Historic England

Gloucestershire

Building Stones of England

The Building Stones of England

England's rich architectural heritage owes much to the great variety of stones used in buildings and other structures. The building stones commonly reflect the local geology, imparting local distinctiveness to historic towns, villages and rural landscapes.

Historic England and the British Geological Survey (BGS), working with local geologists and historic buildings experts, have compiled the Building Stones Database for England to identify important building stones, where they came from and potential alternative sources for repairs and new construction.

Drawing on this research, plus BGS publications and fieldwork, guides like this one have been produced for each English county. The guides are aimed at mineral planners, building conservation advisers, architects and surveyors, and those assessing townscapes and countryside character. The guides will also be of interest if you want to find out more about local buildings, natural history, and landscapes.

This guide is based on original research and text by David Owen (Gloucestershire Geology Trust).

First published by English Heritage 2011 and republished by Historic England in 2017. This edition published by Historic England May 2023.

Please refer to this guide as:

Historic England 2023 *Gloucestershire. Building Stones of England*. Swindon. Historic England.

HistoricEngland.org.uk/advice/technical-advice/

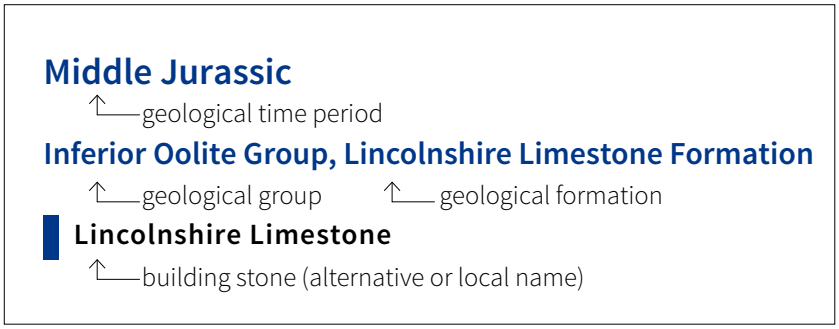
Front cover: Arlington Row, Bibury. Great Oolite Group Limestone. © Adam Burton / Alamy Stock Photo.

How to Use this Guide

Each guide describes the local building stones in their geological timescale order, starting with the oldest layers through to the youngest. The guide ends with examples of other notable building stones from other parts of England and further afield.

Geological time periods, groups, formations and building stones

Each building stone is listed under the relevant geological timescale, group and formation. A formation may be divided into members and where relevant these are referenced in individual building stone sections.



Bedrock geology map and stratigraphic table

To help you with the geology of the area, there is a bedrock geology map and a stratigraphic table which shows the layers of rocks and the associated building stones in this geological timescale, group, formation order.

Page numbers for each building stone are included in the stratigraphic table for ease of reference. The page numbers are inverted to correspond with the geological age order.

Contents list

If you click on the page number for a building stone in the Contents list, you will go straight to the relevant section in the guide.

Building stone sources and building examples

A companion spreadsheet to this guide provides:

- More examples of buildings. Information is included on building type, date, architectural style, building stone source, and listed/ scheduled status
- A list of known (active and ceased) building stone sources such as quarries, mines, pits and delphs
- Additional information on building stones including lithology, grain size, sedimentary structures, key identification features, and notes on failure/weathering, and use.

The Building Stone GIS map allows you to search the Building Stones Database for England for:

- A building stone type in an area
- Details on individual mapped buildings or stone sources
- Potential sources of building stone sources within a given proximity of a stone building or area
- Buildings or stone sources in individual mineral planning authority area.

Further Reading, Online Resources and Contacts

The guide includes geological and building stone references for the area. A separate guide is provided on general Further Reading, Online Resources and Contacts.

Glossary

The guides include many geological terms. A separate Glossary explaining these terms is provided to be used alongside the guides.

The guides use the BGS lexicon of named rock units.

Mineral and local planning authorities

This guide covers the mineral planning authority of Gloucestershire County Council and the local planning authority areas of the City of Gloucester and Tewkesbury, Forest of Dean, Cheltenham, Stroud and Cotswold districts.

The South Gloucestershire unitary authority area is covered in the *Bristol, Bath and Surrounding Areas* guide.

Contents

1 Introduction

The geology of Gloucestershire divides into distinct areas. The geology of each one has greatly influenced its landscape, history, culture and economy. The oldest rocks outcrop in their greatest extent in the north-west and the Forest of Dean, and the youngest are in the Cotswolds.

Forest of Dean

The Forest of Dean lies between the valleys of the rivers Severn and Wye. It is a steep-sided, deeply dissected plateau, formed of a fractured, asymmetrical, synclinal basin and composed of rocks from the Silurian, Devonian and Carboniferous periods.

The Silurian rocks are not widespread and generally limited to the area around May Hill and the southern end of the Malverns. They consist of coarse gritty sandstones at the base, overlain by mainly silty or calcareous mudstones and flaggy limestones. The limestones were deposited in a relatively shallow shelf sea. Towards the end of the Silurian period, the region was affected by a Caledonian uplift, which resulted in a fall in sea level and a gradual change from marine to mostly terrestrial sedimentation and deposition of Old Red Sandstones. However, Middle Old Red Sandstone and the base of the Upper Old Red Sandstone formations are missing in this area as the result of further uplifts, gentle folding and erosion. Towards the end of the Devonian, sedimentation recommenced with the deposition of the Upper Old Red Sandstone, lying unconformably on the Lower Old Red Sandstone.

The predominantly fluvial deposition of the Old Red Sandstone was terminated by an extensive rise in sea level, marking the start of the Carboniferous period. The early Carboniferous sea was clear and warm and supported a diverse range of marine organisms, such as corals, crinoids and brachiopods and led to deposition of limestones. Another period of tectonic uplift towards the middle Carboniferous elevated the area, folded the strata and formed the main syncline of the Forest of Dean Basin. This was followed by a period of erosion, resulting in virtually the whole of the Lower and Middle Coal Measures being absent from the Forest of Dean area. There is one main coal seam but is mainly made up of thin coals and coarse sandstones and mudstones. The unusual feature of the coalfield is that is almost entirely exposed at the surface. It occurs in a raised asymmetrical syncline with a steeper eastern limb that surfaces in the area of Staple Edge and the Soudley Valley producing the steeply dipping strata observable in

this area. The sequence of rocks continues with the sandstones, shales and coal seams of the Upper Coal Measures.

