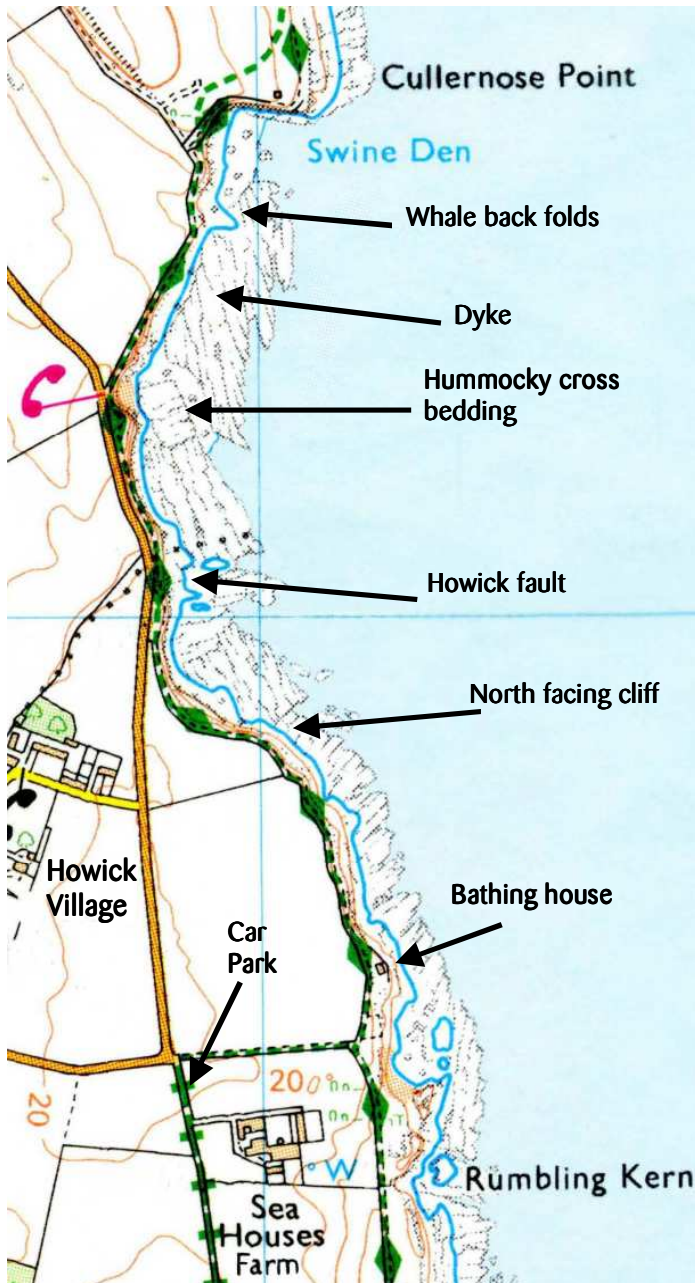


Northumberland Coast Rock-Walks

Exploring the landscape
and its geo-diversity

Storm and stress - Howick to Cullernose

This magnificent section of coast with its cliffs and reefs displays a diverse range of rocks which tell stories of molten rock, earthquakes and tempests. This guide follows these stories on this walk between Howick and Cullernose point.



Essentials:

- 4 km round trip, with beach walking and some scrambling on the foreshore
- Keep a safe distance from the cliff base and avoid overhanging ledges
- Great care should be taken walking on the boulders near to Cullernose point
- Check tide-tables; do not attempt the beach sections coming up to high-tide
- Do bring stout shoes or boots, clothes to suit weather, sun cream (!) magnifying glass, camera and binoculars

Northumberland County Council O.S Licence No. 100049048(2012)



The Trail

From the car park (NU 258 173), take the signposted public footpath down towards the sea. Turn left to follow the cliff path past the Bathing House on your right. Soon Dunstanburgh Castle will come into view in the far distance. Continuing northwards, in the low cliffs on the seaward side you can see large tilted beds of yellow sandstone. Within these beds fine striations can be seen at an angle to the main beds. This conspicuous cross-bedding was formed when sand was laid down in channels, hence its name, channel sandstone - a good



Picture 1. Cross-stratification in sandstone



Picture 2: View of shoreline to Cullernose Point

example can be seen at NU 261 176 (picture 1 and box 2) When you reach a position above an east-west running cliff at NU 259 178 you will see a fine view of the shoreline up to the imposing Whin Sill at Cullernose Point (picture 2). Just down below where you are standing (picture 3) is the surface bearing some of the oldest footprints in Britain, belonging to an amphibian probably part of the *Baropezia* family. Sadly these are now much eroded and very hard to see.

