Coastal Landscapes in the UK Knowledge Organiser

The Coast is Shaped by a Number of Physical Processes

Coastal Processes

Weathering Processes

Mechanical weathering – rain and sea water expands when it freezes and turns to ice, then as temperatures rise again, the ice melts. This continual expansion and contraction can put pressure on rocks and break them apart. It is also known as frost shattering or freeze-thaw weathering.

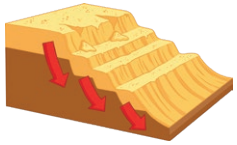
Chemical weathering – this is when water reacts with minerals in rocks and the structure of the rock is changed. The best example is **solution**.

Mass Movement (Sub-Aerial Processes)

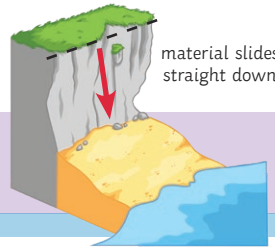
The shifting of loose material down a cliff. There are three main types:

Sliding – material shifts down a slope in a straight line. Image requested through RCP

Slumping – saturated soil and rock move down the slope (with rotation) over impermeable rock.



Rock falls – the base of the cliff is eroded, leaving the rock above unsupported. This breaks up and collapses.

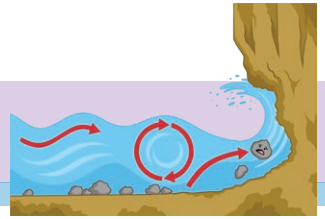


Erosion

Hydraulic power – as the powerful waves smash into the cliff face, air is compressed in the small cracks in the rock. Tiny fragments of rock get blasted away as the process is repeated many times.

Attrition – eroded material in the sea bumps into each other and eventually wear each other down. Over time, the material becomes smaller and more rounded.

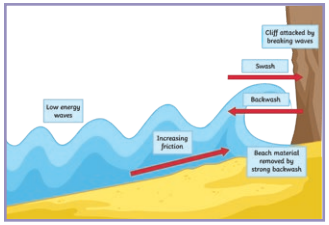
Abrasion – during storms, the strong waves pick up rocks, pebbles and sand. The material is then smashed into the cliff face. This can break off pieces of the cliff face.



Destructive waves carry out erosional processes.

Key characteristics:

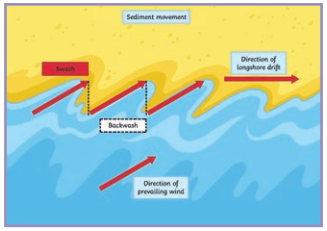
- steep and high waves;
- waves have a high frequency (10-14 waves per minute);
- the backwash is more powerful than the swash, removing material from the coast.



Transportation

Longshore drift – material is moved along the coast:

- waves travel in the same direction as the prevailing wind and hit the coast at an angle (swash);
- material is carried back down the beach at a right angle (backwash);
- material zig-zags along the coast.



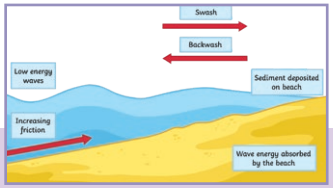
Deposition

Constructive waves deposit more material than they erode.

Key characteristics:

- low and long waves;
- low frequency waves (6-8 waves a minute);
- the wash is more powerful than the backwash, depositing material on the coast.

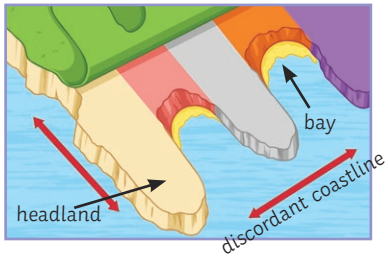
Material carried by seawater is deposited on the coast when the water loses energy. More material will be deposited when there is lots of erosion (e.g. after a storm) or when there is lots of transportation.



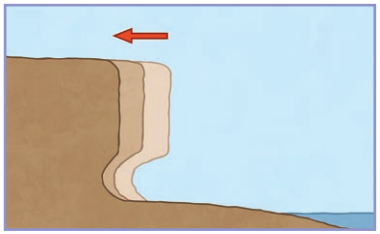
Distinctive Coastal Landforms – are the result of rock type, structure and physical processes.

Erosional Landforms

Headlands and bays – when a coastline is made up of different types of rock, they are called discordant coastlines. The rocks will erode at different speeds. The less resistant rock is eroded faster, forming a bay. The more resistant rock is eroded slowly, forming headlands at either side of the bay.



Cliffs and wave-cut platforms – waves cause most erosion at the foot of cliffs creating a wave-cut notch. The rock above will eventually collapse and the cliff will retreat, leaving a wave-cut platform in front of the cliff.



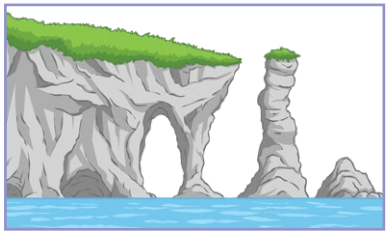
Headlands are normally made of resistant rock which do not erode easily, but cracks can develop into caves, arches and stacks.

Caves – hydraulic power and abrasion enlarge cracks in headlands creating caves.

Arches – caves continue to erode until they break through the headland creating arches.

Stacks – erosion will continue to weaken the rock supporting the arch until it collapses forming a stack.

Stumps – continuing erosion will lead to the collapse of the stack, leaving a stump.



