



# HADLEY QUARRY



Community Earth Heritage  
**CHAMPIONS**  
project

# GEOLOGICAL HISTORY OF THE AREA

Ten geological systems are represented in Worcestershire:

1. Precambrian (4600 million years ago to 542 million years ago)
  - Igneous and metamorphic rocks making up the Malvern Hills and an area to the north, here they are approximately 680 million years old, and amongst the oldest in England.

2. Cambrian (542 million years ago to 488 million years ago)
  - Quartzite, sandstone and shale formed as the sea level began to rise; found in small areas adjacent to the Malvern Hills and an area to the North.
3. Ordovician (488 million years ago to 444 million years ago)
  - Volcanic material was erupted and then deposited in water during this time. At a later stage, sand deposited in a warm, shallow sea formed quartzites. Rocks of this age are found in the Lickey Hills.

Geological Map of Worcestershire



Key to Geological Map of Worcestershire

<b>Quaternary</b> (1.8 million years ago to recent)	
<b>Neogene</b> (23 million years ago to 1.8 million years ago)	
<b>Palaeogene</b> (66 million years ago to 23 million years ago)	
<b>Cretaceous</b> (146 million years ago to 66 million years ago)	
<b>Jurassic</b> (199 million years ago to 146 million years ago)	
<b>Triassic</b> (251 million years ago to 199 million years ago)	
<b>Permian</b> (299 million years ago to 251 million years ago)	
<b>Carboniferous</b> (359 million years ago to 299 million years ago)	
<b>Devonian</b> (416 million years ago to 359 million years ago)	
<b>Silurian</b> (444 million years ago to 416 million years ago)	<b>Pridoli stage</b> (419 million years ago to 416 million years ago)
	<b>Llandovery, Wenlock and Ludlow stages</b> (444 million years ago to 419 million years ago)
<b>Ordovician</b> (488 million years ago to 444 million years ago)	
<b>Cambrian</b> (542 million years ago to 488 million years ago)	
<b>Precambrian</b> (4600 million years ago to 542 million years ago)	



## Location of Hadley Quarry

The hamlet of Hadley can be found off the A4133 to the west of Ombersley. Permission to visit the quarry must be obtained in advance; contact information can be found on the back page of this leaflet.



4. Silurian (444 million years ago to 416 million years ago)
  - a. Pridoli stage (419 million years ago to 416 million years ago)
    - Mudstones, sandstones and calcrites (calcium-rich fossilised soil) deposited within a flat, arid landscape near the coast, crossed by seasonal streams.
  - b. Llandovery, Wenlock and Ludlow stages (444 million years ago to 419 million years ago)
    - At the start of the period, sandstones and conglomerates (sediments containing rounded pebbles) formed from the material brought down into a shallow sea during flash flood events. Then limestones and shales formed as the sea level rose.
5. Devonian (416 million years ago to 359 million years ago)
  - Sandstones deposited by streams in an otherwise flat arid landscape. These rocks are found in the west of the county around Tenbury Wells.
6. Carboniferous (359 million years ago to 299 million years ago)
  - Clays, coals, shales and sandstones formed in a flat, swampy delta, which experienced frequent flooding as the sea level rose and fell. These rocks are found around the Wyre Forest Coalfield area. There are also igneous intrusions of this age found in the Teme Valley and near Kidderminster.
7. Permian (299 million years ago to 251 million years ago)
  - Red desert sandstones. At the start of the period, breccias (sediments containing angular fragments) formed during catastrophic events such as flash floods or earthquakes. These rocks are found in small areas in the north and west of the county.
8. Triassic (251 million years ago to 199 million years ago)
  - Sandstones, conglomerates, evaporites (salts), breccias and mudstones representing a change in environment from a flat, arid landscape covered in rivers and lakes, into oceanic conditions.
9. Jurassic (199 million years ago to 146 million years ago)
  - Limestones and mudstones deposited in a warm, shallow sea. These rocks are found in the east of the county from Redditch to the Cotswold Hills.
10. Quaternary (1.8 million years ago to recent)
  - Glacial deposits, river sands, gravels and alluvium, and chemical deposits such as tufa, overlying the hard rocks (but not shown on the geological map).

