FACT SHEET 6:

PEAK DISTRICT
NATIONAL PARK AUTHORITY

Rocks and minerals of the Peak District National Park

IN THIS FACT SHEET:

Rocks and minerals of the Peak District National Park

The rocks of the Peak District National Park which were formed over millions of years, are now the basis of the spectacular landscapes we see today. The rocks have a huge influence, not only on the soils and types of plants and animals [Wildlife Fact Sheet] that live in the area, but also on where people live and the jobs they do.

The underlying geology gives the area many of its special qualities and is one of the reasons why the Peak District was designated as the UK's first National Park [PDNP Fact Sheet] in 1951. The rocks and minerals of the Peak District are also an important resource, for example limestone is used in the chemical industry, for agricultural purposes, and in the construction sector for cement and aggregate.

The Peak District National Park has eight distinctive landscape character areas:

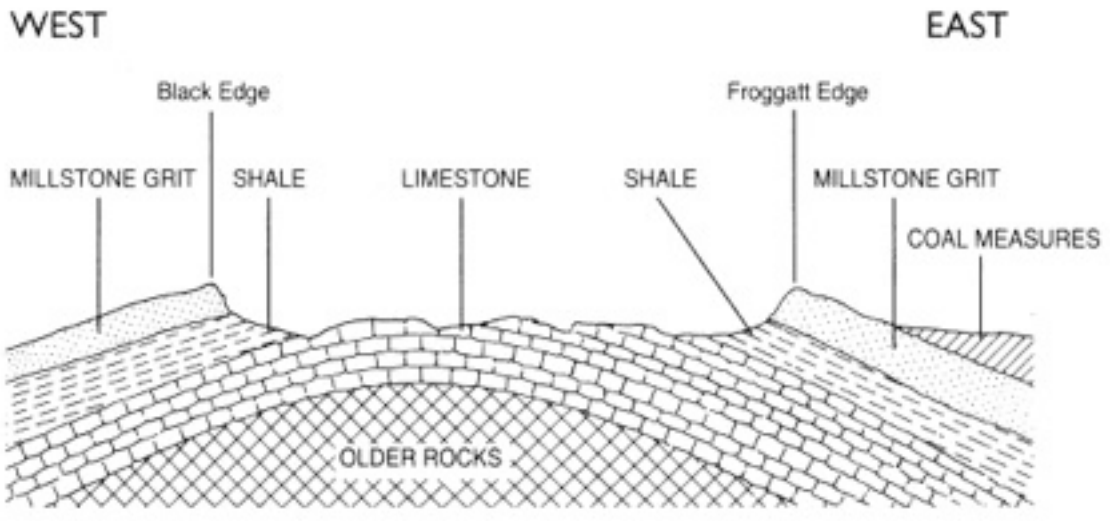
- Dark Peak
- Dark Peak Western Fringe
- Dark Peak Yorkshire Fringe
- South West Peak
- Eastern Moors
- Derbyshire Peak Fringe
- Derwent Valley
- White Peak

The Dark Peak and the associated Fringe areas, the Eastern Moors and the South West Peak lie on gritstone while the White Peak lies on older rock - limestone. At the interface between the White and Dark Peak the rock is mainly soft shale - this is where the main valleys of the region have formed. The gritstone has been strongly folded in the South West Peak, creating rocky edges and steep slopes. Coal measures have been exposed in some limited places, such as the Goyt Valley. [Goyt Valley Fact Sheet]

The limestone, gritstone and shale rocks are sedimentary in origin and were formed between 360 and 300 million years ago during the Carboniferous Period. The maximum total thickness of the Carboniferous sediments in the Peak District was about 1,800 metres (over a mile) prior to uplift and erosion.

In addition to these sedimentary rocks, there are igneous rocks (basalts, dolerites and tuffs) in the White Peak formed from ancient volcanic lava and ash flows. The limestone also contains deposits of mineral ores such as galena (lead sulphide), chalcopyrite (copper iron sulphide), fluorspar (calcium fluoride), calcite (calcium carbonate) and barite (barium sulphate). Lead and copper have been mined for three thousand years and supported a substantial industry during the 18th and 19th centuries. Fluorspar is still mined today (with other minerals recovered as by-products).

