Coastal Change and Conflict

Outline of the Topic

- **Contrasting Coasts** – why do all coasts not look the same?
- **Geology of the coast** – the impact rock structure has on the coastline
- **Waves** – Constructive and destructive waves.
- **Coastline Deposition** – Features and processes.
- **How coasts will be affected by climate change** – rising sea levels and increased rates of erosion.
- **Coastal erosion case studies** – impacts of coastal erosion and management methods.

Contrasting Coasts

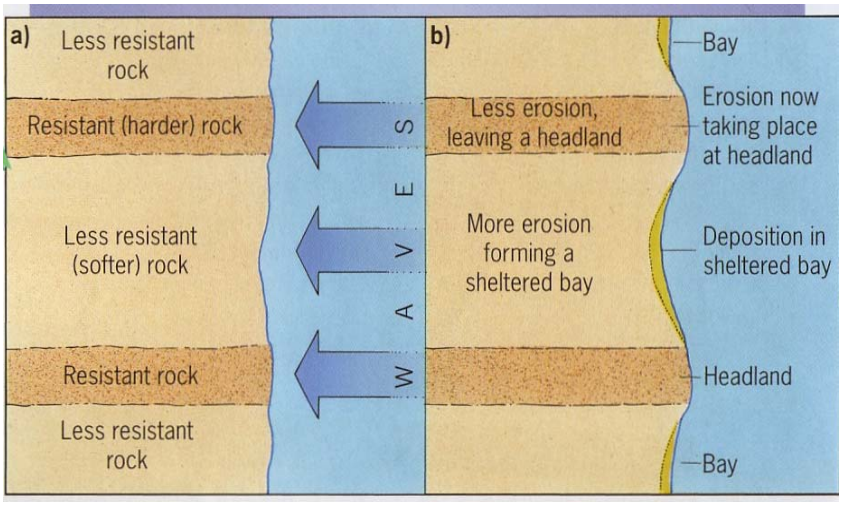
Advantages of living near to the coast:

1. Access to the sea for fish and resources.
2. Access for trade and connecting with other places.
3. Recreation and tourism opportunities.

Rock type

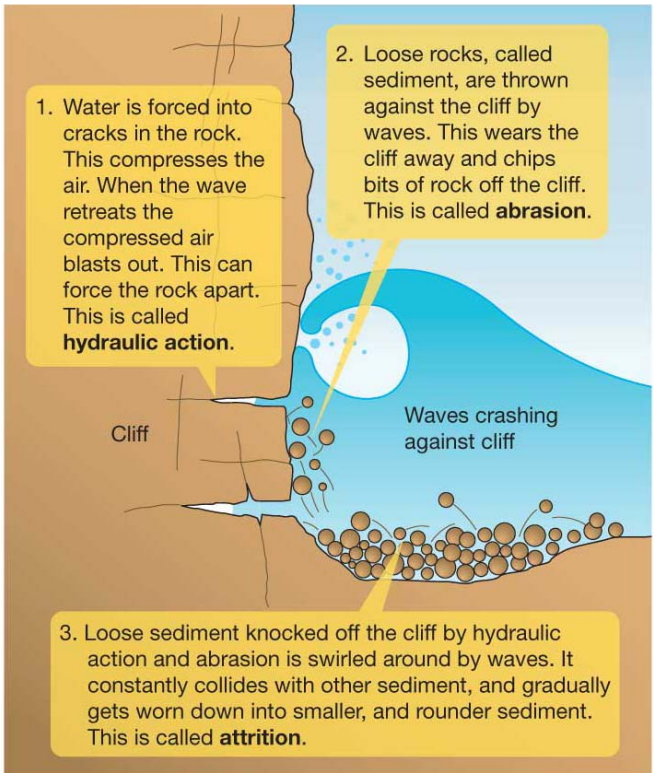
Some rocks are more resistant to erosion, whereas others are eroded more easily.

- Very resistant rocks are igneous rocks, such as granite.
- Weaker rocks such as clay are least resistant and will erode the quickest.



- This can cause the formation of headlands and bays.

Erosion – The process of wearing away and breaking down rocks.



