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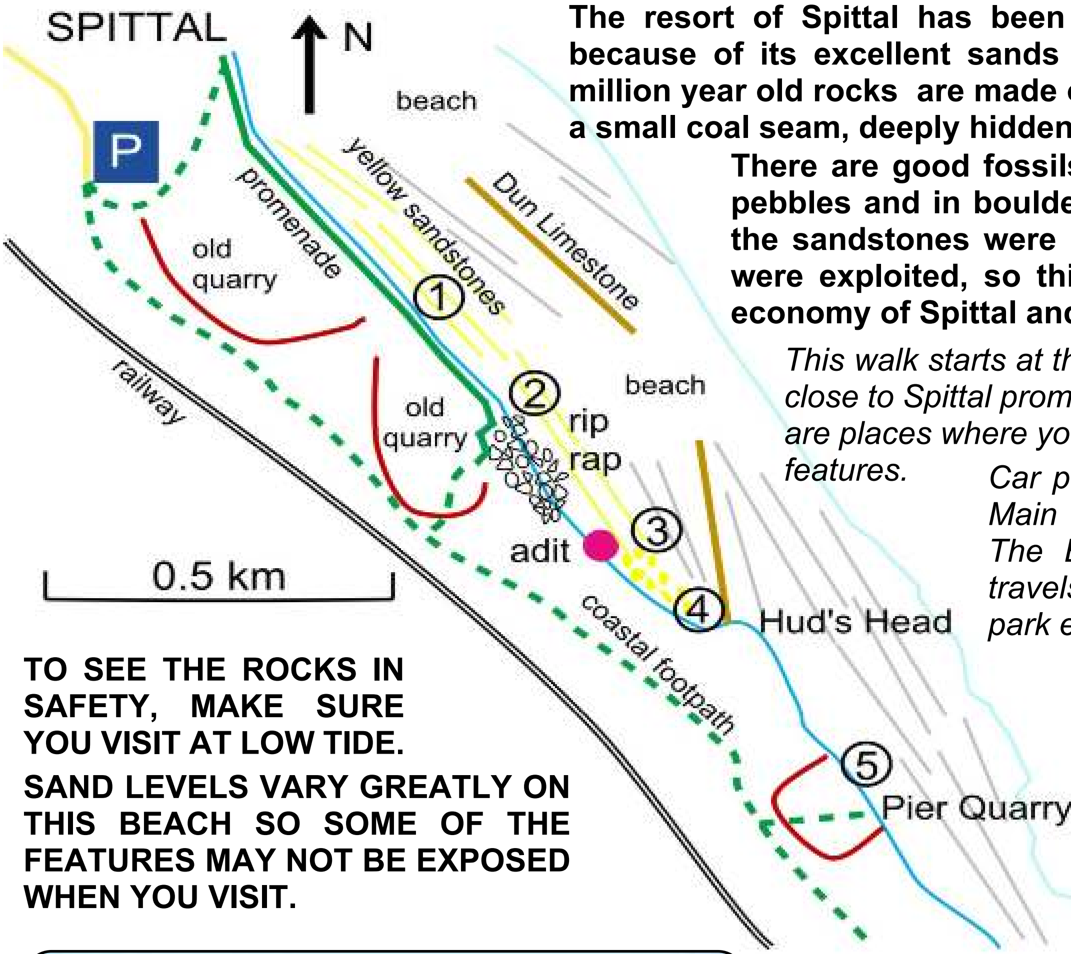
SPITTAL BEACH AND PIER QUARRY



The resort of Spittal has been visited for several centuries because of its excellent sands and attractive cliffs. The 330 million year old rocks are made of limestones, sandstones and a small coal seam, deeply hidden in the base of the cliff.

There are good fossils to be found in the limestone pebbles and in boulders of sandstone. In past times the sandstones were quarried and local coal seams were exploited, so this area has contributed to the economy of Spittal and Berwick.

This walk starts at the well known yellow sandstones close to Spittal promenade. The numbers on the map are places where you can stop and look at geological features.

