2. Coasts

2.1 Coastal Processes

Two parts of coastal environment - Onshore & Offshore

Much of marine processes involve waves

Waves friction between the wind and the water set the wave's motion

The strength of waves depends on the strength of the wind

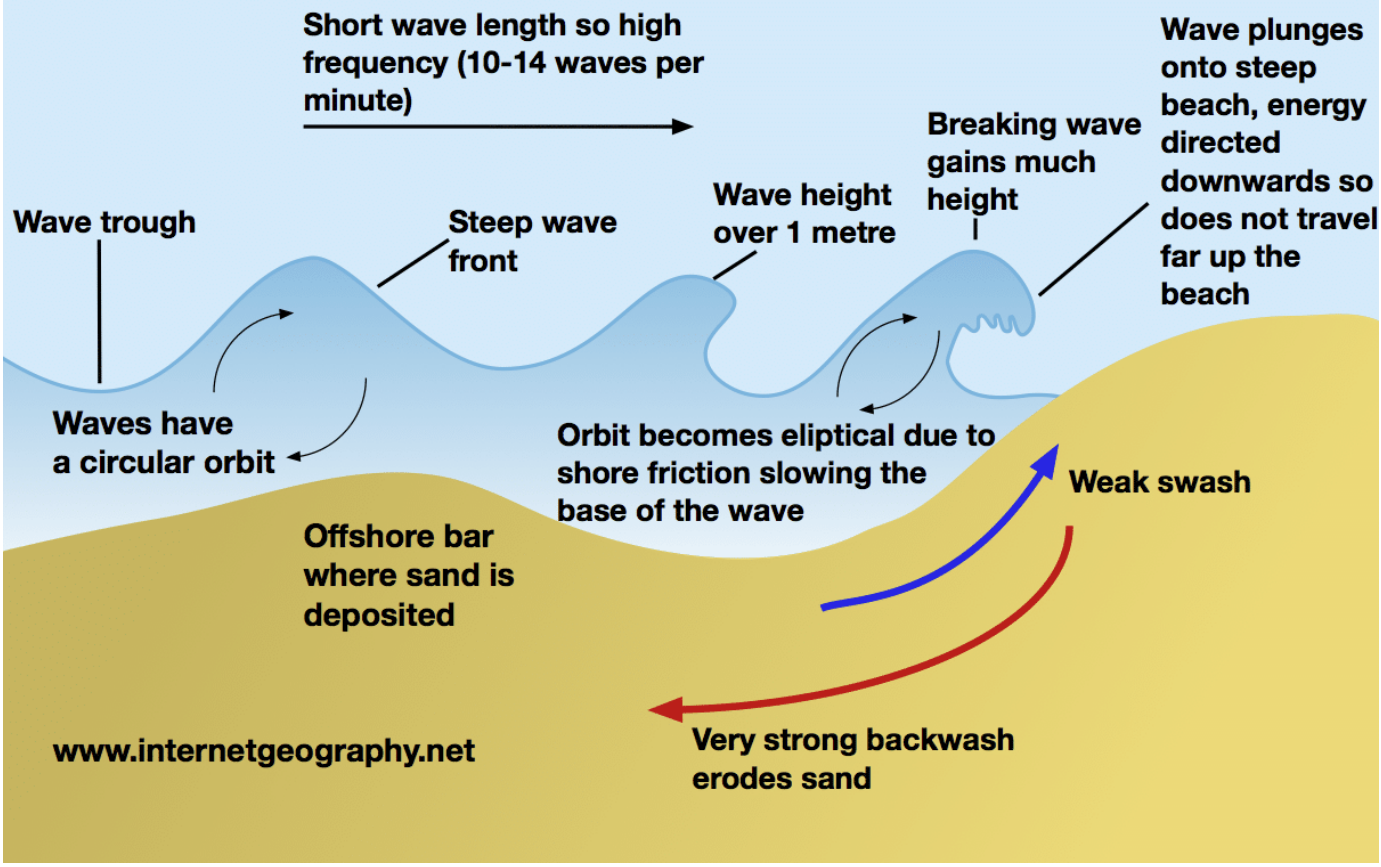
Fetch - length of time and distance over which which has been blowing at the wind

Constructive wave - Long wavelength, shallow gradient waves, strong swash, weak backwash, beach built up by deposition of material brought up in wash
Destructive waves - tall waves with short wavelength, steep gradient waves, weak swash, strong backwash, beach eroded