Coal seams, formed from Carboniferous vegetation and peat swamps, were laid down on top of the gritstone around 316-300 million years ago.



Cross section showing profile of different rock types in the Peak District National Park

Where did the rocks come from?

Formed in the early part of the Carboniferous Period (between 360 and 326 million years ago) limestone is the Peak District's oldest exposed rock. At this time the land that is now the Peak District lay just south of the equator and was covered by a shallow tropical sea. The sea was warm and full of nutrients, providing an ideal habitat for many marine species. Corals grew to form reefs encircling clear tropical lagoons in which prehistoric sea plants and creatures lived and died. Many sea creatures, such as sea-lilies (crinoids), brachiopods and bivalves, had a hard outer skeleton (exoskeleton) of calcium carbonate. When these creatures died their bodies would sink to the bottom of the sea floor and the soft inner parts would rot away leaving the exoskeletons. Over a period of around 30 million years, the calcium carbonate turned into limestone.

Reefs made from corals were mostly found in a fringe or barrier around the lagoon. A good example of a fossilised barrier reef is the hill behind Castleton [Castleton Fact Sheet] on which Peveril Castle stands. There is reef limestone in Middleton Dale and in the Dove Valley [Dovedale Fact Sheet], where Thorpe Cloud and Parkhouse Hill stand as isolated reefs. Crinoids tended to grow on the edges of the reefs, so reef limestone is usually surrounded by limestone containing many crinoid fossils. Looking like nuts and bolts in the rock, the fossilised stems are known as Derbyshire Screwstone.

Limestone has many uses – as building stone and aggregate (crushed stone) for roads or concrete; to make cement (with shale); and, as burnt lime or pure calcium carbonate, in the chemical industry. Most current quarrying and mineral extraction [Quarrying and Minerals Extraction Fact Sheet] operations are carried out under old planning consents which were given before the area became a National Park.

The gritstones and shales were laid down in the middle Carboniferous Period (around 326-316 million years ago) when the northern part of the Peak District was covered by a huge river delta flowing down from what is now the Scottish Highlands and Northern England. The river carried sediments of mud, sand and pebbles which were deposited on the bed and at the front of the delta as it flowed into the shallow sea.

Fine grained mud and sand sediments formed shale and siltstone. Coarser sand and pebbles eventually became gritstone, also known as Millstone Grit because millstones were made from it.

As the delta advanced slowly southwards deposits of mud, sand and pebbles were laid down in successive layers on top of the limestone. The alternating layers of shale and sandstone seen in the face of Mam Tor overlooking Castleton [Castleton Fact Sheet] are a result of sands cascading down the front slope of the delta beneath the surface of the sea (turbidites). Later layers of gritstone, such as the Kinderscout Grit which forms the Kinder plateau and the Chatsworth Grit (found around Baslow and the Chatsworth estate) were coarser.

The gritstone outcrops now form a horseshoe shape around the northern fringe of the Peak District National Park, and their sharp edges (scarps) can be seen around Curbar and Calver in the east, Edale in the north, and the Roaches and Ramshaw Rocks in the west. Non-marine fossils are rarely seen in the gritstone rock, but marine fossils can be found in the shale layers of the turbidites, showing that the area was once close to or beneath the sea.

In the swamps behind the delta, plants such as giant ferns and mosses grew to form a tropical forest. Over time, layers of debris from the dead plants built up and were buried. Pressure and chemical changes eventually turned the debris into seams of coal covering the whole of what is now the Peak District and the land on either side. Around 300 million years ago, movement from deep underground caused the area to bulge upwards, and subsequent erosion wore away the coal measures to reveal the underlying gritstone and limestone. The coal measures on the eastern and western fringes of the Peak District were relatively thin compared with those in the surrounding lowlands. They were largely worked out by the end of the 19th century.

What about the volcanic rocks?

