Flamborough Head
- North Bay

Flambrough Heads' North Bay lies on the east coast of England. It is made up of two chalk headlands and a sandy beach with chalk deposits.

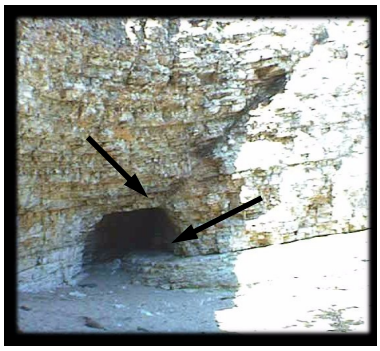
Most of the visible landforms have been created in the chalk cliffs, although the site does also have deposits of Glacial Moraine, mainly to the inshore side of the beach.

The chalk cliffs have been formed and shaped by the seas movement. The cliffs are slowly retreating due to the action of the waves against the rocks - the sea cuts what is known as the 'Wave cut notch' in the base of the cliff, causing the rock above to un-supported and so collapse. The wave cut notch can be seen around the base of all the chalk cliffs in the bay, it is at the bottom of the darkened patch on the cliffs. At the base of the cliffs can also be seen a platform of rock, this is the wave cut platform and can only be seen at low tide. This platform is also eroded by the sea, but is eroded downwards, so making the cliffs higher and steeper the more it is eroded. Erosion of both the wave cut platform and the wave cut notch, happens by the process of Hydraulic Pressure and corrasion.

Wave cut notch

Wave cut platform

Hydraulic Pressure is the sheer force of the waves hitting the rock, this effect is increased when the sea traps air in the cracks in the rocks which then forces the cracks further open. Corrasion is when larger waves hurl beach material [stones, etc.], at the rock, chipping parts off.



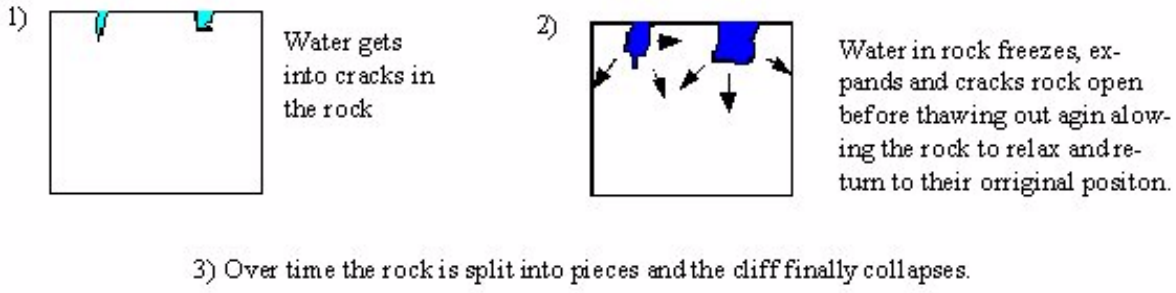
Two weaknesses meet at this point, the cave is formed here.

This process happens along the whole of the bottom of the cliff, slowly making the cliffs retreat, but where there is a weakness in the cliff, the rocks bedding plane or fault in the rock, the sea begins to dig away a cave by eroding the crack from the inside and making it larger. The cliffs such as the ones it the North Bay have many weaknesses, so there is a lot of scope for caves forming. The photo (left) shows that this cave (at the back of the bay), is where two faults in the rocks meet, causing a large weakness. The sea has eroded this crack into the cave we see today.

The next stage of erosion of a cave is when the cave is widened and deepened so far cuts through the cliff completely to form an arch. This can also be seen in the bay. The next stage can not be seen at this site, but it is when the roof of the arch collapses into the sea, as it has nothing to support it from underneath, this leaves the stack standing on its own, detached from the cliff. This stack will its self be eroded down and collapse leaving a stump standing out of the water. This is visible at the end of the cliffs in the bay.

The whole process is shown below:

The chalk cliffs are also eroded by other types of weathering.
Freeze - Thaw action plays a part in the weathering of the rocks in the cliff. Water gets into the cracks in the rocks and, when the temperature drops, the water freezes, expands and forces the cracks open and wider. This opens up the cracks before the water melts and the rock can relax back to its original position. Over time this process will force the cracks open and will cause bits of the rock to break away from the cliff, so the cliffs slowly



The soft clay at the back of the beach, Glacial Moraine, has been left behind from the Ice age.
During the ice age the rain falls as snow, this causes the cracks in the ground to be filled, and any more precipitation which falls to freeze. As time passes and more snow falls it gets compacted and freezes to create a block of ice - the Glacier. As the size of the Glacier increases so does the weight of it, this means that it is pulled down the land, and towards the sea. As it dies this it tears away at the hillside and valley floors, dragging bits of the rock (moraine) along with it , this is known as plucking. The Glacier also picks up Moraine from the floor of the valley - this is called abrasion. Abrasion happens as the ice moves over the ground wearing it away into smaller pieces and taking this ground up rock with it, this process is just like sand paper rubbing over wood and wearing it away.

In the past this moraine has been carried to, and deposited in the bay by a Glacier - you can tell this because the clay at the back of the beach and ontop of the cliffs does not fit in to the surrounding environment, and does not match the rocks around.
At the time the Glacier reached an area near this coast, the climate changed meaning the Ice began to melt and small streams (melt water) began to run from the Glacier. These streams carried some of the rocks which had been held by the Glacier and spread then out away from the ice. As the melt water dried up the moraine was deposited as a layer of boulder clay. This process happened over many years meaning that many layers were built up creating visible layers in the clay, or Fluvio Glacial Deposits. These deposits can also be seen at our second site, Barmston, infact the layers are more visible there as the glacial moraine has been cleanly cut away by the sea and has not slumped like in the north bay.