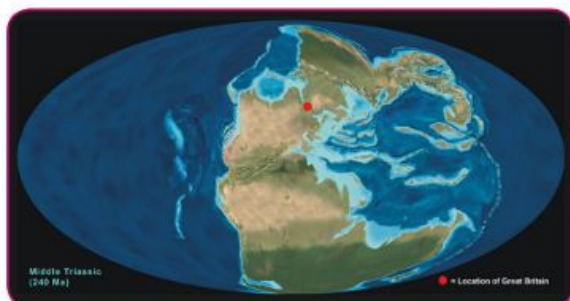
# GEOLOGICAL HISTORY OF THE SITE

▶ The last grooves cut by hand pick to release large blocks of stone are still visible



The rocks seen in Hadley Quarry formed during a period of time known as the Triassic, approximately 245 million years ago. At this time the layout of the oceans and continents across the Earth was very different from that today. Britain was located in the northern tropics and was part of a supercontinent called Pangaea.

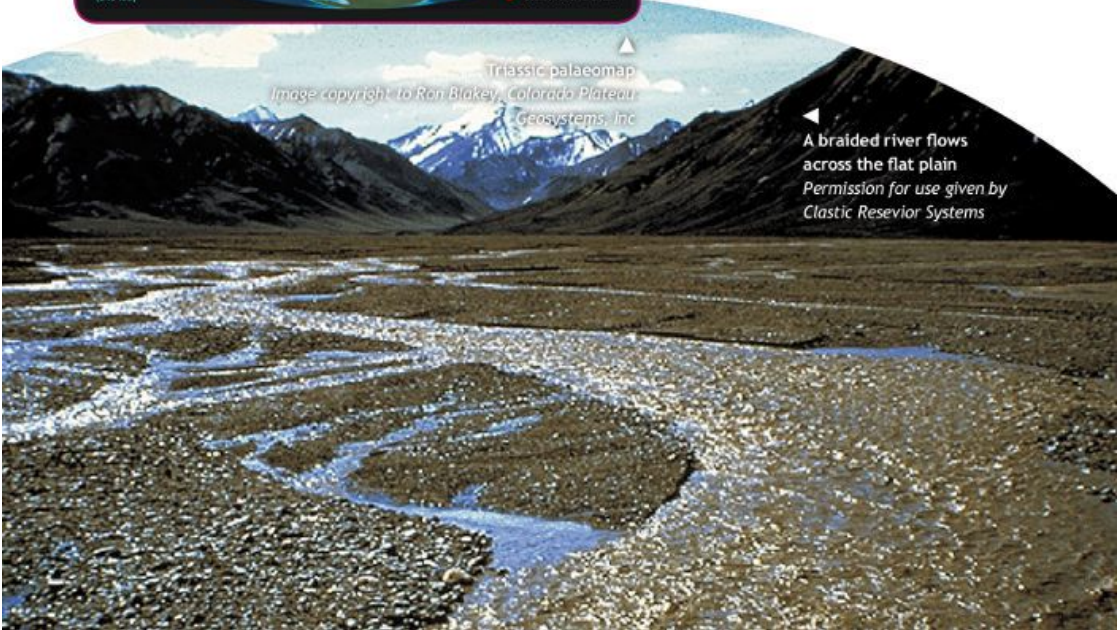
During the Triassic period the hot, dry and flat Worcester plain was covered by a series of many small winding rivers, known as a braided river system. This system was part of the 'Budleighensis River', an overall large river which flowed from France northwards to the Midlands and finishing at the east Irish Sea.



As these small rivers flowed across the Worcester plain, sediment was transported with the water and blown across the land by wind, gradually building the sediment up into layers. The sediments that make up the rocks in Hadley Quarry are sand and so the rocks are known as sandstones.

▶ Triassic palaeomap  
Image copyright to Ron Blakey, Colorado Plateau Geosystems, Inc

◀ A braided river flows across the flat plain  
Permission for use given by Clastic Reservoir Systems





# SANDSTONES



## Did you know?

Plant fossils have been recorded in Hadley Quarry. Unfortunately these fossils are poorly preserved as most of the organic matter has been haematised (the iron atoms have been oxidised, the same process seen when iron rusts). If you look carefully you can see the rust coloured sections within the sandstone; the original organic matter is black.