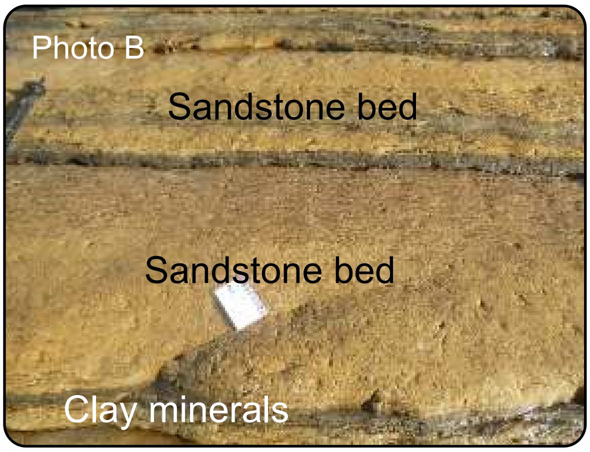
Car parking is available at the end of Main Street, Spittal (NU 0095 5105). The B1 Berwick Town Service bus travels from Golden Square to the car park every 30 minutes.

Keep away from the cliffs after rainfall as there are regular land-slips at Hud's Head. From Hud's Head to Pier Quarry the shore has sea-weed covered boulders. If the sand level is high, the walking is easy, but if not you can reach Pier Quarry from the coastal footpath and then by the steep grassy path into the quarry.

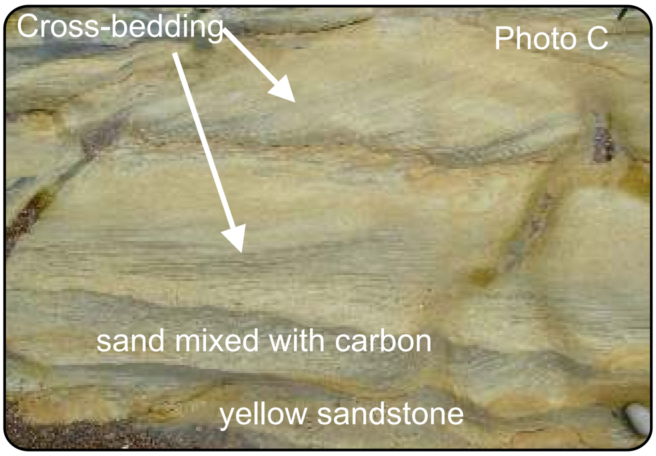
TO SEE THE ROCKS IN SAFETY, MAKE SURE YOU VISIT AT LOW TIDE.

SAND LEVELS VARY GREATLY ON THIS BEACH SO SOME OF THE FEATURES MAY NOT BE EXPOSED WHEN YOU VISIT.

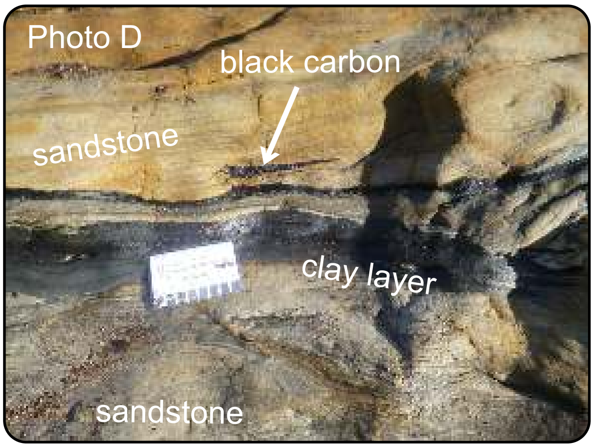
① Photo A was taken when sand levels were exceptionally low after a winter storm. Sometimes the yellow sandstones are nearly covered by sand, but you will still be able to see some of their features. The rock varies in colour between pale grey and yellow. After the wet sand was buried by later sediments, iron-rich water soaked through the pore spaces between the sand grains in some parts of the rock only.



