Exploring aggregates along the Geopark Way

An informative and illuminating insight into the aggregates industry together with an overview of nine former aggregate sites found on or near the Geopark Way trail

ACKNOWLEDGEMENTS

This booklet has been produced with contributions from Gloucestershire Geology Trust, volunteers, community groups and individuals living near the Geopark Way trail.

Volunteers and other interested parties visiting a former aggregate quarry which was last worked in 1992. Astley and Dunley parish, Worcestershire

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Abberley and Malvern Hills Geopark

NATURAL ENGLAND

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INTRODUCTION

Imagine a world without aggregates. Would it look so different from the one we live in? Would it be a better place? In truth such a world could not exist, as humans have been extracting and using aggregates for many thousands of years. From digging out sand and clay to make bricks and tiles, to breaking up rock to create roads, aggregates were, and still are, the basic building materials upon which our civilisation is built.

The general view is that aggregates are used only in the construction and road industries. Whilst this is largely true in around 90% of cases, the remaining 10% are used in a number of surprising ways. Aggregates are, for example, essential in sugar purification and for making medicines palatable, as well as being important in the animal and human food industries.

What are Aggregates?

Aggregates are crystalline or granular rocks that are extracted for use in the construction industry. These can be either **primary aggregates** (extracted from the ground in quarries) or **secondary aggregates** (recycled from construction waste and manufactured materials such as slag). Aggregates are essential materials in building and repairing roads, railways and homes.

Defra (Department for Environment, Food and Rural Affairs) and **HM Revenue and Customs** have a specific list of recognised aggregates, mostly confined to sand, gravel and rock chippings, which are subject to the **Aggregates Levy** - an environmental tax on UK-produced commercial aggregate. Other organisations, such as the aggregates industry, include a broader spectrum of materials in their definition of 'aggregates'.

Right: Aerial photograph of Daglingworth Quarry, Gloucestershire. Reproduced by kind permission of Hanson Aggregates

THE GLOBAL PICTURE

Almost every country in the world has exploitable aggregate reserves. Some markets, such as in Europe and America, are fully exploited, while the African, Central American and Asian markets are under-exploited.

Currently, around 58 billion tonnes of mineral and rock resources are extracted globally each year, but this enormous figure is growing as the Asian markets develop and expand.

The current level of resource extraction is unsustainable in the long term and new technologies will need to be developed. Recycling resources including aggregates will become a priority as winnable reserves become scarce. A major issue the people of the world will need to face is the environmental damage caused by mineral extraction itself, and the transportation (over increasingly greater distances), processing and consumption of these materials. The UK is a world leader in researching and reusing aggregate and mineral resources.

Piles of aggregate, which can be seen all over the world in almost every country.
Reproduced by kind permission of Gloucestershire Geology Trust

THE UK PICTURE

The aggregate industry has a long history in the UK. For over 2000 years aggregate has been quarried; firstly by late Iron Age peoples as ballast for their boats (Ballast Quarries at Hengistbury Head, Dorset), through the Romans who used it to build their roads and cities, to the Industrial Revolution of the late 18th Century, and onwards to today.

Being a geologically diverse island, the UK is self-reliant in aggregates and can meet all its own needs. Indeed, it exports aggregates to some unexpected places: The UK exports building sand to Saudi Arabia, as the sand there has too high a salt content and so cannot be used in the construction industry.

The UK's marine dredging fleet is one of the largest in the world, and currently recovers around 27 million tonnes of sand and gravel, primarily off the SE and Welsh coasts. Around 7 million tonnes is sold for export, with the rest used for beach nourishment and construction projects. About 0.14 % of the UK's seabed is currently dredged for aggregates.

Key Facts About the UK Aggregates Industry

- There are 1300 active quarries in Britain, supplemented by a fleet of 25 marine dredgers as of the start of 2011.
- During 2009 about 210 million tonnes of aggregates were produced in the UK.
- 88,000 people are employed by the industry, of which 50,000 are indirectly employed.
- At 4.8 tonnes per head, the UK uses less aggregate than the typical European's 6.9 tonnes.
- The average house requires around 60 tonnes of aggregates.
- The aggregates industry accounts for around 10% of the UK's GDP.

Marine dredging vessel and barge

HOW AGGREGATES ARE USED IN THE UK

The most widely used aggregates in the UK are sand and gravels followed by limestone, then igneous and metamorphic rocks (mostly extracted in Scotland) and finally sandstone.

Gravels are the primary rock type used to make concrete. Igneous and metamorphic rocks are used where strength is required such as for railways and roads. Limestone is the most versatile of the rocks quarried, and is used in many industries including construction, agriculture and pharmaceuticals.

Because aggregates come from a wide range of sources; natural, manufactured and recycled, the uses to which they are put reflect this diversity. Aggregates are used to make cement (lime and sand, mixed with water to form mortar), concrete (mixture of broken stone or gravel, sand, cement, and water) and asphalt (mixture of pitch with sand or gravel, used to surface roads). More obviously, aggregates are used on footpaths, driveways and as ornamental gravels in gardens and fishponds.

Aggregate surfaced church pathway

Aggregates, and the products resulting from their extraction and processing, are used in a surprisingly wide range of industries.

Examples of uses for limestone extraction by-products:

- In the printing industry paper is coated with a limestone filler to give it a smooth finish.
- In the manufacture of paint, soap, household cleaners and toothpaste.
- Baking powder is made by reacting pure phosphoric acid with lime – a substance consisting of calcium oxide, obtained by heating limestone.
- In agriculture lime is used in animal feeds and for fertilizers.
- Pharmaceutical industries use lime to make chemicals.

Aggregates and the processes to extract them are thus used in a very wide range of industries, which impact on almost every aspect of our lives.

Seconday and Recycled Aggregates:

Secondary aggregates include china clay sand, slate aggregate, blast furnace slag, ash, and recycled glass/plastic/tiles.

Recycled aggregates include construction and demolition materials (concrete, tiles, and bricks), highway maintenance waste (asphalt planings) and spent railway ballast.

Both the introduction of the Landfill Tax and the Aggregate Levy have resulted in the growth of the secondary and recycled aggregates industries and market. However, whereas primary aggregates generally travel short distances from source to site, the cost advantage of secondary and recycled aggregates has resulted in these goods being economic to transport over much longer distances.

Right: Daglingworth Quarry in Gloucestershire showing the processing plant. Here, limestone is crushed, sorted and graded to be used as road aggregate and ornamental gravel, whilst the dust is used for brick making. Reproduced by kind permission of Gloucestershire Geology Trust

PROBLEMS ASSOCIATED WITH EXTRACTION

Like many industries, the aggregates industry has its associated problems and opposition to quarrying can be very vocal.

Quarrying is a noisy and dusty process, often involving lorries using country lanes to get to main roads or railways. In addition the industry is perceived as creating huge ugly holes in an often picturesque landscape. But how true is this image?

There are fewer quarries in operation today than fifty years ago. Modern quarries are generally much larger than in previous years; whilst this can increase the impact on the local environment it reduces the impact over the wider area.

Quarry companies are also generally larger, with better resources to manage their quarries. Controls on pollution have improved in recent years, with new technologies being developed. For example, the dust from limestone quarries is collected and used in brick making while quarry companies employ specialist personnel to manage and implement restoration plans. In the past, once extraction had finished, a quarry was simply left and this is why there are now many small quarries dotted around the landscape.

Up until the late 20th century, some important archaeological sites were lost to quarrying. Today a full archaeological assessment has to be carried out before any quarrying starts.

The quarrying industry is very tightly regulated, with a number of strict controls put in place before any permission for extraction is granted. Whilst these do not completely eliminate problems they do seek to address local concerns.

Common Concerns about Quarrying:

- Visual damage to the landscape
- Lorry traffic, noise, dust and vibration
- Loss or diversion of footpaths and bridleways
- Use of site once extraction has finished
- Damage to agriculture and forestry

To Mitigate Against Potential Problems, Companies will:

- Invest in pollution reduction technologies
- Undertake full public consultation before extraction begins
- Undertake full environmental and archaeological impact assessments
- Where possible, screen quarries with vegetation or earth banks
- Develop and implement full restoration plans for when extraction ceases

Typical dumper trucks used in the aggregates industry. Reproduced by kind permission of Gloucestershire Geology Trust

POSITIVE ASPECTS OF EXTRACTION

Historically, the quarrying industry has not been very successful in educating the public in the positive aspects of the work that it undertakes . All too often it is the negative side of the business that dominates the news, resulting in a misunderstanding of the quarrying industry.

- Around 15-20% of the aggregates market is now met from recycled aggregates.
- The quarrying industry is the second biggest user of rail freight, after coal, with around 36 million tonnes being moved this way.
- The aggregates industry emitted about 9.98kg of carbon per tonne during 2004; which equates to 0.6% of the UK's total.
- In a typical year about 14,300 hectares of land is being quarried, 434 hectares prepared for quarrying and over 860 hectares restored.
- 80% of quarrying products are used within a 30 mile radius of the source quarry.
- Environmental standards are continually being improved and implemented.
- The aggregates industry plants around 195,000 trees and 20,000 metres of hedgerow in a typical year, making the quarrying industry one of the major contributors to forestry in the UK.
- To date, 700 Sites of Special Scientific Interest (SSSI) have been designated in quarry sites. Of these 500 are geological designations.
- The quarrying industry invests around £10 million a year in archaeological investigations.
- Many millions more are invested by quarrying companies into increasing biodiversity within and around active quarries, and once quarrying has ceased.