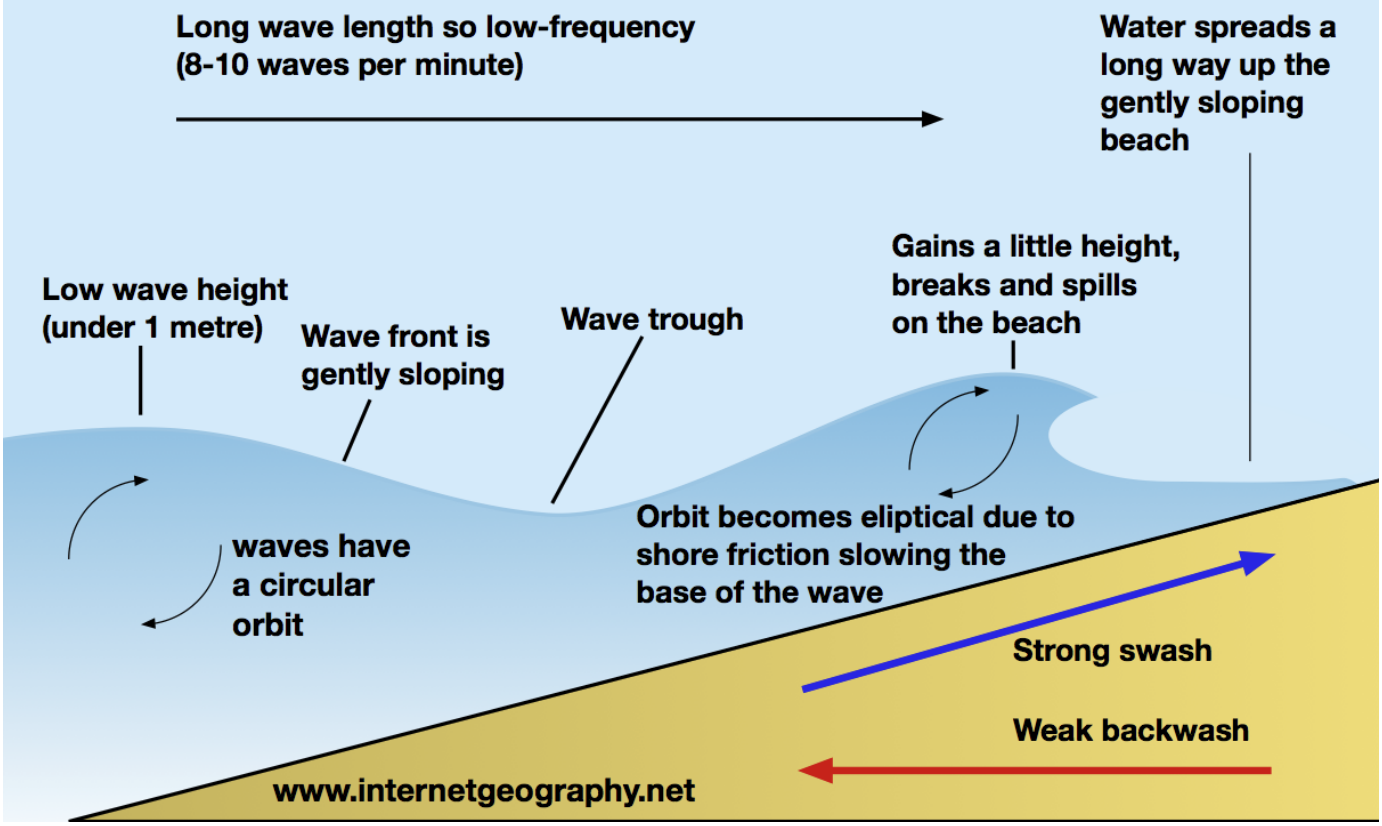
In constructive waves, the swash is stronger than the back wash so material is moved up the beach

In destructive waves, back wash is stronger so material is dragged back down the beach and moved along the coast by long shore drift (LSD).