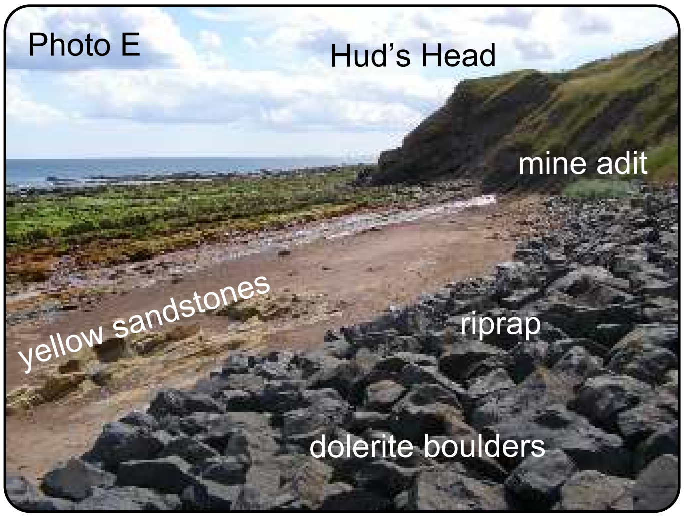
There are many thin **beds** of sandstone, often separated by thin layers of dark grey clay **minerals** (Photo B). Within most of the beds there are gently sloping lines called **cross-bedding**, which represent the sand banks of small channels on sand flats close to sea level on the surface of an extensive delta. During this time in the **Carboniferous** period, northern Britain was part of a large continent lying near the equator, with a hot, wet climate.



We know that there were trees growing nearby because the sandstones sometimes include very delicate cross-bedding outlined by fine black carbon flakes from decomposed leaves that drifted down river channels (Photo C). Plant stems which lodged between sand banks decomposed into pure carbon when the water was driven off by pressure from more sand deposited above (Photo D). The sandstones are not ideal as stone for buildings as they have many small breaks in them.



② *Walk along the beach, enjoying the yellow sandstones which are unusual and distinctive. When you reach the steps at the end of the promenade stop at the black boulders of **riprap**, designed to prevent erosion of the cliff below the railway line.*



The riprap (Photo E) is designed to prevent storm waves breaking over the base of the cliff and causing erosion to the slope above. The boulders have to be rough and angular so that waves break quickly and so that water drains through into the riprap. The rock has to be tough enough to resist breaking up under the pressure of storm waves. **Crystalline** rocks are best for this purpose as they are harder than any other rocks, because many types form from hot **magmas** which cool as small crystals which lock together tightly. The boulders here are made of **dolerite**, probably brought from quarries at Belford.

③ *Walk further along the beach until you see the mine adit (tunnel) in front of you (Photo F). Sometimes a high sand level allows you to get close to the adit entrance, but generally you will find that you have to cross the small stream and walk carefully over orange-stained rocks.*

ACID MINE WATER

The water from the **adit** (tunnel) drains extensive inter-connected disused coal mines under Scremerston and Berwick Hill. The drainage water becomes acidic under-ground in contact with coal seams which contain sulphur. The acid mine water removes iron from coal seams and local mudstones/shales under ground. When the water reaches the surface it reacts with the oxygen in the air and precipitates iron minerals which have stained the sandstones.

DO NOT ENTER THE ADIT WHICH MAY BE UNSTABLE AND LIABLE TO COLLAPSE.

COAL MINING IN SCREMERSTON AND BERWICK HILL

There were at least six coal mines in the Scremerston area, some with shafts as deep as 200 m, extracting coal from eight coal seams in the local rocks. Most of the coal seams are about 0.5 m thick and were worked with hammers and picks in conditions of extreme discomfort. The Scremerston Main Coal is 1.3 m thick and was the most valuable seam, although all the coals in this area are mixed with shale, so are not of good quality and were used only locally. There were many small pits owned by local families who employed just a few miners to extract the coal. The Scremerston and Berwick Hill mines are connected underground and water could be drained from the mines by adits. The adit on Spittal beach drains the Scremerston Main Coal and was in existence in the year 1764, indicating how old the coal mining industry is in this area.