There are three types of igneous rock in the Peak District, formed at around the same time as the limestone:

- 'Intrusions' were formed when lava squeezed from deep underground into the limestone without reaching the surface. As the lava gradually cooled it developed large crystals, eventually forming an igneous rock called dolerite. Dolerite weathers to a rusty colour due to its high iron content. It can be found at the disused quarry in Tideswell Dale, a Site of Special Scientific Interest (SSSI).
- 'Extrusions' were formed when lava erupted through the limestone onto the sea floor of the tropical lagoons. The lava quickly solidified and eventually formed a fine-grained, very dark crystalline rock known as basalt. Some of the basalt flows contained abundant gas bubbles which subsequently became filled with minerals, forming distinctive 'amygdaloidal' basalts. A basalt extrusion, also a SSSI, can be seen at a cutting on the **Monsal Trail** between Millers Dale and Litton Mill.
- 'Wayboards' were formed when fountains of volcanic ash erupted onto the shallow sea. These ash clouds settled onto the sea floor, smothering the coral reefs and eventually decomposing into thin, soft layers of clay, known as wayboards. These do not form visible outcrops and are generally only seen where they have been exposed in quarry faces.

The local name for these igneous rocks is toadstone, possibly due to their colour and texture. Alternatively, it could be a reference to 't'owd stone' (the old stone).

Uplifting, folding and wearing away

About 300 million years ago, the area, now infilled with gritstone, shale and coal measures, was uplifted as a result of movement within the Earth forming a gentle anticline (or upfold) across what is now the Peak District. The land took on a dome-like shape, and is generally referred to as the Derbyshire Dome. The folding caused faults (or cracks) to appear in the rocks – particularly in the limestone.

The coal measures were gradually worn away (eroded) leaving the gritstone exposed. At the highest part of the dome, the gritstone was also eroded to reveal the limestone beneath. This formed the southern part of the Peak District, known as the White Peak. The exposed gritstone edges fringe the White Peak in a horseshoe shape around its northern, western and eastern fringes.

Where layers of gritstone and shale alternate, the ground can be unstable. As the shale erodes it becomes softer, causing the harder layers of gritstone to slide apart. These unstable rocks still cause landslips today at places such as Mam Tor, which is also known as the Shivering Mountain because of its loose slopes.

Why does limestone contain minerals?

After the Carboniferous Period (from the Permian Period onwards), the faults and cracks created in the limestone became filled with a hot liquid which crystallised to form minerals. One theory is that this liquid, rich in dissolved metals, was expelled from deep sediment-filled basins located to the east of the Peak District. The hot liquid flowed through fissures in the limestone, depositing minerals in cavities as the liquid cooled and mixed with shallower groundwater.

Shaping the landscape of today

Over the subsequent 300 million years the land that would eventually become Britain moved northwards from the equator to its present position in the northern hemisphere, bringing it within the influence of the Arctic ice cap. From around two million years to 12,000 years ago alternating warm (interglacials) and cold periods (glaciations or Ice Ages) carved the natural landscape we see today.

In the Peak District deposits formed during this period are widespread. An important example is glacial till (boulder clay) which was formed from rocks and debris trapped under glaciers. Deposits of glacial till can be found in the Bakewell area. A layer of fine sands and silt (loess) was blown from the north to settle on top of the limestone plateau in some places.

Fast flowing rivers fed by melting ice in the warm interglacials formed and deepened the valleys. As the rivers became deeper and wider the dales of the present White Peak landscape were carved out of the limestone by water. Some dales were formed as caverns in the limestone collapsed. Cave Dale in Castleton provides a good example of this. Many of the limestone dales are dry because the water now flows deeper underground as a result of lower water table levels. Surface water flowing into the ground and underground streams helped to carve out large caves by dissolving the limestone, which eventually became filled with air as the water table fell.

Above the Dark Peak's edges the harder gritstone has been weathered into extraordinarily shaped rock tors. The most outlandish formations have been given descriptive names, such as the Eagle Stone above Baslow Edge, the Salt Cellar and Cakes of Bread on Derwent Edge, and the Woolpacks on Kinder.