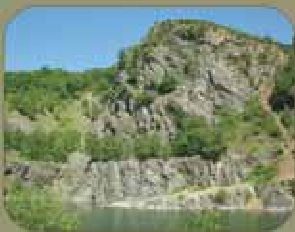
The aggregates industry is an important, at times surprising, very varied and old human activity that has shaped the world around us and will continue to do so into our future.

Top: Cleveland Lakes in the Cotswold Water Park, showing the extent of aggregate extraction within the area. Once extraction has ceased the area is restored. Extraction still continues in the area. Kindly reproduced © 2011 RH Bewley

Bottom left: Linton Quarry: A geological SSSI

Bottom right: Anglo-Saxon period watermill at Wellington. Kindly reproduced © Worcestershire Historic Environment and Archaeology Service

Abberley & Malvern Hills Geopark Map



AGGREGATES AND THE ABBERLEY AND MALVERN HILLS GEOPARK

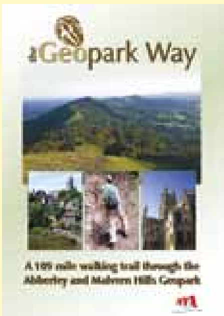
The Abberley and Malvern Hills Geopark covers 1250 square kilometres and takes in parts of the four counties of Gloucestershire, Herefordshire, Shropshire and Worcestershire. The Geopark is driven by local organisations seeking to celebrate its geological heritage and achieve sustainable development through geotourism. In the Abberley and Malvern Hills Geopark you will find outstanding geology that spans 700 million years of our Earth's history. This, coupled with dramatic landscapes and a wealth of ecological, historical and cultural gems, makes the Abberley and Malvern Hills a truly unique Geopark.

The Geopark has a long history of aggregate extraction which can be traced back to Roman times. Currently there are two aggregate quarries operating in the Geopark and there are several hundred inactive and disused sites including pits and quarries.

Several of these disused sites feature in Geology and Landscape trails devised and written by the three Geology Trusts within the Abberley and Malvern Hills Geopark. A list of the publications available can be found on the back page of this booklet.

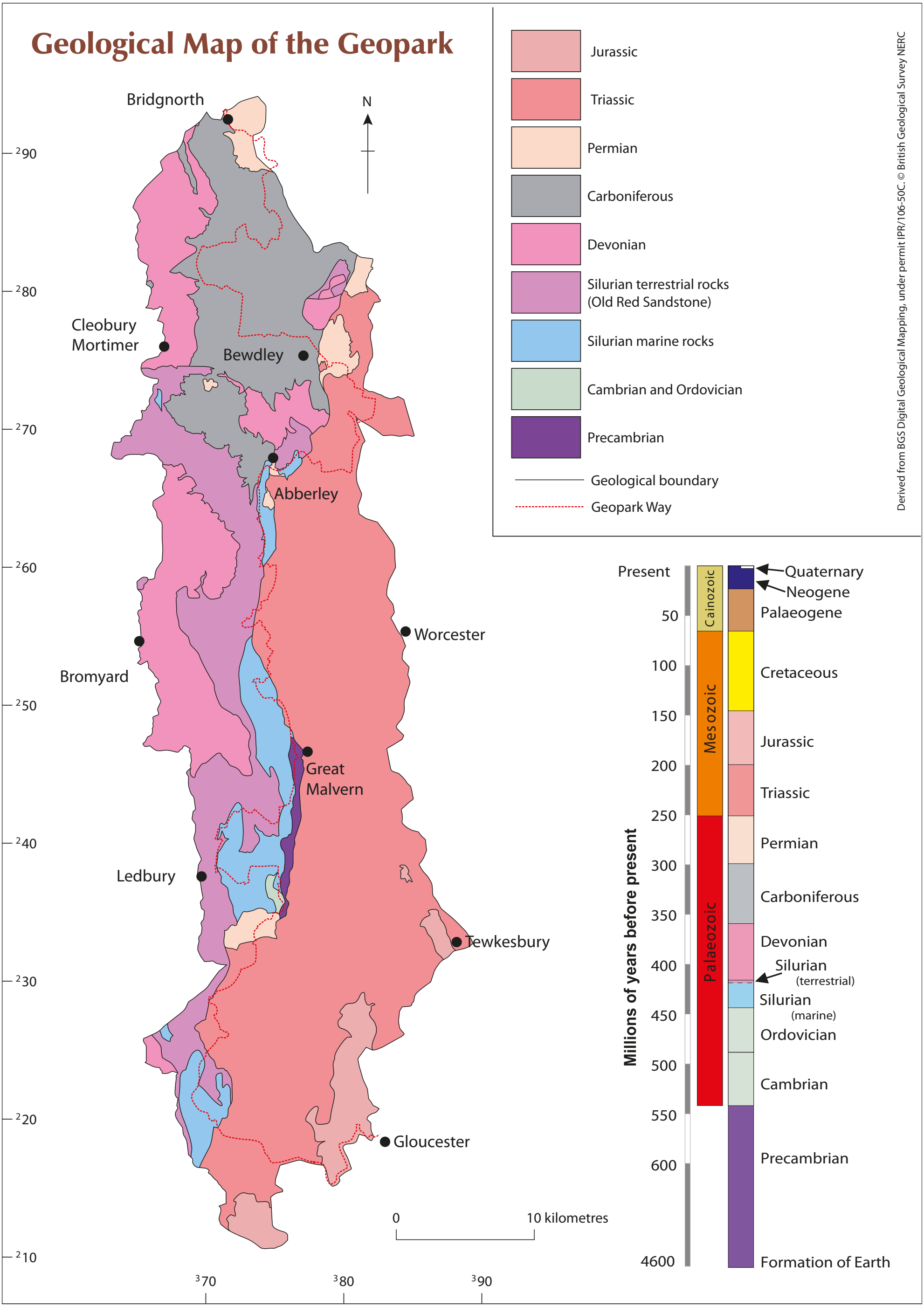
The Geopark Way and the Geopark Way Circular Trails:

The Geopark Way winds its way for 109 miles through the Abberley and Malvern Hills Geopark from Bridgnorth to Gloucester, passing through delightful countryside as it explores 700 million years of the Earth's history.



Each of the Geopark Way circular trails incorporates a section of the main trail whilst visiting sites of interest, including a number of aggregate sites, found off the main route.

Geological Map of the Geopark

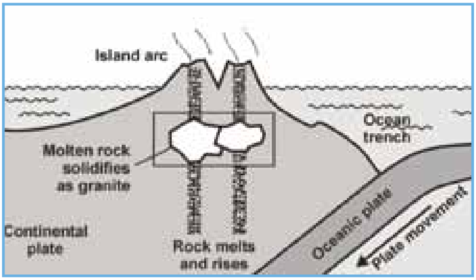


The Geopark contains rocks which span almost 700 million years of time and include some of the oldest rocks in England. The rocks that you can see within the Geopark tell amazing stories of continental collision, tropical seas, hot deserts, equatorial swamps and coastal lagoons and of vast ice sheets and polar deserts. Formed in different latitudes under diverse conditions, the materials of our present landscape have been gradually assembled through geological time until today they constitute a land area in our temperate latitudes.

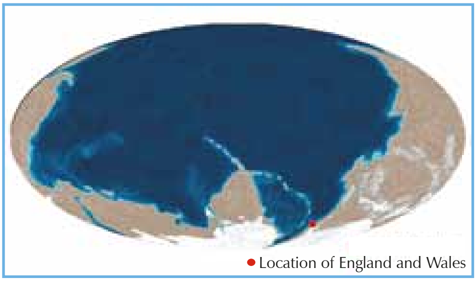
During these 700 million years a wide variety of rock types have been deposited within the Geopark. Not all of them have the necessary qualities to be extracted and used as aggregate. From the rock types present it is the Precambrian igneous rocks, the Silurian limestone and the Quaternary age sand and gravel that have been most commonly exploited for commercial aggregate purposes.

The Precambrian

Imagine that you were transported back 700 million years to be on that piece of the Earth's crust which was to become part of today's Geopark. You would have been in quite a different part of the world; about 60º south of the Equator, close to the Antarctic Circle. You would find yourself in a place of violent geological activity, amidst volcanic mountains and subject to frequent earthquakes as the rock around you was slowly bent and buckled into a mountain chain. It was during these dynamic times that the rocks that make up the Malvern Hills were formed beneath a volcanic island arc. Here, tectonic plates (part of the Earth's crust) collide and one plate is dragged under another along a subduction zone (diagram below), a situation like that of the Pacific Rim today. Intense heat



A diagram of a subduction zone



A globe showing the location and shape of the continents during Precambrian times: 600 million years ago. © Ron Blakey and Colorado Plateau Geosystems, Inc.

and friction cause melting to form magma in the overlying rocks. Some of the magma reaches the surface to form volcanoes but if it solidifies deep within the crust, as with the Malvern rocks, it forms intrusive igneous rocks such as granite and diorite. In the case of the Malvern Hills the surface layers, and therefore the evidence of volcanoes, have subsequently been eroded away, leaving just the rocks seen in the boxed area of the diagram (page 16) to form the landscape we see today.