Continue to walk across the rocks for a few more metres until you are walking over large boulders of pale sandstone that have fallen from the cliff above (Photo G). Many of them contain carbonised plant fossils which look black against the pale sandstone. Here are some examples.

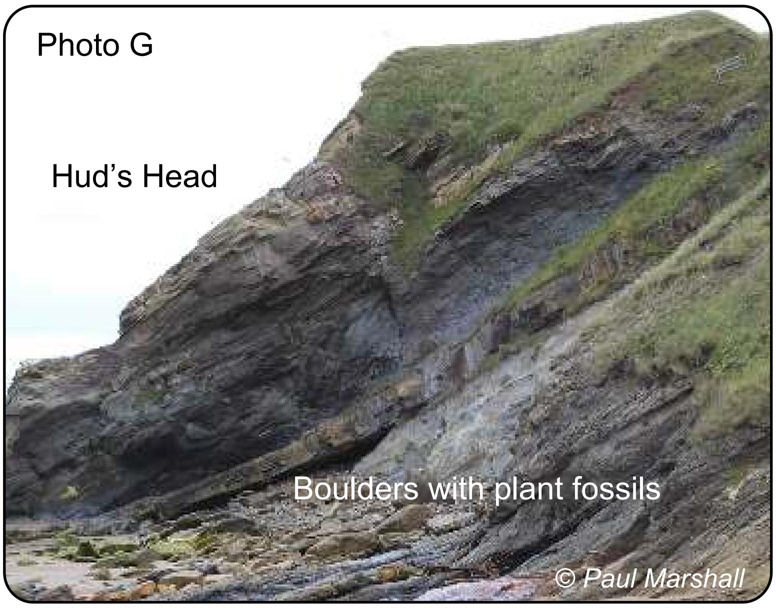


Photo G


Photo H Twigs and branch of *Lepidodendron*


Photo I *Lepidodendron branch*

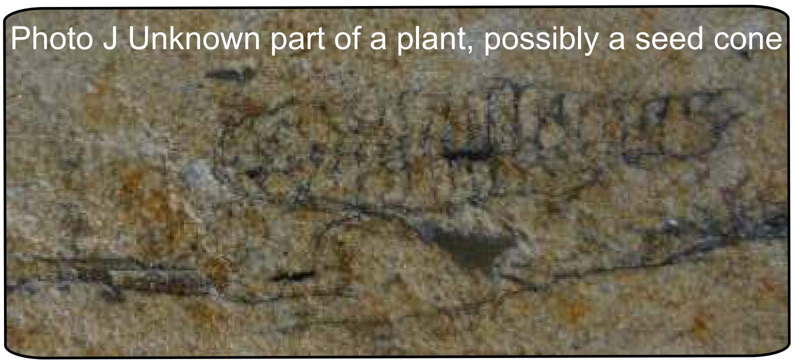


Photo J Unknown part of a plant, possibly a seed cone

CARBONIFEROUS FORESTS AND CYCLOTHEMS

Carboniferous forests grew in a hot, wet climate in equatorial regions in low-lying marshy swamps and deltas with large river channels bringing sand, silt and mud from nearby mountain ranges. Most of the plant species were very different from present-day vegetation as they were spore-bearing, not pollen-bearing. Some Carboniferous tree species are ancestors to present day plants, such as horsetails and club mosses. The forested deltas were flooded by sea water when the sea level changed, so that decomposing plants were covered by sediments and compressed into carbon-rich coal (Diagram 1).