Because the Moraine is soft it is prone to landslides and slumps. When water seeps through the cracks in the rock below the surface it causes the shale to weaken. When support is weak the Moraine slides down the bedding shale.
The roots of plants in the soft moraine also causes the weathering of the rock. The roots get into faults and cracks in the moraine and pushes it apart, this can dislodge the moraine from its bedding and so cause a slump.

There are many different types of protection against the sea at different points along the east coast. Some sites have not been protected, where as others, such as Hornsea, have many protections to prevent the erosion of the built up areas along the coast line.

All the sites we visited had at least some form of protection - Flambrough Head has two forms of protection; Gabions and a revetment. The revetment is a built up concrete slope at the back of the beach which brakes the force of the waves. This is at this site to protect the boat houses and the shops by the car park.

At Barmston Rip-Rap has been used to protect the carpark and the shop, but nothing else. This is probably because of the cost of this form of protection - £10,000/m. Rip-Rap workes by taking the energy out of the sea before it hits the shoreline.

Gabions at Flamborough

The sea hiits the shoreline with its full force where it is not protected, however, where the Rip-Rap is, the sea hits the actuall shore with less force so gets eroded far less quickley. Therefore, over time, the shore will end up less eroded than the rest of the shore line.

However, this may not be the best form of protection - the sea will erode around the Rip-Rap causing an Island protected by the rocks, and this too will eventually be eroded away leaving only the protection in place. This methold can also be very expensive due to the need to import forign boulders, but on this site the Rip-Rap has been made of concrete, this can itself provide many problaims - the concrete is softer than actual rock so gets eroded fast, nad this is visible here by the rounded edges to the protection, it is, however, cheap.

At the built up town of Hornsea, more money has been spent on protection than at the other two sites. The town has sea walls with rock armour and groynes.

The groynes run out to sea at regular points along the built up part of the coastline (every 200 metres). They work by preventing (or minimising the affect of) Longshore Drift. As the sea goes out at an angle it takes snad and other beach matirial with it and down the coastline making the beach ever smaller. The groynes prevent this erosion by trapping the sand up aginst them as it is carried by the sea, so allowing the beach to build up against them.

Groynes

Groynes are a very good preventative measure of stopping coastal erosion and are also cheap.

The groynes, however, are not capable alone of protection the coastline fully - at very high tides and during storm conditions the sea still reaches the top of the beach. For this reason, in Hornsea a sea wall with rock armour has also been built at the back of the beach.

Sea walls work by simply stopping the sea from toutching the actual coast. They are built at the back of the beach an get in the ay of the sea, by being hit by the waves themselves they protect the natural coast.

The walls on the Hornasea coast also have rock armour to protect the wall itself, this works by absorbing the seas energy in the rocks, so the sea just runs back to the beach having caused no damage.

This is even more affective than just the sea wall, but is is also more expensive - it can cost up to £10,000/m, as an initial investmant. It does however save on future wall maintinaces.

All of the sites along the coast have some form of protection, and then have all worked to some extent.

The revetments at Flamborough Head has most certainly worked - the buildings above show no sign of subsidence, eventhough where there is no protection there has clearly been slippage. Also the Gabions serve there purpose to hold back the Moraine, behind them you can see where they have caught the moraine from slumps, but there is none infront.

The Barmston Rip-Rap has also clearley worked - you can see that the areas protected by the 'boulders' are pertruding further that that left unprotected, this form of protection does pose problains (see above).

The groynes have worked at Hornsea very well - the beach level is high along the whole streach of the protected coast and the wall has also been successfull by comletely preventing the erosion of the coastline.

Over all the Holdernes coastal management scheme has been very successfull, but what els could have been done along this area of the coast? The options are:

Prevent & Discorage - Planning regulations prevent further development of the coast, this means that there is no need to protect the coastline. This is probably not much use of this coast due to the nature of the building, in Hornsea for example the majority of buildings are old.

Managed Retrete - Do not protect currnt coast, but defend it in advance further inland. This whould give the council time to implement good defences all along the coastline (as opposed to just in one or two spots), but most of the current buildings and alot of land would be lost to the sea.

'Hard' Defences - Sea walls, rock armour, etc. This is the form of protection already in place on this coast.

'Soft' Defences - Build up the beaches using sand dreged from out at sea. Most of this coast already has a good beach line, and this methold is very expensive also, so it really is unsutable.

Nothing - Do nothing and let a natural balance be found. If this coast is left a huge number of buildings would be lost to the sea, in this case it is not relly an option.

One other thing which could be done is like that on the Sefton coast, There thhey have controled human access to the coast line so as to prevent as much 'extra' erosion as possible. By preventing the human erosion, the coastline has time to build up its own natura sea defences such as sand dunes. This scheme workes on the Sefton coast due to the small ammount of built up areas on the coast, however, it would not be appropriate on the Holderness coastline because of the large numbers of built up sea side towns. The Holderness coast is past this sort of protection measures. This type of scheme is simply not feesable on the Holderness coastline.

It is clear that this coast line needs defending from the sea, but there are a few probalims sith this. Firstly the cost of coastal defences is too high to make defence of the whole Holdernes coast a viable option, this then causes the second problaim of where to defend. The desition to only defend the built up areas of the coast has been taken by the councils, which seems to be the most sensible option, but is bound to cause arguments.

The Holdernes coast line is retreting at a rate of ??????????, but the coastal protection measures in place along it seem to be working affectivly. Although the measures taken have been some of the most expensive ones, it seems to have been a good decition to protect some of Englands finest coastline and its residents.