Dufton is in the North Pennines Area of Outstanding Natural Beauty (AONB) and European & Global Geopark

European and Global Geoparks

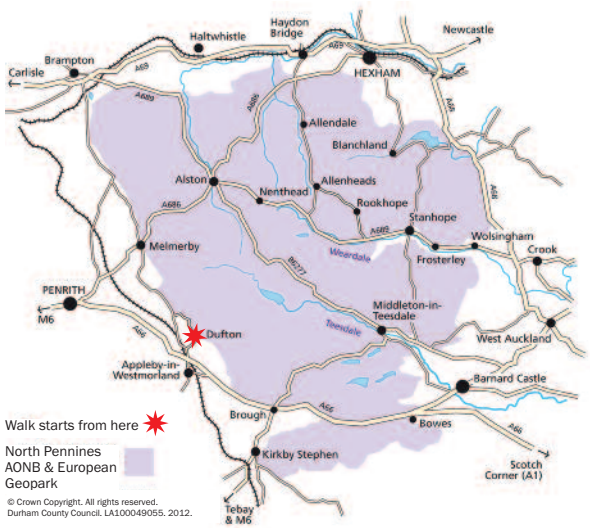
The North Pennines AONB is Britain's first European Geopark, a status supported by UNESCO, and a founding member of the Global Geoparks Network. Geoparks are special places with outstanding geology and landscape, and where there are strong local efforts to make the most of geological heritage through interpretation, education, conservation and nature tourism. To find out more visit www.europeangeoparks.org

Find out more about North Pennine geology

This leaflet is one of a series of geological publications about the North Pennines. These are part of the North Pennines AONB Partnership's work to make the most of our special geological heritage. This work includes events, education resources, publications, displays and much more...

To find out more about the geology of Dufton and nearby High Cup Gill, visit High Cup Winery, 2 km (1¼ miles) outside Dufton along the road to Murton. It houses a display on the local geology, which can be viewed whenever the winery is open (contact: 017683 53714, info@highcupwines.co.uk, www.highcupwines.co.uk).

Geology and landscape display at High Cup Winery



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Geology and landscape around

Dufton

A 3¾-mile walk exploring landscape, rocks, archaeology and mining heritage

Landscapes for life .org.uk

NORTH PENNINES One of the AONB family

Welcome to a special landscape...

...shaped by millions of years of natural processes and thousands of years of human activity.

The landscape around Dufton has been nearly 500 million years in the making and contains some of the oldest rocks in the North Pennines. From explosive volcanoes and tropical seas to deserts, glaciers and miners — all have helped shape this beautiful landscape.

This circular walk around Dufton Pike will introduce you to some of the special features of the landscape. By spotting clues in the hills, valleys and buildings you'll find out how to read the landscape and discover more about its fascinating past.

The sections opposite describe how the local rocks formed and how the landscape has been shaped by ice and, in more recent times, by people.

Walk length/time: Approx. 6 km (3¾ miles) with 150 m of ascent, taking about 2–2½ hours

Start/finish: Dufton village car park
Grid Reference NY 689 250

Terrain: This route is on public footpaths and bridleways, and two short stretches of minor road. It follows good paths and tracks, with several stiles. After a sustained but gradual climb, the route is gentle and undulating. Walking boots are recommended as the route can be rough and muddy in places. Please keep dogs under close control (on a lead on the moor and through fields with livestock) and leave gates as you find them.

Public transport: For timetable information call Traveline on 0871 200 2233 (www.traveline.info)

Facilities: The Stag Inn, Dufton Youth Hostel, car park and public toilets (visit www.duftonvillage.info for further details, including more accommodation)

Useful maps:

Ordnance Survey

1:50 000 Landranger 91 Appleby-in-Westmorland
1:25 000 Explorer OL19 Howgill Fells & Upper Eden Valley

British Geological Survey

1:50 000 Geological Sheets 31 (Brough-under-Stainmore) and 30 (Appleby)
1:25 000 Cross Fell Inlier Classical Areas Map