Box 1: Setting the Scene

For the most part, the rocks you will see exposed along this part of the coast were laid down in a series of horizontal beds of limestone, shale, sandstone and coal, rhythmically repeated (see box 4 on Cyclothems) over millions of years. The rocks were laid down within the early, lower (in time) part of the Carboniferous Period, between about 360 and 328 million years ago. At that time this area lay close to the equator, slowly moving north and was part of a growing, vast landmass which would become the super-continent called Pangaea.

Across Britain the Lower Carboniferous was predominantly a time of clear, warm, shallow seas and limestone formation whereas the later Carboniferous was dominated by hot, wet, deltaic swamps initiating coal formation. On this part of the coast we see both of these ancient environments.

Faulting, folding and uplift of the sedimentary beds, caused by the Variscan Orogeny (a mountain building event taking place in the south of England and north of Europe), came late in the Carboniferous Period. The east-west trending Howick Fault seen on this walk is a good example. This was followed by the intrusion of very hot molten material which cooled and crystallized to form an igneous rock (dolerite), known as the Whin Sill.



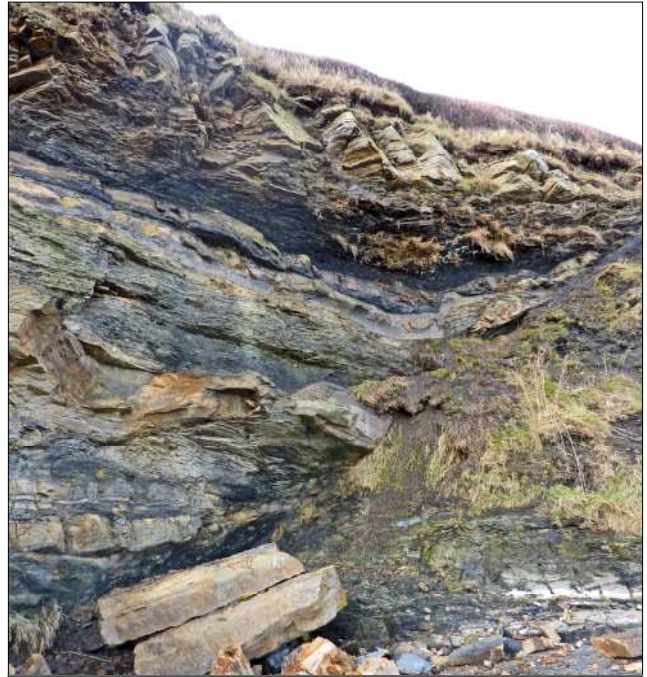
Picture 3: Location of amphibian footprints



Follow the footpath around and up to the gate, then along to a dip in the path where there is a signpost, a bench and an adjacent parking area at NU 258 180. Here, **with care**, you can make your way down the bank to shore level.

About 30 metres to the south look up to the cliff face and you will see the continuous bands of sedimentary rock suddenly truncated along a steeply angled line up the cliff (picture 4) This is the main Howick Fault dipping 40° to the south; detailed mapping has shown that beds to the south of the fault have been dropped down by some 200m.

The line of the fault can be followed from the base of the cliff out along the shore line (picture 5). Towards the low tide line, careful searching will reveal a mass of blocky hard grey-black rock in the line of the fault as well as extending in a thin shelf for a few metres between a sandstone and a limestone bed (picture 6). This is Whin Sill dolerite, which as hot molten rock used the fault as a conduit before spreading out in a mini-sill. This demonstrates how the larger parts of the sill may have been intruded.



