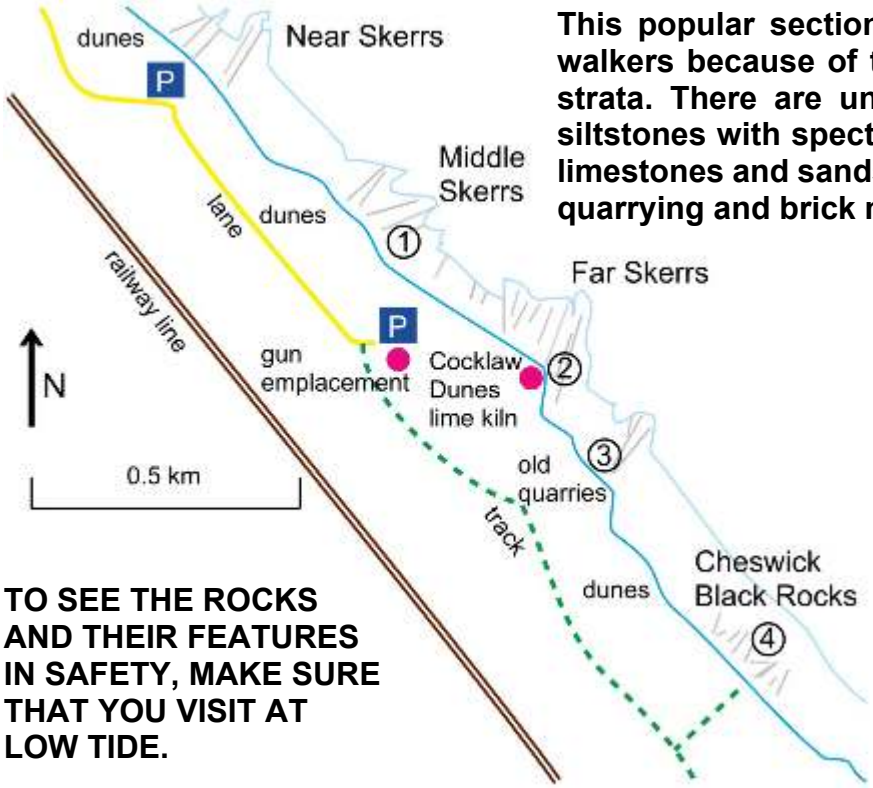
CHESWICK BLACK ROCKS



This popular section of beach attracts geologists as well as walkers because of the interesting shapes and colours of the strata. There are unusual fossils of tracks and trails in the siltstones with spectacular weathering and erosion features in limestones and sandstones. Imagine the scene when limestone quarrying and brick making industries were active here.

Visitors can park at the small car park by the gun emplacement (NU 032 482) at the far end of the Cocklawburn lane or near the sands at Cheswick and walk north up the coast. The whole coast is accessible by bike from Route 1 between Berwick and Holy Island. A bus from Berwick would take you to Scremerston, followed by a 2 km walk to Sea House (see Saltpan Rocks leaflet) on footpaths. The walk along the beach is 2 km, with a 1 km return walk along the track.

The numbers on the map are places where you can stop and look at features of geological interest.

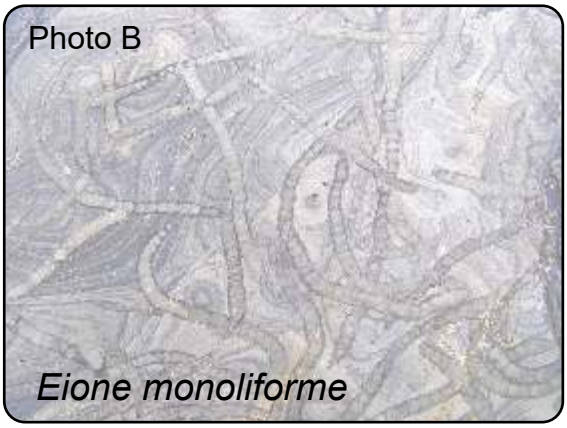
TO SEE THE ROCKS AND THEIR FEATURES IN SAFETY, MAKE SURE THAT YOU VISIT AT LOW TIDE.