The Silurian

Of particular influence on the landscape in the Abberley, Suckley and Ledbury Hills are those rocks laid down in a shallow tropical sea over the continental shelf that stretched from a shoreline to the east of the Geopark to the deeper ocean west of the Welsh borders. Around 420 million years ago this area lay about 30º south of the equator, drifting northwards through the southern tropics. By this time a great number of sea creatures had evolved hard external skeletons – trilobites, coral, crinoids, brachiopods, molluscs, and more. Many of these creatures colonised the large areas of reefs formed at this time. Sediments laid down in these tropical waters over time would form into limestone and siltstone. These rocks frequently contain fossilised remains of the Silurian sea creatures.

A globe showing the location and shape of the continents during mid-Silurian times: 420 million years ago. © Ron Blakey and Colorado Plateau Geosystems, Inc.

An artist's impression of a Silurian sea. Image created by John Watson

The Carboniferous

By 330 million years ago this area lay just south of the equator. A lush equatorial jungle on swampy lowland plains covered the area of the Geopark. Here newly evolved tree-sized ferns grew and there were huge dragonflies with 1.5m wing-spans. It was a dynamic environment within which a wide variety of sedimentary rock types formed including coal, ironstone and hard conglomerates.

During the Carboniferous period a major mountain building event (the Variscan Orogeny) was taking place. This earth movement sparked volcanic activity and large masses of molten material (magma) was forced up from within the Earth and intruded into the overlying rocks.

A globe showing the location and shape of the continents during the early Carboniferous: 340 million years ago. © Ron Blakey and Colorado Plateau Geosystems, Inc.

The Finishing Touches

Over the last one million years the global climate has fluctuated: Temperatures plummeted, polar ice-caps increased enormously, sea-level fell and we were in the grip of the recent Ice Age. The ice has retreated and advanced several times, most recently a mere 25,000 years ago when the last major advance of the ice came as far south as the Midlands. It was the glaciers of this period, along with the huge amounts of melt-water generated when the climate warmed again about 14,000 years ago, that put the finishing touches to our present day scenery. Sand and gravel deposits were left spread across the wide flood plains of the huge Ice Age rivers and our varied present-day soils developed over rock scraped bare by the ice.

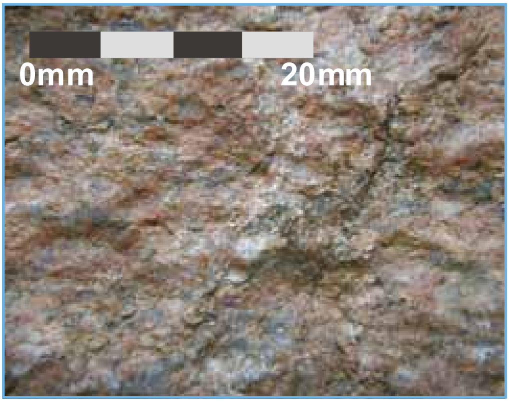
An artist's impression of a Carboniferous swamp. Image created by John Watson

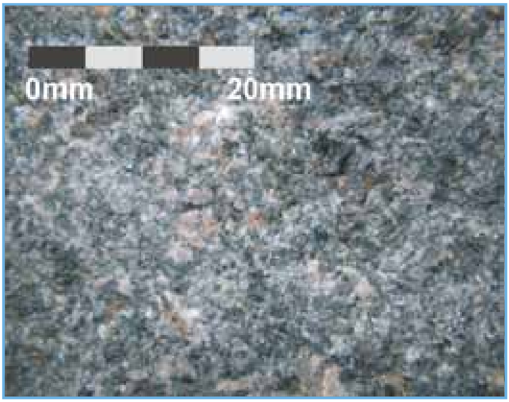
The following pages of this booklet explore a number of former aggregate sites within the Geopark that lie on, or close to, the Geopark Way walking trail.

Woolly Mammoths roamed Britain during the last Ice Age. The youngest and most complete British specimen, found in Shropshire, was dated at 12,800 years old. © Worcestershire Historic Environment and Archaeology Service

The Geology of the Malvern Hills

The main body of the Malvern Hills comprises a north-south trending ridge of igneous and metamorphic rocks. The extremely resistant nature of these rocks contributes towards the elevated nature of the Hills in comparison to the surrounding landscape. Throughout their geological history the Hills have experienced lengthy periods of uplift with localised folding and faulting in response to major Earth movements. Compressive forces associated with the creation of the supercontinent Panagea, some 300 million years ago, contributed to the elevation of the Hills and also led to the development of a series of faults which cut across the ridge. These faults have disrupted the north-south alignment of the Hills, displacing some of the Hills to the west.





There are two main rock units that make up the Malvern Hills: the older Malverns Complex unit, and the younger Warren House Formation unit. Both are Precambrian in age. The composition of the Malverns Complex varies greatly across the Hills; the dominant rocks are classified as diorities, tonalites and granites. The Warren House Formation is a suite of igneous rocks associated with volcanic activity, comprising spilitic basalts, rhyolites and ignimbrites; they make up only a small percentage of the Malvern Hills.

Malverns Complex - granite (top picture)
Malverns Complex - diorite (bottom picture)

The Geology of Chase End Quarry

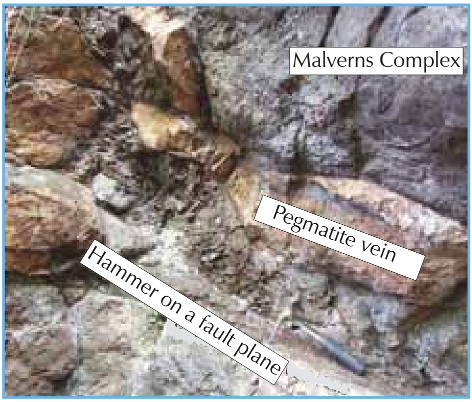
The quarry lies within a fault-bounded inlier (an area of older rocks surrounded by younger rocks) composed of the rocks of the Malverns Complex unit. This inlier forms the southernmost extent of the Malvern Hills and, as such, the quarry is the most southerly exposure of the Malverns Complex.

Malverns Complex, Cryogenian - approximatley 680 millon years old

The rocks in this quarry appear to have been originally diorites (medium to coarse-grained intrusive igneous rock), which have been deformed by intense pressure and heat (metamorphosed) crushing them and producing the coarse-grained metamorphic rock gneiss. Diorites usually develop in areas where subduction is occurring (refer to page 16). It is believed that the rocks seen at this quarry where formed about 670 – 680 million years ago in a subduction zone. Later, around 600 million years ago hot, quartz-rich fluids opened up planes of weakness (along cracks) within the gneiss. This quartz-rich fluid cooled very quickly to form granite pegmatite veins. These veins have been further deformed by later intense Earth movements causing them to pinch, swell and break up, a feature known as 'boudinage'.

The metamorphic rock exposed at Chase End Quarry showing the characteristic 'stripes' called Gneissose Foliation. This occurs when nearly all traces of the original structures and fabric of the rock are wiped out as new minerals recrystallise and migrate under the intense pressure and heat during metamorphism. This results in dark and lighter 'strips' being formed

In the main quarry face, the gneiss has been cut through by thrust planes (a type of faulting), where the rocks have been forced over each other.



Malverns Complex rocks cut by granite pegmatite veins

Quarrying History

The Malvern Hills have been quarried for centuries. Initially extraction was on a small scale and purely for local purposes. Extraction increased in 1836 when the Wyche Cutting (between Summer Hill and Perseverence Hill, north Malverns) was altered to make a more accessible road through the Hills. Once completed, extraction levels died down to what was considered acceptable levels. By the later stages of the 19th century vocal opposition to quarrying on the Hills began to be raised. During the opening years of the 20th century quarrying on the Hills had developed to a commercial scale, the most notable operator being the Pyx Granite Company. With the ever growing popularity of motor vehicles there was a commercial market for Malvern Rock for use as road aggregate. This rise in extraction levels was equally matched by opposition to the quarrying. Concerns included the effect that extraction was having on local communities and the damage it was doing to the Malvern Hills. Quarrying continued, supplying aggregate for roads and, later, motorways, until 1977 when the last quarry, Gullet Quarry, ceased operating.

It is thought that Chase End Quarry was worked during the 19th century. There is no evidence that explosives were used at the quarry to extract rock, suggesting that extraction was by mechanical means. This would have been a laborious and long process.

Earnslaw Quarry entrance and buildings, including toll house c.1930.

Current Use of the Site

The Malvern Hills are a popular destination for recreational pursuits, most commonly walking, mountain biking and horse riding. The more adventurous local organisations and clubs go hang gliding, abseiling, climbing and diving. The latter three of these make use of the former quarries.

