Moor House-Upper Teesdale National Nature Reserve

Knock Geological Trail

quaternary tertiary cretaceous jurassic triassic permian carboniferous devonian silurian ordo

Knock Geological Trail

This trail is approximately 9.5km long. It follows marked footpaths up the North Pennine escarpment and through part of the Moor House-Upper Teesdale National Nature Reserve. The different types of rocks you will see on this trail tell a story of the events and processes that have created this landscape over nearly 500 million years of Earth history. Stout boots, warm clothing and good waterproofs are advised as even in summer the climate of the North Pennine escarpment can be harsh and cloud can descend quickly. Allow a full day for the complete walk. Use of an Ordnance Survey map and compass is recommended for this route.

In places the route passes old mine workings, parts of which may be unstable. Please keep to footpaths and do not attempt to enter old tunnels or any old surface excavations. Do examine the rocks and minerals you will see along the way but please do not collect them: leave them for others to enjoy.

Useful maps:

Ordnance Survey
1:25 000 Explorer OL31 North Pennines Teesdale and Weardale
British Geological Survey
1:25 000 Geological Sheet NY82 and part of NY92 Middleton-in-Teesdale
1:50 000 Geological Sheet 25 Alston
1:50 000 Geological Sheet 31 Brough-under-Stainmore
1:25 000 Geological Special Sheet - The Cross Fell Inlier

Travel west of Knock and take the minor road that passes the Christian Centre. Park sensitively at the end of this public road *(NY 686 288)*.

Walk up the private road to reach the sheep pens at the entrance to the National Nature Reserve.

1 At the sheep pens

Much of the ground here is poorly drained and has a thin cover of glacial deposits, including scattered boulders. These were left behind when the last ice sheet that covered the area finally melted about 11,500 years ago. The wider view tells a story of much earlier times in Earth history. The North Pennine escarpment is made of near-horizontal Carboniferous rocks that are seen in detail further along the trail. However, the distinctive, small, steep hills along the foot of the escarpment are formed from much older rocks on which the Carboniferous rocks were deposited. Burley Hill is made of slates, and Dufton and Knock pikes are made of volcanic ashes deposited approximately 450 million years ago during the Ordovician Period.

Leave the road, turning right (south-east) to follow the indistinct path that runs parallel to the fell wall until you reach Sink Beck.

2 Sink Beck

The pale grey rock exposed here is the Melmerby Scar Limestone. The limestones of the North Pennines were formed as layers of limey mud on the floor of a shallow tropical sea, about 360 million years ago during the Carboniferous Period of Earth history. In this sea, marine life was abundant and varied. The most conspicuous fossils in the limestone here are small fragments of crinoids, sea creatures related to modern sea urchins.

Continue along the track until you reach the Pennine Way. Turn uphill and continue for approximately 200m.

3 Swindale Beck

Limestone, shale and sandstone beds are exposed in the banks of the beck here. The shale beds formed from mud that accumulated on the floor of the Carboniferous sea and the sandstone beds formed from sand washed into the sea by rivers draining a land area to the north or north-east. The North Pennines are built up of regular repetitions of limestone, shale and sandstone beds. The variation in rock type is reflected in the shape of the landscape. The more weather-resistant limestone and sandstone beds form flat-topped benches in the hillside, whereas the shale beds weather easily to form the steep slopes between benches.

You many wish to descend carefully into the beck to examine the rocks as there are good fossils in the limestone beds. Continue up the track for approximately 800m.

4 Sink holes

The conspicuous hollow between the footpath and Swindale Beck is a sink hole, also known in the North Pennines as a 'shake hole'. These features are common in limestone country.

Limestone dissolves gradually in rainwater. As a result, joints in the rock widen, cave systems develop and the overlying soil and rock debris fall into these openings generating distinctive hollows (sink holes) on the surface.

A large sink hole in limestone country

5 Whin Sill

From the side of the sink hole, you can see columns of Whin Sill exposed in Swindale Beck. The Whin Sill formed around 295 million years ago when molten rock, called magma, rose from deep within the Earth and spread out as a flat sheet, or 'sill', between the rocks of the North Pennines. The magma was at about 1100°C and as it pushed its way between the surrounding rocks it 'baked' and altered them. The bottom of the sill and underlying baked rocks are visible in the streambed.

It is not advisable to climb down into the stream to see the features as the banks are very slippery. Rocks baked by the Whin Sill can be examined easily further along the trail at stopping point 11.

Continue along the Pennine Way stopping at the points 6, 7 and 8 as indicated on the map.

6 Knock Hush

The scar in the landscape here is known as a hush. This is a man-made feature caused partly by the controlled release of water on a slope to remove surface material in the search for mineral veins.

The remains of a reservoir, dam and sluice gate that supplied the water are visible at the top of the hush. The Scar Limestone and overlying sandstone are exposed in the sides of the hush.