Processes of Erosion

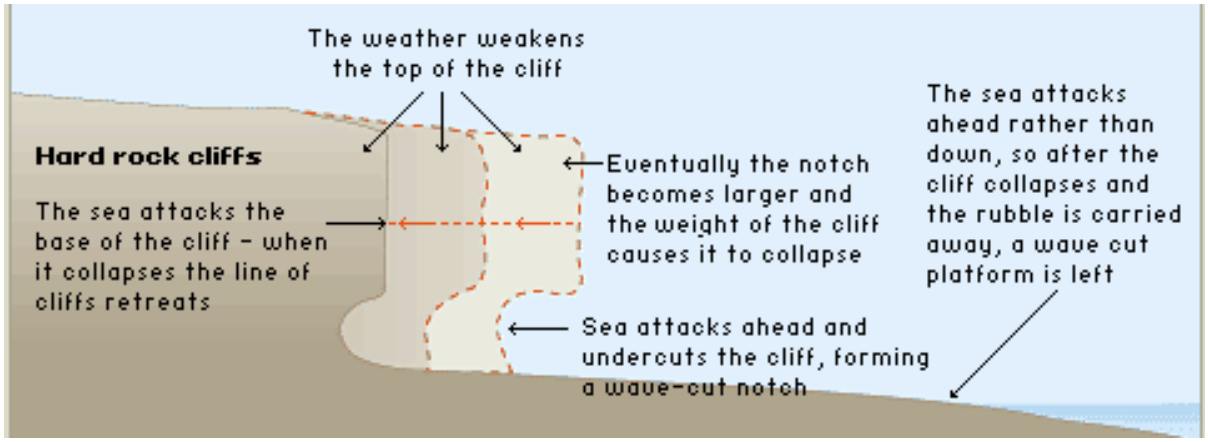
1. **Hydraulic Action:** The weight and impact of water against the coastline.

2. **Abrasion:** Waves throw sand and pebbles against the rock face, breaking off pieces of rock and causing undercutting.

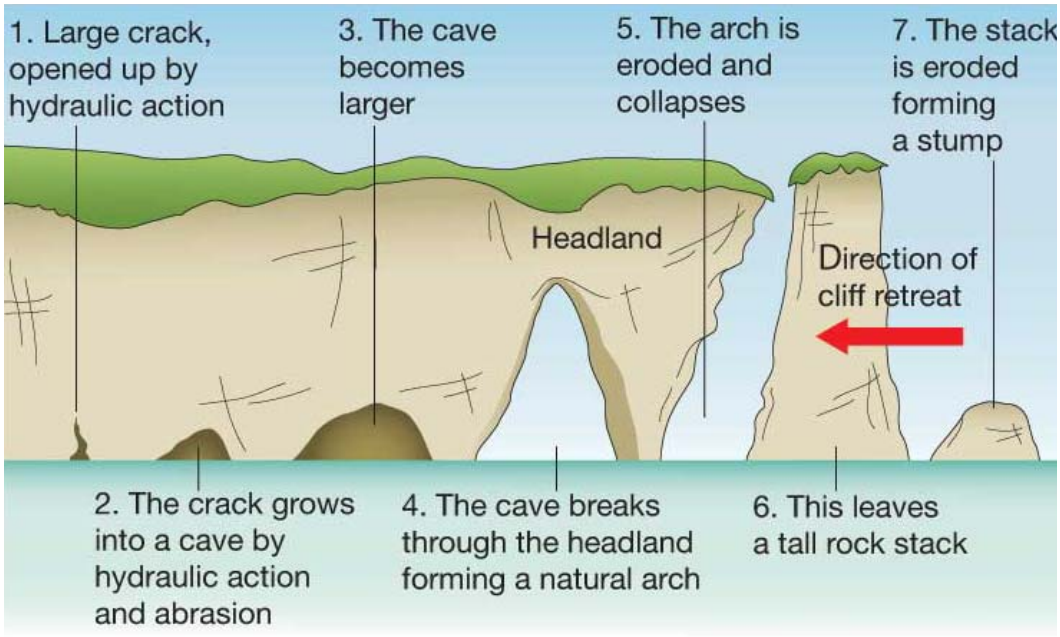
3. **Attrition:** Boulders and pebbles are broken down into sand sized particles when they collide with the rock face or each other

