
Dinantian rocks

Dinantian rocks were formed during the Dinantian Epoch of the Carboniferous Period, between approximately 327 and 316 million years ago. The name Dinantian is taken from the Belgian town of Dinan, where there are good sections in the limestone cliffs of the River Meuse.

Currently protected sites of Dinantian rocks within the AONB SSSIs

Dinantian rocks are exposed within a number of areas scheduled as SSSIs. However there are no sites within the AONB specifically designated for protection of the Dinantian rocks within the Geological Conservation Review.

RIGS

Punchbowl Bridge, North Stainmore [NY 3008 5128]

Durham County geological sites

Black Cleugh, Burnhope [NY 853 394]

Bow Lees Beck [NY 907 283]

Green Gates Quarry, [NY 934 236]

Horsley Burn Waterfall, Eastgate [NY 975 384]

Middlehope Burn, [NY 906 381]

Killhope Burn, Copthill Quarry and Wear River at Butreeford Bridge [NY 855 406]

Killhope Lead Mining Centre [NY 823 433]

Scoberry Bridge to Dine Holm Scar [NY 910 274]

Sedling Burn, Cowshill [NY 855 405]

Stanhope Burn [NY 987 398]

Widdybank Fell [NY 820 290]

Other representative sites in the area

Ardale Beck [NY 661 349]

Ashgill Force, Garrigill [NY 758 405]

Cow Green, Upper Teesdale [NY 813 307]

Falcon Clints, River Tees [NY 830 284]

Summerhill Force (Gibson's Cave), Bowlees [NY 910 287]

Knock Ore Gill [NY 701 300]

Knott Quarry, Cow Green [NY 818 309]

Dinantian rocks in Great Britain

Sedimentary rocks make up the bulk of the Dinantian succession, although volcanic rocks are present locally in the English Midlands, Cumbria, north Northumberland and southern and central Scotland. Over much of Britain, the pattern of Dinantian outcrops reflects deposition within the pattern of fault-bounded blocks and basins, which characterised the Carboniferous. The Carboniferous Dinantian successions of northern England generally comprise cyclic repetitions of marine limestones alternating with deltaic mudstones and sandstones. Much greater thicknesses of sediments accumulated within the basins than on the intervening blocks, though widespread marine limestones enable correlation between basins and blocks. Although the succession of Dinantian rocks varies considerably from area to area, across much of northern Britain the rocks record a progressive change from thick marine limestones to the highly characteristic repeated sequences known as Yoredale cyclothem.

Dinantian rocks in the AONB

Outcrops of Dinantian strata cover 55,997 hectares in the central and western areas of the AONB. Because of their general easterly regional dip, the oldest beds crop out in the west and are succeeded eastwards by progressively younger beds.

As discussed above, the classification of the Dinantian rocks of the AONB, adopted in this document, is based on that used in currently available 1:50000 scale geological maps.

Basement Group

The Basement Group comprises the first Carboniferous sediments deposited, following a period of erosion in the Devonian Period. These rocks rest unconformably upon older rocks. The lowest part of the Group consists predominantly of conglomerates composed of fragments of Ordovician and Silurian rocks, overlain by sandstones and shales, a few bands of impure limestone and, rarely, thin coals. The thickness of the strata varies as the sediments filled irregularities in the underlying surface. Outcrops of the Basement Group rocks are restricted to the North Pennine escarpment and the Teesdale Inlier at the foot of Cronkley Fell

The Basement Group may be subdivided as follows:

- Roman Fell Sandstones
- Roman Fell Shales
- Basal Conglomerate

Orton Group

The Orton Group is poorly exposed, mainly on the North Pennine escarpment. The group generally consists of about 30m of interbedded dark grey limestones, mudstones and sandstones. The Group is most completely developed in the Brough area, where it may be divided into the following units:

- Hillbeck Limestones
- Ashfell Sandstone
- Ravenstonedale Limestones

Alston Group

The Alston Group consists of a succession of well-developed typical Yoredale cyclothem, conventionally named from the limestone at the base of each. Up to at least 17 named limestones are recognised, though several of these are only