Picture 4: Howick Fault



Picture 5: Location of Whin Sill along Howick Fault line



Picture 6: Whin Sill following Howick Fault

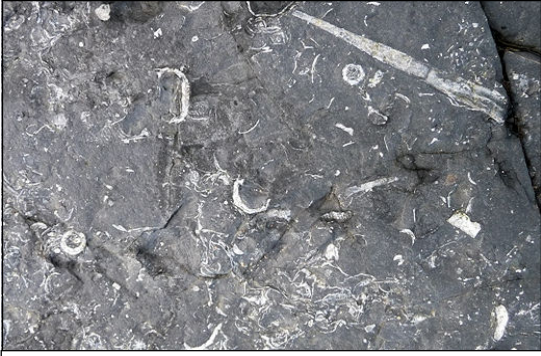


Picture 7: Location of Stigmaria

Keeping a safe distance from the cliff face, scramble further south towards a shallow bay. Small faults related to the Howick Fault can be seen in the cliff and foreshore, which cut through bands of sandstone and shale. On the upper surface of several of the larger fallen blocks of sandstone at the north end of the bay (picture 7) can be found dimpled log-shaped plant remains. These fossil rootstocks, called *Stigmaria* (picture 8), are from one of the coal-forming plants, a type of giant lycopod.



Picture 8: Stigmaria



Picture 9: Acre limestone fossils

Re-trace your steps, and on the foreshore north of the main Howick Fault you can see the upstanding face of the hard Acre Limestone. In this you will find brachiopods, crinoids and corals (picture 9). On the top bedding surface of the Acre Limestone, north of the point where you scrambled down onto the foreshore, you can find what looks like a series of offset slashes filled with a white mineral (picture 10). These

tension gashes, filled with calcite, give useful information about the direction in which these rocks were stressed.

Above the limestone you can find dark shales which in places have calcareous nodules and tiny glinting gold-coloured crystals around fossilised brachiopod shells. These crystals are of iron pyrites also called Fool's Gold, which is formed in anoxic environments through the action of sulphur fixing bacteria.

Picture 10: calcite-filled tension gashes

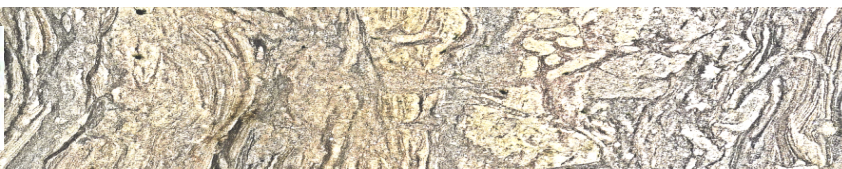


Picture 11: Hummocky cross-bedding

If you are sure of the tide, continue walking north; in the cliff, the shales are succeeded by sandy shales, muddy sandstones and then pale gray sandstones. Here you can see examples of hummocky cross-stratification where curved sets of cross-beds cut each other at a low angle (picture 11 and box 2) This happens when sediment is being deposited very fast but is also periodically being scooped away again. This can occur during a storm, when the water is filled with sediment and the deep wave bases can scour sediment laid down in deeper water.

Box 2: Activity in Beds

The sandstones we see on the coast here form extensive flat layers which are parallel to the ancient land surface on which these sandy sediments were progressively laid down. Within these beds there is fine cross-bedding between the layers, like the hummocky cross-stratification. Ripples invariably form when sediments are deposited from flowing water, and the way the sediment is deposited depends on how the water is flowing - how fast, in which direction, how deep and with how much sediment. In rivers - which flow in only one direction unless tidal - sediment is deposited on the downstream edge of asymmetric ripples leaving behind cross-bedded sediments. If the direction of flow in the river changes, or a new channel is formed, then the cross-beds may be cut by a new regime of cross-beds. In the sea the current from wave action is in two directions and symmetrical ripples may form. In both environments it is the boundaries between the sets of cross-beds which tell us where erosion has taken place. Similarly, the angle of the cross beds in a given set tells us the direction of flow which laid them down.





Continuing northwards you find that cross-bedded and planar-bedded white sandstones succeed the storm-structured sandstones. There are trace fossils here in the form of a variety of worm burrows including the beaded burrow left by *Eione moniliforme* (picture 12 and box 3). These sediments will have been laid down in shallower water, in the shoreface and foreshore areas.