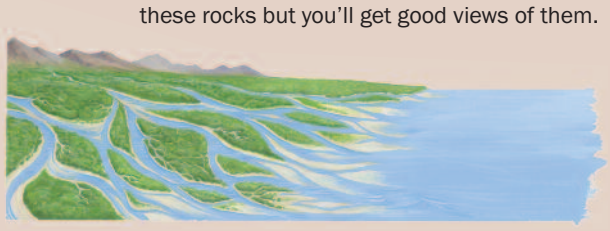
The oldest rocks in the North Pennines

The oldest rocks in the North Pennines are exposed in a belt along the escarpment and form distinctive conical hills like Dufton Pike. These rocks are slates and volcanic rocks, which formed between 480 and 420 million years ago, in the Ordovician and Silurian periods of Earth history. They were once mud and volcanic ash at the edge of a wide ocean. When the ocean closed the mud and ash were squashed and altered to form hard slaty rocks. These rocks are separated from the rocks of the Eden Valley and the North Pennine hills by faults — cracks in the Earth's crust along which the rocks have moved relative to each other.

Looking south-east along the escarpment, along the line of faults which separate the North Pennine hills to the left, from the 'pikes' on the right. Dufton Pike is in the middle distance

Tropical North Pennines

The rocks that lie above the slates and volcanic rocks, and which make up most of the North Pennines, are layers of limestone, sandstone and shale. They formed in the Carboniferous Period — 360 to 300 million years ago. Back then, the North Pennines lay near the equator and was periodically covered by shallow tropical seas and deltas. Over time, the limy ooze on the sea floor hardened into limestone, and the delta sands and muds turned into sandstone and shale. This walk doesn't pass over these rocks but you'll get good views of them.

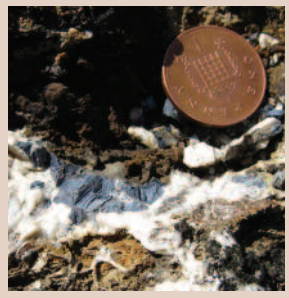


Carboniferous river deltas building out into tropical seas

Mineral riches

The North Pennines is famous for its mineral deposits. These formed about 290 million years ago, from warm mineral-rich waters flowing through fractures underground. As the fluids cooled, their dissolved minerals crystallized in the cracks, building up mineral veins.

In the 18th and 19th centuries Dufton was a busy mining village. The London Lead Company mined lead ore in these hills until the 1870s. In the late 1800s Dufton Fell Mine was turned over to the production of barytes, a heavy white mineral used in the chemical and paint industries.



Mineral vein sample from Great Rundale, containing bands of barytes (white) and the lead ore mineral, galena (lead-grey)

Desert rocks

The Eden Valley is underlain by red sandstones, which formed between 290 and 210 million years ago in the Permian and Triassic periods. These rocks formed from sand deposited in dunes and rivers, when this area was a desert north of the equator. You can see these red rocks in the buildings in Dufton and elsewhere along the foot of the escarpment and in the Eden Valley.

The North Pennine escarpment about 250 million years ago

Sculpted by ice

This landscape also owes much to the action of ice and meltwater. About 20,000 years ago a vast ice sheet covered the area. It smoothed the hills and valleys, and dumped clay, gravel and boulders. Meltwaters flowing under and around the ice carved channels and deposited sand and gravel. You'll see examples of these on this walk.

Geology and landscape around Dufton

1 **Red building stone**
Many buildings in Dufton are made of the local red sandstone, known as the St Bees Sandstone. It dates from the Triassic Period, around 250 million years ago, and formed from sand deposited in rivers flowing over desert plains.

Turn right out of the car park. After the left bend in the road turn left to follow a lane. Follow this for about 500 m until you reach a small stream crossing.

2 **At fault**
You're about to walk over a fault — a fracture along which the rocks have moved relative to each other. Here, it is hidden under glacial deposits. It is one of many faults along the North Pennine escarpment and separates very different rocks. Behind you are red sandstones; ahead are much older slates and volcanic rocks. You can see some of these rocks in the walls. The white boulders are quartz from the sequence of slates and volcanic rocks.