developed locally. Whereas most of these cyclothem units can be traced across the AONB and beyond, some are incomplete and cannot be traced across the whole area. The thickest limestone unit within the AONB is the Melmerby Scar Limestone. Of the rock types within this succession, limestones are the most widespread and consistent in composition and thickness. Apart from the Melmerby Scar and Robinson limestones, which are typically pale grey, the limestones are mostly medium to dark grey in colour. Between the limestones, the succession of rock-types, mainly comprising mudstones and sandstones, is much more varied in character and thickness from place to place. Immediately above the limestones, the shales are locally fossiliferous and calcareous. They typically pass upwards into dark grey or black mud rocks, in places with clay-ironstones. Although several of the more prominent sandstones can be traced over large areas, their thickness may vary markedly and in places the sandstone may be absent. The top of the sandstone unit may be a seatearth with abundant rootlet traces and a strong siliceous cement, giving the distinctive rock known as 'ganister'. Coal, if present, is rarely more than a few centimetres thick. In addition to the limestones, all of which were named at an early date by miners and quarrymen, many of the most persistent sandstones were also named. Only one shale unit, the Tynebottom Plate, has acquired a widely used name.

Impact on the landscape

The extensive outcrop of Dinantian rocks within the AONB has a profound influence on the landscape. Weathering of the alternately hard and soft beds within the Yoredale cyclothem units has produced a highly distinctive terraced form to many of the hillsides. Limestones and many sandstones are typically resistant to erosion, compared to interbedded shales and softer sandstones. These hard beds thus tend to be expressed as steeper slopes, in places marked by small rocky scars; softer beds give rise to more gentle slopes or areas of 'slack' ground. In numerous streams and rivers, waterfalls mark the outcrop of many of the harder limestones and sandstones. Good examples include Ashgill Force, Summerhill Force (alternatively known as Gibson's Cave) and Nent Force. These commonly provide excellent exposures of complete or nearly complete cyclothem units.

The extensive low-angle slopes that lie to the east and north-east of Cross Fell reflect the gently inclined beds of Dinantian rocks. Wide outcrops of the Melmerby Scar and Robinson limestones on the escarpment in the Melmerby and Brough areas, give rise to crags and locally some areas of limestone pavement. Lines of sinkholes typically mark the position of many of the area's limestone outcrops and are well developed on the Melmerby Scar Limestone (see Karst).

In contrast with the rest of the Dinantian rocks, the lowermost part of the succession, the Basement Group and the Orton Group, have more limited impact on the landscape where they form the lower slopes of the escarpment.

Many miles of drystone walling, which are such a distinctive feature of the landscape, are built from locally quarried Dinantian sandstones. The pattern of improved pastures and fields, so characteristic of the North Pennine dales, owes much to the use of slaked lime produced from locally quarried Dinantian limestones.

Impact on biodiversity

As with their effect upon the landscape, the Dinantian rocks exert a fundamental influence on the area's biodiversity. Bare limestone crags and pavement provide extremely important habitats for a number of specialised plant communities, including lichens and other lower plants. Elsewhere, outcrops of limestone, where free, or substantially free, of superficial cover, typically support areas of limestone grassland. The comparatively brighter green, more species-rich, vegetation on the limestone, compared to the rather sombre vegetation of the more acidic soils developed on the intervening shales and sandstones, is often a conspicuous landscape feature visible from some distance and may be a useful clue to identifying limestone outcrops. Carboniferous limestones, where exposed as cliffs tall enough to exclude grazing sheep, provide refugia for plants such as alpine conquefoil, roseroot and rare grass species. Some cliffs support nesting sites for birds such as peregrine and raven. Caves and enlarged joints within natural outcrops and quarries locally serve as important bat roosts.

Outcrops of shales or sandstones, where substantially free of superficial cover, typically support a range of neutral to acidic soils upon which neutral to acid grassland vegetation is characteristic.

Economic use

Dinantian rocks have been of considerable economic significance within the AONB.

The outcrops of most of the limestones are marked by small quarries and associated kilns, formerly worked to provide local supplies of quicklime and slaked lime for use as a soil improver. Extraction of limestone from the Robinson Limestone at Helbeck Quarry, Brough, and the Great Scar Limestone at Hartley Quarry, Kirkby Stephen, continues today. Many of the Dinantian sandstones have been employed as building stones, mostly for very local use. Substantial amounts of locally produced sandstone have been employed in drystone walling. The Dinantian rocks comprise important host rocks for metalliferous veins and associated replacement deposits. Only a few coals in the Alston Group have ever been worked.

Wider importance

The North Pennines AONB includes some of the best and most complete examples of 'Yoredale' cyclothems to be seen in Great Britain. Comparison of this area with adjacent sedimentary basins, such as those of the Solway, Midland Valley and Craven basin, allows correlation of rock units to further understanding of the UK's evolution during Carboniferous times.

