AS Geography 1.3 Coastal Environments *Student Notes*

Coastal Processes

The Mechanisms (Processes) by which The Sea Erodes.

Hydraulic Action. When a parcel of air is trapped and then compressed, either in a joint in a cliff or between a breaking wave and a cliff, the resulting sudden increase in pressure, when repeated time after time, can weaken, loosen and break off fragments of rock (or sea defences).

Wave Quarrying. The impact or shock pressure can remove fragments of cliffs that have already been loosened, or are composed of unconsolidated rock.

Abrasion. This is considered to be the most effective form of wave erosion. Waves, armed with boulders, fragment of rock, pebbles or even sand, hurl their load against a cliff face, wearing away the rock face. Where there are alternating bands of soft and hard rocks, such as at Hartland Quay, this can lead to differential erosion where the less resistant rock is removed more effectively and the harder strata become more prominent.

Attrition. Wave attrition affects the detached material produced by other erosional processes. Particles collide resulting in both the reduction in size and increased rounding of fragments. Most rounding takes place in the breaker zone, so the movement of tides can increase the range of the attrition vertically. Rounded pebbles on beaches provide evidence of attrition.

Corrosion/solution. Solution is particularly important on limestones by carbonic acid in seawater. Biological activity can assist the process of solution as the secretions of algae attack rocks. Some molluscs, such as *Lithophagus* bore into rocks and seaweeds attached to rocks can help fragments of rock to be wrenched away by storm waves.

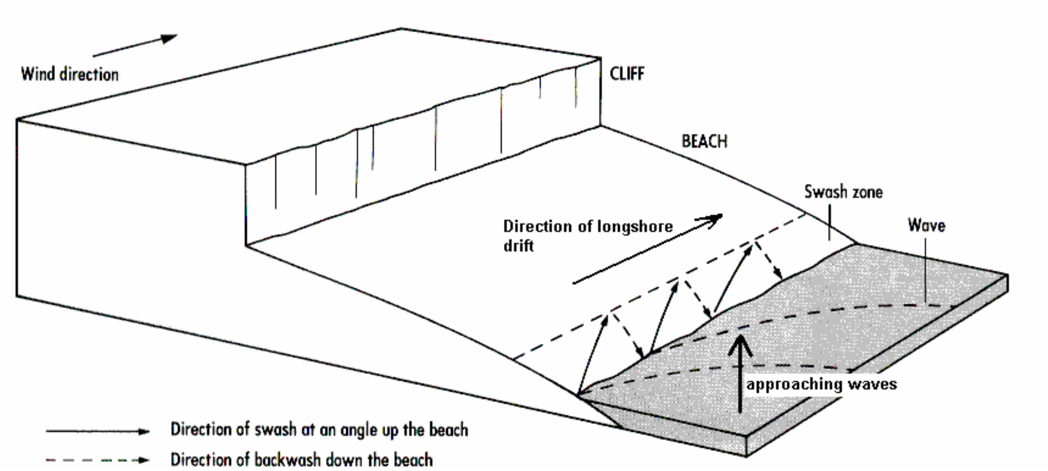
Subaerial Processes. Cliff recession occurs primarily as a result of the mass failure. The marine processes can only affect the base of a cliff creating a **wave-cut notch.** This increases the cliff's gradient or undermines it. The rocks of a cliff face will be affected by a range of weathering and slope processes, which weaken rock and eventually result in its failure. These processes will involve, throughflow and runoff and atmospheric influences including rainfall, frost and wind. Such processes are dominant on the cliff slopes at Hartland Quay.

- The main **physical weathering** processes include frost shattering, pressure release, salt crystallisation and mechanical biological weathering.
- The main **chemical weathering** processes include oxidation, hydration, hydrolysis, carbonation, solution and chelation.
- **Mass movement** processes include soil creep, earthflows, mudflows, rockslides (including land slips, rotational landslides or slumping) and rockfalls. Major landslides are found At Keivill's Wood, near Bucks Mills in Bideford Bay, one of which crosses the beach access road.