Figure 1: View from Symonds Yat, Forest of Dean.

North west Gloucestershire

In the north west, there is a faulted zone between Permo-Triassic Old Red Sandstone of Herefordshire and the mudstones of the Severn Vale. Precambrian and Lower Palaeozoic rocks can be found around the southern end of the Malvern Hills including Malverns Complex igneous rocks, Cambrian shales, Ordovician quartzites and Silurian limestones and shales.

Severn Vale

Crossing into the Severn Vale is a giant leap, geologically, from the folded Palaeozoic rocks to the west to an area of gently inclined Mesozoic strata. The rocks in this area are generally softer and provide fewer good building stones.

The oldest rocks to the east of the boundary fault are the Triassic Merica Mudstone Group mudstones and sandstones. These are overlain by the Penarth Group mudstones, shales and siltstones, representing a transition between terrestrial and marine deposits and forms the junction between the Triassic and Jurassic strata. Within the Penarth Group is an important bed of fossilised fish, reptile and dinosaur bone. Above this lies Lower Jurassic rocks, the source of the most important local building sandstones.

Figure 2: Tewkesbury, Severn Vale.

Cotswolds

The Cotswolds hills, stretching for nearly 60 miles, are part of an outcrop of Jurassic rocks that runs from the Dorset coast to the North Sea off Yorkshire. The rocks of the escarpment are almost exclusively marine and were mainly formed in warm tropical seas. The steep western scarp of the Cotswolds exposes sections through Lower and Middle Jurassic rocks that dip gently eastwards towards Oxford and London.

At the base of the Jurassic and making up the lower slopes of the escarpment are the clays, silts and sands of the Lias Group. These were deposited on the floor of quite a deep ocean, but an ocean that occasionally shallowed to allow the formation of some limestones, such as the Marlstone Rock Bed. At the top of the Lias Group there is a change in sediment type as loose sand replaces the clays and silts; and in the south of the area there is more sand than clay in its upper part.

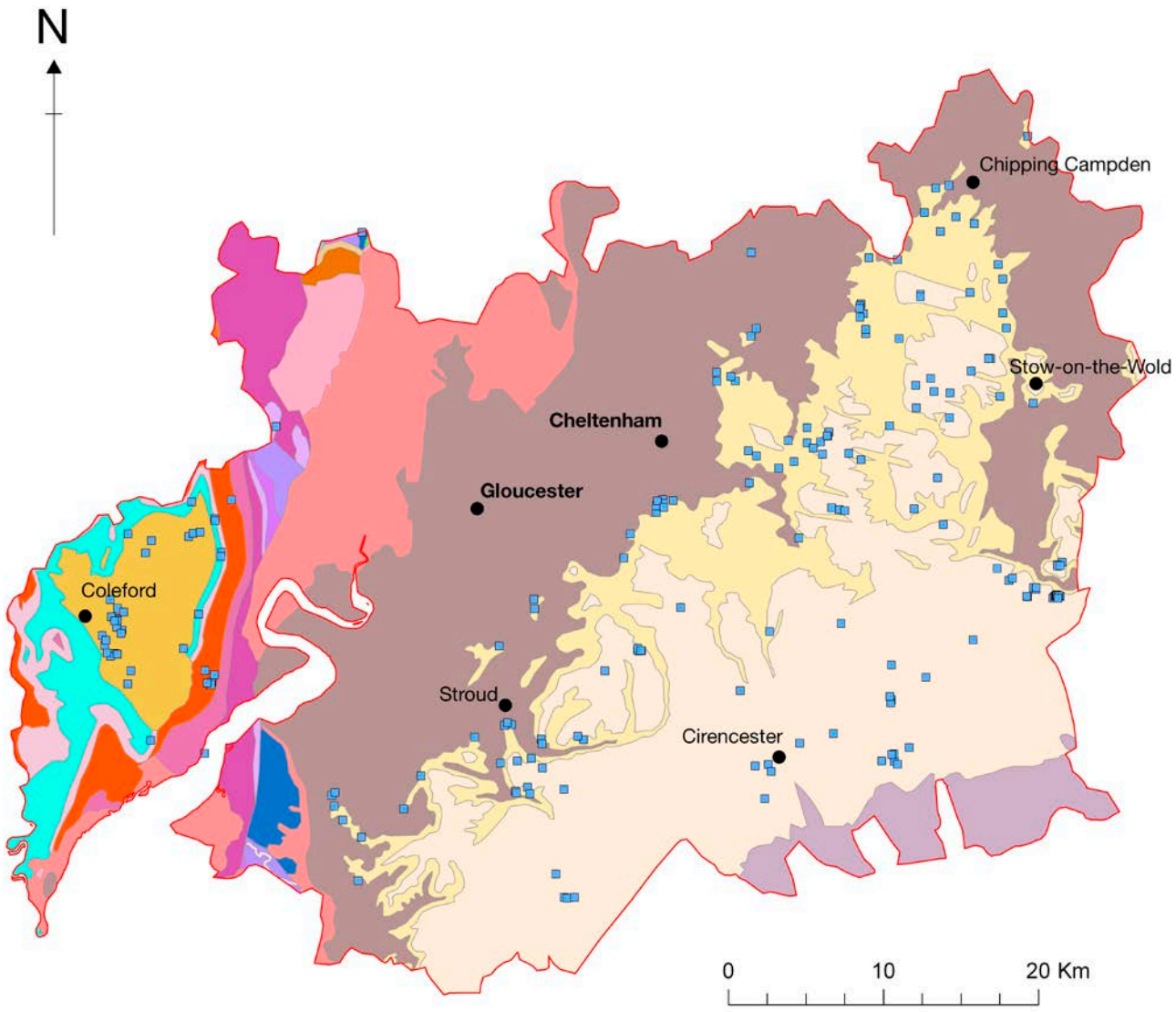
The Middle Jurassic rocks are the characteristic Cotswold limestones. The Inferior Oolite Group consists of the rocks seen in the numerous exposures along the western facing scarp of the Cotswolds. Soft, yellow, sandy limestones at the base of the Inferior Oolite Group give way to more solid rocks as the sequence moves upwards and the thick beds of fine grained oolitic limestones of the Birdlip Limestone Formation that were widely used as a high-quality building stone. Towards the top of the Inferior Oolite the limestones become more fossiliferous and are widely referred to as grits due to their coarser texture. At Leckhampton Hill and Cleeve Common, the thickest and most complete sections of Inferior Oolite rocks anywhere in the country are exposed.