Picture 12: Eione moniliforme

Box 3: Fossils and Traces

All along the coast a variety of fascinating fossils can be found preserved in the rocks: corals, crinoids (sea-lilies), brachiopods and coal plants amongst others. Along with these preserved remains of the actual creatures, we can sometimes find evidence of their activities—these are known as trace fossils. The now poorly preserved footprints at Howick are a classic example which give an instant fossilised gait analysis of the creature (the footprints are thought to have been made by a temno-spondyl amphibian, with a track of 6 prints, 3 on either side of a central groove where the creature dragged its body through the sand). You can also find many other types of trace fossils in the form of burrows and grazing trails. These can be quite numerous and not only give evidence of the way the creatures lived - moved around, fed, defecated - but also tells us more about the environment they lived in. We know by looking at present day shorelines that different types of grazing and burrowing happen at different places, so that the burrows found close to the shore will be different from those in sediments further out to sea. Analysis of these trace fossils can be a great help in understanding the complex succession of ancient environments we see on the shore here.

From the exposure of the Acre Limestone we have been following a sequence of rocks lying on top of each other and so becoming younger as we go up the stratigraphic sequence. Here in a good cliff exposure we reach the final part of the Acre Limestone cycle of sediments before the Sandbanks Limestone (box 4). In this cliff section, the white sandstone is now massive (i.e. it shows no stratification) but it does have black streaks of fossil roots. It is a very clean seatearth and above it in a narrow recess, there is a thin coal seam. At the top of the small cliff is the Sandbanks Limestone, beginning the next cycle of sediment deposition.

Box 4: Cyclothems

At first the large number of different types of rocks scattered in bands across the beach seem a jumbled mess. However, through the detailed mapping which has been done on the rocks, a pattern of cyclic sedimentation emerges. On this geowalk you will see three different limestones which are very useful markers to help understand these cycles or cyclothems as they are known. The cycles start with a marine shale just below the limestones which are succeeded by a series of deltaic sediments starting with shales and coarsening upwards to cross-bedded sandstones. Finally there are palaeosols (sometimes including rootlet beds) and a coal before the cycle starts all over again with marines shales and limestone. These cycles may be related to the rise and fall in sea-level caused by the advance and retreat of ice from the Carboniferous ice-caps in much the same way that it has done in the more recent ice-age.



Picture 13: Cullernose Dyke

You may have noticed in passing, and now behind you, what looks like a narrow wall crossing the foreshore (picture 13). This is a dyke of Whin Sill dolerite. As at Howick the molten rock has exploited a fault, baking a narrow zone of sandstone on either side.



Picture 14: Whale-back folds

Climb up and onto the bedding surface of the Sandbanks Limestone. Here you can find fossil brachiopods, crinoids and corals. On the lower foreshore the Sandbanks Limestone is thrown into several “whale-back” folds. (picture 14) which can be explored at low tide. The fold axes run north-south and their folds are asymmetric, the limbs being steeper on the west (shore) side. Between these folds and Cullernose point there is another big fault. It has been suggested that horizontal movement on this fault might account for the whale-back folds with their asymmetry.

Right in front of you now

is Cullernose Point, with its dark-coloured, massive rock, white streaks, birds’ nests and well-developed columnar jointing (picture 16). The columnar jointing forms as the dolerite cools and shrinks. It is characteristic of many of the Whin Sill outcrops and can be seen, for example, in the walls of the Craster car park.

If the tide is low explore the area leading up to the base of Cullernose point, scrambling over the large (and slippery when wet) wave-worn boulders of whin sill. In the cliff at the back of this beach are exposed complex interactions between the Whin Sill and the sediments it cuts, with dyke like structures and rafts of sediment seemingly floating in the whin rock. Here you can find dolerite in contact with sedimentary rocks and see the effect of the heat of the molten rock baking the sedimentary rock to produce a metamorphic rock (picture 15).



Picture 15: contact metamorphism

As you leave the beach, beside the path you will pass a small outcrop of shale overlying the Sandbanks Limestone. Fragments of trilobites can be found here. If you have time it is worthwhile continuing up the cliff-top path onto Cullernose Point until you can get a good view of the shore area you have just left.

The walk back to the Seahouses Farm Car Park is about 1.25 miles. If you are continuing along the Coast Path to Craster it is about three quarters of a mile to the Harbour.

Picture 16: View of Cullernose Point