Erosion of most cliffs is not a regular, steady process. Instead it is a result of infrequent catastrophic events by which large fragments of the cliff slope will fail.

The Processes By Which Waves Transports Material Along The Shore (swash, backwash and longshore drift).

A large number of beaches show alignments at an angle to the dominant wave fronts. This usually occurs where the beach gradient is relatively steep and the wavelength is short. In the swash zone, fragments are washed up the beach diagonally. As the **swash** slows it becomes the **backwash**. It flows, under gravity, back down the beach, taking the most direct route and dragging beach particles with it. In 24 hours there may be up to 15,000 waves breaking, each dragging the beach fragments along the beach. The total movement of sediments can be very great. The process is known as **longshore drift**, **beach drift** and **littoral drift**.



Note that longshore drift can operate in more than one direction along a coast as it is determined by the wave direction, which, in turn is determined by the wind direction. Some coastlines may experience longshore drift associated by both the prevailing wing and the strongest wind directions, which may be different.

Where there is a sudden change in beach alignment, this can result either in the creation of **swash aligned beaches** or **spits**, depending on whether the coast turns seaward or landward. The eastern end of Chesil Beach in Dorset is a Swash aligned beach, so is the beach at Saunton Sands in North Devon. An example of a spit is the Pebble Ridge Spit at Westward Ho!

You need to be aware of where, when and why deposition occurs and you need to recognise the sequential nature of this process.

Nearly all lengths of coastline will experience both erosion and deposition. Even exposed lengths of coastline, such as that at Hartland Quay, will experience localised deposition although erosion rates exceed rates of deposition. Depositional environments are located where the rate of deposition exceeds the rates of erosion such as in the Torridge Estuary or Swanage Bay.

Deposition occurs when there is a loss of energy in the coastal system. This is usually in sheltered locations where wave and tidal influences are minimised. As with rivers, the coarsest material is deposited first where energy levels are still relatively high. Only in the lowest energy environments will the finest silts and mud be deposited. Such locations include the low energy environments of estuaries and salt marshes as well as parts of the offshore zone where wave energy is at its minimum.

In some environments, coastal deposition is closely associated with the presence of vegetation in ecosystems such as sand dunes, salt marshes and tropical mangrove swamps.

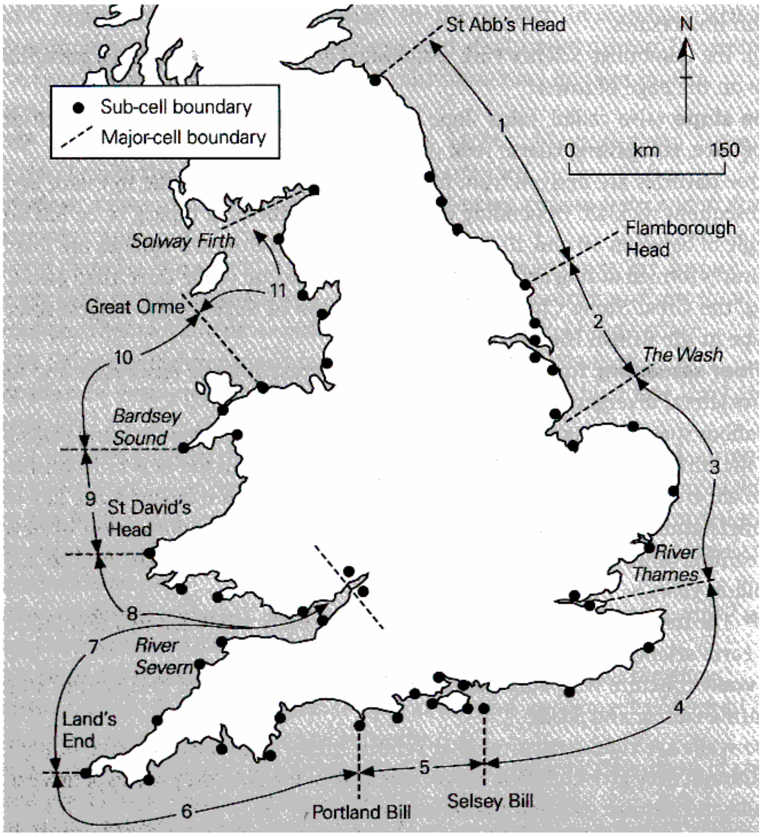
On beaches, there is a clear sorting process with the coarser materials deposited by high-energy waves on the storm beach and shingle berms. The beach material will become increasingly fine through the foreshow, reaching its finest in the offshore zone (See later notes on beaches)