Lying above the Inferior Oolite Group is the Great Oolite Group. This consists of an extremely varied sequence of rocks that can change quite dramatically both through the sequence and geographically across the area. Important formations within the Great Oolite include Fuller's Earth, a thick bed of clay that contains a mineral which was used to remove grease from fleeces and contributed greatly to the success of the Cotswold wool trade in the Middle Ages. Other formations important to the area's economy today are the White Limestone Formation, quarried as an aggregate, the Chipping Norton Limestone Formation, quarried as an aggregate and a building stone, and the Cotswold Stone for traditional roofing slates.

The Quaternary deposits are varied unconsolidated glacial and fluvial beds plus a mixed group of periglacial deposits. They are scattered widely across the area but their heaviest concentrations occur in the Vale of Moreton and in the area around Cirencester, where they are extensively worked for gravels.

Figure 3: Bourton on the Hill, Cotswolds.

Bedrock Geology Map



Key

Building stone sources

Bedrock geology

Kellaways Formation and Oxford Clay Formation — mudstone, siltstone and sandstone

Great Oolite Group — sandstone, limestone and argillaceous rocks

Inferior Oolite Group — limestone, sandstone, siltstone and mudstone

Lias Group — mudstone, siltstone, limestone and sandstone

Triassic Rocks — mudstone, siltstone and sandstone

Triassic Rocks — sandstone and conglomerate, interbedded

Permian Rocks — sandstone and conglomerate, interbedded

South Wales Upper Coal Measures Formation — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Warwickshire Group — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Dinantian Rocks — limestone with subordinate sandstone and argillaceous rocks

Upper Devonian Rocks — sandstone and conglomerate, interbedded

Lower Devonian Rocks — mudstone, siltstone and sandstone

Lower Devonian Rocks — sandstone and conglomerate, interbedded

Pridoli Rocks — mudstone, siltstone and sandstone

Pridoli Rocks — sandstone and conglomerate, interbedded

Ludlow Rocks — mudstone, siltstone and sandstone

Wenlock Rocks — mudstone, siltstone and sandstone

Llandovery Rocks — mudstone, siltstone and sandstone

Silurian Rocks — limestone, mudstone and calcareous mudstone

Unnamed Extrusive Rocks, Silurian — mafic lava and mafic tuff

Tremadoc Rocks — mudstone, siltstone and sandstone

Unnamed Igneous Intrusion, Neoproterozoic — mafic igneous-rock

Stratigraphic Table

Cotswolds

Geological timescale	Group	Formation	Building stone	Page
Quaternary	various	various	Tufa (Puff Stone)	25
Middle Jurassic	Ancholme Group (part)	Oxford Clay Formation (part)		
		Kellaways Formation		
	Great Oolite Group	Cornbrash Formation	Cornbrash	24
		Forest Marble Formation	Poulton Slates	24
		White Limestone Formation	Dagham Stone	24
		Hampen Formation		
		Athelstan Formation	Athelstan Oolite (Planking, Chinastone)	23
		Taynton Limestone Formation	Minchinhampton Weatherstone Taynton Stone	23 22
		Througham Tilestone Formation	Througham Tilestone	22
		Fuller's Earth Formation	Cotswold Stone slate (Pendle)	21
		Chipping Norton Limestone Formation	Chipping Norton Limestone	21
	Inferior Oolite Group	Salperton Limestone Formation		
		Aston Limestone Formation	Gryphite Grit, Trigonia Grit, Buckmani Grit, Notgrove Limestone	21
		Birdlip Limestone Formation	Cotswold Limestone (Painswick Stone, Lower Freestone) Lower Limestone, Pea Grit	19 18
Lower Jurassic	Lias Group	Bridport Sand Formation		
		Whitby Mudstone Formation		
		Marlstone Rock Formation	Marlstone (Hornton Stone)	17
		Dyrham Formation		
		Charmouth Mudstone Formation		
		Blue Lias Formation	Blue Lias	17
Triassic	Penarth Group	Lilstock Formation	White Lias	16
		Westbury Formation		
	Mercia Mudstone Group	Blue Anchor Formation		
		Branscombe Mudstone Formation		
		Arden Sandstone Formation	Arden Sandstone	15
		Sidmouth Mudstone Formation		
	Sherwood Sandstone Group	Helsby Sandstone Formation		

Building stones in geological order from the oldest through to the youngest layers.

Severn Vale

Geological timescale	Group	Formation	Building stone	Page
Triassic	Sherwood Sandstone Group	Helsby Sandstone Formation	Bromsgrove Sandstone	15
Permo-Carboniferous	New Red Sandstone Supergroup	Bridgnorth Sandstone Formation	Bridgnorth Sandstone (New Red Sandstone)	15
	Warwickshire Group	Haffield Breccia Formation		
Ordovician	Not defined	Bronsil Shale Formation		
		Unnamed Igneous Intrusion		

North west Gloucestershire

Geological timescale	Group	Formation	Building stone	Page
Precambrian	Malverns Complex		Granite, Gneiss	14

West Gloucestershire and Forest of Dean

Geological timescale	Group	Formation	Building stone	Page
Upper Carboniferous	Warwickshire Group	Grovesend Formation		
		Pennant Sandstone Formation	Pennant Sandstone Forest of Dean Sandstone	13 13
		Trenchard Formation		
Lower Carboniferous	Pembroke Limestone Group	Hunts Bay Oolite Subgroup		
		Cromhall Sandstone Formation		
		Llanelly Formation		
		Gully Oolite Formation		
		Black Rock Limestone Subgroup		
	Avon Group	various	Avon Group limestones	12
Devonian	Upper Old Red Sandstone Group	Tintern Sandstone Formation	Tintern Sandstone	12
		Quartz Conglomerate Formation	Quartz Conglomerate	11
	Lower Old Red Sandstone Group	Brownstones Formation	Brownstones	11
		St Maughans Formation	St Maughans Sandstones	10
Silurian		Raglan Mudstone Formation	Bishop's Frome Limestone (Psammasteous Limestone)	10
		Downton Castle Sandstone Formation	Gorsely Stone	9
	Upper and Lower Ludlow Shales groups	various		
	Not defined	Much Wenlock Limestone Formation		
		Coalbrookdale Formation		
		Woolhope Limestone Formation		
	May Hill Sandstone Group	Yartleton Formation		
		Huntley Hill Formation	Huntley Quarry Beds, Huntley Hill Sandstone	9

Building stones in geological order from the oldest through to the youngest layers.