Destructive Wave

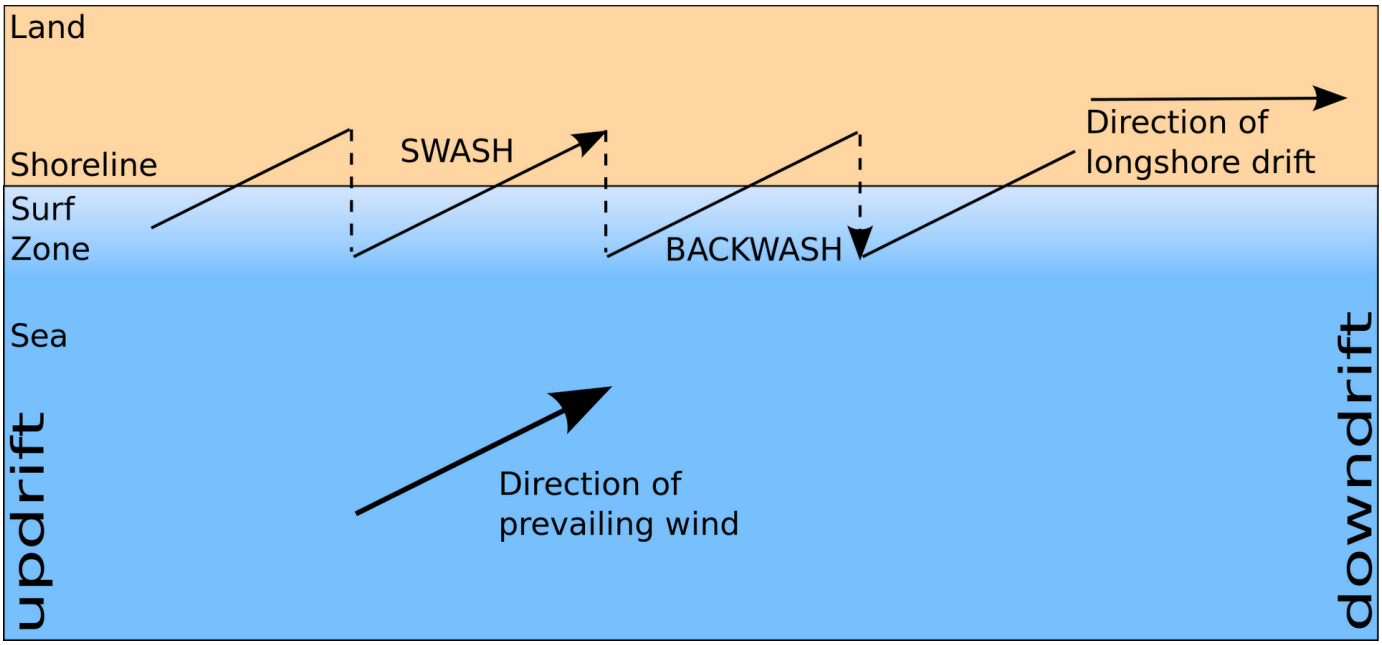


Constructive Wave



Destructive Waves cut away at coastline through:

- Hydraulic action - result from force of waves hitting the cliffs and forcing pockets of air into cracks and crevices
- Abrasion - caused by waves picking up stones and hurling them at cliffs and so wearing the cliff away
- corrosion (solution) - dissolving of rocks by sea water



Land Processes

Main processes at work on landward side of coastline:

- weathering - breakdown of rocks which is caused by freeze-thaw and growth of salt crystals, by acid rain and by growth of plant roots
- Erosion - wearing away of rocks by wind and rain
- Mass movement - removal of cliff-face material under the influence of gravity in the form of rock falls, slumping and landslides

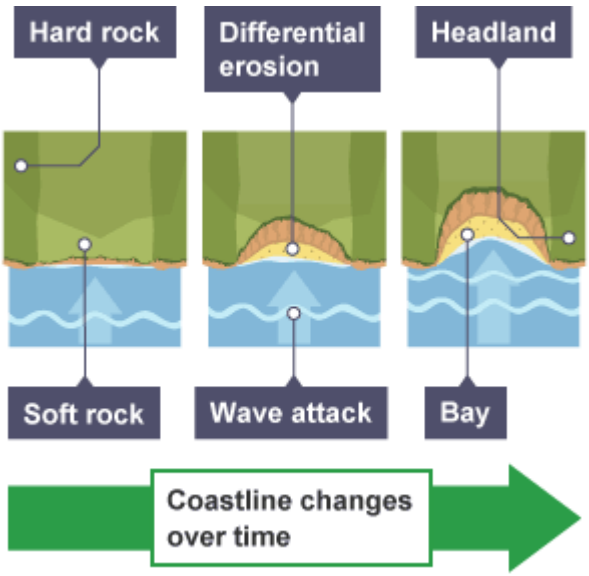
2.2 Coastal Landforms

Erosional Landforms:

alteration of headlands and bays -most common coastal landform, gives coastline irregular appearance

- Concordant coasts - costs where the rock outcrops run parallel to the sea, makes straight coastline
- Discordant coasts - coasts where the rocks outcrop at right angles to the sea, makes headlands and sea