Depositional Landforms

Beaches

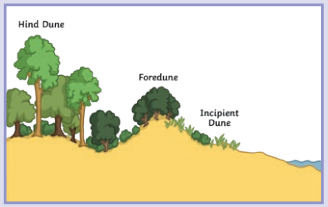
- In sheltered bays, deposition of sediment often leads to the formation of sandy beaches with a gentle slope.
- If cliffs are being eroded and there are high energy waves, this could lead to the formation of a pebble beach with a steep gradient.
- The profile of a beach is unlikely to be smooth.
- At the top end of the beach you may find a storm beach where boulders and shingle have been deposited by the strongest waves in a storm. There may also be a line of shingle and sand below this called a berm – this marks the usual high tide.

Sand dunes – wind carries sand deposited by longshore drift up the beach to create sand dunes.

Incipent Dune - grass covered and changing

Foredune - larger vegetation and more stable

Hind Dunes - established soils, large vegetation, little affect from ocean spray/winds



Spits – form at sharp bends in the coastline. Longshore drift doesn't turn the corner so it takes the sediment out to sea forming a long, sandy ridge known as a spit. As the ridge extends into more open water, it is affected by waves and wind. This leads to the tip of the spit curving. Eventually, the sheltered area behind the spit can become a mudflat or salt marsh.

Bars – sometimes the ridge of sand can go all the way across the bay or river mouth; this is called a bar. A lagoon can develop behind the bar.

Example of UK Coastline

Chesil Beach

The Dorset coast has many features of coastal erosion:

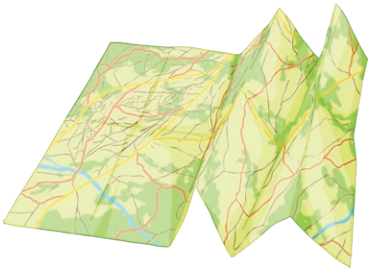
A 30km tombolo (a type of bar which connects an island to the mainland) which encloses Fleet Lagoon.

Headlands and Bays

Formed along a discordant coastline, where resistant rock forms headlands (Ballard Point and Durlston Head) and softer rock erodes to form bays (Studland Bay and Swanage Bay).

Old Harry Rocks

A cave and a stack (Old Harry Rock) has been eroded from the chalk headland.



Different Management Strategies Can Be Used to Protect Coastlines from the Effects of Physical Processes

The Costs and Benefits of Management Strategies

Hard Engineering

1. Sea Walls

Made out of hard material (e.g. concrete) to reflect waves back out to sea.

Pros – prevents coastal erosion and flooding.

Cons – expensive to build and maintain. Can cause greater erosion downdrift due to waves reflecting off seawall.

2. Rock Armour

Large rocks dumped to absorb and reflect wave energy.

Pros – allows material to be deposited.

Cons – expensive. Boulders need to be transported long distances (e.g. from Norway).

3. Gabions

Wire cages filled with rocks to form a wall.

Pros – cheaper and easier than many other management strategies.

Cons – the wire cages corrode over time. Can be considered to be ugly structures.

4. Groynes

Wooden/stone fences built at right-angles to the coast.

Pros – traps material transported by longshore drift.

Cons – can be costly. Can cause greater erosion downdrift.

Soft Engineering

1. Beach Nourishment and Reprofiling

Sand/shingle/pebbles shifted up the beach profile.

Pros – creates wider beaches which reduces erosion and flooding.

Cons – constant maintenance needed, especially after extreme weather/high tides.

2. Dune Regeneration

Creating/restoring sand dunes through beach nourishment or planting vegetation to stabilise sand.

Pros – provides a barrier between land and sea.

Cons – often limited to small areas as nourishment is expensive.

Managed Retreat – Coastal Realignment

Removal of sea defences to allow the formation of salt marshes.

Pros – cheap and easy. No maintenance. Prevents erosion and flooding elsewhere.

Cons – salt can alter ecosystems. Land and buildings will be lost – compensation cost could be high.

An Example of a Coastal Management Scheme in the UK: The Holderness Coast

The Reasons for Management

- The Holderness Coast is made of soft boulder clay which is eroding at an average rate of 1.5-2.5 metres a year. The cliffs at Golden Sands Chalet Park, Hollym near Withernsea, have retreated by more than 122m in 25 years! In some places erosion has been even more dramatic.
- 26 villages mentioned in the Domesday Book have been lost to the sea along the Holderness Coast.
- Prevailing winds and longshore drift in the North Sea erode and transport material downdrift, exposing cliffs for further erosion.
- To protect settlements (e.g. Withernsea with over 6,000 inhabitants) and infrastructure (e.g. B1242 road near Mappleton).

The Management Strategy

1. Withernsea is a popular tourist town. Various sea defences have been built at Withernsea over the last 100 years: a sea wall (which cost over £6.3 million) and rock armour to protect the promenade. Wooden groynes that were over one century old have been replaced.
2. In 1991, a £2 million scheme at Mappleton dumped blocks of granite (rock amour) at the base of the cliffs, protecting them from erosion. Also, two rock groynes were built on the beach to trap sediment creating a wider beach which prevents the waves from reaching the cliff.

The Resulting Effects and Conflicts

1. Withernsea has been protected from erosion. However, the groynes trap sediment on Withernsea's beach and as a result this sediment no longer is transported south causing increased erosion downdrift (e.g. the loss of land at the Golden Sands Chalet Park which is south of Withernsea).
2. Mappleton village and the B1242 have both been protected. However, the area to the south of the sea defences have faced increased erosion (from an average of 1.7m a year to 3.3m a year). Farmland to the south of Mappleton has been lost, including the complete loss of Cowden Farm and Grange Farm.