2 Local Building Stones

The geology of Gloucestershire divides into three distinct areas: West Gloucestershire and the Forest of Dean, the Severn Vale, and the Cotswolds.

Forest of Dean

Silurian

May Hill Sandstone Group, Huntley Hill Formation

Huntley Quarry Beds, Huntley Hill Sandstone

The Huntley Hill Formation is part of the May Hill Sandstone Group, which also includes the Yartleton Formation. The latter tends to be more mudstone rich and less used as a building material than the massive conglomeratic and pebbly sandstone beds of the Huntley Hill Formation. These red-coloured, coarse, gritty sandstones are often used in agricultural buildings in the area around May Hill and in some local cottages. They are also employed extensively for walling. Very few available exposures of this formation remain, and even fewer of these provide access to stone suitable for use as a building material. The best exposure is at May Hill Farm.

The Huntley Quarry Beds are an extremely rare rock, limited to just one small outcrop, now a geology reserve. They consist of an interbedded sequence of sandstone and fissile mudstones, with a significant proportion of volcanic glass and ash within the sandstone matrix. The rocks were used mainly as aggregate, but some nearby cottages in Hinders Lane, Huntley, contain blocks of Huntley Quarry Beds sandstones in their walls.

Silurian–Devonian

Lower Old Red Sandstone Group, Downton Castle Sandstone Formation

Gorsely Stone

The Downton Castle Sandstone has been used extensively for roofing tiles, and also for ashlar and massive freestone. The rocks are fine grained, micaceous, yellowish-buff sandstones, locally flaggy and current bedded, with some fissile mudstone horizons. The rocks have been

worked extensively in Herefordshire, but the most notable workings in Gloucestershire are the former quarries at Clifford's Mesne, where particular facies, known locally as the Clifford's Mesne Beds, was worked. Unfortunately, the largest quarry has been mostly infilled and is now the garden of a private house. Next door is the Church of St Peter, built of stone taken directly from the quarry. Stone from the village was used as far eastwards as Highnam at least.

Figure 4: Church of St Peter, Clifford's Mesne. Gorsley Stone.

Devonian

Lower Old Red Sandstone Group, Raglan Mudstone Formation

Psammosteus Limestone (Severn Stone)

This limestone forms the boundary between the Raglan Mudstone Formation and the St Maughans Formation of the Old Red Sandstone. It is a calcareous horizon within a sandstone sequence formed as a result of precipitation of calcium carbonate released from evaporating waters on an arid land surface. It has been used as a building stone in Naas Court manor house, Lydney, and Arlingham Court manor house, Arlingham, and as an altar top in the crypt chapel at Gloucester Cathedral. Psammosteus Limestone was possibly quarried from Fairtide Rock, in the River Severn. Some stone was used at Berkeley Castle in the 14th and 17th centuries, where it was known as 'Severn Stone'.

Lower Old Red Sandstone Group, St Maughans Formation

St Maughans Sandstones

The thinly bedded sandstones of the St Maughans Formation were not ideally suited for use as building materials. However, they were employed in the Forest of Dean area to produce roofing slates, mainly for agricultural buildings and outbuildings. There are currently no known exposures of this formation accessible in the county.

Lower Old Red Sandstone Group, Brownstones Formation

Brownstones

The Brownstones were used to produce roofing slates. However, in places, the sandstones are more thickly bedded, which allows for a wider variety of uses, including building blocks, steps, paving and carved ornamental mouldings. They are currently worked at Copes Quarry near Blakeney.

Figure 5: Detached cottage. Brownstones.

Figure 6: Dean Heritage Centre (a former mill), Soudley Valley. Brownstones.

Upper Old Red Sandstone Group, Quartz Conglomerate Formation

Quartz Conglomerate

The very coarse-grained Quartz Conglomerate is particularly resistant to erosion and forms much of the rim of the Forest of Dean syncline. It ranges in thickness from 2 to 30m and can include interbedded sandstones between

the conglomerate bands. Large slabs of Quartz Conglomerate were used for the walls of central chambers of Neolithic long barrows, but a more common and recent usage has been as quern-stones and apple cider presses. The local millstone industry, especially in the Wye Valley, ceased around 1875 and lost or discarded millstones can be seen especially along the river. The large pebbles in the Quartz Conglomerate can make the stone difficult to work and shape as a building stone, but some local cottages, such as those in the Soudley Valley, have made use of it. It is also employed in some of the river walls at Tintern in Monmouthshire, Wales.

Upper Old Red Sandstone Group, Tintern Sandstone Formation

Tintern Sandstone

The Tintern Sandstone is at its best developed in the area around Tintern, Monmouthshire, Wales and a great deal of it was used in the construction of Tintern Abbey, just across the River Wye. The main site for its working was at Barbadoes Quarry in Monmouthshire. However, a large disused quarry in the Tintern Sandstone Formation occurs on the Gloucestershire side of the river, several hundred metres upstream of the abbey, and this may also have supplied stone for the abbey buildings. The village of Tintern is littered with Tintern Sandstone used as building blocks, much of which seems to have been reused from the abbey. The rock is typically a grey-green, red and purplish-brown, coarse, conglomeratic sandstone, but some finer sandstones occur within the succession, as do red and green mudstones. Tintern Sandstone was also quarried to the north as a yellowish, sometimes greenish, fine sandstone, much used in the ancient medieval churches of the Forest of Dean, although the exact locations of these quarries remain uncertain.

Figure 7: Tintern Abbey, Tintern, Monmouthshire. Tintern Sandstone.

Lower Carboniferous

Avon Group, various formations

Avon Group limestones

These formations are not typically known for building stone, but it has been used where limestones predominate over shales at the top of the sequence, towards the south-west part of the Forest of Dean. The principal building stone of the formation is the coarse bioclastic and ooidal limestone, commonly reddened by haematite staining and containing ripple marks and current bedding in places. These limestones are often very fossiliferous. The formation is used for a variety of building purposes, from block stone to walling stone and paving, and it is also crushed for aggregate. It was worked to make cement at a site in Mitcheldean, quarried from Stenders Quarry (now a nature reserve). It is currently worked at one quarry in the Forest of Dean: Stowe Green Quarry.