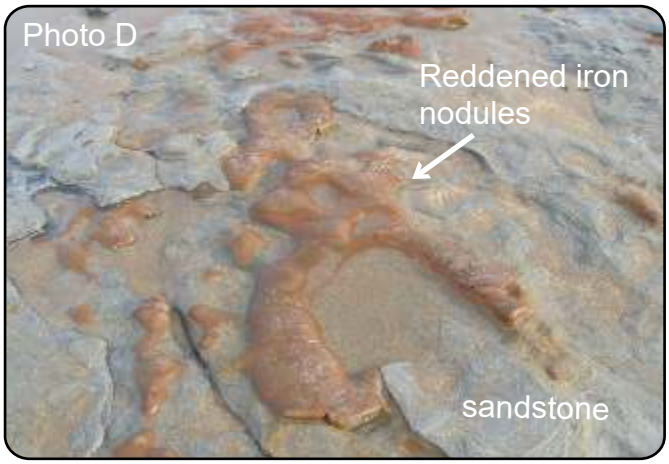
The coastline is part of the Northumberland Coast Area of Outstanding Natural Beauty and has sand dune and beach habitats which attract a wide range of plants and birds, so please enjoy and respect the wildlife. Leave rocks and pebbles on the beaches so that other people can enjoy them. Note that the sand level on the beaches varies depending on recent weather and tide levels. You may not be able to see some of the low-lying rocks if sand levels are very high.

① *From the car park at the gun emplacement walk down onto the beach through the sand dunes, keeping to the left of the fence. When you reach the beach, turn left and walk towards the large boulders* (Photo A). If the sand levels are not too high you may be able to see green/grey fine-grained **sandstones** and **siltstones** which contain some unusual **fossils**. The beaded trails in Photo B are thought to be the feeding tracks of a soft-bodied invertebrate whose remains have not survived. Geologists can tell that the animal crawled through wet sand sieving out food particles and leaving 'beads' of sand in its track. The **trace fossil** is called ***Eione monoliforme*.**

CARBONIFEROUS ROCKS

The rocks on the Cocklawburn and Berwick beaches date from the **Carboniferous** period and are about 330 million years old. The area that is now northern England was lying close to the equator and was covered by clear shallow seas in which **limestones** formed. Rivers carried sand, silt and mud from high mountains to the north and the sediments were deposited in the shallow waters. Sea level fluctuated, so that the sediments which became sandstones, siltstones and **mudstones** were interbedded with limestones.





Nearby you might be able to find pale grey siltstones and dark grey mudstones which have been burrowed by invertebrates. Burrowing mixed the silts and muds so that traces of animal activity are visible 330 million years later. (Photo C).

The green/grey sandstones were invaded by iron-rich water which has formed red **nodules** in places (Photo D). The process by which this happens is not fully understood by geologists.

Walk a few metres onwards, towards the grey limestone boulders at the top of the beach. They have been broken off the Four Fathom Limestone (Photo A) by wave erosion during storms. Northumberland limestones are named because they are identifiable by their thickness, colour and their distinctive fossils.

HOW DOES LIMESTONE FORM?

The bed of limestone in front of you was deposited as **lime mud** in warm, clear water which covered the sands, silts and muds when sea levels rose. The warm, shallow seas of the Carboniferous period were teeming with animal life, such as **corals**, shelled invertebrates and **crinoids**, the extinct ancestors of sea urchins. When the creatures died, the calcite in their shells dissolved into the warm water and formed lime mud which **precipitated** on the sea bed when the concentration in the water was high enough. The smooth surface of the limestone is called a **bedding-plane** and was the surface of the sea bed as lime mud was being deposited in the clear water.