Since extraction ceased, the Malvern Hills Conservators have rehabilitated many of the quarries under their jurisdiction through landscaping and planting schemes. Several quarries have since become pooled with spring water creating habitats that without quarrying would not exist on the Malvern Hills.

Chase End Quarry is owned and managed by the Bromsberrow Estate. The quarry features in two geological walking guides as a site to visit to examine the rocks of the Malvern Hills: 'Chase End Hill Trail' and the 'Geopark Way' (refer to page 48).

Site Location and Access

Location: The Malvern Hills straddle the county boundaries of Herefordshire, Worcestershire and Gloucestershire. Chase End Quarry is situated at the extreme south of the Malvern Hills ridgeline.

Grid Reference:

Northern tip of the Hills SO 7667 4735

Southern tip of the Hills SO 7575 3490

Parking: There are several car parks dotted along the length of the Hills. Visit www.malvernhills.org.uk to view a carpark map. There is a layby on the road immediately south of Chase End Quarry.

Walking: Several long distance walks, including the Geopark Way, pass over the Malvern Hills. There are several promoted Malvern Hills walking trails.

The Malvern Hills

MARTLEY ROCK

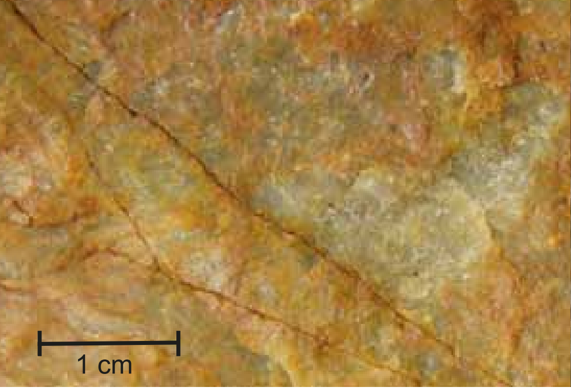
The Geology of Martley Rock

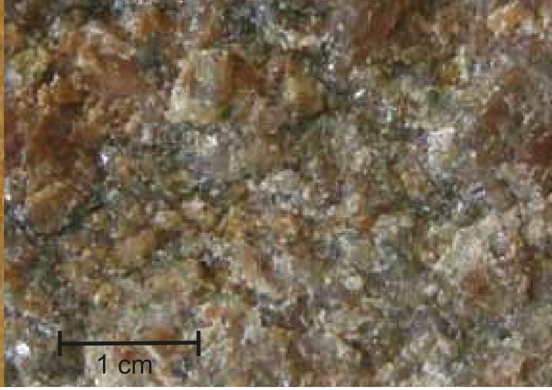
Martley Rock exposes the most northerly outcrop of the Precambrian Malverns Complex, roughly 15 kilometres north of the main Malverns Complex exposure on the Malvern Hills ridgeline. This inlier of Precambrian Malverns Complex and Cambrian Malvern Quartzite Formation is surrounded by Carboniferous and Silurian-aged strata. The site is cut by two trenches. It is within these trenches that the rock units can be observed.

Malverns Complex, Cryogenian approximately 680 million years old.

These rocks are the oldest within the Abberley and Malvern Hills Geopark. The composition of the Malverns Complex rocks varies at the site. Most exposures are heavily sheared altered granite/diorites which are also highly weathered.

One of two trenches dug at Martley Pit in early 2010. The rock face on the right of the picture exposes heavily sheared Cambrian Malvern Quartzite faulted against Precambrian Malverns Complex. The opposite side of the trench cuts through the quarry infill material.

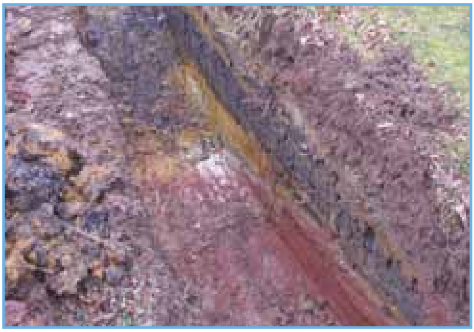




Left: Malvern Quartzite Formation
Right: Malverns Complex containing the minerals quartz, feldspar, chlorite and mica

Malvern Quartzite Formation, Cambrian 542 million years old

The quartzite is composed of almost wholly rounded grains of the mineral quartz, with some feldspar. The average grain-size is about 0.5mm in diameter. Grians are bound together by a quartz cement. The majority of the exposures are stained yellow.



Raglan mudstone in the trench floor unconformably overlain by Carboniferous-aged multicoloured siltstones and clays

Raglan Mudstone Formation, Silurian 418 – 416 million years old

The mudstones are exposed in the floor of the far western end of the trench - a dark red-brown mudstone with occasional green spotting.

Halesowen Formation, Carboniferous estimated 308-306 million years old

The trench sides expose layers of siltstone and clay in a wide range of colours (green, black, dark grey, orange and cream). The Halesowen Formation lies unconformably on the Raglan Mudstone Formation.

The site is bounded and cross cut by a number of faults. A fault is a line of weakness along which movement occurs. The Cambrian and Precambrian-aged rocks have been heavily sheared to varying degress across the site.

Quarrying History

This small quarry pit was opened to extract the hard Precambrian and Cambrian rocks for use as aggregate locally. The pit experienced a number of stages of extraction. The first must have been pre-1839 as the eminent geologist R. Murchinson refers to the 'pit' in chapter 31 of his work 'The Silurian System'. References to the site in a number of other geological papers and field notes over the subsequent 125 years imply that further extraction took place.

In the 1960s the site was visited by the British Geological Survey who noted the site as very overgrown. This together with local geologist's field notes indicate that though overgrown the pit in the 1960s had only been partly infilled. By the late 1980s the quarry had been infilled by none other than a young South African rugby player called Ruben Kruger who played in the SA World Rugby Cup winning side in 1995. On the top of the infilled quarry Ruben planted Christmas trees which are still there.

Current Use of the Site

Since the trenches were dug in 2010 the site has been visited by groups of geologists and keen amateur geologists along with interested parties from the local community. The site sits on agricultural land.

Location and Access

The site is located in Martley, Worcestershire. The site is on private land.

Geological survey being undertaken by the Geology section of the Woolhope Naturalists Field Club. March 2010

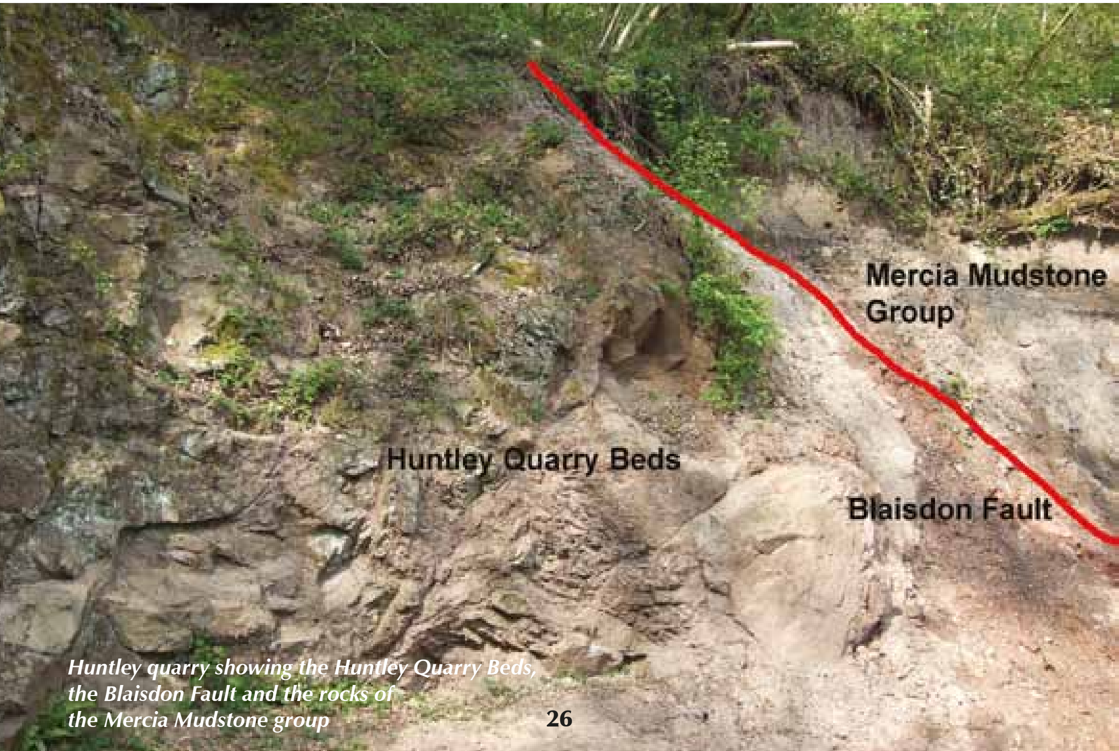
HUNTLEY QUARRY

The Geology of Huntley Quarry

Within the quarry there are two quite distinct rock types: the volcanic sandstones and siltstones of the Huntley Quarry Beds and the mudstones of the much younger Mercia Mudstone Group. These are separated by a major fault, the Blaisdon Fault that runs along the eastern side of the quarry.