Upper Carboniferous

Warwickshire Group, Pennant Sandstone Formation

Forest of Dean Sandstone

The Pennant Sandstone is often known locally as Forest of Dean Blue or Forest of Dean Grey when referred to as a building stone. This is because of subtle differences in colour. The rock makes up the greater part of the Coal Measures of the Forest of Dean, and it contains several notable coal seams within the sequence. It has been worked for building stone most extensively between the Yorkley and Whittington coal seams, and quarries are found particularly where strata have a low angle of dip, within the Forest of Dean syncline. The blue stone is most valued as a building stone. Some of it is almost gun-metal blue in colour, as seen in the windows at St Michael and All Angels' Church at Mitcheldean. The grey and green varieties are widely employed as a dense heavy stone in engineering and construction for docks (locally and in South Wales), breakwaters, railway works, engine sheds and so forth. A reddened, iron-stained variety of the sandstone is quarried at Mine Train Quarry.

Pennant Sandstone

The Pennant Sandstone is one of the region's most important building stones, and over the centuries it has been used in many buildings in Gloucestershire and beyond. These include Thomas Telford's bridge (named Over Bridge) over the River Severn near Gloucester, Eastnor Castle in Herefordshire, Bristol waterworks, several notable buildings in London and the 15th-century Church of St John the Baptist at Ruardean in the Forest of Dean. A handful of quarries remain active in the Pennant Sandstone Formation, including Mine Train, Bixhead and Birch Hill. Many disused or dormant quarries can be found in this formation that it should be possible to safeguard a long-term supply fairly easily.

Figure 8: Over Bridge, near Gloucester. Pennant Sandstone.

North west Gloucestershire

Precambrian

Malverns Complex

Granite, Gneiss

Malverns Complex rocks form the central ridge of the Malvern Hills and consist variably of gneiss, schist and granites. In north west Gloucestershire, the rocks crop out at Chase End Hill, where an old quarry exposes both gneiss and granitic pegmatite veins. This rock is found locally in boundary walls and in some local cottages, but it is restricted to the immediate vicinity of Chase End Hill and Bromsberrow.

Figure 9: Wall, Bromsberrow. Malvern Complex rocks.

Severn Vale

Permo-Carboniferous

New Red Sandstone Group, Bridgnorth Sandstone Formation

Bridgnorth Sandstone (New Red Sandstone)

This soft red sandstone, part of the sequence of the New Red Sandstone of Permo-Carboniferous age, formed in an arid desert as wind-blown dunes. The sand grains are poorly cemented together, and the rock is easily eroded and broken up. It can often be crushed between your fingers.

This did not prevent its use as a building stone where it was found to crop out locally. However, its widest use was as a crushed stone aggregate for sand. One quarry at Bromsberrow, in the north-west of the county, remains active in the Bridgnorth Sandstone Formation, but all their product is crushed sand and not block stone.

Triassic

Sherwood Sandstone Group, Bromsgrove Sandstone Formation

Bromsgrove Sandstone

The Bromsgrove Sandstone has been widely used as a building material. It contains deposits of red, brown and grey pebbly sandstone, siltstone and mudstone, together with more uniform red sandstones. Within the formation there are both aeolian and fluvial facies and both have been employed in the construction of buildings, such as St John the Baptist Church at Huntley and St Mary's Church at Bromsberrow (the stone was quarried just north of the church). Some small, disused pits remain visible, but there are currently no active quarries in this formation in Gloucestershire.

Figure 10: St John the Baptist Church, Huntley. Bromsgrove Sandstone.

Cotswolds

Triassic

Mercia Mudstone Group, Arden Sandstone Formation

Arden Sandstone

The Arden Sandstone Formation is a relatively thick sandstone unit occurring within the Mercia Mudstone Group. It runs from Newnham in a sinuous outcrop northwards up the west side of the River Severn towards Tewkesbury. It consists of varicoloured green/blue, brown, buff and purple sandstones, with beds of conglomerate occurring locally. It is commonly used not far from its outcrop, mostly as coursed rubble but also occasionally as ashlar, usually mixed with Lias Group calcareous mudstones. It can commonly be mistaken for Lias limestone. The Arden Sandstone is identified by quartz pebble content and lenticular holes caused by the weathering out of softer clay clast inclusions.

There are some ancient quarries around the village of Corse. These sandstones were used from medieval times, mainly for churches and large farmhouses, and a few isolated blocks can be found in Tewkesbury Abbey. The apparent last use of the stone was in 1829 for the Roman Catholic Old Chapel Hall and St Mary's Church at Hartpury. A good quality white sandstone, with black lines of carbonaceous material, useful for identification, was used as ashlar in St Mary Magdalene's Church at Twyning. This is presumed to have come from a medieval quarry.

No quarries remain working in the Arden Sandstone Formation, but perhaps the best site with potential for providing a source of this stone is Glebe Barn Quarry, where a good section has been worked to provide stone for a nearby house.

Figure 11: Old Chapel Hall, Hartpury.

Penarth Group, Lilstock Formation

White Lias

The Langport Member forms the upper part of the Lilstock Formation, the bounding rock unit separating the Triassic and Jurassic periods. It dominantly consists of pale grey and cream limestones, with mudstone partings that tend to be irregular and rubbly in their lower part, but hard and well bedded towards the top. The White Lias was used in the south of the county in several medieval churches, intermixed with red or purple sandstone, and it was also popular as kerbs, flags and coursed rubble.

Lower Jurassic

Lias Group, Blue Lias Formation

Blue Lias

Thinly interbedded limestones, calcareous mudstones and siltstones make up the Blue Lias, with individual beds being often no more than 0.3m thick. Blue Lias is often mistaken for Purbeck Marble in the shafts of Gloucestershire churches. The thinly bedded nature of the strata led to numerous different uses, and at Ashleworth Court and the Church of SS Andrew and Bartholomew at Ashleworth the good and poorer stones have been mixed in alternate courses. Blue Lias was also used for paving and gravestones.

Figure 12: Tithe barn, Ashleworth. Blue Lias.

