greater than **half the wavelength** have essentially no motion generated by surface waves.
    - The circular orbits of water molecules are flattened into oval patterns as the wave approaches the shallow water near the shore and start to **'feel'** the bottom.
    - A sloping bottom near shore pushes the wave up, and slows its lower portion. The result is the top of the wave builds and falls over forward as a **breaker.**



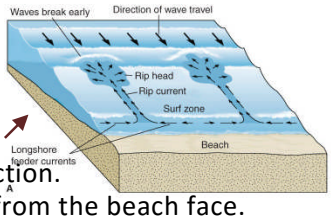
Wave shape as it approaches shore

  - Wave interaction with shore
    - **Refraction** - Waves approaching at an angle will bend and become more parallel to shore.
    - Waves approaching shore at an angle will also create a **longshore current.**
    - **Rip currents -** are formed when water from waves rushing up a beach face return through the surf zone in a straight narrow 'finger' perpendicular to shore.

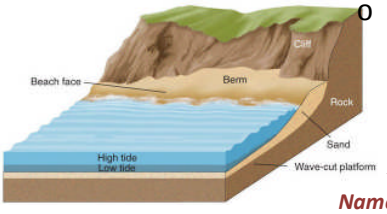


Wave refraction as it approaches shore at an angle

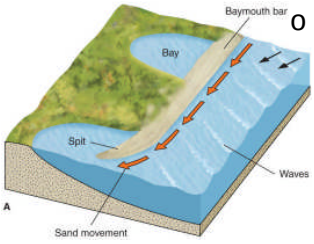
- **Beach** - The area of sand or gravel *(more rarely silt)* that covers the shoreline from the low-water edge to a well-defined upper elevation, such as a bluff or vegetated surface
  - Parts of a beach
    - **Beach face** – the steep portion of the beach receiving wave action.
    - **Wave-cut platform** – semi-flat submerged area just offshore from the beach face. This will be known as a **Marine Terrace** if it undergoes uplift.
    - **Berm** – the landward edge of the beach.



Rip current formation

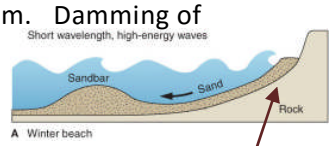


Names of the parts of a beach

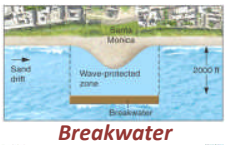


Features resulting from the 'river of sand'

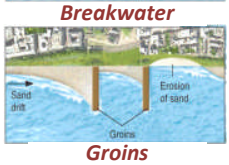
- Beach deposition
  - **Beach drift** – is the movement of sand on the beach face *(parallel to the beach)* as a result of waves hitting the beach at an angle.
  - **Longshore drift** - is the movement of sand in the surf zone in the direction of a longshore current. Also a result of waves approaching the beach at an angle.
  - The traveling sand may eventually be deposited further along the shore as a **spit** or **baymouth bar**, or drop into a submarine canyon.
  - **Tombolo** – a bar of sediment that connects the shore with an off-shore feature such as a sea stack.
- **Beach composition** – most beaches are composed of quartz sand transported to the shore by rivers. Other sources include erosion of local rock, replenishment from sand stored seaward of the surf zone, and carbonate remains of shelled marine organism. Damming of local rivers can cut off the river sand supply and cause beach erosion.
- Seasonal changes
  - **Summer beaches** - tend to have more sand and wider beaches.
  - **Winter beaches** – energy from storms tend to move the sand off-shore and reduce the beach size.



Winter beach

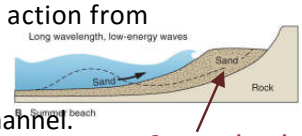


Breakwater

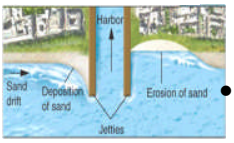


Groins

- Beach engineering – must take the continuing natural processes into account to succeed.
  - **Breakwater -** is an artificial structure built parallel to shore to stop wave action from reaching a harbor or shoreline.
  - **Groins** - are walls built perpendicular to a beach to retain sand.
  - **Jetties** - are walls built on both sides of a harbor entrance to maintain the channel.

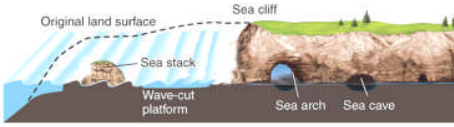


Summer beach

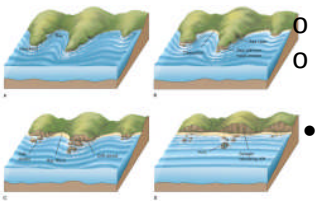


Jetties

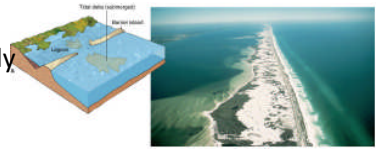
- **Shoreline features**
  - An irregular coast has many coves separated by irregular rocky points called **headlands.**
  - **Coastal Straightening** - results from wave refraction causing most of the wave energy to be directed towards the headlands, while depositing the resulting sediment in the adjacent bays.
  - **Wave-cut platform** – as sea cliffs retreat, they leave behind, beneath the surf, semi-flat areas cut into rock by wave action for a distance away from shore.
  - **Sea cliffs** - result from constant wave action along a rocky shore.
  - **Stacks** - are erosional remnants of sea cliffs that are rooted to the wave-cut platform.
  - **Sea arches** - are headlands whose centers have been eroded through.
  - **Sea caves** - are cavities that are eroded into rock in the wave zone.
  - **Barrier islands** - are large, elongated masses of sand that parallel the coast and form islands, are dynamic with rapid erosion and deposition, and are common on depositional coasts.



Shoreline erosional features


Coastal straightening by headlands erosion

- **Emergent coast** features are usually a result of tectonic uplift.
  - **Marine terraces** - were formed below an older surf zone as a wave-cut platform and are generally found along tectonically active coastlines.


Barrier island

- **Submergent coast** features are usually a result of rising sea level.
  - **Fiord -** is a steep-walled, fingerlike coastal inlet that was carved by glacial action during lowered sea level, and later flooded by the rising sea.
  - **Estuaries** - are submerged parts of old river channels that now extend inland from the coast.
- **Tides** - the daily rhythmic rise and fall of sea level along a coastline.
  - The tide is a result of the gravitational attraction exerted upon the earth by the moon, and to a lesser extent by the sun.
  - Tides occur about fifty minutes later each successive day for about twenty-nine days, which completes one cycle *(a result of the moon's orbital motion).*
  - **Spring tides** - occur at new and full moons. The earth, sun, and moon are aligned, causing the greatest difference *(from gravitational pull)* in tidal elevations.
  - **Neap tides**, producing lesser tidal differences, occur midway between the spring tide
  - Tidal currents preceding high tide are called **flood currents** *(flowing in)*, while **ebb currents** are those following a high tide *(flowing out)*.


Marine terrace (uplifted wave-cut platform)