Huntley Quarry Beds, Late Ordovician to Early Silurian 445 – 439 million years old

These sediments are the oldest strata in the May Hill inlier and indeed in the Forest of Dean area. The Huntley Quarry Beds consist of an alternating sequence of coarse, medium and fine-grained sandstones and siltstones. The sandstone layers range in colour from red and purple to a greenish grey whilst the siltstones are grey and purple to a dull yellow. The sandstones are composed of a wide range of materials including quartz, granite and basalt as well as volcanic material, lava and ash fall deposits.
The siltstones also include volcanic material as well as the minerals quartz, mica, chlorite, zircon and feldspars.



Huntley quarry showing the Huntley Quarry Beds, the Blaisdon Fault and the rocks of the Mercia Mudstone group

Huntley Quarry Beds

Red mudstones of the Mercia Mudstone Group

Mercia Mudstone Group, Middle to Late Triassic 237 – 203 million years old

Three metres of this group are exposed along the Blaisdon Fault where the Mercia Mudstone abuts the Huntley Quarry Beds. The Mercia Mudstone is essentially a massive, red-brown silty mudstone. Within this essentially structureless mudstone are blocky beds of a harder, finely laminated mudstone. This material was not quarried; the Blaisdon fault marked the most easterly extent of quarrying.

Faulting seen within the Quarry

A major feature seen within the quarry is the effect that faulting has had on the rocks. The eastern side of the quarry is bounded by the Blaisdon Fault (part of the East Malvern Fault), which has moved several times, in different directions over the last 400 million years. The Huntley Quarry Beds can be seen to be cut by numerous smaller associated faults. The beds of rock are also folded.

Right: A fold seen in the Huntley Quarry Beds, which is characteristic of the complex geological structures seen at the site

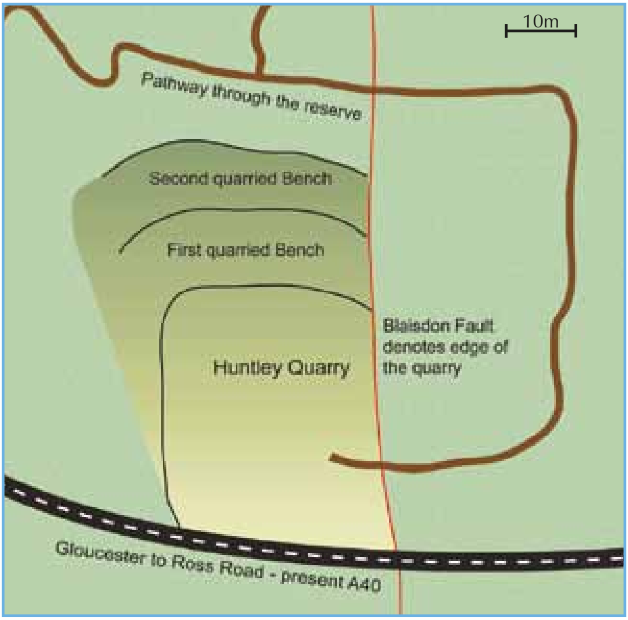
Quarrying History

The Ordnance Survey sheet of 1815 indicates the immediate area around the quarry and road was not wooded. This increases the possibility that the Huntley Quarry Beds were being worked as building stone, on a small local scale, before this date.

During the first half of the nineteenth century the quarry was probably worked for road aggregate for the Gloucester to Ross-on-Wye road (A40). The quarry appears to have fallen into disuse in the second half of the nineteenth century as several eminent geologists (including Sir Roderick Murchinson) do not mention it as a working quarry. Therefore the quarry was probably worked for less than fifty years.

Huntley Quarry was worked as a series of benches (quarryman's term for a ledge) that extended to the back of the present face in a northwards direction. Behind the quarry in the wooded area, two of these benches are still discernable.

The Huntley Quarry Beds are a very hard rock, which breaks into irregular blocks making it unsuitable, despite its strength, as a building stone. However, it is one of the hardest rocks in the immediate vicinity of the A40 and this was probably the reason why this site was chosen for aggregate extraction.



Right: A map showing the location of the benches cut into the hillside when the quarry was active. The use of benches allowed the quarrymen to work the safely at different levels within the quarry

Current Use of the Site

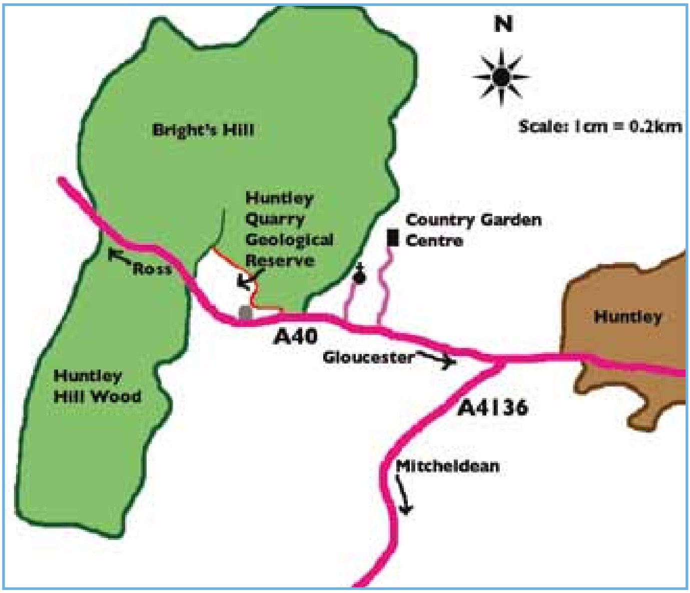
Huntley Quarry forms part of the Huntley Quarry Geological Reserve, which is owned and run by the Gloucestershire Geology Trust. There are three quarries for the public to visit each with its own interpretation panel. There are a further two panels, one is a general reserve panel and the other describes an ancient oak found at the reserve. The reserve is open to the public at all times.

Gloucestershire Geology Trust
Tel: 01452 864438
Email: info@glosgeotrust.org.uk
Website: www.glosgeotrust.org.uk

Site Location and Access

Location: The quarry is situated about 1km to the west of Huntley village, in the Forest of Dean, on the Gloucester to Ross-on-Wye road (A40). It lies on the south eastern side of May Hill in Gloucestershire.
Grid Reference: SO 7095 1955
Parking: The Country Garden Centre immediately to the south of the quarry has given permission for visitors to the reserve to park cars in their car park (closed from 5pm to 9am). Once parked follow the signs for the Geopark Way, which can be found beside the school, on a small path leading up Bright's Hill. It's a five minute walk.
Walking: Huntley Quarry lies on the route of the both the Geopark Way and the Gloucestershire Way.

GLOUCESTERSHIRE GEOLOGY TRUST



A map showing the location of the reserve and some of the local landmarks

PENNY HILL QUARRY

The Geology of Penny Hill Quarry

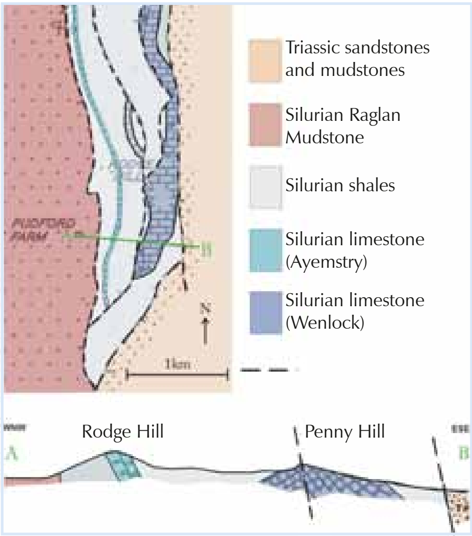
There are a number of exposures of the Much Wenlock Limestone Formation remaining in this former quarry site. The two largest exposures can be found at the southern end of the site.

The Much Wenlock Formation, Silurian 425 million years old

The rock face shows nodular limestone beds which average 7cm in thickness with shaley partings. The limestones are medium to light grey in colour, compact and crystalline. Thicker beds measuring several metres in thickness were recorded when the quarry was operational. Crinoids and shell debris sometimes form a marked proportion of thicker beds often amounting to several feet in thickness. Fossils are common throughout the unit. The unit also contains small reef structures known as bioherms.

Steeply dipping limestone beds with a bioherm in Penny Hill Quarry

The areas of Penny Hill and Rodge Hill (to the west) have, throughout geological time, been subjected to incredible forces which have caused the rocks to bend, buckle, fold and tear. Pressure exerted from the east and south-east resulted in the overfold of the Rodge Hill Anticline. On the eastern side of the fold slices of successively older rocks have been forced westwards along two thrust-planes, the Rodge Hill Thrust and the Penny Hill Thrust.