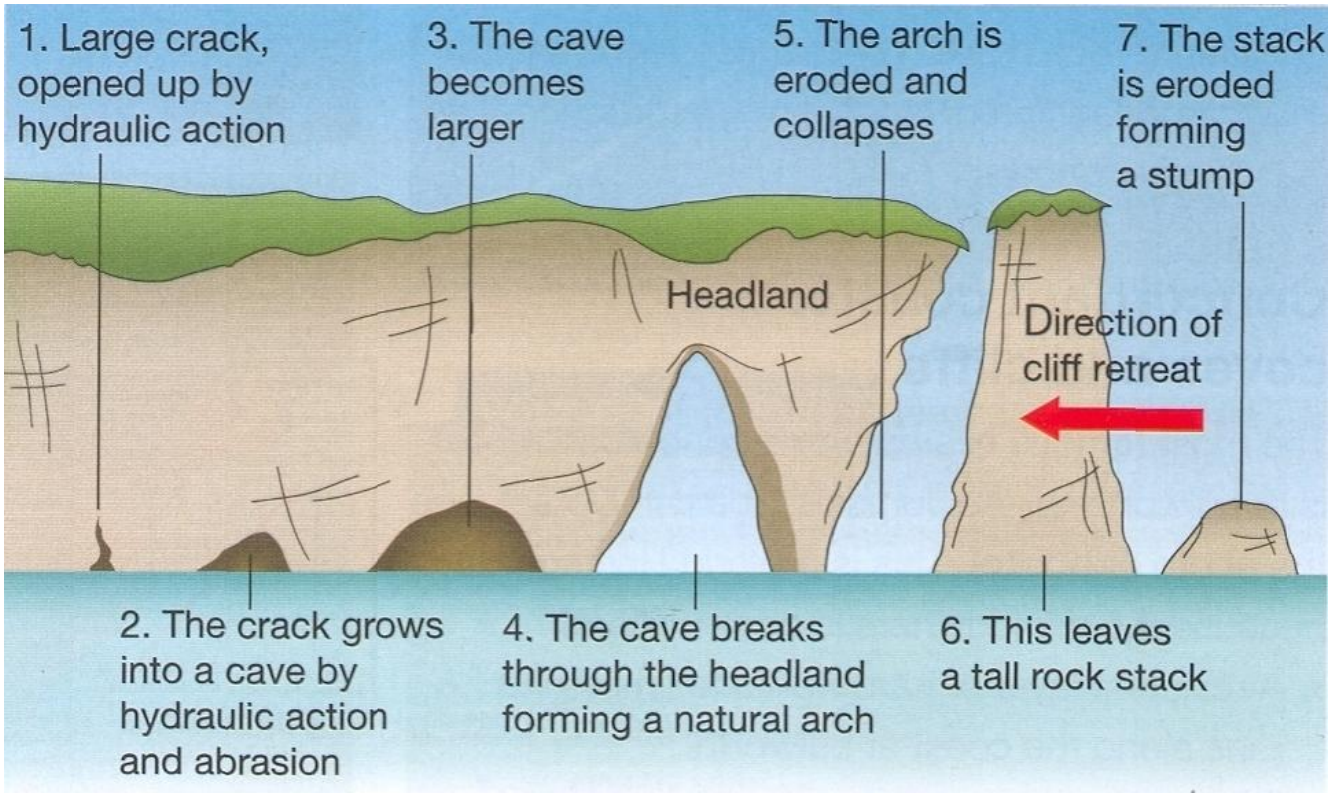
Weak rocks (such as clay) are easily eroded by sea to become bays
More resistant rocks, that are able to withstand the destructive waves, protrude as headlands



Most headlands are edged by cliffs

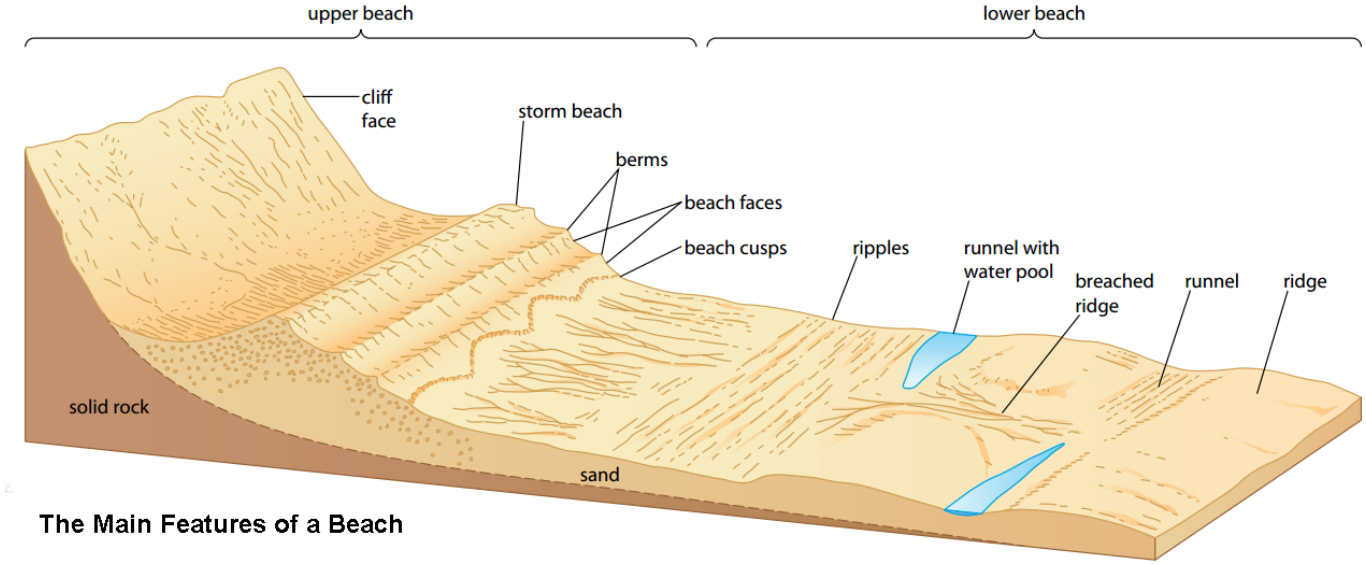
Process of cliff erosion from destructive waves:

- Headland
- Caves
- Arch
- Stack
- Stump



Depositional Landforms - made by constructive waves

Beaches - most common depositional landform, resulting from accumulation of material deposited



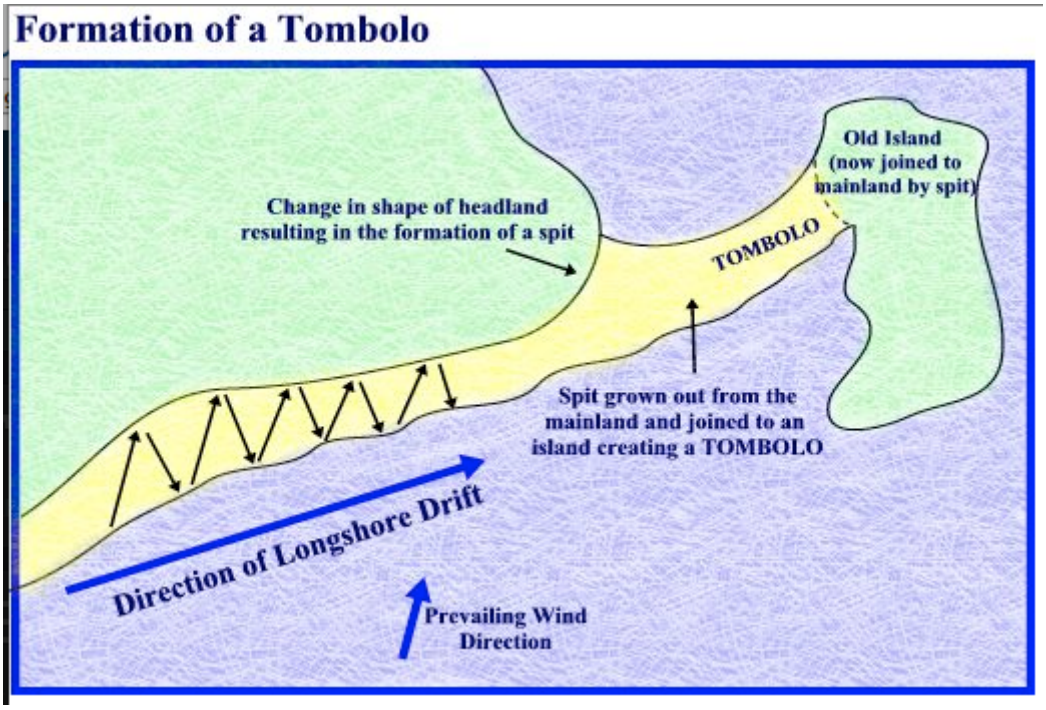
The Main Features of a Beach

Spit - long narrow beaches of sand or shingle that are attached to the land at one end, extend across a bay, an estuary or where the coastline changes direction. Formed by longshore drift in one dominant direction.

Bar - formed from spit development in a bay, building across it and link two headlands. Any water on the landward side is trapped to form a lagoon.

Tombolo - spits that have continued to grow seawards until they reach and join an island

Sand dunes - dunes made from wind accumulating sand. Gradually, the older ridges become colonized by vegetation and helps to stabilize them



2.3 Factors Affecting Coastal Environments

Geology

Feature	Hard Rocks	Soft Rocks
shape of cliffs	high and steep	generally lower and less steep
cliff face	bare rock and rugged	smoother; evidence of slumping
foot of cliff	boulders and rocks	few rocks;some sand and mud

plan view - headlands and bays
vertically - height and profile of cliffs

Vegetation

Longer existing landforms have greater chance of vegetation. They can support structures such as sand dunes and mangrove swamps

Sea level changes

Low lying coasts will be drowned by rising sea levels can be drowned from global warming and climate change
Falling sea level can cause raised beaches made from old wave-cut platform

Human activities

- Settlement - coastal lowland attracts people and many of the world's most populated cities are located on the coast.
- Economic development - people have taken advantage of economic opportunities provided by the coast such as land for agriculture, industry, and tourism
- Coastal management - people trying to control coastline. (ex. building sea walls and groynes)