7 Geology and landscape

A row of sink holes can be seen in the hillside. These mark the top of another limestone unit in the North Pennine sequence – the Four Fathom Limestone. The influence of different rock types on vegetation is obvious here. The rich green grassland on the limestone contrasts markedly with the coarse grasses and rushes on the sandstone and shale.

The NNR is within the **North Pennines Area of Outstanding Natural Beauty (AONB)**, one of England's wildest and most special places. The North Pennines AONB is also Britain's first European Geopark and a founding member of the UNESCO Global Geoparks Network. **To find out more, contact the North Pennines AONB Partnership on 01388 528801 or visit www.northpennines.org.uk**

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For further information about the area, including public transport, contact Appleby TIC: 017683 51177.

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8 The Heights

The summit of Knock Fell is made of sandstone with different characteristics from the sandstone units we have seen so far. It resembles the Millstone Grit rocks of the Yorkshire Pennines. The grains that comprise the rock are so large that the rock is very abrasive and ideal for making millstones to grind corn. Many of the sandstone blocks show ripple marks on their surfaces much like the ripples found in shallow water or on beaches today. The ripples indicate that that these rocks were formed in a similar environment during the Carboniferous Period. The blocks also contain fragments of tree roots, called *Stigmaria*, indicating that during deposition the sandstone was periodically above the water level and covered with vegetation.

Large, angular blocks of rock are strewn all over the summit, forming a landscape feature known as a 'boulder field'. Repeated freezing and thawing of water within cracks in the sandstone has gradually opened them up and forced the blocks away from the outcrops. This process was common during, and immediately after, the last Ice Age and still continues to a lesser degree today.

Take extra care walking over the boulders.

Keep walking along the Pennine Way track for about 500m.

Tree root fragments in sandstone

9 Bell Pits

On north side of The Heights there is evidence of mining. Circular 'doughnuts' of spoil from two bell pits are visible. The pits are workings on a mineralised fault. A white coating can be seen on some of the limestone blocks in the spoil. This is the mineral baryte. This limestone is called the Great Limestone and is the unit that hosts much of the mineral deposits in the North Pennine Orefield.

Bell pits on The Heights

Keep walking along the Pennine Way track until you reach the metalled road. If you wish, you can take a short detour to visit Dun Fell Hush by following the Pennine Way uphill for approximately 400m, before returning to this point.

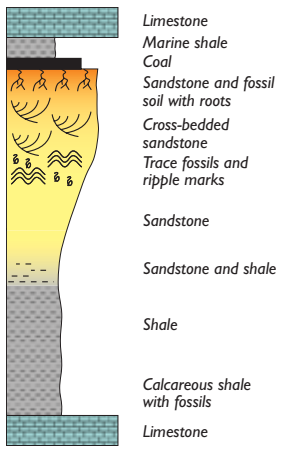
Dun Fell Hush is one of the largest in the North Pennines. The excavation follows the course of Dun Fell Vein that was worked for galena (lead ore) and limonite (iron ore). It has been estimated that 300,000 tons of material were excavated during the construction of the hush.

Dun Fell Hush

10 Cyclothems

A good section through the rocks below the Great Limestone is visible on the left-hand side of the road. Shale dominates the lower part of the exposure but sandstone beds become more common higher up. The shale was deposited in the Carboniferous sea but the sandstone beds contain fossilised tracks and feeding traces of ancient creatures and ripple marks, indicating that the beds were deposited on a beach. The variation in rock type and the change in fossil content upwards through the section indicate that the water depth became shallower through time. As the water shallowed, the environment changed from a sea to a beach and finally to dry land before the land was flooded once again to form a tropical sea in which the overlying Great Limestone was deposited.

Feeding trace fossils in sandstone



After deposition of the Great Limestone, the water shallowed again and a similar sequence of rocks to those exposed here was deposited on top of the Great Limestone. Sequences of rocks that repeat in this way are known as 'Yoredale Cyclothems' and are a dominant characteristic of the Carboniferous rocks of the North Pennines. The diagram to the left shows the rock characteristics that can be expected in a typical cyclothem; not all rock types are present in all cyclothems.

As you go downhill you pass Green Castle, an impressive outcrop of the Great Limestone.

11 Limestone Quarry

Here is a small quarry in the Tynebottom Limestone. About 2m of medium to dark grey, evenly bedded limestone is exposed. It has a slightly different appearance from the other limestones visible on this walk as it has been baked or 'metamorphosed' by the Whin Sill beneath it. The Whin Sill is visible in the stream on the right-hand side of the road.

12 Knock Quarries

The quarry workings are in sandstone which lies between two limestone units – the Melmerby Scar and Robinson limestones. The sandstone was quarried for building stone and has been used to build dry-stone walls around the nearby fields.

13 Limekiln

The building beside the road is a limekiln. Limestone from the small quarry above was burned in the kiln to produce lime to improve soil quality. The limekiln is close to, and level with, the bottom of the quarry making it easy to fill. In the North Pennines, the presence of old limekilns often indicates that limestone beds form the landscape nearby.

A limekiln

The top of the North Pennines - Great Dun Fell with Cross Fell behind