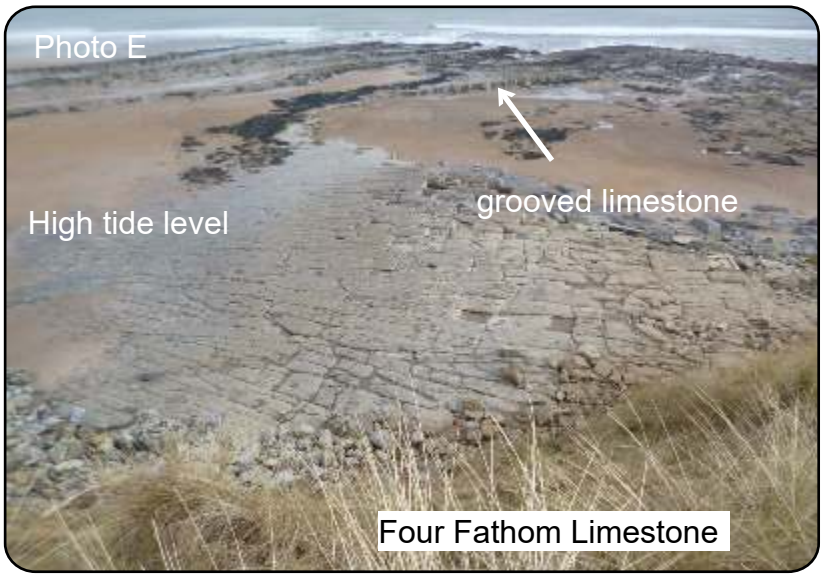
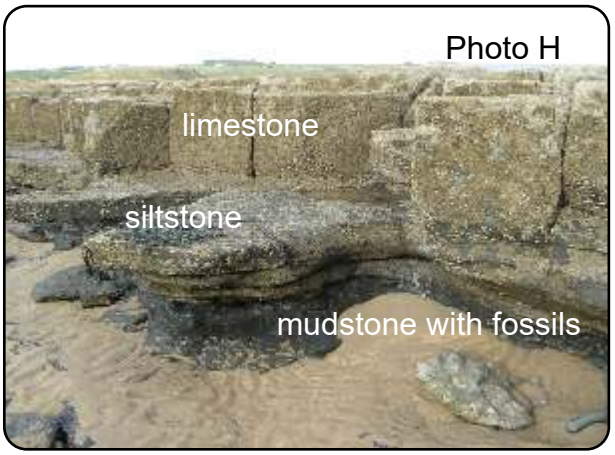
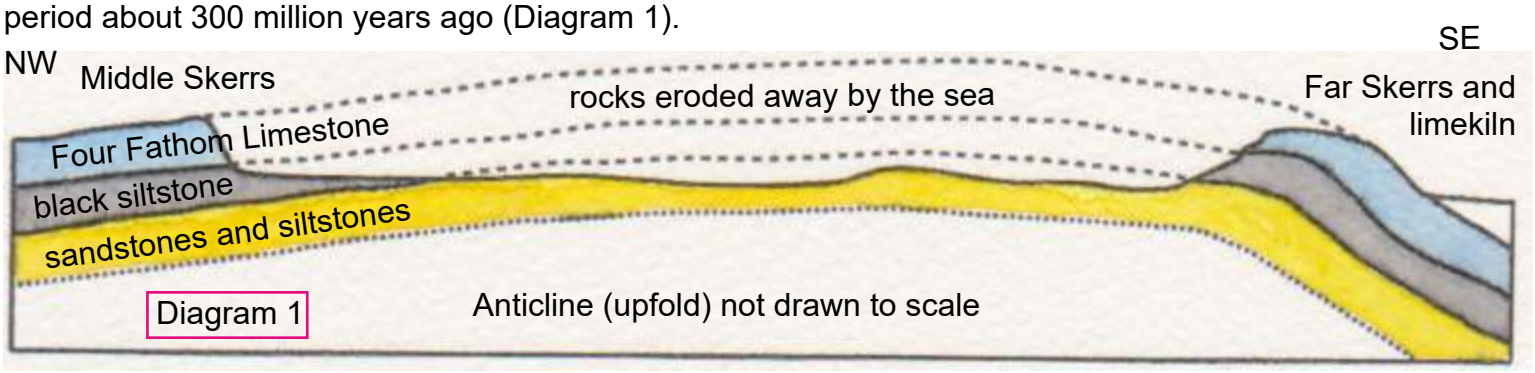


Photo E shows the extent of the bedding-plane seawards. If you turn right and walk towards the sea over the sand or on the top of the bedding-plane, taking care not to trip over the joints or slip on seaweed, you will reach a section of the limestone which has large grooves incised into the bedding plane (Photo F). These grooves are produced by the erosion of the limestone by waves carrying sand grains (Photo G). However the regular width of the grooves is more difficult to explain, particularly as similar grooves with a similar width have been found in other places on the Northumberland coast. It is thought that the energy of the waves in the North Sea generates a different type of wave, an **edge wave**, which travels along the shoreline and increases wave energy in a regular way.