Features of Erosion

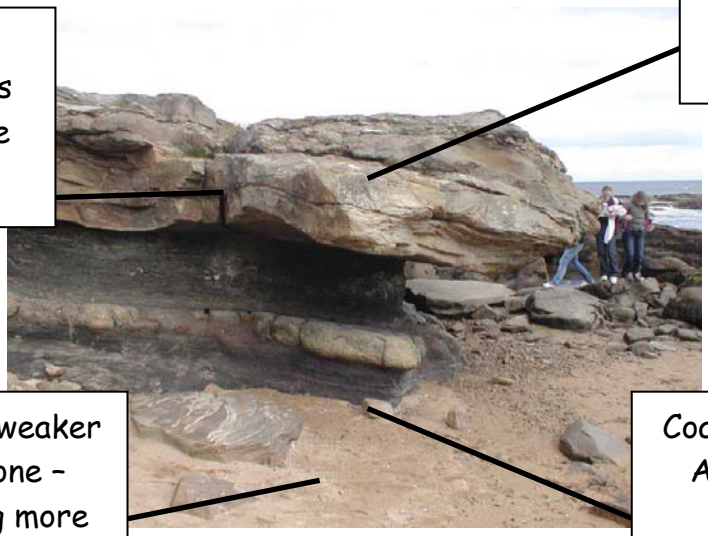
1. Wave cut platform



2. Cave, Arch, Stack and Stump



Geology



Cracks and joints in the rock are lines of weakness that can be eroded by the waves.

More resistant sandstone forms a very large overhang.

The shale is much weaker than the Ironstone – therefore eroding more quickly and leaving an overhang.

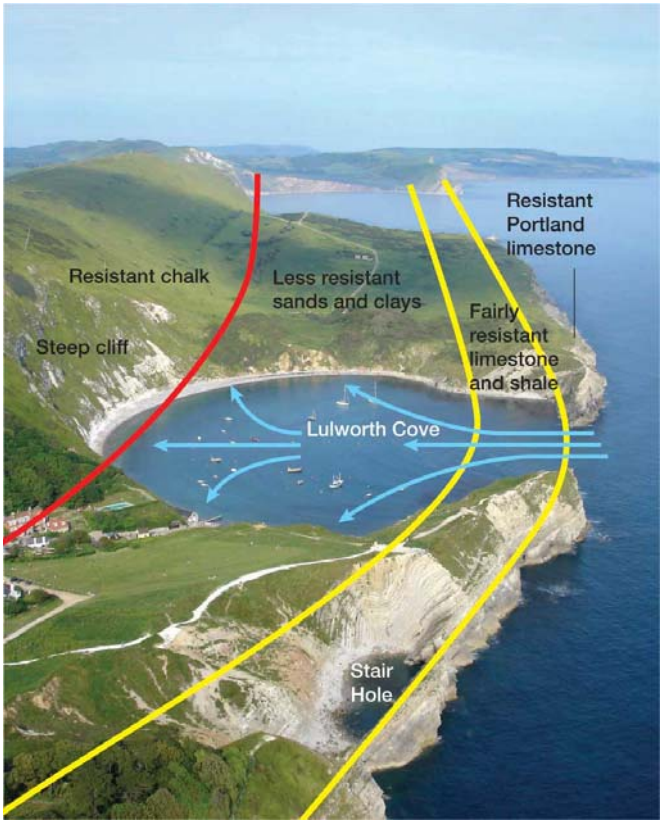
Coal is a very weak layer. A wave cut notch has been eroded.