Sketch geology map of the area and cross-section along A-B on the map (based on Groom 1900)

Quarrying History

From the 1905 edition of the Ordnance Survey map it is clear that quarrying had taken place at Penny Hill over many years. Planning permission was granted in 1952 for an extension of the working with further extensions approved in 1969 and 1974. The last permission was granted to extract at a rate of 150,000 cu m per year. The quarry operated intermittently between these dates. Stone was quarried from the centre of the ridge forming a steep-sided trench-like void, enclosed at its northern end with access through a narrow entrance from the south. The stone would have been used for road aggregate, with some loads being transported as far as Brize Norton, for the RAF to build runways.

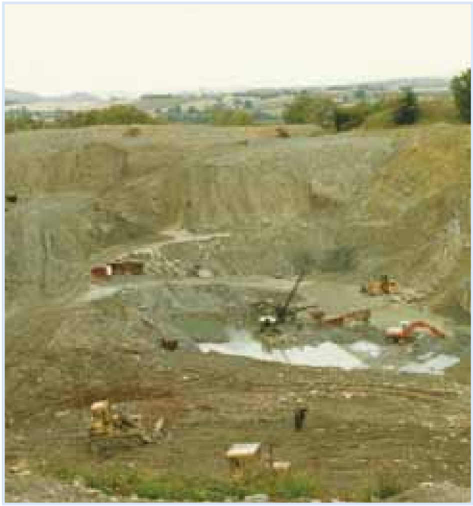
Local residents clearly remember when the quarry was operational. Though the quarry was masked from view, the lorry traffic, dust and noise pollution from the blasting left a bitter taste among locals. Surprisingly, it was not an isolated incident when rock, blasted within the quarry, projected itself out onto private land. The quarry, when not active, became the forbidden hideout for several local children. Many quarry fossil finds now decorate Martley gardens.

Penny Hill Quarry c. 1970
Photograph courtesy of Peter Oliver

Post-Extraction Use of the Quarry

In 1979 a planning application was submitted to use Penny Hill Quarry for landfill. Initially the application was rejected. A subsequent application was accepted and landfill commenced; domestic and commercial waste only. There was local opposition to the site being used for landfill even though planning consent had been given. Particular grievances were the smell and the lorry traffic.

When the landfill site was full the process of restoration began. The site was sealed with material stockpiled from the original quarry. The height of the landscaped dome hill was (and probably still is) higher than the original/natural Penny Hill. This wasn't a miscalculation but purposful planning to account for the subsidence the hill would encounter over the years as the underlying landfill material was further compacted. Wildflower seeds, fitting of those that would naturally grow on a limestone hill, were planted on the capping material. It will take many years for the vegetation on resurrected Penny Hill to rival that of neighbouring wildflower meadows and alkaline grasslands, but the restoration process is well underway.



Penny Hill Quarry before landfill and landscaping c. 1980. Photograph courtesy of Peter Oliver

In 1992 a powerplant was installed at Penny Hill Quarry site to capture gases expelled from the landfill material. This is converted into electricity and fed into the national grid.

Penny Hill quarry in 1995 landscaped with wild flowers growing on the dome shaped hill

Location and Access

Location: Martley, Worcestershire
Access: No access allowed.

WHITMAN'S HILL QUARRY

The Geology of Whitman's Hill Quarry

There are two rock formations present in the quarry: 12m of the Coalbrookdale Formation, which forms the basal units and 25m of the Much Wenlock Formation which sits above. The boundary between the two units represents a rapid decrease in sea level in the area.

The Coalbrookdale Formation, Silurian 427 million years old

These sediments are characterised by olive-grey to dark blue-grey silty mudstones with some calcareous siltstones and contain calcareous nodules and impersistent nodular calcareous beds. The beds are highly fossiliferous and contain a wide range of marine fauna, including brachiopods, trilobites, corals, calcareous algae, bivalves, orthocone nautiloids, crinoids and bryozoa.

Ball-like structure composed of a calcareous cement within the Coalbrookdale Formation unit

At the bottom of the track leading through the quarry, in the eastern rock face, are ball-like structures from 10cm to over 2m in size. These balls are composed of calcareous cement, and are believed to have grown during the early phase of the rock's formation. Their composition makes them more resistant to weathering than the surrounding siltstones.

Aerial photograph of Whitman's Hill Quarry

The Much Wenlock Formation, Silurian 425 million years old

The overlying Much Wenlock Formation is characterised by pale grey nodular to thinly bedded limestones. Some of the more nodular beds are known locally as the 'Storridge Porridge'. The Much Wenlock Formation also contains small reef structures known as bioherms.

A Trilobite, Calymene. The most famous fossil that can be found at Whitman's Hill quarry

Bentonites

During the Silurian period there were sporadic volcanic eruptions which produced a great deal of volcanic ash. The ash sank to the seabed, was altered chemically and then preserved in the sediments. These thin layers of ancient volcanic ash are called 'bentonites'. Within the quarry face nine bentonite layers have been identified. They have weathered to a far greater extent than the harder limestones so are easily identifiable within the long 'notches' which cross the quarry face.

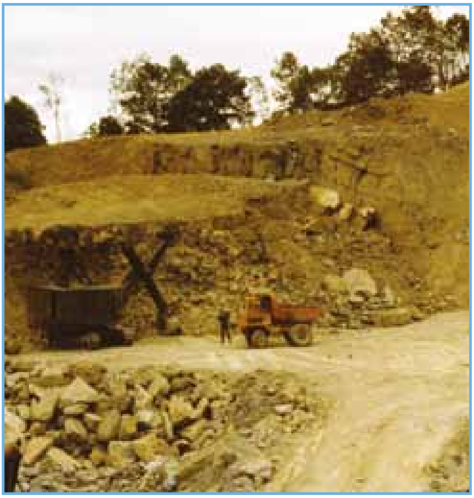
The back face of the quarry showing Much Wenlock Limestone Formation overlying the Coalbrookdale Formation

Quarrying History

The exact date of when Whitman's Hill quarry first operated is unknown. However, directory records show the quarry being in operation in 1876. Work in these quarries in the early days was done by hand, with shovels, picks, sledge hammers and crowbars. The limestone extracted was used to produce lime.

By 1965 emphasis had shifted to stone production. An account by the chairman of the quarry in 1970 states that the site was usually operated by just four people. One man operated the loading bucket that collected rock from the face and put it in the dumptruck which conveyed the rock to the crushing plant. The next man tipped the rock into the hopper, then the crusher and then the screening plant, where it was separated into various grades. The third man drove the wheeled loader which loaded the lorries. Finally the material went to the weighbridge where the fourth person recorded and ticketed the crushed rock before the lorries left for their destination.

During the 1970s and 1980s extraction output was about 50,000 to 70,000 tonnes per annum. It is believed that all of the material extracted during this period of peak extraction was used within 15-20 miles of the site. Primarily, it was used as roadstone and for general construction purposes, supporting the growth of Worcester and Malvern. Quarrying at the site ceased in 1988.



Whitman's Hill quarry circa 1977

Mrs Jean Horne, who used to work on the weighbridge at Whitman's Hill quarry, recalls that during busy periods she had to calculate the timings of the loads to coincide with the journey times of the delivery trucks which, at times, would be alternating collections between limestone from Whitman's Hill, sand from Mathon and gravel from Boremill.

Post-Extraction Use of the Quarry

In the 1980s the option of using the site for landfill was considered but deemed unsuitable as there was lack of demand and too much competition.

Herefordshire and Worcestershire Earth Heritage Trust (H&W EHT) ran the Whitman's Hill Geodiversity Discovery Venture from 2005-2007 which involved research into the geology, natural history and local heritage of the site. The project saw significant ground work take place in the quarry and allowed the Trust to obtain a 10 year lease on the site. Further details can be found on the website: www.whitmanshill.earthheritagetrust.org.

Currently the site forms part of the Community Earth Heritage Champions project (2008-2011) being run by H&W EHT. The project has seen a local community Champions group develop which carries out conservation work, promotes the use of the site to other people in their parish and monitors the site for any changes.

This quarry is also used by many groups and organisations for research and educational activities, with the fossil collecting area being particularly popular with school children.

Location and Access

Location: Storridge, Herefordshire
Access: By prior arrangement only. All enquiries to be directed to H&W EHT. Tel: 01905 855184 or email: eht@worc.ac.uk

Guided site visits (left) and school visits (right) led by H&W EHT volunteers

CALLOW HILL QUARRY

The Geology of Callow Hill Quarry

On the eastern wall of this small quarry there are two rock exposures displaying a variety of rocks types found within the Wyre Forest. The diversity of rock types seen reflects the dynamic environment in which they formed. All sediments are water lain yet their environment of deposition varies from anoxic swamps to high energy rivers.

Etruria Formation, Carboniferous around 310 million years old

The two main rock types present are coarse grained sandstone and a conglomerate. These two hard, green to buff coloured rock types form alternating bands within the quarry. The sandstone is the dominant rock type, with the conglomerate forming impersistent bands throughout the Wyre Forest area.

Alongside the sandstones and conglomerates the quarry face displays bands of fossilised soils known as 'palaeosols'. These formed during periods when the ground became swampy and waterlogged. Such soils were subsequently buried and underwent complete oxidation giving the beds their red colour, the same process seen when iron rusts. Iron-rich nodules within the palaeosols were also oxidised during burial and formed haematite (iron oxide) as a result. These iron-rich nodules may have been quarried as a source of iron ore for the local iron industry.