Black organic lenses  
containing plant fossils  
(scale in cms)

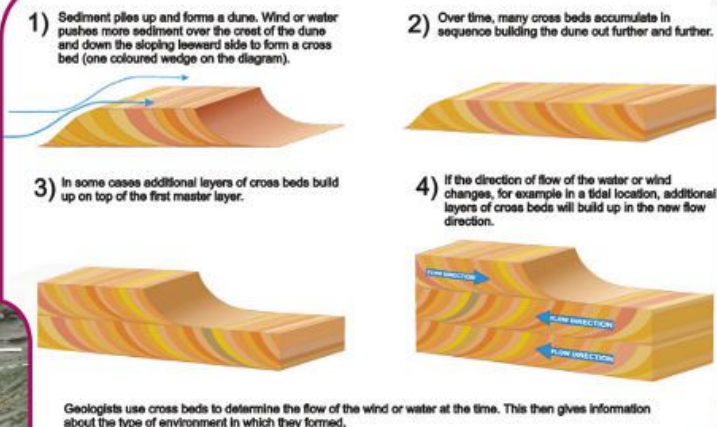
**S**andstones are made up of sediments containing grains of sand. The sand is gradually pressed together as more and more sediment builds up on top. The individual grains of sand then get cemented together either by tiny particles of mud or by new minerals (e.g. iron compounds or calcium carbonate) carried by water trickling through the gaps between them. The mud or minerals grow between the grains, filling the gaps, and cementing them together. Eventually, after millions of years, the compacted sand becomes a rock known as sandstone.

The sediment that makes up the sandstones was transported by current systems, either in streams or by wind across land. This transportation forms specific structures which are unique to sedimentary rocks. If you look closely at the sandstone you will see there are various lines and structures running through it. One of the most common structures seen in this quarry is known as cross-bedding.

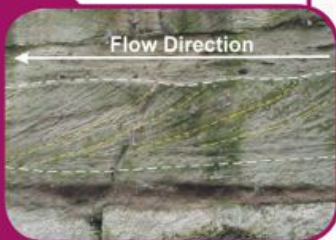
Cross-bedding is an important structure as it tells us the direction in which the water or wind was moving when it deposited the sediment.

The formation of  
cross-bedding

Cross-bedding in  
the northern  
rock face



Flow Direction



# BIODIVERSITY

**T**he overhanging trees, which are mainly Ash with an occasional Beech and Oak, make Hadley Quarry a damp and cool place. Consequently, the plants on the ground are those which can tolerate this low light level.

The main plant is Dog's Mercury, which forms a green carpet early in the year before the leaves on the trees block out the light. Later there will be Herb Robert and Red Campion in lighter patches. The damp environment allows ferns to thrive. The commonest one with simple leaves is Hart's-tongue fern dominating the spoil slope, but more divided-leaved ones such as Broad Buckler, Male fern and Hard Shield fern may also be found.

The rock face supports Maidenhair Spleenwort and another fern, Common Polypody, which has a simply divided leaf and can be seen in the crevices. The green encrustations on part of the rock are liverworts, which are very primitive plants and only thrive in damp places. This also suits mosses which would dry out elsewhere.

The ivy hanging over the rock face provides ideal nesting places and sheltered roosts for birds and possibly bats.

▶  
Hart's Tongue  
Ferns on the  
spoil slopes



# ARCHAEOLOGY

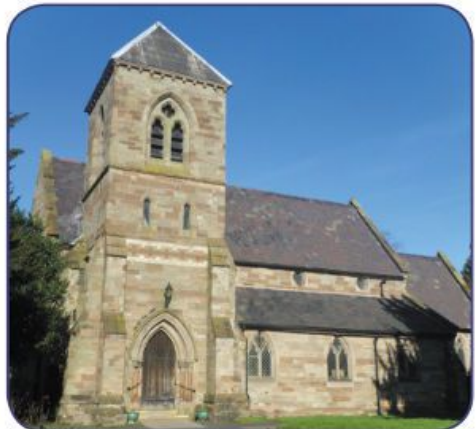
**T**he date when quarrying started at Hadley is unclear. A famous geologist called Roderick Murchison made reference to visiting the quarry in 1837:

*"At Ombersley, and the adjoining hamlet of Hadley, these beds have been much quarried; and they afford a beautiful lightish-coloured, fine-grained, slightly micaceous, quartzose sandstone, sometimes tinged with slight shades of pink and green; but a delicate olive colour prevails. At Hadley, the quarries expose from 30 to 40 feet of sandstone, covered by red marl."*

*Taken from the Transactions of the Geological Society of London in 1840.*

The sandstone in Hadley Quarry is an ideal building stone, leading to its use in the construction and renovation of a number of local buildings: the

Worcester City Walls, Worcester Cathedral, St Stephen's Church in Barbourne, Worcester and St Nicholas Church in Droitwich.



▲  
St. Nicholas Church in Droitwich



The remains of a building have been found in the lower section of the quarry. Beam slots that supported the roof of the building are clearly visible in the rock face. It seems most likely that the building was a site hut used by people in charge of quarrying operations. The site of a forge was uncovered in the base of this building, along with a number of finds such as bricks, tiles, pottery, earthenware, metalwork and glass items. A lack of structural remains suggests that the building was dismantled at the end of its life, rather than being allowed to collapse.

A stone-lined extraction trackway leading from the quarry to the lane is an impressive archaeological feature and hints at the scale of extraction that must have been taking place. Similarly, the barn and stable, which are also linked to the quarry by a smaller path, suggest that machinery and/or animals used during quarrying were kept on site. Evidence for an extension or earlier building is present in the northern wall of the barn, where beam slots and a blocked door can be clearly seen. Excavations, where foundations were uncovered, add further weight to this theory.

The recovery of a hand pick and tool marks present on numerous rock faces clearly show that stone from this site was extracted by hand using the plug and feather method. The machinery, which would have been required to haul the stone out of the quarry, is unfortunately no longer present.

Since the stone was dressed into blocks in the quarry, a lot of the quarry is filled with spoil from the trimming process.



▲ All of the quarry faces show pick marks made by the workers, this is one example

## Did you know?

The plug and feather method became popular after 1800. Multiple sets of plug and feathers are typically used to split a single, large piece of stone. The stone is first examined to determine the direction of the grain. After the location of the intended split is chosen, a line is scored on the surface of the stone. A number of holes are then cut or drilled into the stone face along the scored line approximately 10 - 20 cm apart. Plug and feather sets are then inserted in the holes. A series of long iron rods, known as plugs, is driven in (by hand) into the rock along the line that they wish cut.



▲ Plug and feather extraction, note the fracture running between the plug and feathers.

*image copyright to Anna Frodesiak*

The rods are inserted between thin iron plates, known as feathers, with the 'ears' of the feathers facing the direction of the desired split. The plugs are then struck with a small stone maul in sequence. An audible tone from the wedges changes to a 'ringing sound' when the wedges are tight. Between each series of strikes, a pause of several minutes allows the stone to react to the pressure. Eventually a crack appears along the line that was scored on the surface and the stone splits apart. This method of extraction is still used but a compressed air drill is now employed to make the holes.



## what is the Community Earth Heritage **CHAMPIONS** project?

The Community Earth Heritage Champions Project, funded by the Heritage Lottery Fund, and Natural England through Defra's Aggregates Levy Sustainability Fund, has involved communities across Herefordshire and Worcestershire.

Each of the nineteen geological sites chosen for the project has a Champions community group carrying out conservation work, promoting the use of the site to other people in their parish and monitoring the site for any changes in condition.

The idea of the project is to take a holistic view of the environment and to understand the relationships between geology, ecology and archaeology.

The Champions have received training in a number of subjects in order to understand the features observed at their site; knowledge which they will now pass on to new volunteers. The conservation work being undertaken will help to ensure the protection of these important features and enable people to enjoy the natural world for years to come.



For more information about the project, or any aspect of the work carried out by the Herefordshire and Worcestershire Earth Heritage Trust, please contact us at:

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