The Four Fathom Limestone has been **eroded** by the sea, exposing the rocks beneath. If the sand level is low, you may be able to see the black siltstones and mudstones that underlie the Four Fathom Limestone bed. They are full of fossils of shells which are pale in colour, including crinoids and worm burrows. Crinoids were animals like sea urchins with **calcite** stems which anchored the animal to the sea bed. Fossils of the stems look rather like tubes of Polo Mints, with a central hole which carried sensory nerves in each of the stem sections.



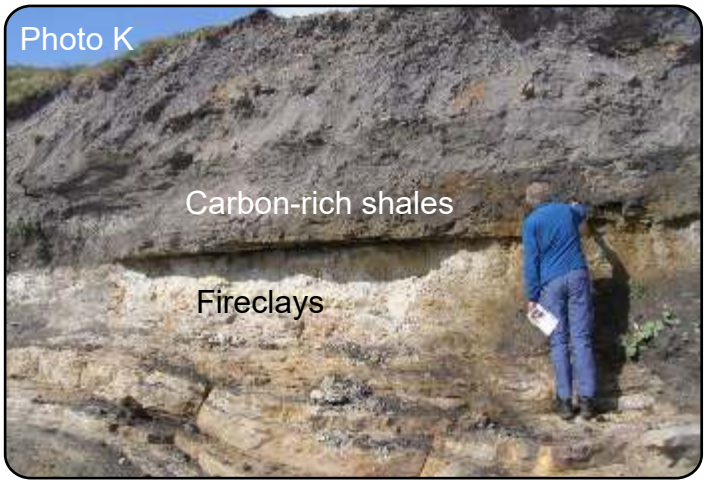
Walk towards the old Cocklaw Dunes limekiln at Far Skerrs. You are crossing an **anticline** (an upfold) caused by pressure during a tectonic plate collision at the end of the Carboniferous period about 300 million years ago (Diagram 1).



THE LAW OF SUPERPOSITION

Geologists realised from early times that sediments are deposited in estuaries, on beaches or on the sea bed and are continually covered by more sediment. The **Law of Superposition** says that the rocks at the bottom of the pile will be the oldest. The centre of the anticline is made of sandstones and siltstones (Diagram 1 and Photo I) which are therefore the oldest rocks in this sequence that we can see here. The younger beds above them have been **eroded** away by wave action. Photo I shows bedded grey siltstones in the centre of the anticline, with a hammer for scale.

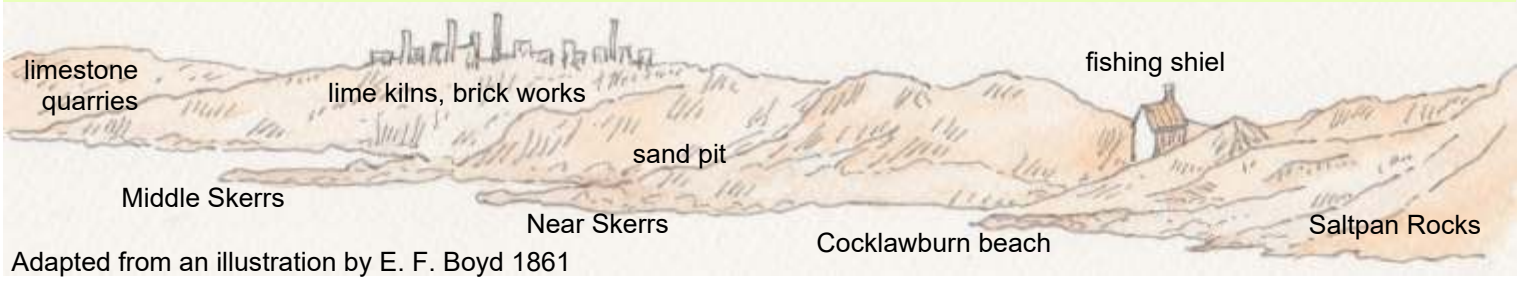
② *Walk towards Cocklaw Dunes limekiln at Far Skerrs. There is a bit of climbing here but the sandstone beds are usually easy to walk over except in wet weather. When you reach the top of the rocks there is a very good view looking south-east.* The limekiln stands on beds of yellow sandstone with curved bedding-planes, representing sand banks in a river that carried sand grains into a delta or estuary. Changes in sea level occurred because a huge **ice sheet** over the South Pole was expanding in size or melting roughly every 100 thousand years. When sea level fell, forests could grow in areas that had been shallow seas.