3 **Cup-marked stone**

Where the track crosses Eller Beck, look at the wall on the right. One of the stones on top has several small depressions. This intriguing 'cup-marked' stone is probably an example of prehistoric rock art, carved up to 5,000 years ago.

Follow the track past Pusgill House to reach open hillside.

4 **Dufton Pike**
The conical hill in front of you is Dufton Pike. Like the other 'pikes' along the escarpment it is made of slates and volcanic rocks. You can find examples of these rocks in the track. The pale, streaky rocks are a type known as ash-flow tuff, which formed in explosive volcanic eruptions around 450 million years ago.

Continue round the side of the hill and through a gate.

5 **Volcanic rocks**
Through a gateway on the left there's a small field quarry, which was probably once worked for walling stone. These volcanic rocks have been deformed and crumpled, unlike the flat-lying Carboniferous rocks that form the skyline hills.

Looking ahead along the track you can see Brownber Hill, which is made of slates. The white patch near the top is a quartz vein. The 'nick' between Brownber Hill and Low Scald Fell (to its right) marks the line of a fault. This fault separates 470-million-year-old slates from 330-million-year-old Carboniferous rocks.

Continue for about 150 m.

6

Meltwater channels
Curving around a small hillock on your right is a glacial meltwater channel. Sinuous channels like this, which formed under ice during the last ice age, are common along the escarpment. Just ahead, the track passes through another meltwater channel.

7 **Great Rundale**
At a right bend in the track, look up the valley of Great Rundale. The crags at its head are mainly layers of Carboniferous limestone. Below them is an old limekiln where limestone was burnt to produce lime for improving upland soils. In the 18th and 19th centuries Great Rundale was a busy, industrial place. Adits were driven into the valley sides to work mineral veins for lead ore and, later, barytes.

Go over the stile to your left and descend to another stile. Turn right to follow a grassy track (from where you get a superb view up Great Rundale — see right). Continue to a fork in the track by a waymarker post.

8 **View to Knock Pike and Cross Fell**
On the hillside on your left are patches of scree made of pale, volcanic rock. The conical hill ahead is Knock Pike, also made of volcanic rocks. Its name has ancient origins as it derives from Celtic 'cnoc' and Norse 'pik', both meaning 'hill'. From here you can look north to flat-topped Cross Fell which, at 893 m, is the highest hill in the Pennine chain.

Take the right fork and follow the path down to a ford.

9 **Clapper bridge**
Look over the gate at the clapper bridge over Great Rundale Beck. Many clapper bridges are thought to be ancient. The slabs are made of limestone, which must have been brought here from the sequence of Carboniferous rocks higher up the escarpment.

Don't go over the bridge but follow the track uphill and round a bend.

10 **Cosca Hill**
The smooth, sweeping slopes of Cosca Hill to your left are underlain by glacial sand and gravel. These were deposited in the last ice age by meltwater flowing through channels under the ice. When the ice melted, the sand and gravel were left as ridges and mounds.

Continue until 150 m past the derelict farm of Halsteads.

11 **Dufton Microgranite**
This stretch of wall contains blocks of orange rock. This is the Dufton Microgranite, which formed 400 million years ago from molten rock. It was injected into the rocks that now form Dufton Pike, and solidified underground. After millions of years of erosion it is now exposed. It contains crystals of quartz (pale grey and glassy), feldspar (pinky orange) and mica (silvery and flaky).

Continue along the track, an old drove road called Hurning Lane (also the Pennine Way). Go through Coatsike Farm and continue to the west end of Dufton.

12 **Dufton fountain**

The fountain on the green was provided by the London Lead Company in 1858. This Quaker-owned lead mining company made many improvements to Dufton, building houses for mining families and installing piped water.

For a pleasant short extension...

Turn right out of the car park and immediately right again to follow a track to nearby Dufton Ghyll, which you can explore using the many paths. In this wooded gorge there are cliff faces of St Bees Sandstone, which were once worked for building stone. Look out for quarrymen's tool marks and carved names.