Geology and people

The geological resources of the Peak District have provided its inhabitants with a livelihood from the very earliest times.

Gritstone was quarried in the Iron Age to make hand-powered stones to grind grain ('querns'). Later, gritstone was quarried to make millstones for use in water, wind and steam mills, crushing stones for mineral extraction and as grindstones for the Sheffield edge tool industry. There are more than 1,000 discarded millstones scattered in parts of the Peak District National Park, and the millstone is the Park's symbol. Gritstone is used as a building material because it can be easily shaped. Chatsworth House is built from gritstone, as are many other buildings in the Peak District. Gritstone was often used to make lintels around doors and windows, gateposts and water troughs.

Limestone is also an important construction material. It was quarried by the Romans who used it for building stone and mortar. Since the 17th century, the Peak District has been a major producer of lime and limestone, employing thousands of people. Dark limestone, containing fine-grained organic material and other impurities, was the basis of the black marble industry at Ashford and Bakewell from the late 17th until the early 20th century. When polished, the stone turns a deep glossy black.

The numbers working in mining and quarrying [Quarrying and Minerals Extraction Fact Sheet] has declined dramatically throughout the 20th century. Nowadays fewer than 2% of residents of the National Park work in the mining and quarrying sector. In 2008-09 there were 47 'active' quarries in the Peak District National Park covering 3,299 hectares. Around half of these are actively extracting material; the rest are subject to on-going restoration or are not operational for other reasons.

Bronze Age farmers mined copper, one of the main constituents of bronze, sometime between 2,000 and 1,500 BCE, as well as small quantities of lead for ornaments and ritual objects. The Romans mined lead on a much larger scale, with Roman lead ingots ('pigs') from the Peak District found as far away as Normandy. Several local lead mines were mentioned in the Domesday Book of 1086. Lead was used for water pipes, gutters and on roofs, and later, for lead shot, leaded windows and in paint. The lead mining industry reached its height in the 18th century when there were thousands of lead mines in the Peak District. By the end of the 19th century the lead mining industry was in decline and the last big lead mine, Millclose Mine at Darley Bridge, located just outside the National Park closed in 1939. There are many **remains of the old lead mining industry** scattered throughout the region.

In the 20th century it was the waste material (gangue minerals) from lead mining, notably fluorspar, barite and calcite that became important.

Fluorspar is used in the chemical and steel industries, and in other applications such as fluoride in toothpaste. Currently, almost all British fluorspar ore is mined in the Peak District.

Barite is used in paint and paper manufacture, and as an additive to drilling fluids in the oil extraction industry. Calcite crystals are used for ornamental chippings and finishes.

A special type of fluorspar is found on a small scale at Castleton [Castleton Fact Sheet]. It is called Blue John which comes from the French words for the two main colours in the mineral – bleu (blue) and jaune (yellow). A number of shops in Castleton sell jewellery and ornaments made from Blue John.

Today, the Peak District's

spectacular landscapes attract millions of visitors [Tourism Fact Sheet] every year. Thousands visit the show caves at Castleton and the limestone crags and gritstone edges draw rock climbers from around the world. Many sites are **Regionally Important Geological and Geomorphological Sites (RIGS)**, and some are also designated as Sites of Special Scientific Interest (SSSIs) for their geological value.

Further information

- **The National Stone Centre**,
  Middleton by Wirksworth, tel: 01629 824833
- **Peak District Mining Museum**,
  Matlock Bath, tel: 01629 583834
- **The Lead Legacy: the Prospects for the Peak District's Lead Mining Heritage**,
  J. Barnatt and R. Penny, 2004
- **Peak District Landscape Character Assessment**
- **Peak Geology**
- The Peak District: Landscapes Through Time,
  John Barnatt and Ken Smith,
  published by Windgather Press, 2004.
- The Geology of England and Wales,
  P J Brenchley and P F Rawson (eds.),
  published by Geological Society, 2006.