Lias Group, Marlstone Rock Formation

Marlstone (Hornton Stone)

The Marlstone Rock Formation is a conspicuous feature within the mainly soft mudstones, siltstones and claystones of the Lias Group. It consists of an iron-rich, sandy, very fossiliferous impure limestone, containing brachiopods, lamellibranchs, crinoids and belemnites. It passes into calcareous sandstone, which forms noticeable plateaus and ledges along the western scarp of the Cotswold escarpment. Marlstone was used to a limited extent wherever found, notably between Wotton-under-Edge and Uley, extracted

from The Quarry near Cam. It is also found around the Moreton-in-Marsh area in the Lias outcrops. Although tough to work, the stone is rather soft and liable to spalling and weathering. It has a pleasant rusty brown colour, making it an attractive building stone. St Mary's Church at Fretherne is built of Marlstone, although it was repaired in 2010 with Hornton Stone from Oxfordshire. Marlstone is known as Hornton Stone outside Gloucestershire.

Middle Jurassic

Inferior Oolite Group, Birdlip Limestone Formation

The Birdlip Limestone Formation contains individual members that have been used widely as building stones.

Lower Limestone, Pea Grit

The Crickley Member consists of two distinct lithologies, formerly known as the Lower Limestone and the Pea Grit. The usefulness of the Lower Limestone as a building stone depends greatly on where it is sourced. It reaches its thickest development around Frocester Hill, where it consists of around 10m of unfossiliferous, current bedded ooidal limestone. The Lower Limestone provides a hard, durable freestone, sometimes containing occasional small quartz pebbles. It has a variable colouring when newly worked and weathers to a silver-grey, as seen in All Saints' Church at Selsey. It was worked in numerous quarries south of Crickley Hill, but to the north the limestone of the Cleeve Cloud Member was preferred as a building stone. Used in the older churches and farmhouses of the Severn Vale, it is an unusual and distinctive building stone. Quartz pebble-rich beds were found within the Lower Limestone and worked at Hudding knoll, Selsey, Standish and Haresfield quarries. Lower Limestone is best seen as isolated ashlar blocks in St Nicholas' Church at Standish and St Peter's Church at Haresfield, and it was also used in Ebley Chapel (since demolished).

The Pea Grit is a coarsely pisoidal unit consisting of large, disc-shaped, algal-coated grains, making up a sequence of buff, marly and rubbly limestones. It crops out in the area between Stroud and Cleeve Hill, where numerous old quarries on the escarpment provide exposures. The most significant of these are at Crickley Hill, Birdlip Hill and Leckhampton Hill, where the rocks are best displayed. They were quarried here until the 1920s. The Pea Grit is termed a 'weatherstone' because of its resistance to erosion. It was employed for many different purposes, from mouldings to gateposts, from north of Gloucester to Tewkesbury in the Vale. It was used in medieval buildings in Tewkesbury, Winchcombe and Soudley, as well as at Hailes Abbey near Winchcombe.

Recently, Pea Grit has been discovered in Gloucester Cathedral, where all the earliest Romanesque work is Pea Grit, from the Coral Bed and Birdlip Hill. A medieval quarry still exists on the end of the hill, covered in ivy, but with no weathering of the face at all.

The limestone has been identified by the presence of large echinoids, but it is usually indistinguishable from Painswick Stone. Other rougher, yellowish-brown, vuggy limestone beds from Upton St Leonards and Painswick were used by the Romans in Gloucester's city wall and later for the plinths of the cathedral.

Figure 13: Hailes Abbey near Winchcombe. Pea Grit.

Cotswold Limestone (Painswick Stone, Lower Freestone)

The Cleeve Cloud Member is by far the most important unit used for building stone in the Cotswolds. It consists of a thick succession of massive, uniform oolite, strongly current bedded with very little fossil content. It achieves a thickness in excess of 50m around Cleeve Hill and Leckhampton Hill. The last quarry supplying this stone closed at Painswick in 1962, but it has been worked in many quarries along the Cotswold escarpment, as well as from numerous underground galleries in the Chalford and Nailsworth Valleys to Horsley, where it was marketed as Painswick Stone. It is not identifiable as a building stone south of the Woodchester Valley.

This limestone was the most widely used and versatile of the Cotswold limestones, perhaps the only one to reach the national markets. It has been used since the Roman period and widely exported since medieval times to various abbeys, cathedrals and other notable buildings. With the coming of the canals and railways, it was exported all across southern England and parts of the Midlands, where it was used especially for decorative carving and internal church work of all descriptions. The intricate fan vaulting inside St John the Baptist’s Church at Cirencester was constructed from large single sections of Cleeve Cloud Member limestone. It has also been used as paving at Tewkesbury Abbey and Gloucester Cathedral, and at Windsor Castle (Berkshire). Used in conjunction with Minchinhampton Weatherstone, it creates some of Gloucestershire’s best table-top tomb stones, including those in Elmore and Painswick churchyards and Pittville Pump Room, Cheltenham.

Figure 14: Church of St John the Baptist, Cirencester. Cotswold Limestone.

Figure 15: Pittville Pump Room, Cheltenham. Cotswold Limestone.

Inferior Oolite Group, Aston Limestone Formation

Gryphite Grit, Trigonia Grit, Buckmani Grit, Notgrove Limestone

The ‘grits’ of the Aston Limestone Formation consist variably of rubbly, commonly iron-shot and often conglomeratic limestones, crowded with fossils that lend their names to the various units, depending on their type and relative abundance. Such names include Gryphite Grit, Trigonia Grit and Buckmani Grit. Despite being resistant to weathering, the hard, rubbly and fossiliferous nature of the grits makes them difficult to work. However, they were used for field walls, foundations, occasional ornamental rustic work and rockeries. These rocks are found throughout the Cotswolds area and show varying thicknesses within the sequence, most notably along the ridge of the Cotswold escarpment and in several disused railway cuttings further to the east.

The Notgrove Limestone is a hard, white, fine-textured ooidal limestone that was difficult to work. Consequently, it was used in small blocks for random or coursed walling.

Great Oolite Group, Chipping Norton Limestone Formation

Chipping Norton Limestone

The Chipping Norton Limestone Formation is an extremely variable unit from the Great Oolite Group. It ranges from fawn-coloured to white, shelly ooidal limestone (some 2 to 5m thick) to buff, hard, sandy and splintery ooidal limestone, sometimes flaggy. Decalcification has, in some cases, reduced it to sand. Outcropping around the north-east of the Gloucestershire Cotswolds, it has been worked at just eight known quarry sites in total. Records of its use as a building stone in Gloucestershire seem limited to the flaggy beds being utilised as paving.