The pale grey clays (**fireclays**) (Photo K) were leached soils in which forests grew in muddy swamps filled with debris from decomposing plants. Sometimes you can find black fossilised rootlets in the fireclays. Often **coal seams** are found above fireclays because water and gases from the organic matter in the marsh were driven off when the wet marsh sediments were compressed leaving carbon. In these rocks, there was not enough carbon to produce a coal seam, but black **carbon-rich shales** lie above the fireclays.

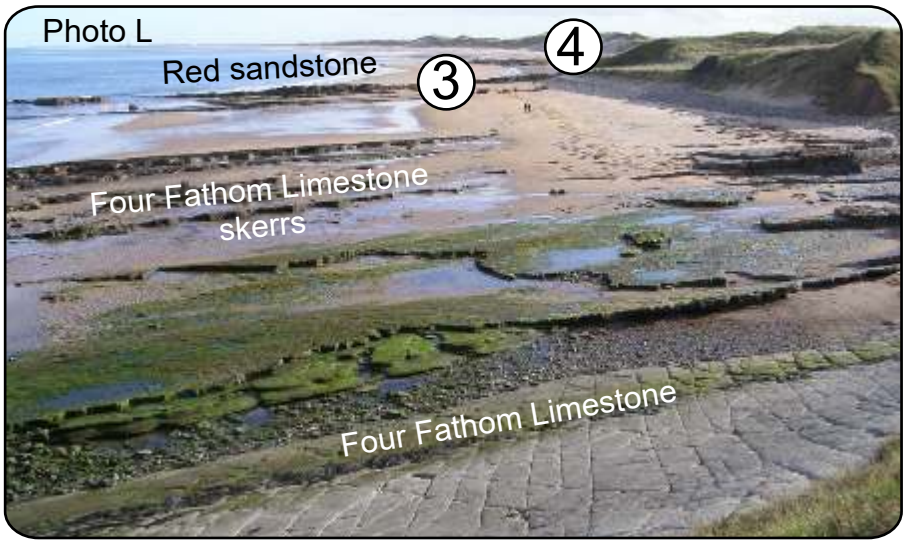
LIMESTONE QUARRYING IN THE SANDBANKS LIMESTONE

The Four Fathom Limestone is more than 9 metres thick and is divided into separate beds by bedding planes with thin mudstones. This makes the limestone ideal for extraction by quarrying because it was easy to break off blocks of rock using simple tools like picks and crowbars. Because of the demand locally for lime to fertilise the rich agricultural area of Northumberland and the Tweed valley, as well as the use of lime as mortar for building, this limestone was quarried on a large scale along the coast at Cocklawburn for at least two centuries. The irregular ground between the road and the beach was occupied by limestone quarries, clay and sand pits with associated buildings and several rows of cottages for the workers. The old Cocklaw Dunes limekiln at Far Skerrs was replaced by three lime kilns operated by the Scremerston Limeworks company. The works were very active from the mid-nineteenth century onwards but trade diminished and they closed in 1900. The kilns were filled in and the gun emplacement was built on top of them during World War II. The long grassy ramp behind the gun emplacement had an engine to haul trucks of lime and coal to the top openings of the limekilns. It is hard to imagine that this peaceful coast, covered with limestone-loving flowers in summer, was once a very busy industrial site, with quarries, limekilns, a windmill, a brick kiln, chimneys, tracks for wagons and several workers' settlements, as shown in the illustration below.