Concordant and Discordant Coastlines

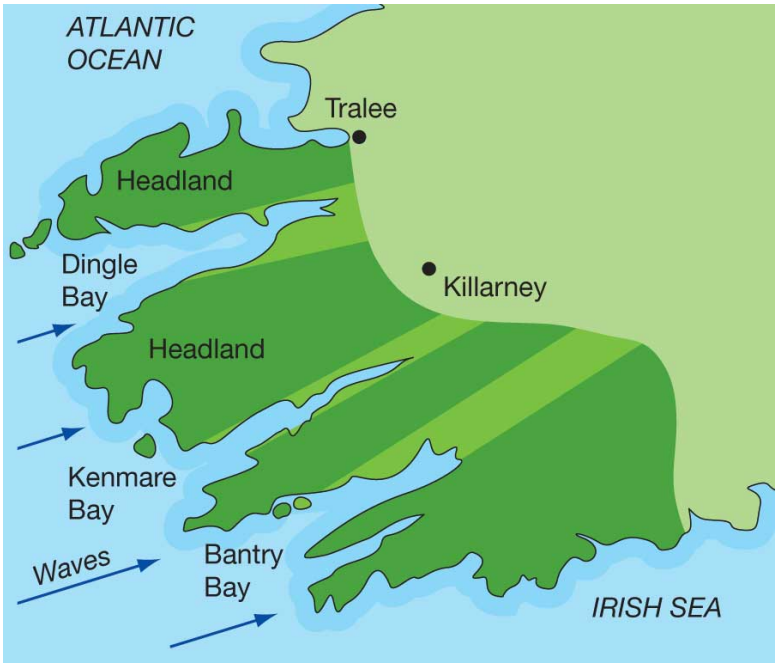
Concordant

Example: Lulworth Cove, Dorset

- Resistant layer of limestone runs along the coast.
- Hydraulic action and abrasion have 'punched' through exposing the less resistant rock behind.
- Where waves can reach the soft rock, coves have been formed.
- A steep chalk cliff is also formed.



Discordant



Example: South Ireland.

- Layers of resistant sandstones and less resistant limestone are found along the coast.
- Waves have eroded the limestone to form bays, laving the harder rock as headlands.

Waves

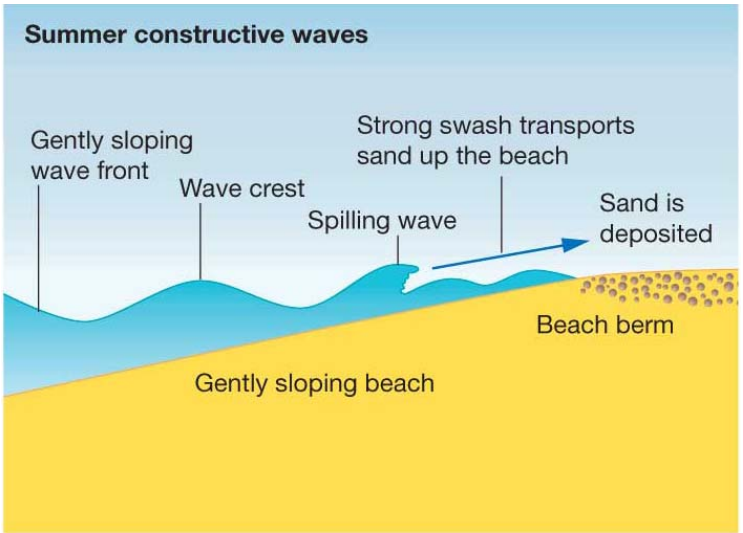
When wind blows across the sea, friction between the wind and water surface causes if waves. The size of the wave depends on:

- The strength of the wind.
- How long the wind blows for
- The length of water the wind blows over – called the FETCH.

Constructive waves:

The characteristics of constructive waves are:

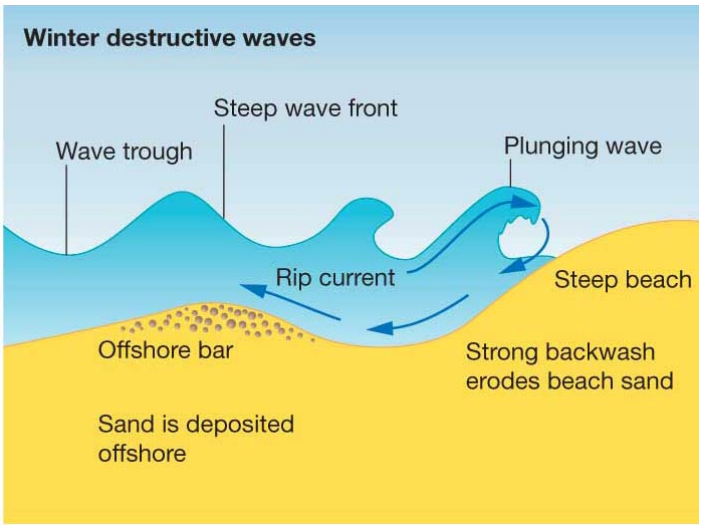
- Occur in **calm** conditions – light winds
- Gentle waves – 6-9 per minute
- **Long** in relation to their height
- **Swash** is **stronger** then backwash
- The load of the waves (sand, shingle pebbles) – is **DEPOSITED** by constructive waves.