2.4 Coastal Ecosystems of the World

coasts are rich in biodiversity

Coral Reefs

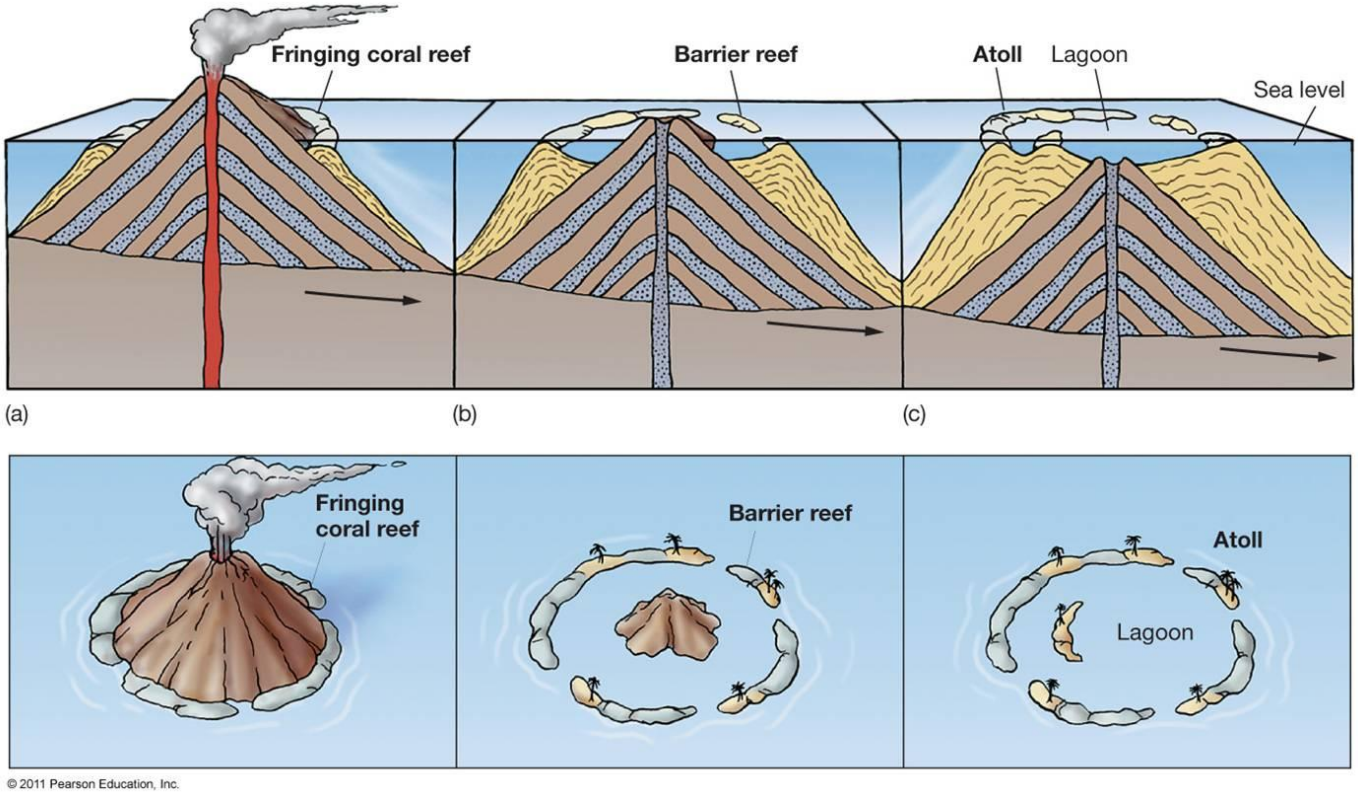
Reefs are huge deposits of calcium carbonate made mainly of corals

Global distribution factors:

- Temperature - coral growth needs a minimum water temperature of 18C; they grow best between 23C and 25C
- list - needed for coral to grow, corals only grow in shallow water

- water depth - needs light, most reefs grow where the sea is less than 25 meters deep
- salinity - only survive in saltwater
- wave action - need oxygenated water made by strong wave action
- exposure to air - if exposed to air for too long, they die
- sediment - need clean air, clean water, any sediment in the water blocks their normal ways of feeding and reduces the amount of light