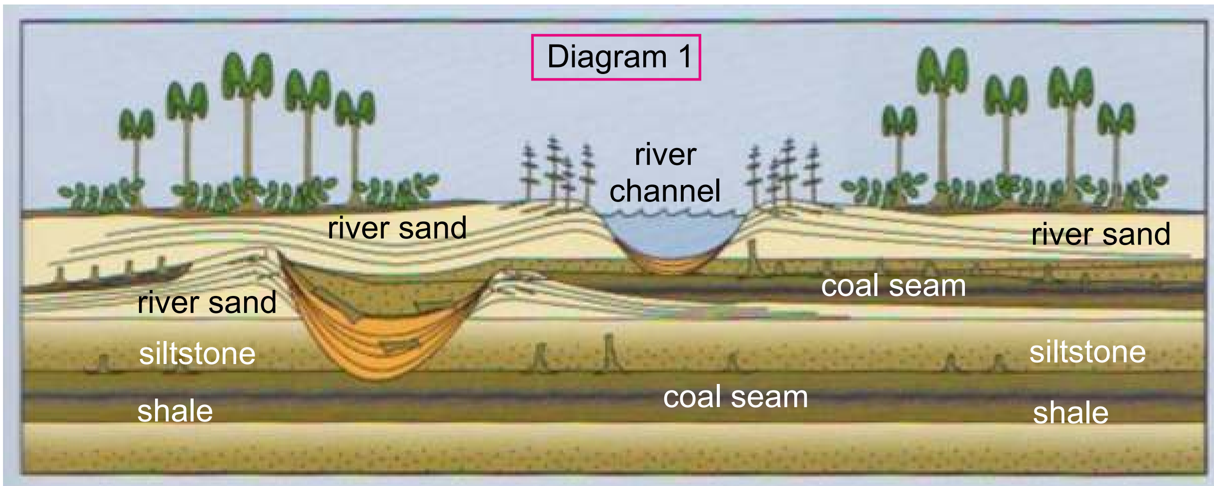


Diagram from *The Last Billion Years* by the Atlantic Geoscience Society

This process was repeated for millions of years, forming the geological sequence of marine limestones with deltaic muds and sands above and a coal seam at the top of the sequence (Diagram 2). This sequence is called a **cyclothem** and is repeated in many of the rocks of this age in north Northumberland.

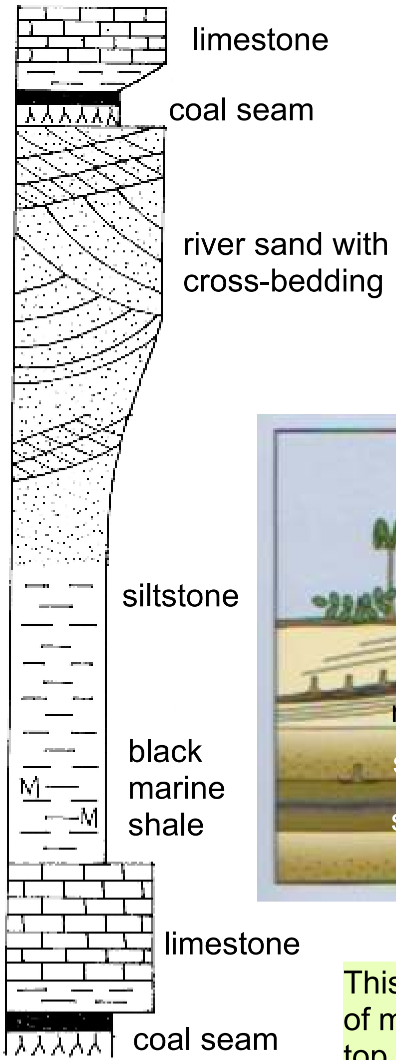
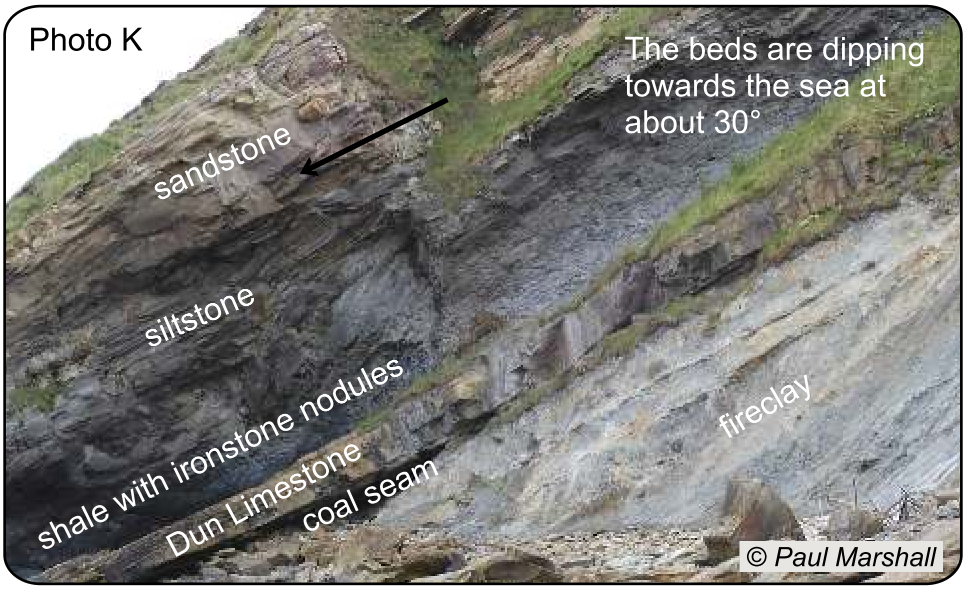


