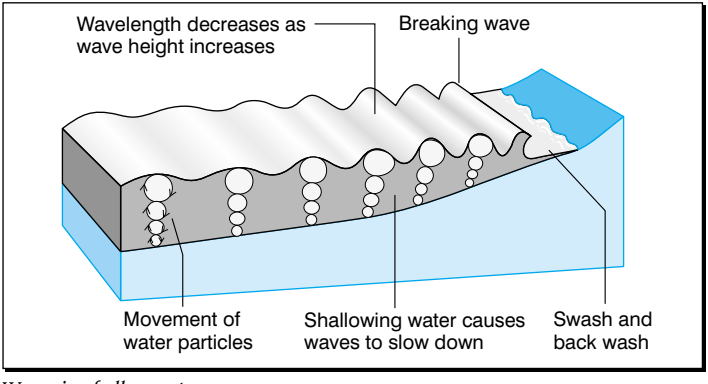
Wave action

- The sea erodes, transports and deposits by wave action. Waves are formed by the wind. When waves reach shallower water, friction with the sea bed slows down the bottom of the waves. The wave increases in height until it breaks or plunges. The water runs up the beach to form the **swash**. The **backwash** is the water that runs back down the beach. There is less frictional loss of energy where the offshore gradient is steep.



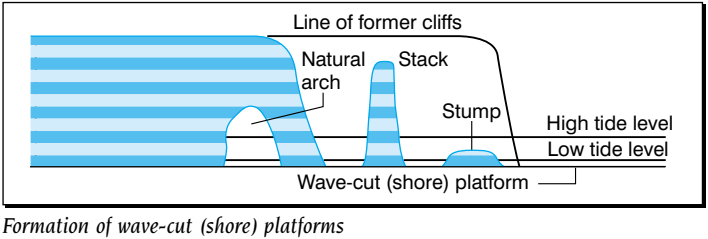
Waves in shallow water

- **Constructive waves** have a strong swash and a weaker backwash. These are more likely to deposit material on the coast. The backwash of a **destructive wave** is stronger than its swash. Destructive waves erode material from the coast. The most powerful waves are caused by strong winds which blow continuously over a long **fetch**.
- Erosion by the sea is the result of a number of processes: **abrasion** or **corrasion**; **corrosion** or **solution hydraulic action** and **attrition**. These are most effective where the coast is made up of less resistant rock, such as sands and clays.

	Processes of wave erosion
Abrasion/corrasion	Sand and shingle carried by waves scour and grind the rocks along the coastline.
Hydraulic action	The pounding effect of water on the coastline during storms. Even the hardest rocks can break up as they are loosened along joints and bedding planes.
Corrosion/solution	The dissolving of rocks by sea water.
Attrition	The wearing away and rounding of sediments (to form sand and shingle) by abrasion and by rubbing against each other.

Coastal features

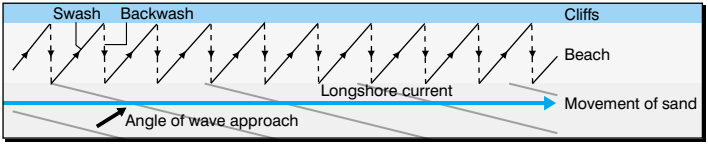
- On an **accordant coast** the **strata** of the rocks lie parallel to the coast giving it a very smooth outline.
- On a **discordant coast** the rock strata are at right angles to the coast allowing differential erosion to occur. This results in the formation of a series of **headlands** and **bays**. Headlands are left when wave action forms bays in areas of less resistant rock. Wave action erodes weaker parts of headlands too. This can result in the formation of **caves**, **arches** and **stacks**.
- **Wave action** forms a notch at the base of a cliff. This undercutting causes the cliff to collapse. As this cycle repeats over time the cliffs retreat inland. The cliffs get higher and steeper. A **wave-cut platform** forms at the base of the cliff. This is covered with beach deposits which are transported from the cliff face and eventually deposited in the sea.



Formation of wave-cut (shore) platforms

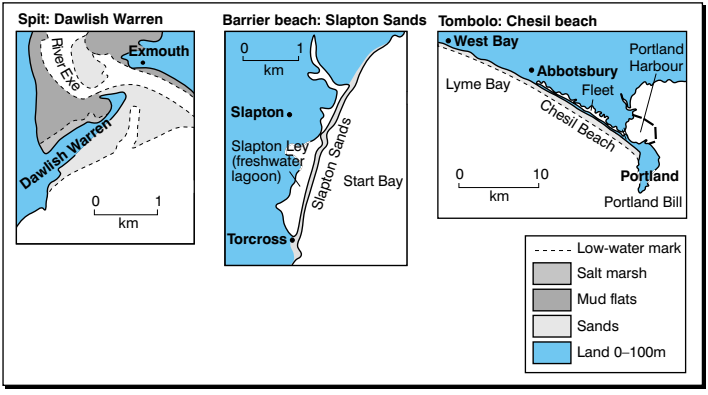
COASTS (3)

- Beaches are accumulations of wave deposits. Some of this material comes from cliff erosion. The rest is transported by rivers or along the coast by wave action. Material is transported along the coast in a zig-zag movement called **longshore drift**. The swash runs up the beach at an angle but the backwash runs straight back down the beach.