Ex. Great Barrier Reef in Australia

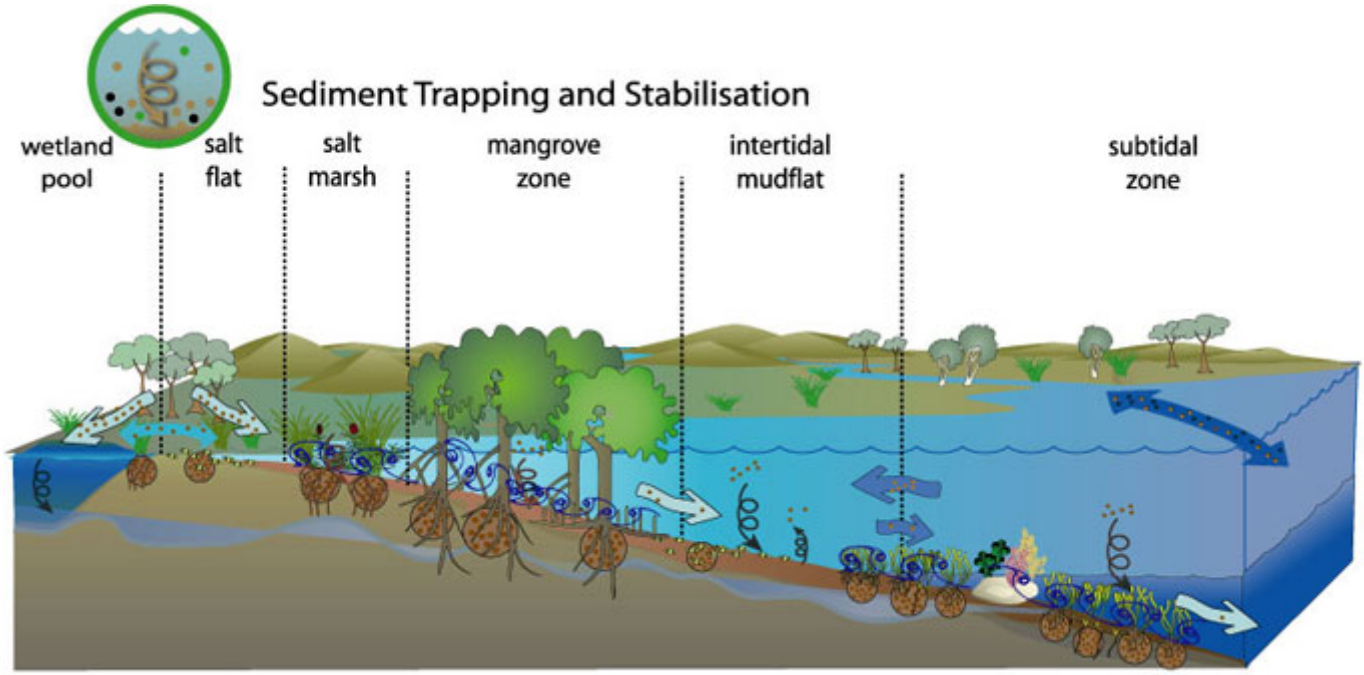


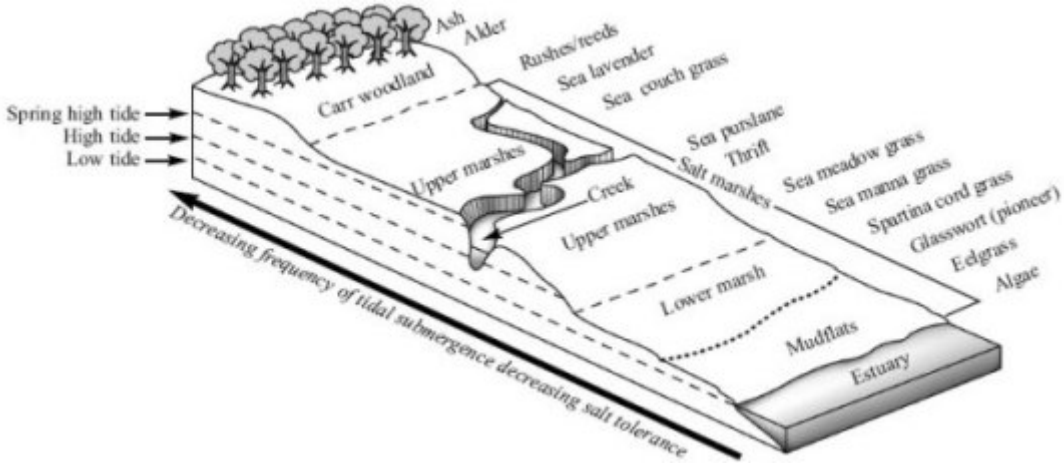
Mangroves

- Most common in South-East Asia
- Found within 30 degree altitude of the equator
- live on the coastline, in the intertidal zone (consistent changing environment)
- can cope with great heat and mud
- range in size from small shrubs to trees over 60m high
- clever at adapting to environment
- filtration system to keep much of the salt out
- complex root system adapted for survival in intertidal zone
- some have snorkel like roots that stick out of mud to take in air
- fruits and seedlings of all mangrove plants can float to drift with the tide to spread

Salt Marshes

- occupy midway location between mudflats that are permanently submerged by water and terrestrial (land) vegetation lying above the high tide mark
- ecosystem of intertidal zone
- develop in locations sheltered from the open sea, heads of bays and in estuaries
- water is brackish, in bays, the water is salty
- vegetation depend on salinity
- criss-crossed by meandering creeks, allow tidal water to drain in and out





Coastal Sand Dunes

Develop with:

- wide beach and large quantities of sand
- prevailing wind is onshore (from the sea to the shore)
- suitable locations for the sand to accumulate

Over time, vegetation grows and becomes 'fixed' vegetation. Older, inner parts have greater vegetation cover. They need to cope with:

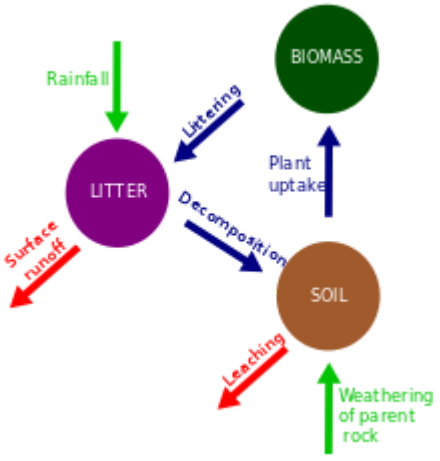
- salinity
- lack of moisture as sand drains quickly
- wind
- temporary submergence by wind-blown sand

Plant succession - vegetation process

2.5 Coastal Ecosystem Characteristics

Def
Biotic components - living parts (plants and animals)
Abiotic components - parts of the ecosystem that are not living, but are essential to life (climate, minerals, etc)

- Ecosystems survive by nutrient cycling - transfer of nutrients within ecosystems
  - involves circulating minerals around three stores:
    - Nutrient source (ex. soil)
    - biomass (living matter of the ecosystem)
    - litter (nutrients released back to the source)



Nutrient cycle in coral reef ecosystem:

- Sea water - 'soil' of ecosystem. Supply of nutrients in the sea water is maintained by on-shore ocean currents
- Biomass - three main components:
  - Coral itself
  - seaweeds attached to the coral
  - fish and invertebrates

- Litter - dead coral and fish

Food chain - organized food web

2.6 Coastal Ecosystem Under Threat

Goods	Services
fish and shellfish	protection from storms
fish meal and animal feed	harbors
sea weed for industrial use	shelter
salt	recreational opportunities

Coral Reefs

Value of coral reefs:

- biodiversity
- protection they give to low-lying coasts from the impact of tropical storms
- rich fish stocks - supply basic food requirements of many developing countries
- appeal to tourists

Threats:

- contact with human body
- pollution, over fishing
- quarrying of coral for building stone
- coral bleaching - rising water temperatures associated with global warming

Mangroves

Threats:

- human deforestation due to lack of education about importance of having mangroves for lumber

Salt marshes

Values:

Collectors of silt and organic matter
nursery areas for fish and crustaceans
protection against wave erosion and sea-level rises

Threats:

- Reclamation to create farmland and sites for industrial port developments
- industrial pollution particularly in water
- agricultural pollution - fertilizers
- pressure from developments such as marinas & recreational facilities

Coastal Sand Dunes

least threatened

2.7 Coastal Conflicts

Coastal System

Inputs:

- Sediment - from rivers by weathering & erosion

Stores:

- beaches
- spits
- forelands
- sand dunes

Transfers:

- movement of sand and shingle along the coast by longshore drift (lsd)

Conflict Between Development and Conservation

There is a overriding coastal conflict between conservationists and developers

Conflict between coastal users

Stakeholders - users of the coasts:

- local residents - good choice of housing, clean environment
- employers - access to labor
- farmers - well-drained land, shelter from strong offshore winds
- fishers - harbors, unpolluted wars
- port authorities - harbors and space for port side services and terminals
- transport companies - good roads and terminals such as ports and airports
- tourists - beaches, hotels, recreational amenities, heritage sites
- developers - greenfield sites

2.8 Coastal Flooding

Tsunami - tidal wave caused by the shock waves originating from an earthquake

Reducing The Coastal Flooding Risk

Prediction:

- Look back at historic records and identifying those areas that have been flooded most often and most seriously
- Relying on an accurate forecasting of possible hazard events

Prevention:

- building flood defenses along those stretches of the coast most at risk
- building emergency centers where people can be safe from flooding
- removing housing and human activities from high-risk areas
- plan new development with risk consideration
- educate local people

2.9 Coastal Management Strategies

Coastal cells - mini systems

Coastal erosion and retreat

Some coasts are retreating at the rate as high as 10 meters per year

Coastal flooding

- can result from coastal erosion
- occur along low lying coasts
- occur from storm surges and tsunamis

Hard - Engineering Management

Involves some type of sea defense, usually from rocks or concrete

- Most structures are expensive to build and maintain - repair of sea wall coast up to 3000 Pounds a meter
- Effective defense in one place can have serious consequences for a nearby stretch of coastline
- Defense structures such as sea walls, gabions and rip-rap cannot keep with rising sea levels
- structures can spoil the natural beauty of coastline

Ex:

- Groyne - concreet wall with wood or steel ping to stop LSD
- Wooden revetment
- recurved steel wall
- gabion - steel wire mesh cage filled with small rocks
- rip-rap - large boulders dumped on beach

Soft-Engineering management

Tries to work with natural processes

Ex:

- Beach replenishment - pumping/dumping sand and shingle onto beach to replace eroded material
- building bars - underwater bars located just offshore to reduce wave energy
- Fencing, hedging and replanting vegetation - reduces erosion
- cliff regrading - angle of cliff is reduce so that is not so steep - no retreat

Managed Retreat

Abandoning existing coastal defenses and allowing low-lying coastal areas to flood and develop into salt marshes

Case Studies