Great Oolite Group, Fuller’s Earth Formation

Cotswold Stone (Pendle)

The Eyford Member is the Gloucestershire equivalent of the famous Stonesfield Slate of Oxfordshire. It is a varied sequence of strata consisting of fissile, sandy, shelly and ooidal limestones, which has been worked for roofing slates from an impersistent bed near the base of the member. Former quarries occur at Eyford Hill Farm, near Bourton-on-the-Water, and the member is still worked to produce stone roofing slates at nearby Huntsman’s Quarry.

Figure 16: Cottage roof, Taynton. Cotswold Stone slate.

Great Oolite Group, Througham Tilestone Formation

Througham Tilestone

These mainly fissile, sandy limestones occur at the top of the Fuller's Earth Formation around Minchinhampton. Here, the Througham Tilestone Formation forms a transitional unit between the Fuller's Earth to the south and west, and the ooidal Taynton Formation Limestone to the north and east. The limestones were easily split, which made them useful as roofing slates. They were widely exploited where they were available.

Great Oolite Group, Taynton Limestone Formation

Taynton Stone

In the north-central part of the Cotswolds, this rock consists of cross-bedded ooidal limestone with abundant and characteristic seams and wisps of shell detritus, passing into the Hampen Formation. In the Stroud area, it passes westwards into finer grained limestones of the Througham Member. The stone typically weathers golden-brown, with contrasting white shell fragments within it where protected, but grey in colour in more exposed locations. It was widely worked for building stone throughout the area. In Gloucestershire, the main working site is at Farmington Quarry, where it is used for intricate mouldings, carvings and ornaments, as well as for block stone. Recent examples include Highgrove House and the University of

Oxford, among other sites. It was also employed extensively in the Churn and Coln Valleys and was extracted from the Windrush Valley for transport to Oxford, Windsor and London. At several sites, the stone was worked underground and was easy to work into mouldings when 'fresh'.

Minchinhampton Weatherstone

The Minchinhampton Weatherstone is one of the oddities of Jurassic geology in Gloucestershire. It occupies a unique position on Minchinhampton Common, where it forms a transitional lithology between the typical shelly beds to the south and the finer grained limestones of the Dodington Ash Rock Member to the north. It comprises around 7m of cream, cross-bedded, re-cemented ooidal limestones, and it is the re-cementation that produces the exceptional hardness of these rocks. (The initial sedimentary rock forms and then, later, crystalline calcite fills the void spaces and makes the rock much harder.) Quarrying is recorded from the 14th century and the limestone was used for tables, tombs, ledgers and slabs. It is found in the doorway of Holy Trinity Church at Minchinhampton and in parts of Gloucester Cathedral.

Figure 17: Bee shelter, Hartpury. Minchinhampton Weatherstone.

Great Oolite Group, Athelstan Oolite Formation

Athelstan Oolite (Planking, Chinastone)

The Athelstan Oolite consists mainly of white to pale yellow, fossiliferous, ooidal limestones, changing from wellsorted and massive in the south-west of the area to a more bioclastic, coarser, cross-bedded unit in the north-east, where it passes laterally into the White Limestone Formation. At the base of the formation is an impersistent oyster bed, sometimes referred to as 'The Scroff', with the harder limestones known as the 'Planking' or 'Planking Beds'. Planking was used to build Neolithic long barrows and later stiles, copings, flagstones and steps, and numerous old quarries can be found on the commons around Quarhouse. It was also used in the rebuilding of the spires of St Bartholomew's Church at Notgrove and St Mary's Church at Painswick.

Great Oolite Group, White Limestone Formation

Dagham Stone

Another oddity of the Great Oolite in Gloucestershire is the occurrence of Dagham Stone. This is not a particular geological formation, but rather a feature found within the White Limestone Formation. The stone is characterised by tubular cavities in recrystallised limestone, 10 to 20mm across, formed by burrowing organisms and usually filled with calcareous sands. The name comes from Dagham Down, north of Cirencester, and examples in section can be seen at Foss Cross Quarry and Daglingworth Quarry. Dagham Stone was used as an ornamental stone, often in rockeries, but also in walls and as gateposts, as can be seen in the gates to Cirencester Park.

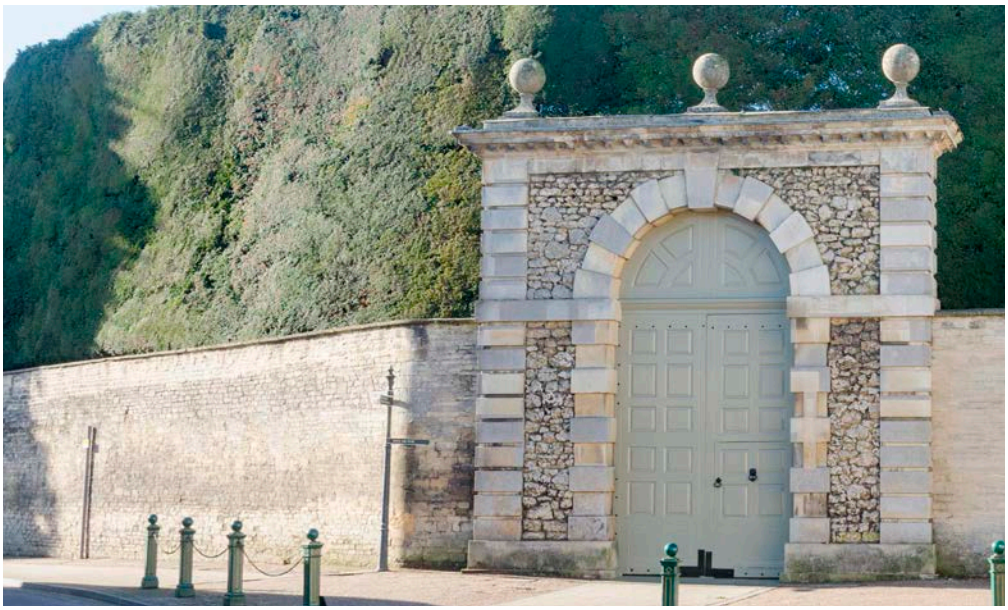


Figure 18: Entrance to the Bathurst Estate, Cirencester. Dagham Stone.

Great Oolite Group, Forest Marble Formation

Poulton Slates

The Forest Marble Formation dominantly consists of very fine, greenish-grey, silicate mudstone, with notable siliciclastic sandy and calcareous facies occurring throughout, including gradation from pure shelly ooidal limestones to sands with concretionary 'doggers'. Between Cirencester and Fairford, the Forest Marble has provided slates, known locally as Poulton Slates. It was used for flagstones, with upright slabs employed as fences, and also for walls and roofing slates.