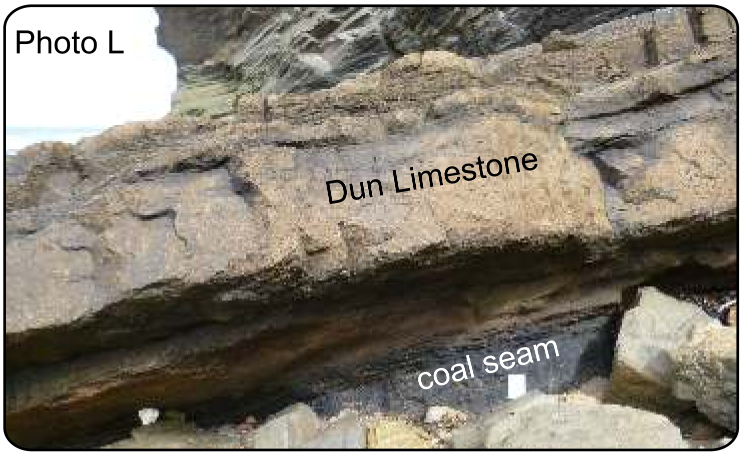
Diagram 2

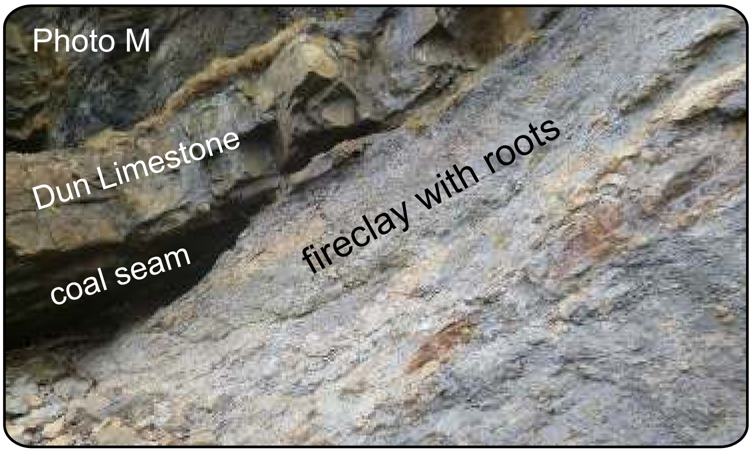
④ *Continue walking carefully across the rocky shore for a few more metres until you are near the Hud's Head cliff face (Photo K).*

This cliff face is a good example of a cyclothem (Diagram 2). In the cliff above the Dun Limestone is the typical sequence of rocks deposited when a river flows into a shallow sea forming a delta. Below the coal is the clay soil in which the Carboniferous forests grew, now forming a rock called **fireclay** which often contains plant remains and roots.