Left: Callow Hill Quarry rock face showing thick beds of hard sandstone and conglmerate

Below: Callow Hill Quarry conglomerate

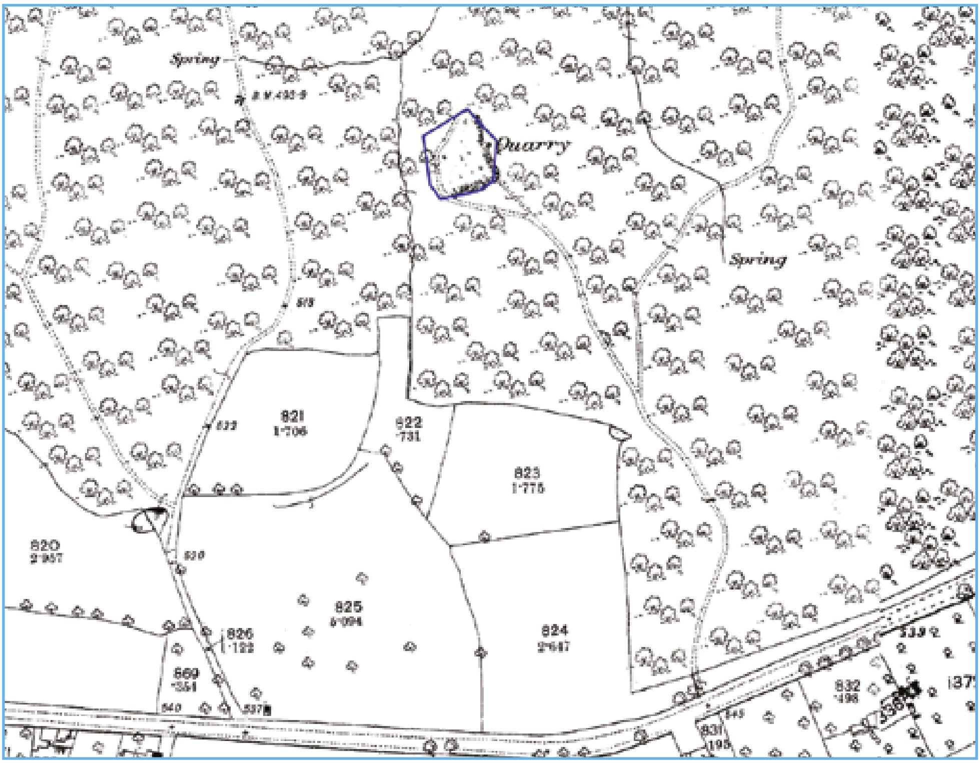
Quarrying History

The Ordnance Survey sheet of 1884 shows the quarry with two extraction tracks running around it. The subsequent map editions of 1903 and 1927 also show the quarry, though the latter no longer shows the extraction route trackways indicating that the quarry, at that time, was not in operation.

There is a long history of quarrying within the Wyre Forest. Unlike many of the other quarries, which are found as groups within the Forest, Callow Hill Quarry is isolated suggesting that stone was extracted from this site for a specific purpose, rather than on an *ad hoc* basis.

The Forest as a whole has a very industrial past and would have required a durable aggregate to surface its trackways thereby servicing the many cottage industries, forestry activity and basic access routes through the Wyre Forest. The conglomerate within Callow Hill Quarry, and from the numerous other small quarries within the Forest, would have been extracted to serve this requirement.

1st edition Ordnance Survey map 1884. Callow Hill Quarry shown with a blue line



Current Use of the Site

Callow Hill Quarry is located within the Wyre Forest. The 6000 acre forest offers recreational activities and a quiet oasis for local residents and for people from the wider West Midlands conurbation. Part of the forest is a National Nature Reserve.

The Forestry Commission-owned section of the Wyre Forest houses a Visitor Centre and a Discovery Centre, offering a programme of special events throughout the year. Callow Hill Quarry is located within the Forestry Commission's educational zone, close to the Visitor Centre. Within the quarry site the floor has been cleared and logs have been placed around the edge, creating an outdoor classroom.

The site also forms part of the Community Earth Heritage Champions project (2008-2011) run by Herefordshire & Worcestershire Earth Heritage Trust. The project has seen a local community 'Champions' group develop which is carrying out conservation work, promoting the use of the site to other people in the area and monitoring the site for any changes.

Site Location and Access

Location: The Wyre Forest Visitor Centre is located at Callow Hill, 3 miles west of Bewdley, Worcestershire on the A456. The quarry is accessed via a footpath leading from the Visitor Centre to the educational zone within the forest. The path to the quarry is gated and locked; therefore permission must be sought from the Forestry Commission before entering the site (01299 266929).

Grid Reference: SO 747 741

Parking: Forestry Commission Visitor Centre carpark.

Walking: There are numerous tracks through the Forest leading out to the surrounding villages and towns. The Geopark Way walking trail passes through the Wyre Forest; a wide track links the trail to the Visitor Centre (a distance of one and a half miles).

Wyre Forest Visitor Centre, Callow Hill

Raggits Quarry

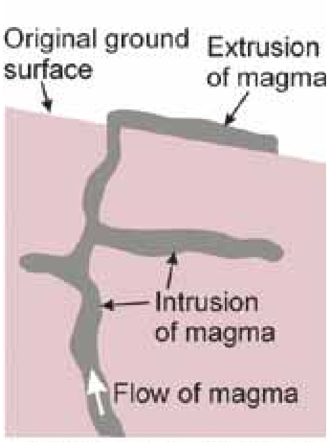
The Geology of Raggits Quarry

Igneous intrusions are found within the Coal Measures at Raggits Quarry and in the vicinity of Knowle Hill. The quarry is 15m in height.

Carboniferous intrusions, around 300 million years old

The main rock mass of the quarry is of olivine basalts. It is highly weathered and decomposed. Where decomposition is at a minimum, spheroidal structures are present. Vesicular basalts have been recorded to the south of the quarry, but not within the quarry itself.

The quarry is traversed by a number of, almost vertical, much harder dolerite dykes that have the same orientation as the general direction of the faults in the area (north-easterly strike). Horizontal slickensides on the sides of the dykes indicate lateral movement.



Emplacement of fluid rock

Raggits Quarry. On the left of the picture narrow vertical ribs of doleritic rock are visible. 1936. ©British Geological Survey.

Quarrying History

It is unknown when Raggits Quarry was first worked. In the early 19th century numerous entries were made in the Kinlet Estate records for obtaining stone from Raggits Quarry. Much of this quarrying would have been from shallow pits. By about 1830 the quarry was a permanent feature with a 5 metre high face. It is presumed that the extracted material was used to maintain the estate tracks and for building construction. However, it is feasible that some of the material was used by the neighbouring industrial businesses within the Wyre Forest Coalfield. Numerous coal mines, clay brick works and iron foundries operated in the area throughout the 19th century and into the 20th century, all of which relied on a network of tramways and railways leading to the River Severn and the main train line.

Trackway leading to the Quarry surfaced with basalt and dolerite, presumably from Raggits Quarry

As late as 1922 there was a proposal that Raggits Quarry should be reopened as a measure to combat unemployment brought about by the closure of Billingsley Colliery. Explorations into the extent of the basalt were made but no long term jobs were created.

Current Use of the Site

Overgrown with dense vegetation.

Site Location and Access

Location: Kinlet, Shropshire.

Access: The quarry is on private land. There is no public access.

Walking: The Geopark Way passes over the top of Knowle Hill. The underlying Carboniferous intrusions give the hill its undulating topography. Large blocks of basalt and dolerite from the quarry sit on the trail by 'The Laundry' farmhouse below Kinlet Church.

EARDINGTON SAND AND GRAVEL QUARRIES

The Geology of the Quarries

Over the last 500,000 years there have been three episodes of glaciation in Britain: The Anglian (between 480,000 and 416,000 years ago), the Wolstonian (380,000 to 130,000 years ago) and the Devensian (120,000 to 10,000 years ago). They were separated by interglacials, when the climate was somewhat warmer than today. We now live in an interglacial that started around 10,000 years ago. It is the sand and gravel deposits from the Devensian glacier outwash, and the later deposits from an established River Severn that overlie the bedrock in Eardington.

Sand and gravel. Devensian glaciation, 120,000 to 10,000 years ago

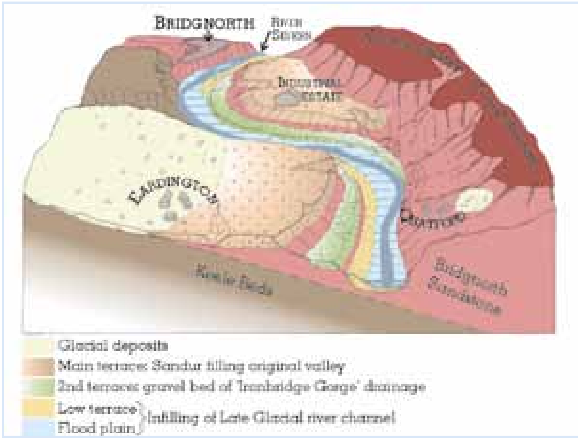
As with all glacial phases, there were fluctuations in temperature and the extent of the physical glacier during these 110,000 years. Maximum glaciation occurred between 23,000 and 18,000 years ago. During this time an ice-sheet travelled from the north and west, stopping in South Shropshire. From the front of the ice-sheet poured melt- water carrying silts, sands, gravels and pebbles which spread down the shallow valley to the south. Beneath the ice-sheet large quantities of summer melt-water, laced with pebbles, scoured networks of channels into the underlying solid rock. By 12,000 years ago the ice-sheet had receded. The majority of the scoured channels became filled with sands and gravels. One in particular did not and served as a main conduit for the large amounts of water flowing from the receding ice-sheet in the area, cutting itself deeper and deeper. This channel was the precursor of what was to become the modern day River Severn.