Longshore drift

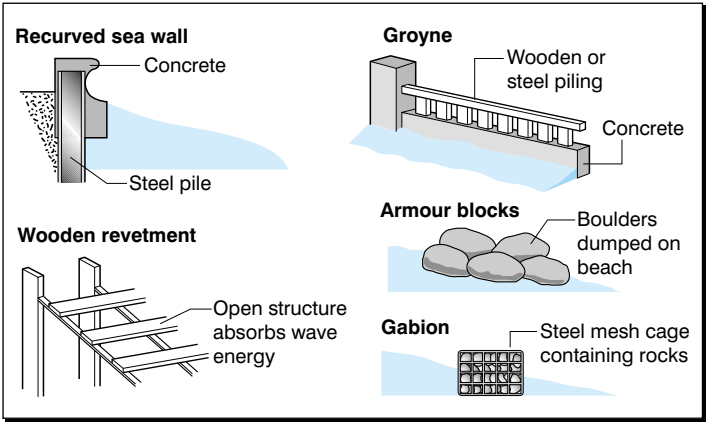
- There are several types of wave depositional features. There are **spits**, **tombolos**, **barrier beaches** and **bay head beaches**. Spits are ridges of sand or shingle that are joined to the mainland at one end. Waves cannot reach the water behind the spit. This allows tidal currents to deposit material which form **mud flats** and **salt marshes**. A **barrier beach** or **bar** is joined at both ends. A tombolo joins an island to the mainland.



- Coastal areas are affected by changes in sea level. If the sea rises or falls the effects are felt worldwide. If land moves then the effects are more localised. If sea level rises, the coast is submerged and **rias**, **estuaries** or **fjords** can form. A fall in sea level forms an emergent coastline with a series of raised beaches above the new sea level.

Coastal management

- Coastal areas need to be managed because both physical and human factors affect them. Coastal erosion can have disastrous effects on people living close to the sea. **Sea walls**, **gabions**, **revetments** and **groynes** defend the coast from wave attack. Global warming is likely to increase the rate of coastal erosion. Some argue that it will become too expensive to defend the coast.



Methods of coastal protection

- Tourism is very important in coastal areas. Trampling over **sand dunes** destroys vegetation and **exposes** the dunes to wind erosion. Sun-tan lotion and boat oil can cause pollution. Careful planning is required to protect the environment.

Coasts (1–4)

1 What is the fetch of a wave? (1)

2 Why is the east coast of Australia good for surfing? (2)

3 "Air is compressed back into cracks in the rock by water. As the waves retreat, the pressure is released. Air implodes into the vacuum left bringing fragments of rock out with it."
What process of wave erosion is being described? (1)

4 Name an example of a stack. (1)

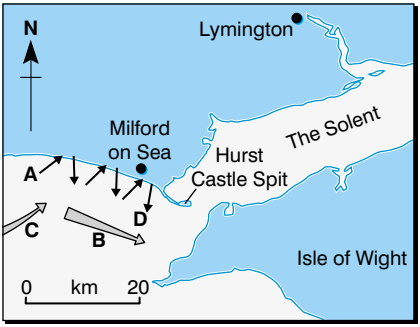
5 What is wave refraction? (1)

6 Why may the building of a groyne increase the danger of coastal erosion further down the coast? (2)

7 Why is global warming likely to increase the rate of coastal erosion? (1)

8 Why are ports more often sited on rias than fjords? (2)

9 Study the diagram. Match the letters with the following words or phrases: direction of swash; prevailing wind; direction of backwash; direction of longshore drift. (4)



10 Why has Hurst Castle spit developed at this particular point on the coast? (1)

11 What determines the direction of the backwash? (1)

12 Suggest three ways that could be used to reduce damage to a coastal environment by tourists. (3)

1 The distance of open sea over which the wind blows. (1) This distance has a greater effect on the size of waves than the strength of the wind.

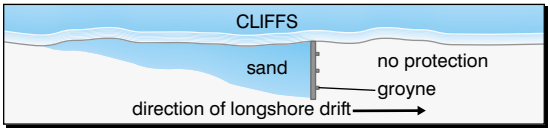
2 It faces the Pacific Ocean, the largest ocean in the world. (1) The winds blow over a fetch of more than 6,000 km. (1)

3 Hydraulic action. (1) Note the difference between this and the hydraulic action of a river.

4 The Needles. (1) Off the western edge of the Isle of Wight.

5 The bending of a wave around a headland. (1) This concentrates the erosional power of the wave on the headland.

6 Sand is the best natural form of sea defence. (1) A groyne prevents sand reaching other parts of the coast, leaving cliffs open to wave attack. (1)



7 There will be a rise in sea level because of melting ice caps . (1) Low-lying coastal areas will be in increased danger of flooding.

8 Fjords are found only in sparsely populated polar latitudes. (1) Their sides are too steep and there is a lack of flat land along the side of the fjords on which to build a port. (1) Plymouth and Milford Haven are major ports built on rias in Britain.

9 A – direction of swash D – direction of backwash
C – prevailing wind B – direction of longshore drift. (4)

10 There is a marked change in the direction of the coast. (1) Spits frequently form at river mouths too, e.g. Orford Ness in East Anglia.

11 Gravity. (1) The wave runs straight down the beach slope.

12 Replanting marram grass on dunes damaged by trampling. (1) Way-marking trails to keep visitors on footpaths. (1) Organised litter and warden patrols. (1) Authorities could also provide amenities for tourists away from most sensitive areas.

TOTAL