Destructive Waves

The characteristics of destructive waves are:

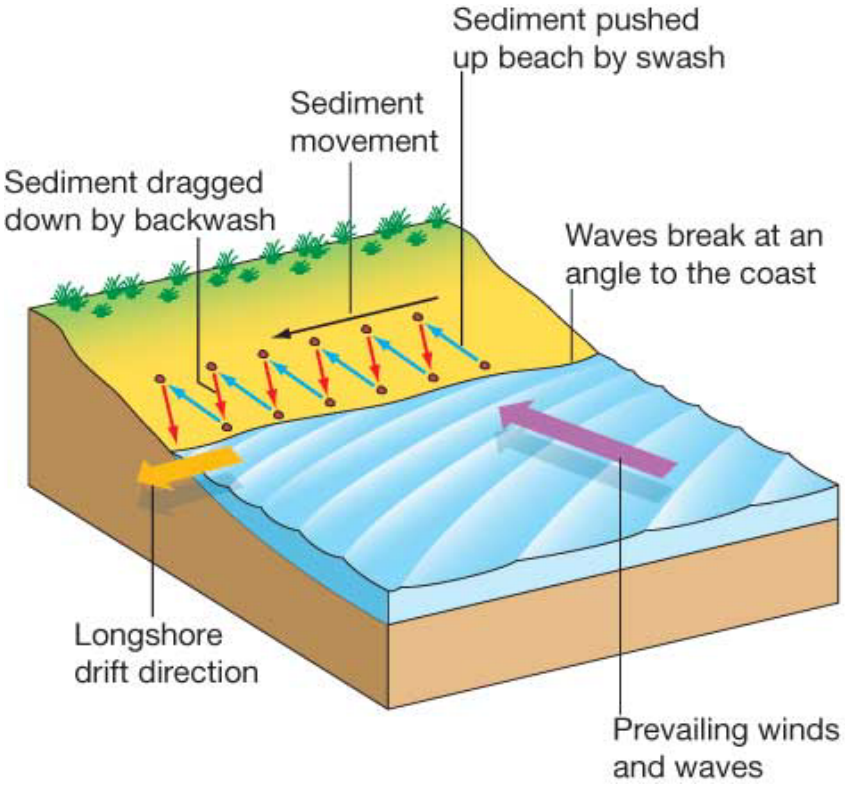
- Occur in **storm** conditions – high winds
- **Frequent** waves – 11-15 per minute
- **High** in proportion to their length
- **Backwash** is **stronger** then swash
- **EROSION** rates are high