The sands and gravels, from the outwash of the late Devensian ice-sheet cover much of Eardington parish. Pebbles of slate, granite, sandstone, limestone and volcanic ash within this material help to reveal the route of the ice as it picked up material on its journey from Scotland, North Wales and the Lake District. As the ice melted, even more water poured down the valley, cutting through these sands and gravels creating a new terrace. This process of down-cutting continued as the river matured. Each phase of down-cutting created a new terrace with its own sand and gravel deposits (refer to diagram over).

Quarrying History

Reference to quarrying, in the then township of Eardington, can be found in John Marius Wilson's account of Eardington in the Imperial Gazetteer of England and Wales of 1870-72. The account does not specify what was quarried, but it is likely that it was sand and gravel as no stone quarries are recorded in the parish.

Local residents remember some of the later sand and gravel quarries with fondness as they employed local people, about 2 or 3 people in each quarry. The aggregate was only used locally, as transport was not as good as it is now. By the early 1940s large quarries operated in Eardington and were worked though to the 1990s moving from site to site over the decades. When the bigger companies took over local people weren't involved as much as they used to be, and, with the road network improved, aggregate was sent further afield. Increased noise and dust levels didn't improve the relationship between residents and the quarry operator.



Post-Extraction Use of the Site

All of the quarries have now been restored to agricultural land. Before some of them closed, filter cake (clay used to filter water at sewage treatments) was disposed of at the site.

Site Location and Access

Location: Eardington, Shropshire.

Access: The sites are all on private land. However a public footpath from Eardington (GR SO 7235 9055) heads east to the River Severn before splitting in two. Both of these paths cross over former sites (now agricultural land). Evidence of the terraces is still evident though slightly obscured by the effect of quarrying.

HARTLEBURY COMMON GRAVEL PITS

The Geology of Hartlebury Common

Hartlebury Common lies to the south of the River Stour and to the east of the River Severn, nestling adjacent to their confluence. The 87 hectare common is divided between the plateau and the lowland. A steep, scarp separates the two. The rocks that underlie the common are the Wildmoor Sandstone Formation and the Bromsgrove Sandstone Formation. The hard rock geology of the common is obscured by loose drift deposits.

Wildmoor Sandstone Formation, Triassic around 240 million years old

This sandstone is characterised by its bright red to orange red colour. It contains locally impersistent bands and blotches of pale yellowish white sandstone. The grains are rounded and current bedding is often noted.

Bromsgrove Sandstone Formation, Triassic around 230 million years old

This sandstone is dull red to reddish brown in colour. Generally the sandstone is soft but it does contain some hard cemented bands. The sandstones are coarser than the underlying Wildmoor Sandstone Formation. The individual grains of sand are moderately rounded and are composed of the minerals quartz and feldspar.

The boundary between the Wildmoor and Bromsgrove Sandstone Formations forms the prominent escarpment that runs across the common.

Hartlebury Common. Photograph taken from the lowland looking at the escarpment

Sand and Gravel deposits, Quaternary, less than 2.5 million years old

The Rivers Severn and Stour have a series of relatively flat terrace features associated with their respective valleys. These are the dissected remnants of previous floodplains, glacial meltwater and river deposits. This has resulted in a series of stepped terraces being formed. Each terrace has been partially destroyed by subsequent terrace development, so that today only fragments of the oldest remain.

Much of Hartlebury Common plateau is covered by coarse sand and gravel terrace deposits of the 'Kidderminster Station Member' (maximum age 180,000 years). Within the sand and gravel are numerous pink or white, very smoothly rounded, pebbles. Most of these have been reworked from the underlying Triassic rocks. Other pebbles are more angular, often darker and may be crystalline. These have been transported to the area by glaciers in the last Ice Age (some 25,000 years ago) and were deposited as the ice melted on the common's plateau.

On the lower part of the common, to the west of the escarpment, there are two younger terraces: The 'Worcester Member' (maximum age 30,000 years) located nearest to the escarpment and the 'Power Station Member Member' (maximum age 15,000 years). These both consist of sand and coarse gravel containing small lenses of clay.

A great part of Hartlebury Common is covered by loose hummocky brown sand which appears to have been blown up by wind from the lower terrace of the Severn and the Stour. This sand covers a considerable part of the lower common. It even extends up the escarpment of Bromsgrove Sandstone Formation and onto the Kidderminster Station Member.

Pebbles, sand and gravels on the plateau of Hartlebury Common

Quarrying History

The first documented evidence of extraction of the Quaternary-aged deposits occurring on the common dates to 1713. In 1777 an Act was passed that referred to the cross roads on the common as part of the road from Waresley to Bewdley. This act allowed for people to extract material, including sand, gravel and stone from the common to repair any part of the said road.

Extraction reached its peak between the late 18th and 19th centuries, beginning with the construction and subsequent development of Stourport. Many of these quarries still exist, with others subsequently used as landfill sites.

Most of the extraction occurred on the upper terrace. The double parallel arrangement of some of the paths may have developed as the result of a system where loaded animals descended the escarpment down one track and unloaded animals ascended the other. This may also explain the pattern seen in the pairs of tracks where one track is deeper than the other; an animal descending a scarp fully laden with aggregates material has far greater erosive impact than those on the lighter uphill journey.

Extensive quarrying continued on the common throughout the 19th century and well into the 20th century.

A small gravel pit on the plateau

Post-Extraction Use of the Site

Hartlebury Common is now a Local Nature Reserve managed by Worcestershire County Council. Other groups and organisations share an interest in the site including 'The Hartlebury Common Local Group' who work to conserve the natural history of the common, to raise awareness of the studies and research work being carried out and to undertake practical conservation projects. There is also great archaeological interest at the site with Neolithic and Mesolithic flint artefacts having being found and recorded on the common.


Green Tiger beetle

Regarded as one of Worcestershire's most important Nature Reserves, Hartlebury Common lowland heath is characterised by dwarf shrubs, such as heathers (ling, bell and cross leaved), gorse and acid grassland. The site is especially noted for its rarer wild plants.

As Hartlebury is no longer grazing land, coupled with the demise of practices such as the collection of wood, heather and bracken, the site has to be carefully managed to prevent scrub encroachment and a gradual return into woodland.

Hartlebury Common is home to a rich faunal population including the adder, common lizard, tiger beetle and sand-burrowing wasps.

Site Location and Access

Location: Hartlebury Common, Worcestershire. DY13 9JB. Located just off the B1495 Stourport to Hartlebury Road
Grid Reference: SO 826 715
Parking: Vehicle and pedestrian access 24 hours. Main car park located at the grid reference given. Other carparks are dotted around the site.
Walking: Hartlebury Common has a self-guided Heather Trail and it lies on the route of the Geopark Way trail.

Publications and Trail Guides that Incorporate Aggregate Sites Within the Abberley and Malvern Hills Geopark

Trail Guides and Site Booklets

- Severn Valley Bridgnorth to Highley Trail # £2.00
- Severn Valley Railway Landscape and Geology Trail* £1.95
- Abberley Hill Landscape and Geology Trail* £1.95
- Abberley Hill Discovery Guide*
- Frome Valley Discovery Guide* £2.00
- Malvern Hills (1) Landscape and Geology Trail* £1.95
- Malvern Hills (2) Landscape and Geology Trail* £2.00
- Chase End Hill Geology and Landscape Trail** £2.00
- Huntley, Longhope & Hobb's Ridge Geology and Landscape Trail** £2.00
- May Hill Geology and Landscape Trail** £2.00
- Huntley Quarry Reserve Guide** £2.00
- Geopark Way Trail guide* £9.95

Walks for Health Leaflets

- Bridgnorth - rocks beneath your feet*
- Alveley and Severn Valley Country Park - from coal pits to parkland*
- Stourport - from gravel pits to nature reserve*
- Ledbury - over coral seas and sandy deserts*

Trail leaflets available to download from www.EarthHeritageTrust.org and www.Geopark.org.uk

Geopark Way Circular Trails

- Alfrick and the Suckley Hills*
- Martley*
- Mathon and the Malvern Hills*

Trail leaflets available to download from www.EarthHeritageTrust.org and www.Geopark.org.uk

Publications by:

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Back Page: Malvern Hills quarrymen at work with pick axes and wheelbarrows c1900. Reproduced by kind permission of the Malvern Hills Conservators