Where there is sufficient longshore drift, there will be increased sorting with the direction of drift. The finest fragments travel further as less energy is required to move them. Hence they are moved more frequently and therefore further. As they travel “down-drift” they are also reduced in size by attrition. (See later notes on spits and bars.)

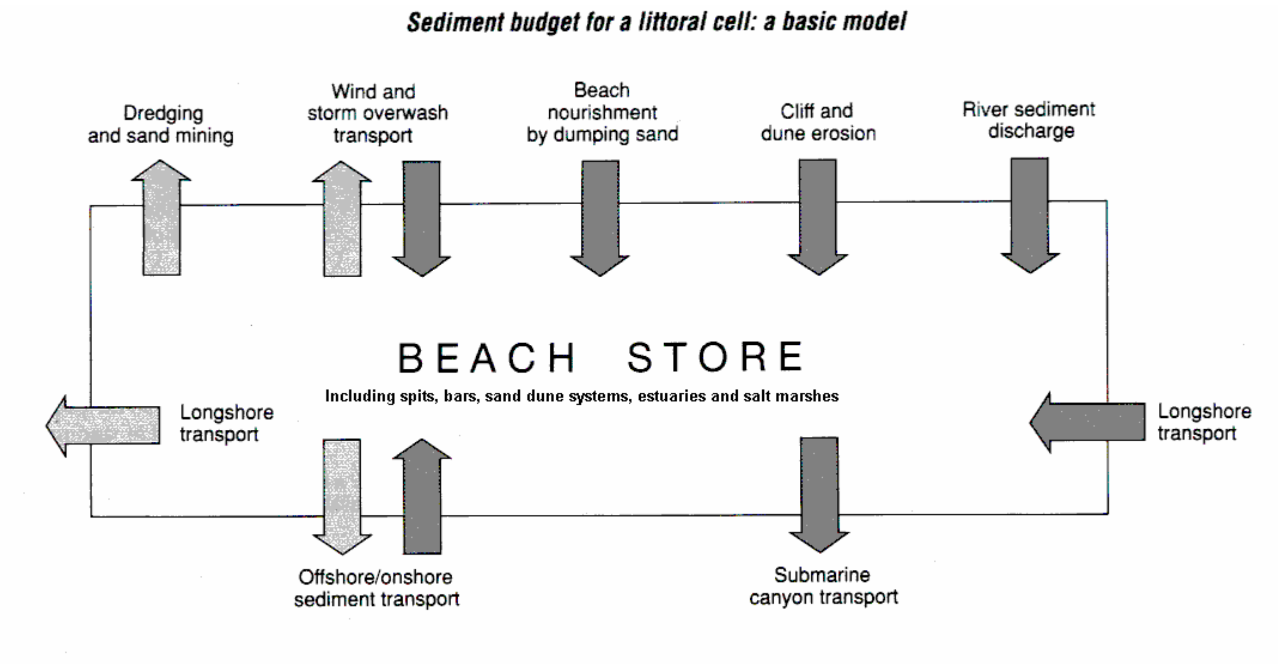
The budget of sediment movements can be analysed.

A “systems approach” can be applied to the movement of sediment along a coastline. The term **littoral cell** or **coastal sediment compartment** is used to describe a stretch of coastline where a complete cycle of littoral (longshore) transportation and sedimentation occurs. It is a useful way of explaining patterns of coastal erosion and deposition at a variety of scales, from single bays to more substantial lengths of coastline called **sediment cells**. Eleven such cells have been identified around the coast of England and Wales, which are the basic units of coastal management. They can be treated as virtually closed systems.