Coastal Transportation

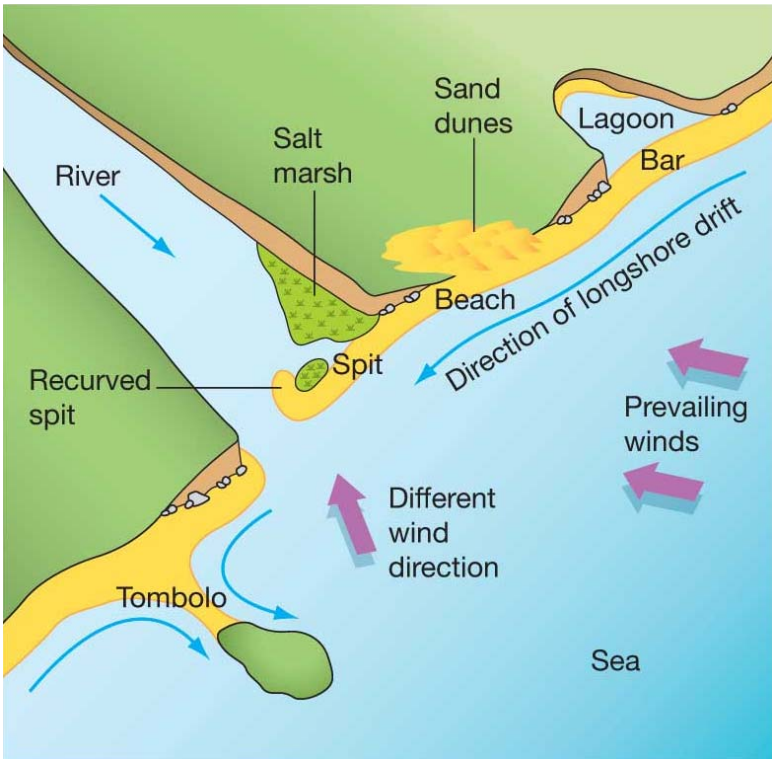
The transport of material (e.g. sand and pebbles) along the coast by waves is called – **Longshore Drift**

- The **prevailing wind** causes the waves to break on the beach at an **oblique** angle to the shore
- The **swash**, which picks up sand and shingle, travels up the beach in the same direction as the breaking wave
- Due to gravity the backwash, and any material it is carrying, tend to be straight down the beach.
- The result is that material is **transported** along the beach in a **zig-zag** movement.



- Longshore drift is usually in one direction only, that of the prevailing wind.

Depositional Landforms



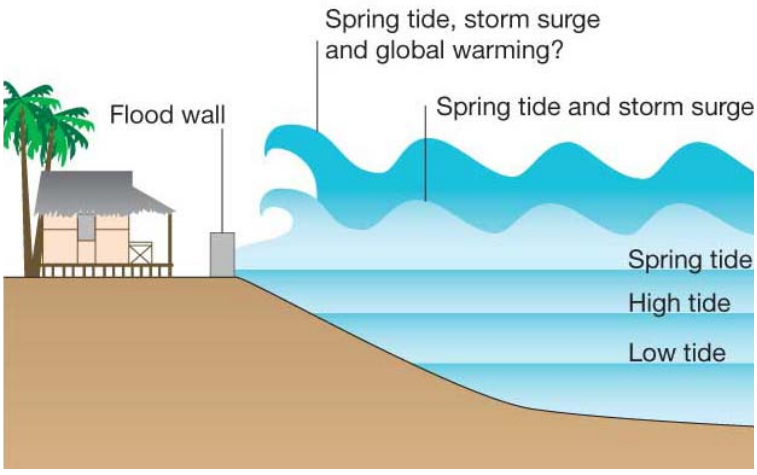
- Strong onshore winds can blow sand inland, forming **sand dunes**.
- Small bays on the coast can sometimes be blocked by a **bar** of sand which grows across the bay. This forms a **lagoon** behind it.
- Where material is deposited at the river mouth a **spit** is formed.
- An unusual **tombolo** can form when a beach grows out to meet an island just off shore.

Marram grass is one of the tough plants that colonises sand dunes. They have long roots to hold them in place and protect against the strong winds.

Coasts and Climate Change

Global warming could causes sea levels to rise – estimates from 30cm to 1m by 2100.

For people living on low lying areas this could be a disaster. In Bangladesh if sea levels rose by 1m, up to 15% of the country might be flooded.



A few times a year there are exceptionally high tides called spring tides. If spring tides combine with low pressure than a storm surge can form.

Erosion levels could also increase with sea level rise and storm surges.

Coastal Protection

Why do cliffs collapse?

1. Marine processes – base of the cliff is eroded by hydraulic action and causes undercutting.
2. Sub-aerial processes – weathering can weaken the rocks.
3. Heavy rain – could saturate the rocks adding to the weight of the cliff.
4. Human actions – Buildings on top of the cliff.

Christchurch Bay

Without coastal management, cliffs would erode by 2m per year. This would threaten many towns along the coast.