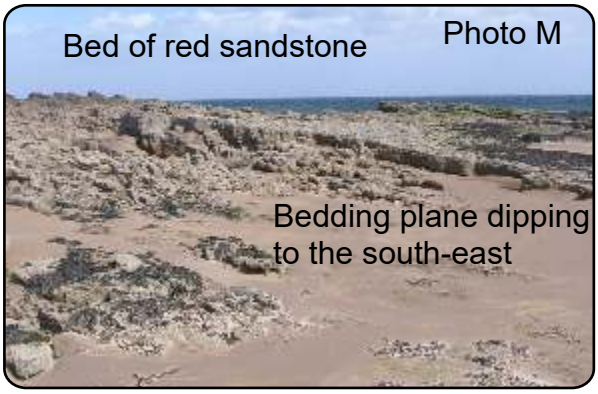


Adapted from an illustration by E. F. Boyd 1861

When you stand on the limestones looking south-east along the beach,you can see the sand dunes of Cheswick and Goswick (Photo L). You may be able to see Lindisfarne Castle and Bamburgh Castle, both of which stand on the Whin Sill, a dramatic feature in the landscape of northern England composed of black ***dolerite****, a tough* ***igneous*** *rock.*



Directly in front of you is the steep Four Fathom Limestone which dips at 20°.The Four Fathom Limestone is composed of nine or ten thinner beds of limestone which form skerrs that run across the beach (Photo L). The limestone has been extensively quarried inland behind the sand dunes. There is very little rock still visible in the quarries and some of them are filled with water, so the pools may be deep and dangerous.



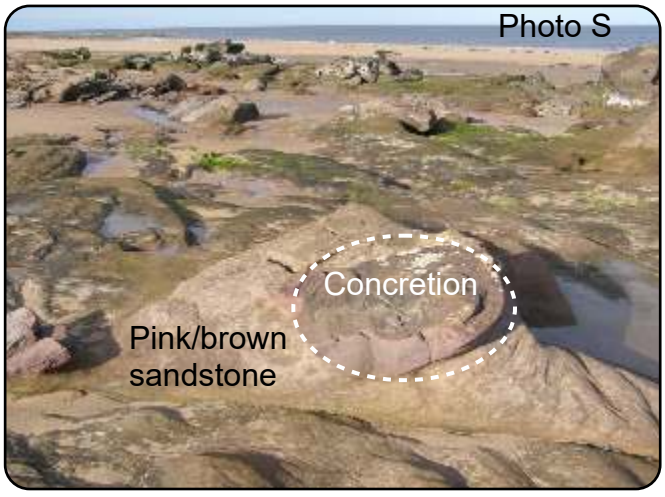
③ *Walk over the limestone skerrs to the red sandstone and have a close look at its features*. The red sandstone (Photo M) has been exceptionally reddened by iron during the processes of compression and cementing that converted the wet sand to a solid rock. So much iron has soaked through the rock that it has deposited thick layers of rusty iron minerals in some of the joints. Photo N shows that the red sandstone has a very **weathered** surface above the high tide level. The rock has been weathered by a combination of rainwater and sea water blown over the sandstone during storms. Exceptionally rough weathered surfaces like this are usually found in rocks which contain **calcite** which is easily dissolved in rain water, so it is likely that this unusual sandstone is made of **quartz** sand grains cemented together by a large proportion of calcite.

④ *Walk onwards to the black rocks at the top of the beach just below the sand dunes* (NU 037 477). The rocks look at first sight like loose boulders but there is solid **bedrock** underneath although it is sometimes covered with sand, leaving the projecting sea weed-covered sandstones visible (Photo O). The cover of sea weed may be why the rocks are called Cheswick Black Rocks.

When you approach the low-lying bedrock you can see that, where it has been scoured by sand grains carried by waves, the sandstone is a pink colour. However, if you can find a fresh piece of rock that has been recently broken off by waves, you can see that the rock is dark brown in colour below the weathered outer layer on the surface (Photo P). The dark brown sandstone is made of large, angular sand grains. It appears pink in places because it contains a high proportion of a pink mineral called **feldspar** as well as other dark-coloured minerals containing iron.

The bedding-planes are scoured into curved troughs that represent the river channels between sand banks carrying sediment into an estuary or delta. Photo Q shows that the river current flowed in the direction of the arrow.

The sandstones are unusual in that they also contain many **concretions** of calcite, the calcium carbonate ($CaCO_3$) mineral which was carried through the rock by water while the wet sediments were being compressed and cemented (Photo R). Geologists are not sure how concretions form, but it is thought that mineral-rich water was found in excess in the wet sediments and the mineral was able to precipitate within the rock under particular chemical conditions. Photo S shows a concretion with concentric layers that has formed within beds in the sandstone.