Coastal Sediment Cells in England and Wales

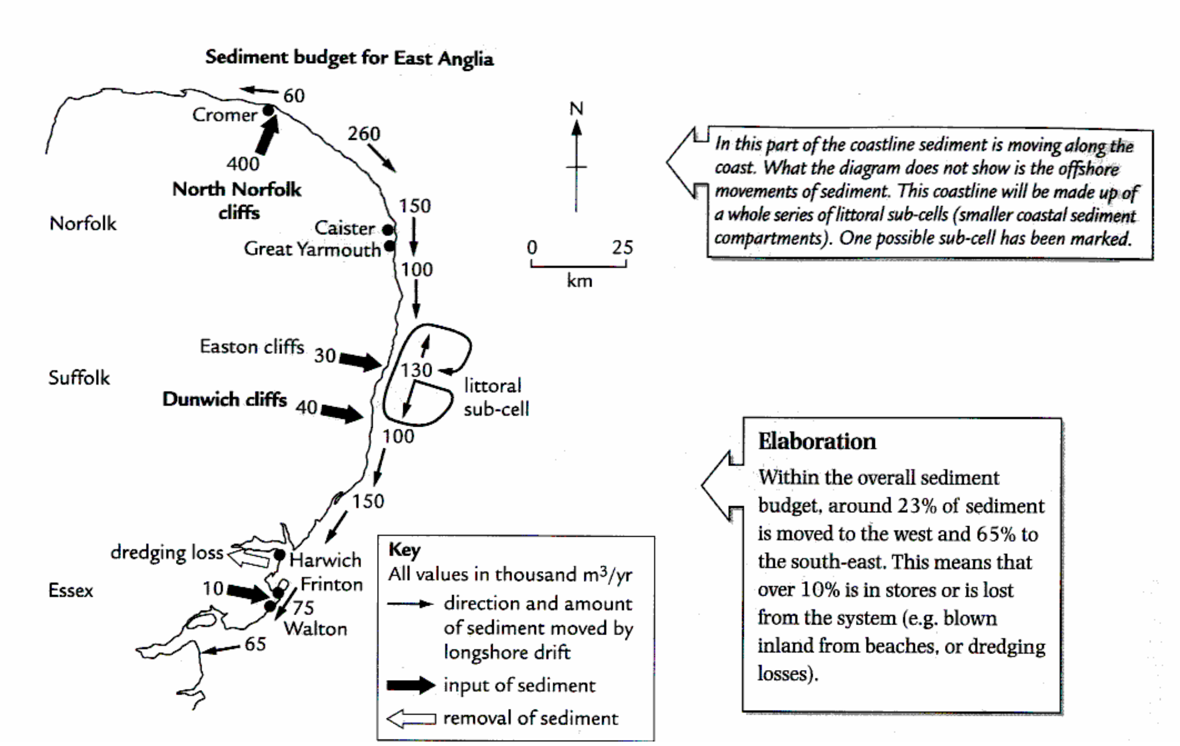


A littoral cell will have **inputs** (wave energy, cliff erosion, river sediments, onshore transport of sediments, littoral or longshore drift, biogenic inputs and beach nourishment by people), **throughputs** (longshore drift, beach destruction and construction), **stores** or **sinks** (beaches, spits, bars, estuaries, salt marshes, sand dunes) and **outputs** (offshore transport, longshore drift, landward dune erosion and human dredging). The cell in a bay may be considered a closed system with negligible sediment transfer around headlands. The cell may be in a state of dynamic equilibrium, depending on the balance of inputs and outputs.



Using a sediment budget, it is possible to assess the potential impact of major storms, of dam construction (such as on the Colorado), of harbour construction, or of other coastal management schemes.

A Case Study of Sediment Budgets on the East Anglian Coast (Cell 3)



Consider how rock type, rock structures (e.g. jointing) beach width, rivers and human activity could influence the sediment budget for East Anglia.