Managing the Coast

Hard Engineering Schemes – Traditional Coastal Management

There are five main types:

Groynes – are structures placed at right angles to the coast where longshore drift occurs.
Advantage – They trap material and build up a beach to protect the cliff
Disadvantage – Effective, but deprives other areas down drift of sand and thus increase erosion in those areas.

Sea walls – curved concrete walls built at the base of cliffs to protect a settlement.
Advantage - reflect (rather than absorb) wave energy.
Disadvantage – Sometimes this wave energy depletes the beach and over time the wall is also eroded.

Revetments – Wooden slatted barriers built towards the back of the beach to protect the cliff.
Advantage – waves break against the revetments which dissipate the energy and material is held behind the barriers protecting the cliff
Disadvantage – environmentally ugly.

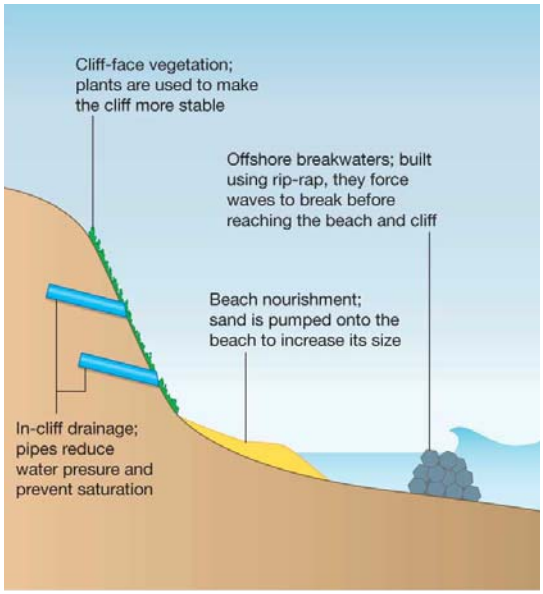
Gabions – boulders wired into mesh cages and placed in front of areas vulnerable to erosion.
Advantage – wave energy is absorbed by the rocks, cheaper than sea wall
Disadvantage – environmentally ugly

Rip rap / armour blocks – large rocks piled up in areas prone to erosion
Advantage – absorb wave energy and hold beach material in place, relatively cheap
Disadvantage – when resting on sand and shingle, can be undermined by the waves

Soft Engineering Schemes – The Modern Way

Soft engineering approaches try to fit in with natural processes and protect the natural environment. This is an example of **sustainable** development.

Beach Nourishment – replaces natural beach material that has been removed by longshore drift. This creates a natural barrier that slows down erosion by absorbing wave energy.



Shoreline vegetation – Planting things like marsh beds on the shoreline binds the beach sediment together, slowing erosion. This also encourages shoreline habitats to develop.

Dune stabilisation – Dunes are an excellent defence against storm floods. By planting Marram Grass to hold dunes in place the rate of erosion is slowed.