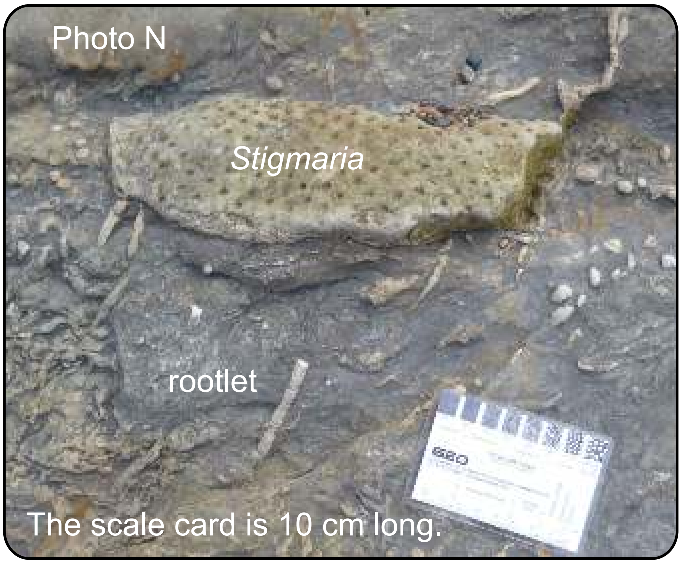


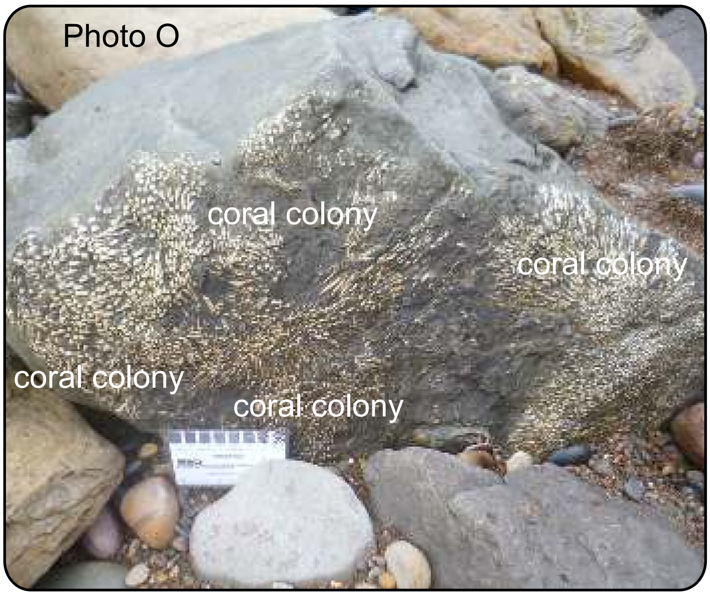
The Dun Limestone (Photo L) is a pale brown colour when weathered and has a distinctive content of fossils of marine shells and corals. The coal seam below the Dun Limestone is visible when you get close to the base of the cliff. It is about 30 cm thick and is too thin to have been mined commercially. However, black flakes of coal eroded from this seam can be found on Spittal beach.





There are plenty of fossils to be seen in the Dun Limestone and in the fireclay beneath it (Photo M). The fireclay contains root fossils, which appear very different from the branch fossils seen in the sandstone boulders on the beach. Photo N shows a root fossil and you can see many separated rootlets as well as the points at which they were attached to the main root. All tree roots look similar once they are fossilised and all are called ***Stigmaria***.