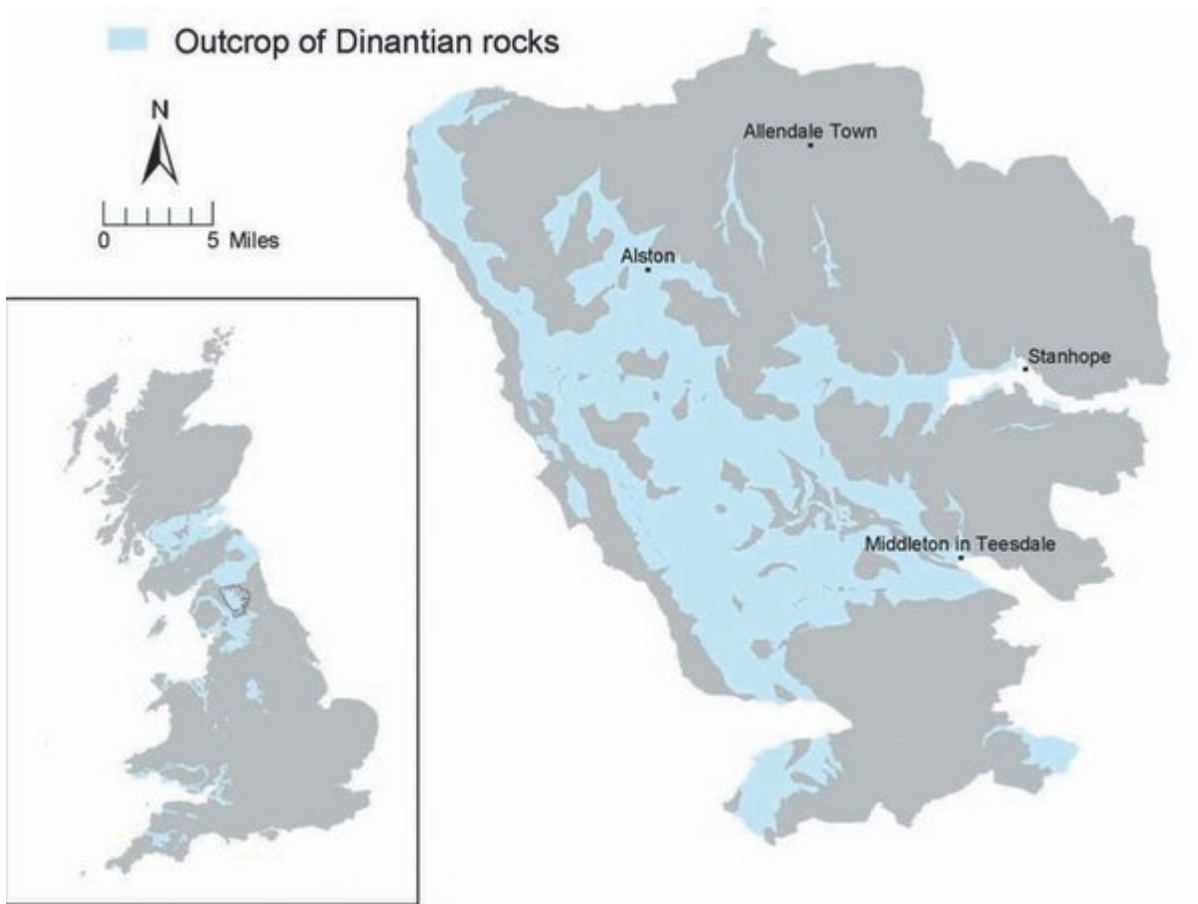
Conservation issues

Whereas most of the exposures of these rocks and features associated with them, in natural exposures and abandoned quarries, are robust elements in the landscape, suitable vigilance should be exercised to ensure that no operations or activities damage the most important of these features. The progressive deterioration of long-abandoned quarry faces, together with risks of quarries being filled, may pose some long-term threats.

Figures

(Figure 17) Outcrop of Dinatian rocks (Figure 18) Falcon Clints, Teesdale. Conglomerates and shales of the Orton Group. © B. Young, BGS, NERC. (Figure 19) Hilton Mines, Scordale. Craggs of Whin Sill overlying Melmerby Scar Limestone. © B.Young, BGS, NERC.

[Full references](#)



Outcrop of Dinantian rocks.



Falcon Clints, Teesdale. Conglomerates and shales of the Orton Group. © B. Young, BGS, NERC.



Hilton Mines, Scordale. Crags of Whin Sill overlying Melmerby Scar Limestone. © B.Young, BGS, NERC.