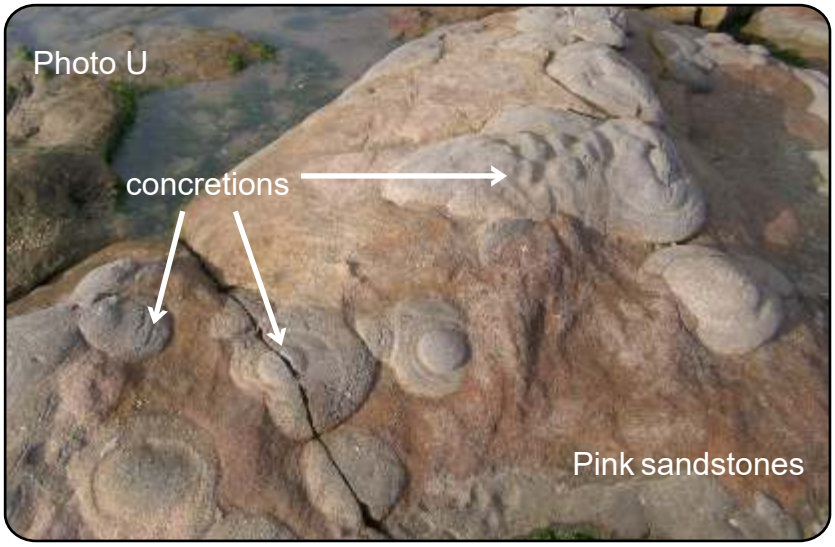
HOW DO WET SEDIMENTS AND LIME MUD FORM SOLID ROCK?

Particles deposited in river channels and on the sea bed, such as sand, silt, mud and lime mud, are put under pressure by sediments deposited above. The pressure squeezes the particles together, drives out the water and cements them together with minerals such as quartz, calcite or iron minerals. As the sediments become a solid, rigid rock, they are put under stress by plate tectonic movements which causes them to crack and form **joints,** often found in a regular pattern.

CONCRETIONS - HOW DO THEY FORM?

The concretions at Cheswick Black Rocks sometimes occupy whole beds of sandstone (Photo T). They often appear to have grown outwards from a nucleus in the centre so that they have concentric spherical layers and rounded shapes, although they vary greatly in size (Photo U).

The rocks are often covered by sand and sometimes cannot be seen at all. Sand levels vary greatly on this coastline from year to year, depending on the balance of wave activity. Strong winds give waves that move sand from the beaches out to sea but the pattern is reversed at other times. Sand is accumulating along the north Northumberland coast on balance, which is unusual for the east coast of England where coastal erosion is common.



At the south end of Cheswick Black Rocks, there are some extraordinary boulders half-buried in the sand (Photo V). The brown boulders are probably concretions eroded out from the local sandstone, but the light grey boulders are blocks of Four Fathom Limestone moved by waves from the shore at Far Skerrs. They have been pitted by weathering because they are made of calcite which dissolves in rain and sea-water. However, one man-made rectangular block of sandstone (Photo W) has been squared off by masons's chisels, as shown by the uneven dints on one surface. It may have come from one of the buildings associated with the quarrying or the lime industries.

The path inland from Cheswick Black Rocks takes you to the track (see map) with a 1 km walk back to the car park. The pool next to the track, which often has interesting bird life, was a limestone quarry exploited sometime after 1860, but it was disused by 1899 and has filled with water since then. You will see the spoil tips of other quarries on your walk back to the car park.

Alternatively, you can return to the car park along the beach the way you came or walk across the Cocklawburn Dunes Nature Reserve on footpaths towards the gun emplacement, taking care not to trample plants and limestone-loving flowers along the paths and avoiding the steep drops into the old quarries.

USEFUL REFERENCE BOOKS

Northumbrian Rocks and Landscapes - A Field Guide 1995 (ed. C. Scrutton) Yorkshire Geological Society, p. 51.

Peregrini Lindisfarne: An Anthology 2017. Peregrini Lindisfarne Landscape Partnership, p. 97.

http://www.northumberlandcoastaonb.org/

USEFUL MAPS

OS 1:50,000 Landranger 75 Berwick-upon-Tweed

OS 1:25,000 Explorer 340 Holy Island and Bamburgh

British Geological Survey 1:50,000 (England) Sheets 1 & 2 Berwick-upon-Tweed and Norham (Solid)