Great Oolite Group, Cornbrash Formation

Cornbrash

The Cornbrash in Gloucestershire is typically a pale grey/purple/olive-brown, marly, fossiliferous, non-ooidal, rubbly limestone. It crops out between Cirencester and Fairford, in the south-eastern part of Gloucestershire.

The rock weathers to a golden-brown colour. The Cornbrash limestone was used as a building stone in the area of Siddington until the early 19th century, and also at Fairford.

Quaternary

Various groups, various formations

Tufa (Puff Stone)

Tufa is a relatively recent deposit, formed by precipitation of lime from water saturated with calcium carbonate. In this area, it generally forms where water has passed through the overlying ooidal limestones on the escarpment edge and has been forced to the surface by the Lias clays. Records show a deposit of tufa from Dursley being more than 7m deep. The rock type was used extensively by the Romans for bath vaults, and it is well displayed in churches at Uley, Nympsfield, Ashleworth and Newington Bagpath. No workable deposits are known to survive in the area.

Figure 19: Church of St Andrew and St Bartholomew, Ashleworth. Puff Stone.

3 Further Reading

The Further Reading, Online Resources and Contacts guide provides general references on:

- Geology, building stones and mineral planning
- Historic building conservation, architecture and landscape.

There is also a separate glossary of geological terms.

Gloucestershire references

Brewer, J N 1825 *Delineations of Gloucestershire*. London: Sherwood, Gilbert and Piper

Campbell, M 2009 Personal communication on Minchinhampton Weatherstone

Cave, R *et al* 1977 *Geology of the Malmesbury District: Explanation of One-inch Geological Sheet 251*. Memoirs of the Geological Survey of Great Britain (England and Wales). London: HMSO

Chidlaw, N and King, R J 1994 'Glebe Barn Quarry', Gloucestershire Geology Trust RIGS database. Unpublished

Earl Berkeley 1938 'Excavations at Berkeley Castle', *Transactions of the Bristol and Gloucestershire Archaeological Society*, **60**, 308–39

Earp, J R and Haines, B A 1971 *The Welsh Borderland*. British Regional Geology. London: HMSO

Gloucestershire Geology Trust guides and publications
http://www.glosgeotrust.org.uk/guides_publications.shtml

Green, G W 1992 *Bristol and Gloucester Region*. British Regional Geology. London: HMSO

Hollingworth, N 2006 *The Geology of Spratsgate Lane Quarry, Somerford Keynes*

McCall, J and Copestake, P 2008 *Cirencester in Stone: A Town Trail*. Brockworth: Gloucestershire Geoconservation Trust

Murchison, I and Strickland, H E 1840 'On the upper formations of the New Red Sandstone system in Gloucestershire, Worcestershire and Warwickshire', *Transactions of the Geological Society of London*, **5**, 331–48

Newent Local History Society 2003 *Chapters in Newent's History (Stone and Lime)*. Newent: Newent Local History Society

Owen, D, Price, W and Reid, C 2005 *Gloucestershire Cotswolds Geodiversity Audit and Local Geodiversity Action Plan (LGAP)*. Brockworth: Gloucestershire Geoconservation Trust

Price, A 2002 'Geology and building materials', *in* Verey, D and Brooks, A (eds) *The Buildings of England, Gloucestershire 1: The Cotswolds*. London: Yale University Press

Price, A 2002 'Geology and building materials', *in* Verey, D and Brooks, A (eds) *The Buildings of England, Gloucestershire 2: The Vale and Forest of Dean*. London: Yale University Press

Simms, M J, Chidlaw, N, Morton, N and Page, K N *British Lower Jurassic Stratigraphy: Volume 30*. Geological Conservation Review Series. Peterborough: Joint Nature Conservation Committee

Sumbler, M G, Barron, A J M and Morigi, A N 2000 *Geology of the Cirencester District: Memoir for 1:50 000 Geological Sheet 235*. Memoirs of the Geological Survey of Great Britain (England and Wales). London: HMSO

Sumbler, M and Cox, B M *British Middle Jurassic Stratigraphy: Volume 26*. Geological Conservation Review Series. Peterborough: Joint Nature Conservation Committee

United Stone Firms Ltd 1913 *A Treatise on Forest of Dean Stone* (facsim edn Black Dwarf Lightmoor Publications, 2001)

Verey, D and Brooks, A 2002 *The Buildings of England, Gloucestershire 1: The Cotswolds*. London: Yale University Press

Verey, D and Brooks, A 2002 *The Buildings of England, Gloucestershire 2: The Vale and the Forest of Dean*. London: Yale University Press

Wye Valley AONB 'Puddingstones and pubs' (A 3-mile circular walk uncovering Penallt's hidden millstone industry) www.wyevalleyaonb.org.uk/exploring-wye-valley-aonb/wye-valley-on-foot/download-walk-leaflets/

British Geological Survey publications

Welch, F B A and Trotter, F M 1961 *Geology of the Country Around Monmouth and Chepstow: Explanation of Sheets 233 and 250*. Memoirs of the Geological Survey of Great Britain (England and Wales). London: HMSO

Witchell, E 1882 *The Geology of Stroud and the Area Drained by the Frome*. Stroud: Geo H James

Woodward, H B 1893 *The Jurassic Rocks of Britain, Volume 3: The Lias of England and Wales (Yorkshire excepted)*. Memoir of the Geological Survey. London: HMSO

Woodward, H B 1894 *The Jurassic Rocks of Britain, Volume 4: The Lower Oolitic Rocks of England (Yorkshire excepted)*. Memoir of the Geological Survey. London: HMSO

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5 Acknowledgements

The Building Stones of England series was developed by Geckoella Ltd (Andy King), the British Geological Survey (Don Cameron, Graham Lott, and Stephen Parry), and Historic England (Clara Willett).

Historic England and the British Geological Survey developed the Building Stone Database for England with advice from many local geologists and historic building experts and all these individuals are thanked for their contributions.

Historic England would like to thank the Gloucestershire Geology Trust for their survey work and assistance with this guide.

The Department for Levelling Up, Housing and Communities supported the development of the Building Stones of England database project.

Figures

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Product code: HEBSE16
Publication date: September 2011
Reissue date: December 2017
Reissue date: May 2023
Design: Historic England