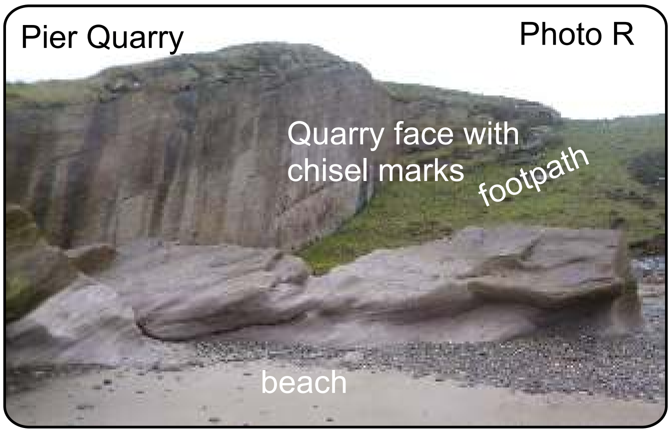


Limestones are formed from **lime mud,** a pale-coloured mud made of calcite dissolved from the shells of the many invertebrates which lived in warm, shallow seas. Lime mud settled on the sea bed amidst the colonies of brightly coloured corals and piles of sea-shells. Photo O shows a boulder with several fossilised coral colonies, made up of fine tubes in which the tiny coral animals lived. Layers of coral and other shells are visible in the Dun Limestone bed.

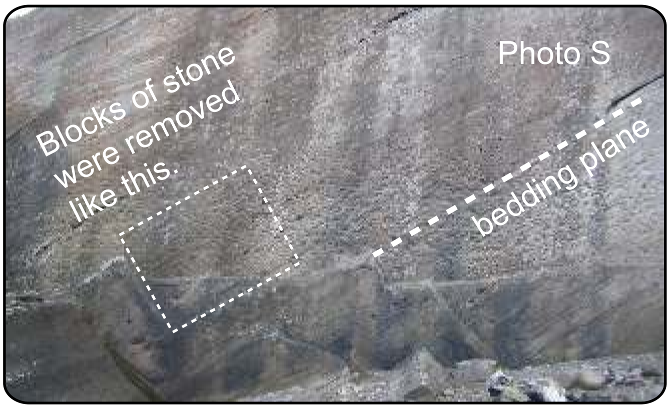
Walk around the seaward end of the Dun Limestone to see the beds directly above the Dun Limestone. The black marine shales of the cyclothem (Diagram 2) contain dark red **nodules** of **ironstone**, often oval in shape and arranged along the **bedding-planes** of the shales (Photo P). The mud particles in shales are full of iron minerals which are nucleated when the muds are buried and compressed and water is squeezed out, although the chemical process is not well understood. The iron content of the nodules is usually about 30%, which was sometimes worthwhile exploiting for iron-making in medieval times.

⑤ *If you want to walk around Hud's Head to Pier Quarry (NU 014 506) make sure that the tide is falling, so you don't get trapped under the high cliffs. Keep well away from the cliffs. Because the rocks are dipping towards the sea (Photo Q), slabs of sandstone are undercut at high tide and slide down onto the foreshore, particularly if there has been recent rain. The red sandstones are heavily potholed and covered with sea weed, so good boots and walking poles are advised. Sometimes the sand levels are so high that these hazards are covered by sand, so walking to Pier Quarry is then very easy.*

Pier Quarry (Photo R) is so named because the stone was used to build Berwick Pier which was completed in 1825. The stone is ideal for building as it has very few weaknesses which would cause it to break unevenly. More than 200 years ago, when the quarry was working, all extraction was done with hand tools, such as crow bars, chisels and hammers. The stone was shaped with chisels by the stone masons who worked in the quarry. The quarry walls are beautifully worked and chisel marks can be seen on some of the smooth walls.



The pink sandstone is composed of large **quartz** and **feldspar** sand grains eroded from the granites of a high mountain range to the north and north-east. The beds of sandstone are thick, suggesting that there was nearly continuous deposition of sand in wide channels on deltas. After the sands were compressed, buried and cemented, they were tilted at about 30°, as can be seen in the quarry walls (Photo S). The stone was removed in blocks parallel to the bedding, to reduce the number of weak bedding-planes in each block of stone.



You can return to Spittal across the rocky foreshore or walk up the steep grassy footpath in the quarry to the coastal footpath on the cliff top, from where, at low tide, there is an excellent view of the rocks on the shore below (Photo T).

USEFUL REFERENCE AND MAPS

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

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

OS 1:25,000 Explorer 346 Berwick-upon-Tweed

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