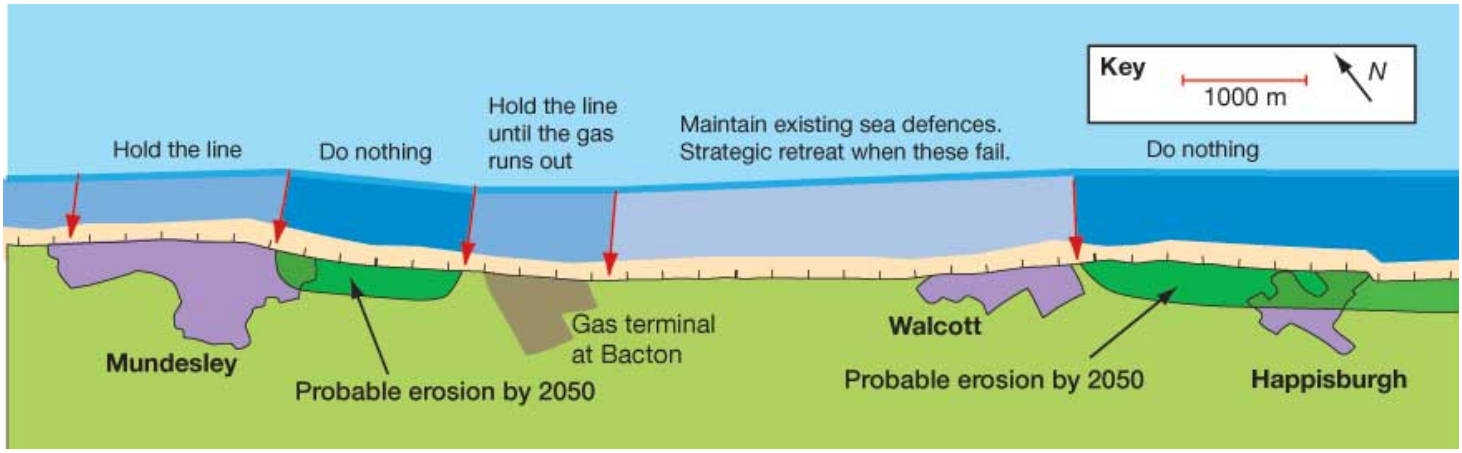
The UK Choices

Hold the line – Use Sea defences to stop erosion.

Advance the line – Use defences to move the coast further into the sea – very expensive.

Strategic retreat – Gradually let the coast erodes and move people and businesses away from at risk areas.

Do nothing



Cost benefit analysis – coastal protection only goes ahead if the **economic value** of the land at risk exceeds the cost of the coastal defences. However, coastal protection schemes can create **conflict** between different groups of people.

Glossary of Key Terms

Erosion – Process of wearing away and breaking down the rocks.

Hydraulic Action – Water forced into the cracks into the rock. This compresses the air and forces the rock apart.

Abrasion – Loose rocks are thrown against the cliff by waves wearing away the cliff.

Attrition – Loose sediment knocked off the cliff by hydraulic action and abrasion is swirled round by waves and collides with other sediment and erodes.

Cove – Oval-shaped bay with a narrow opening to the sea.

Discordant – layers of the rocks run at 90 degrees forming headlands and bays.

Concordant – Layers of rock run parallel to the coastline forming coves.

Fetch – length of water the wind blows over.

Constructive wave – small waves that build the beach.

Destructive waves – Taller and closer together than constructive waves. They erode the beach and cliff face.

Longshore Drift – Process of transportation – sediment is moved along the beach.

Weathering – Break down of rocks in situ.

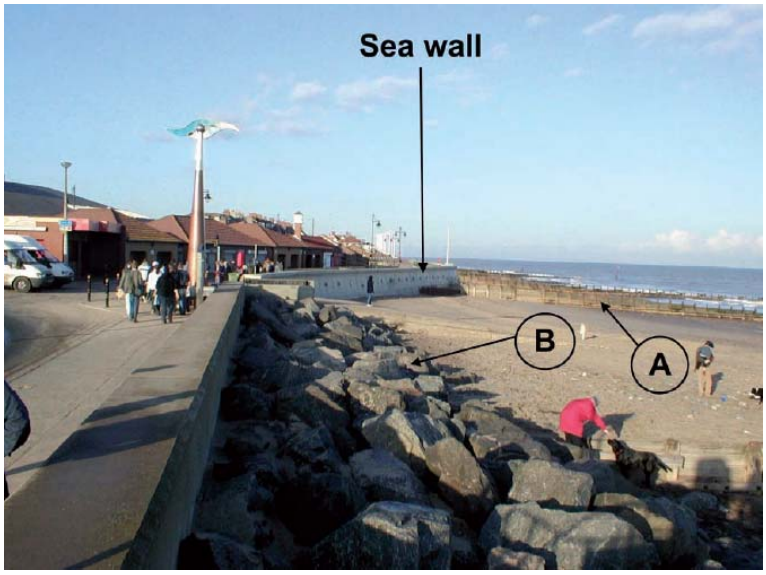
Dissipate – Reduce the wave energy as some of it is absorbed as waves pass through or over sea defences.

Exam Questions

1. Describe how coastal management feature **B** protects the coastline (2)

2. Using examples, explain how rapid erosion on coastlines might be managed (6)

3.



What type of coastal management structure is feature **A?** (1)

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4. Does the photo show hard or soft engineering? Give a reason for your answer (2).

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5. Explain the process of longshore drift. You may use a diagram to help with your answer. (4 marks)

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